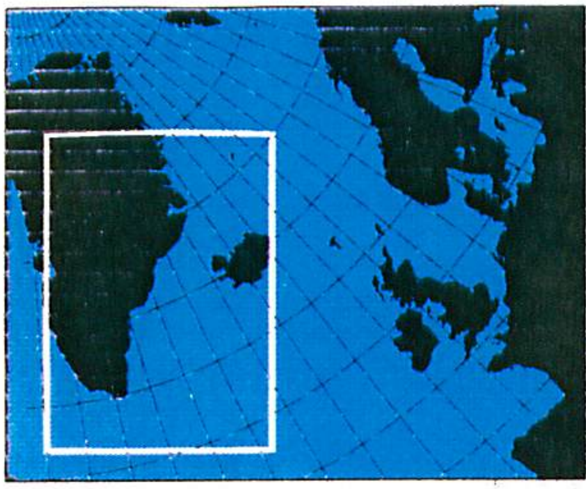
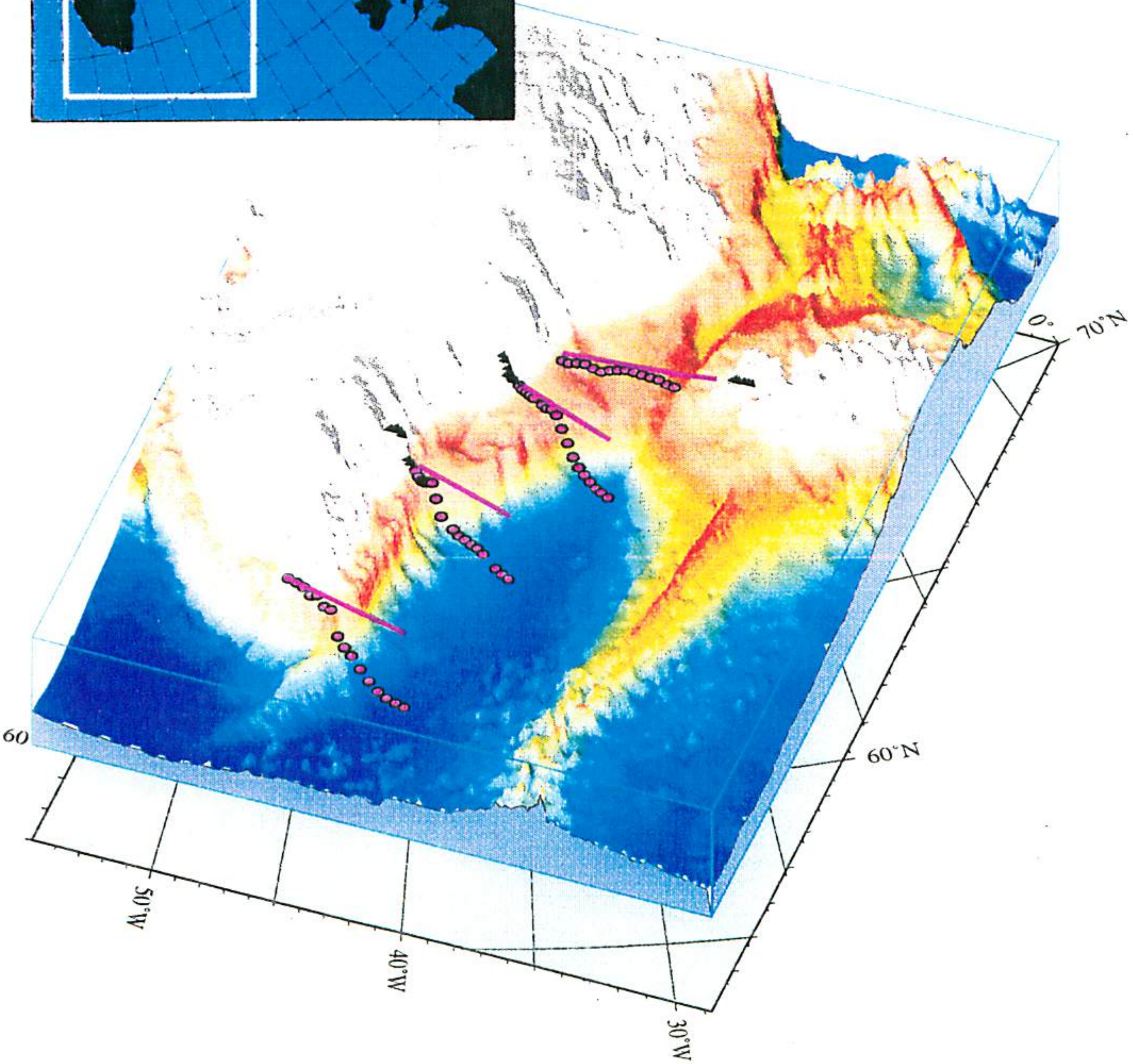


SIGMA

*S*eismic *I*nvestigation of the *G*reenland *MA*rgin

R/V *Maurice Ewing*
August 25 - October 7, 1996



Seismic Investigation of the Greenland MArgin (SIGMA)

Cruise Report
EW-9607
R/V *Maurice Ewing*
St. John's to St. John's, NF
24 Aug – 7 Oct 1996

W. Steven Holbrook

Dept. of Geology and Geophysics
Woods Hole Oceanographic Institution
Woods Hole, MA 02543 USA

Trine Dahl-Jensen

Danish Lithosphere Centre
Østervoldgade 10
Copenhagen, Denmark

Table of Contents

Summary

R/V *Maurice Ewing* cruise EW-9607 formed the major data acquisition phase of SIGMA (Seismic Investigation of the Greenland MArgin), a joint U.S.–Danish investigation of the deep crustal structure of the Southeast Greenland continental margin. Previous seismic data indicate that Southeast Greenland is a volcanic rifted margin that contains significant thicknesses of mafic igneous material emplaced during early Tertiary continental breakup. The purpose of the SIGMA survey was to provide critical missing information on (1) the thickness, velocity structure, and composition of the Tertiary igneous crust; (2) variations in these properties both across the margin and along the margin at increasing distance from the Iceland plume track; and (3) the detailed structure of the continent-ocean boundary. This was achieved by acquiring seismic data along four margin-crossing transects, one along the Greenland-Iceland Ridge and three at successively increasing distances of 200–1100 km from the presumed plume track.

The *Ewing* fired over 33,000 shots from its 20-gun tuned airgun source into an array of offshore and onshore seismic receivers: the *Ewing's* 4-km-long multichannel streamer, eleven Woods Hole Oceanographic Institution ocean-bottom hydrophones (OBH), eight U.S. Geological Survey ocean-bottom seismometers (OBS), and 35 Reftek portable seismometers deployed on two transects in Greenland and one in Iceland. Despite several gales, two storms, heavy fog, cold water, and numerous icebergs, the operational goals of the experiment were largely attained. Sixty-nine deployments and 68 recoveries of OBH/S were accomplished (one OBH was lost during recovery); over 1300 km of MCS data were acquired in four deployments of the multichannel streamer; and four sonobuoys were launched. Preliminary velocity models were produced shipboard for two of the offshore lines. Migrated brute stacks of all MCS lines were produced in near-real-time shipboard, and further shipboard MCS processing, including velocity picking and multiple suppression, provided improved crustal images. The data collected during this experiment will provide key information on the degree of structural and magmatic symmetry on conjugate VRM segments and on the influence of the Iceland hotspot on margin magmatism during and immediately after continental breakup. This information will provide an important framework for interpreting geological and drilling results on the margin and for constraining thermomechanical models of VRM evolution.

This study is a joint venture between US and Danish co-investigators, including data acquisition, processing, interpretation, and project financing.

Scientific Objectives

The SIGMA (Seismic Investigation of the Greenland MArgin) project is designed to make accurate measurements of crustal thickness, velocity structure, and seismic reflectivity along the hotspot-influenced volcanic rifted margin (VRM) off Southeast Greenland.

VRM's are characterized by a prism of igneous rocks, several times thicker than normal oceanic crust, that occupies the continent-ocean transition zone in an 80- to 150-km-wide belt and extends in some regions for more than 1500 km along strike. This thick igneous crust has two characteristics in seismic data: a seaward-dipping reflector sequence interpreted as subaerially erupted basalt flows and intercalated volcaniclastics, and a high-velocity lower crust with P-wave velocities (7.2–7.6 km/s) suggestive of mafic/ultramafic intrusive rocks. Several models for the thermal and mechanical processes involved in the formation of VRM have been proposed, including decompression melting during passive upwelling near a mantle plume; actively upwelling plume heads impinging on the base of the lithosphere; enhanced upper mantle convection driven by steep, cold lithospheric edges adjacent to the rift; and hot upper mantle due to non-plume "hot cells" or insulation by supercontinents.

SIGMA consists of four transects that systematically sample the structure of the SE Greenland margin and the continent-ocean transition at increasing distance from the Iceland hotspot track. The resulting data will provide answers to several questions regarding the SE Greenland VRM, including:

(1) What is the structure of the transition from continental to thick igneous crust, and thence to normal oceanic crust? Is the transition abrupt or gradual? To what extent does faulting play a role? Does the abruptness of the continent-ocean transition change with distance from the Iceland plume?
(2) What was the total volume of magmatism during continental breakup on the SE Greenland margin and its conjugates, and how does it vary in space and time? How does this magmatism relate to distance from the Iceland plume and to its temporal magmatic budget? What is the proportion of plutonic to volcanic rocks, and how does this vary with distance from the hotspot track and with total crustal thickness?
(3) Does high-velocity lower crust exist beneath the margin, and if so, is there any evidence that its composition, thickness, and distribution change along strike? How might such changes relate to variations in melting conditions (temperature and degree of melting) with distance from the plume?
(4) Is the structure of the SE Greenland margin symmetric with its conjugate margins on the Hatton/Rockall Bank and Iceland-Faeroes Ridge? What combinations of pure shear and simple shear processes might explain the conjugate structures?

Operational Objectives

The SIGMA cruise comprised a seismic survey of the Southeast Greenland rifted margin along four transects, one along the Greenland-Iceland Ridge and three at successively greater distances from the presumed track of the Iceland hotspot. Wide-angle seismic data were recorded by 37 onshore Reftek portable seismographs deployed along three profiles, by 11 Woods Hole Oceanographic Institution OBH and 8 U.S. Geological Survey OBS offshore, and vertical-incidence data were recorded by the *Ewing's* 4-km-long towed hydrophone streamer. Shots were fired using the *Ewing's* 130-liter (8495 cu. in.) airgun array and by chemical explosions detonated by the onshore team on Transect II.

The primary operational goals were to:

- Deploy and recover 19 OBH/S on four profiles across the Southeast Greenland rifted margin.
- Fire the 20-gun array into the OBH/S and MCS streamer on all four transects, and into onshore arrays on Transects II and III in Greenland and Transect I in Iceland.
- Record on onshore Refteks and, if possible, OBH and OBS, chemical explosions detonated by the onshore team in Kangerdlugssuagsiak Fjord and off the coast on Transect II.
- Record sonobuoy data on the eastern part of the Greenland-Iceland Ridge profile.
- Maintain good communications with the DLC/WHOI onshore team in Greenland, with the Cambridge onshore team in Iceland, and with onshore PI's at critical decision points.
- Produce SEGY archive files for the OBS/H data and sonobuoy data.
- Produce pseudo-real-time stacks of all MCS data and plots of shot gathers to monitor data quality.
- Produce CDP-sorted data tapes for all MCS data.
- Copy all MCS prestack data to DAT tapes.
- Produce preliminary stacks of the MCS data along all four profiles.

Preliminary Cruise Assessment

Although cruise EW-9607 was far from perfect, we judge it as a success, especially considering the challenging conditions of working on the Greenland margin. We achieved our principal goal of acquiring MCS, OBH/S, and onshore wide-angle data on four transects crossing the Southeast Greenland margin. Key factors in this success include: (1) good fortune with weather when we needed it, particularly for streamer deployments and shooting; (2) good fortune with ice, especially in the lack of sea ice along the coast; (3) flexibility in the cruise plan and clear priorities for cutting lines short when necessary; (4) sufficient contingency time to sit out bad weather, adjust to onshore schedule changes, reshoot portions of the line where dictated by data quality, and steam slowly through fog; (5) timely weather and ice information from the Danish Meteorological Institute and U.S. National Meteorological Center; (6) good communication with the onshore teams; and (7) the highly professional *Ewing* crew, who did everything possible to help us achieve our operational goals while ensuring a safe cruise.

The maturity and reliability of both the WHOI OBH and USGS OBS operations contributed substantially to our success: we lost no time due to OBH/S activities, apart from the search for OBH 21, which was lost when the ship's bow struck it during recovery operations. All instruments lifted off from the seafloor on command, and no delays were incurred due to instrument turnaround between lines. Of the 69 OBH/S deployments, all 69 instruments lifted off the seafloor, 68 were successfully recovered, and 64 returned data — a record which can be called a success, though it leaves room for improvement.

MCS recording was in general acceptable, and we acquired useful data along all four transects. However, data quality was highly variable. While Transects I and III went nearly flawlessly, Transect II was plagued by many acquisition errors, resulting in offset coverage and trace spacing so variable in CDP space that 2D processes (e.g., FK transforms) cannot be expected to work. This will have a serious impact on de-multiple processing. Streamer balance was problematic on Transects II and IV, probably due to currents and variations in sea water temperatures from 2°C to 10°C.

The onshore Reftek operation was only partly successful, due to an apparent error in instrument programming, which resulted in a complete failure of the 16 Refteks on Line 2 to record the principal MCS shoot and chemical explosions. Much of this information, we hope, was regained by redeploying 10 Refteks for the re-shoot of the line, but the innermost instruments could not be redeployed, resulting in an unfortunate data gap. The project PIs, in not requesting (onshore) and verifying (offshore) a post-deployment field check of the Refteks, bear much of the responsibility for this mishap. However, field procedures and programming strategies of the Stanford IRIS/PASSCAL center should be reviewed in light of this incident.

Shipboard processing was a success, for both OBH/S and MCS data. For the first time, we created on board final archive SEGY files for all OBH and OBS, including drift corrections, repositioned instrument locations, and corrected ranges. We also defined complete line geometry shipboard for MCS and OBH/S, including nearest SP, nearest CDP, and x-distance from a defined x=0 point on each line. This will greatly speed the construction of velocity models post-cruise. For MCS data, we produced near-real-time FK-migrated stacks of all lines and monitored shot gather quality using Sioseis. We also defined line geometries, sorted all data into the CDP domain, picked stacking velocities, selected trace mutes, conducted preliminary multiple suppression, and re-stacked all lines using ProMax. The resulting processed data provided both preliminary scientific results and a basis for revising line locations on board.

Preliminary scientific results from EW-9607 include:

1. Seaward-dipping reflectors extend farther seaward than previously thought, at least out to Anomaly 22 (49 Ma) as far south as Transect III.

2. A basement ridge crossed on Transects II, III, and IV between Anomaly 21 and 22 may represent a transition from dominantly subaerial to dominantly submarine volcanism on the young margin.
3. The crust beneath the Greenland-Iceland Ridge (GIR) is 35 km thick and mafic in composition.
4. The influence of the Iceland hotspot during early seafloor spreading appears quite modest: oceanic crust with nearly normal thickness (8.5 km) and velocity structure (layer 3 of 6.9 km/s) exists at the seaward end of Transect II, only 250 km south of 35-km-thick crust on the GIR.

SIGMA Project Principal Investigators

WHOI PIs

W.S. Holbrook sholbrook@whoi.edu
R.S. Detrick rdetrick@whoi.edu
G. Kent gkent@eos.ucsd.edu
P.B. Kelemen pkelemen@whoi.edu

Woods Hole Oceanographic Institution
360 Woods Hole Rd
Woods Hole, MA 02543-1542
USA

DLC PIs

T. Dahl-Jensen tdj@dlc.ku.dk
H.C. Larsen larsenhc@dlc.ku.dk
J.R. Hopper jrh@dlc.ku.dk

Danish Lithosphere Centre
Øster Voldgade 10
DK-1350 Copenhagen K
Denmark

Science Complement

W. Steven Holbrook	Co-Chief Scientist	WHOI
Trine Dahl-Jensen	Co-Chief Scientist	DLC
John R. Hopper	Scientist	DLC
Paul Henkart	Scientist	SIO
James Dolan	Research Associate	WHOI
Rob Handy	Research Assistant	WHOI
David DuBois	Research Assistant	WHOI
Jun Korenaga	Graduate Student	WHOI/MIT
Robert Busby	Consultant	Channel Z Seismometry
Thomas K. Nielsen	Graduate Student	Univ. Copenhagen
Anders G. Bruun	Graduate Student	Aarhus Univ.
Karen Reiner	Watchstander	LDEO
Bruce A. Francis	Science Officer	LDEO
Stefanus Budhypramono	System Manager	LDEO
Paul O. Olsgaard	Electronic Technician	LDEO
John G. DiBernardo	PSSO/Airgun Technician	LDEO
John G. Byrne	Airgun Technician	LDEO
Ropate Maiwiriwiri	Airgun Technician	LDEO
Carlos A. Alvarez	Airgun Technician	LDEO

R/V Maurice Ewing Crew

James E. O'Loughlin	Captain
Louis J. Mello	Chief Mate
William G. Smith	2nd Mate
Jeffrey Sylvia	3rd Mate
John J. Santini	Boatswain
John D. Vezina	A/B
David H. Wolford	A/B
Robert K. Hagg	O/S
George M. Mardones	O/S
Stephen M. Pica	Chief Engineer
Sport W. Moran	First Engineer
Richard D. Reid	2nd Engineer
Paul A. Morris	3rd Engineer
Guillermo F. Uribe	Oiler
William B. Osborn	Oiler
Michael L. Spruill	Oiler
John H. Schwartz	Electrician
Andrew B. Blythe	Steward
John S. Smith	Cook
Luke Moqo	Utility
Peter A. Martin	Radio Operator

Narrative

19 Aug 1996, Monday

Steve Holbrook, Rob Handy, and Graham Kent arrived at *Ewing* Monday morning and met with the captain. David DuBois, Jim Dolan, and Bob Busby arrived later in the day. The truck from WHOI arrived at the dock at 10:00 (after initial reports that it would not arrive until Tuesday). We were unable to unload the truck immediately because the St. John's harbor is a union dock, and we had to await the arrival of stevedores (in a minimum unit of 14 men). Later in the morning we visited Memorial University of Newfoundland, where Jeremy Hall gave us a tour of the MUN seismic lab.

In the afternoon we unloaded the truck and container with the help of the union stevedores. That evening Graham and Steve brought up hekla and orizaba on board.

20 Aug. 1996, Tuesday

The set up of OBH/S electronics began in earnest in the dry staging area. Ken Peal, Jun Korenaga, and Paul Henkart arrived later in the day.

21 Aug. 1996, Wednesday

In the morning the *Ewing* steamed across the harbor to the fuel dock. Set up of computers and electronics continued.

The Danish contingent, Trine Dahl-Jensen, John Hopper, Thomas Nielsen, and Anders Bruun, arrived in the afternoon and met the ship. Their sparc station, mimer, was brought up that afternoon. We discovered that the DLC 3480 drive was damaged in transit and inoperable. There are three options for work-around: (1) borrow or buy a DAT drive, then read in DAT copies created by orizaba; (2) attach spare 3480 drive on hess to mimer; (3) disk-to-disk copy over network.

There was a delay in the arrival of Paul Henkart's computer, sioseis.

22 Aug. 1996, Thursday

A group of professors and students from Memorial University arrived for a tour of the *Ewing*. Jeremy Hall graciously loaned us a DAT drive and appropriate SCSI cables for our use during the cruise, at some inconvenience to his own lab. This will help the DLC group work around the damaged 3480 drive.

A short delay in the ship's departure time announced, from 1000 LT Friday to 1900 LT Friday, due to a delay in shipping of needed barrels of streamer oil.

Kent departed early afternoon.

Henkart's computer arrived at FedEx and successfully booted on board.

By evening the truck containing our streamer oil still hadn't arrived, so another delay in sailing date was announced.

23 Aug. 1996, Friday

The DLC crew continued working on options for reading MCS data onto mimer. The DAT drive works, but this will result in delays getting data onto mimer, since DAT copying on orizaba will only occur after MCS shooting of a transect is complete. Disk-to-disk copy over ethernet is slow and will slow down the 3480-to-DAT copying on orizaba. An attempt to mount spare 3480 drive on mimer failed, due to incompatible SCSI card in mimer. We will attempt a fourth approach, namely, mounting 3480 back on hess and remotely mounting it on mimer. This would allow 3480 tapes to be read in to Promax on mimer during MCS shooting. This system was successfully worked out, with Budhy's help, by Friday evening, but eventually proved unworkable, probably due to the network's failure to keep up with the required I/O rate.

A further delay in arrival of streamer oil is imminent. The truck carrying our streamer oil was booked to cross from Nova Scotia to Newfoundland on a ferry which has broken down (main bearing). Most of the day was spent waiting for accurate information from the ship's agent on the status of the ferry and exploring alternative "North Atlantic" options, including picking up streamer oil in Iceland and/or Greenland. By six o'clock we received news that Mike Rawson at LDEO had had no luck in identifying ways of getting streamer oil to Iceland, and that the ferry had been repaired and our truck was on it. This led us to decide to postpone sailing until Saturday, 1400 LT (though the hour is probably a bit optimistic). The agent assures us that the streamer oil will be on the dock Saturday afternoon.

At 2000 Trine called the onshore team in Ammassalik and informed them of our delay. They are enjoying favorable weather and have already deployed seven instruments on Transect II, with another five deployments planned for Saturday. They will reprogram all the instruments, including those already deployed, with a 36 hour delay in the start times; i.e., the Refteks are now programmed to start recording at 0400 Z, 1 Sept.

<u>24 Aug. 1996, Saturday</u>

After a disagreement with the Chief Mate, AB Dave Graham decided to terminate his employment and disembark the ship. Lou Mello assured us that there were enough hands on board to pick up the slack, so the impact of Graham's departure on science operations would be minimal.

The WHOI group performed a dry run of the OBH deployment procedures on the aft deck, to refresh the deck crew's (and our own) memories of the operation. We decided not to get the anchor or instrument frame wet, since we were docked a mere 50 m from the raw sewage outflow for the town of St. John's.

Throughout the day we awaited information from the agent on the whereabouts of the truck carrying our streamer oil. Just before six the agent confirmed that the driver was not on the 1 p.m. ferry, even though we had been told he was. We decided to sail at 7 p.m. and pursue an option in the North Atlantic (Iceland or Greenland) for picking up oil. The best option would be a delivery of oil to Ammassalik, where we could pick it up with minimal impact on our operations. The backup plan, a delivery to Reykjavik, would cost us 1-2 days of transit time.

The agent came aboard at 6:55 and informed us that the truck had been sighted on the dock in Nova Scotia and was booked on the 1 a.m. ferry. The driver could not be located. If the driver made the 1 a.m. ferry, he would arrive in Port aux Basques at 0700 tomorrow, and would arrive in St. John's at 7 p.m. — i.e., another 24 hour delay. We had no way of confirming the whereabouts of the driver, nor had the events of the last 36 hours given us much confidence that the driver would in fact make the ferry. The agent expressed no confidence in the reliability of the trucking company or the driver. We hedged our bets in this way: we decided to sail as planned, figuring that projections of the truck's arrival were completely unreliable, but that we would check back with the agent during our steam. If the truck could be confirmed for a 7 p.m. arrival in St. John's, we could turn about up to 12 hours out of port and still make it back to St. John's to meet the truck as it arrived.

1920 LT: lines away and we sailed out of the harbor under cloudy skies. Seas were calm as we rounded the imposing headlands. We advanced clocks one half hour, thus eliminating the mysterious "Newfoundland shift"; for the remainder of the cruise we will be 2 hours behind UTC. Fog settled in over night, restricting our speed to about 5 knots.

<u>25 Aug 1996, Sunday</u>

At 0900 LT we placed a call to the agent to get an update on the status of the streamer oil delivery. We are currently about a 10 hr. steam from St. John's (longer if the fog holds), so we could still turn around and get back to meet the truck if it were to arrive by 1900 or so. We couldn't reach the agent and left a message with his answering service.

At noon the agent called and said that he had no information on the whereabouts of the truck. The agent said he would call if the truck showed in St. John's in the afternoon, which it should do if it had made the overnight ferry. By 1800 we still had no word from the agent, so we could only infer that the truck hadn't shown in St. John's.

At 1830 we hove to for out first wireline release test. On our first attempted lowering through the main core block on the stern A-frame, the core wire caught against the guide next to the shiv. Lou decided to rig another block on the A-frame, a job which took about an hour. At 1945 we lowered the rosette through the A-frame. We were at 49°38.21'N, 49°51.14'W in 950 m of water, and we lowered the rosette to 800 m depth and put the 8 releases through the following paces: enable, disable, enable, release, disable, ping to confirm disable. All eight releases confirmed release, and inspection back on deck at 2100 verified that all eight had dropped the D-rings Rob had attached.

At midnight we sent Michael Rawson e-mail outlining three options for picking up streamer oil: two options for Ammassalik (this week or next week) and one for Reykjavik (next week). In the former case we will request an extension of 2-2.5 days on our cruise; in the latter 3 days.

26 Aug. 1996, Monday

0830 LT. The fog is still thick; we have only made 4-5 knots through the night. We have already lost 1-1.5 days contingency due to fog. Preparing for the next rosette lowering; second rosette craned back to A-frame. At 0910 the bridge informed us that they have been tracking a large, nearly stationary object, probably an iceberg, on radar. We will postpone the release test until we have steamed by it, identified it, and are safely past it.

At 0910 we began seeing bergy bits floating off the port bow. Position 50°26.5'N, 49°05.8'W. Because of low visibility (~0.1 nm) we can't make out the main berg, which should be about 0.5 nm off the port beam. The Captain commented that "he could see how those guys on the Titanic got into trouble." We will wait about an hour to start the release test.

At 1015 we received a fax from the agent that our truck with streamer oil had arrived late Sunday night in St. John's. Since this implies that we would not have been able to sail until Monday morning — a three day delay — we believe we made the right decision in steaming from St. John's Saturday evening.

At 1100 we were ready to continue the second release test. There was a delay of 30 minutes or so while Bruce repaired the wire out meter. We finished the second rosette (eight successful confirmed releases) by 1300 as the fog burned off, showing blue sky for the first time on our trip. The clear sky showed our rogue iceberg on the horizon, eight miles directly astern of us: from that distance its tall and narrow aspect looked like a ship. Through binoculars, however, it appeared Matterhornesque: gray/white, steep-sided, with a sharp peak. Pretty obvious why they're called "ice mountains."

At 1400 we received good news from Paul Ljunggren: he has secured 12 barrels of streamer oil in Reykjavik. The issue now was whether arrangements could be made to fly the oil to Ammassalik by Friday morning; Paul was going to talk with Hans Christian Larsen to work on this.

We took advantage of the change in the weather by steaming full speed ahead on three engines and made 12-13 knots over calm seas for the rest of the afternoon. A brief relapse of dense fog slowed us for an hour or so toward evening, but visibility improved again at night.

27 Aug. 1996, Tuesday

The fog stayed away last night and we were able to make 12-13 knots. Skies are cloudy and seas are up a bit, with whitecaps and modest swells — as Dave D. put it, it's starting to feel like we're at sea. At 1015 LT Hans Christian Larsen called and discussed options for picking up streamer oil. He said that the chances of getting oil to Ammassalik by Friday were less than 10%, so that we may want to consider steaming straight to Reykjavik to pick up the oil. This adds 1.5 days time to our plan (including steaming back to transect II but not including port time), so that in order to endorse this option we would need assurance from LDEO for a 3-day extension to our cruise. We called Paul Ljunggren at LDEO just before lunch and expressed this position; he said he would talk with Denny Hayes and get back to us.

At 1500 we received a telex from Paul Ljunggren informing us that arrangements had been made with Flugvelag Nordurlands to transport all 10 (12?) barrels of streamer oil to Ammassalik, weather permitting, before Friday Aug. 30. This is excellent news, as we should now be able to pick up the oil on our way up the coast, resulting in a minimal delay. Paul said he is unable to respond to our request for additional days. We have changed course slightly to head straight for Ammassalik.

<u>28 Aug. 1996, Wednesday</u>

Continued our steam northward, making good progress. We are rolling a fair bit in moderate seas. We learned via e-mail that the LDEO Marine Office (Paul Ljunggren) has arranged for transport of our streamer oil to Ammassalik tomorrow, Thursday. So we are on schedule. Also received another bit of good news: the DMI reports that all indications are that this is an exceptionally light ice year for East Greenland, with no sea ice anywhere south of Scoresby Sund. So it'll just be the rogue icebergs we'll have to dodge.

From 1800-2000 we conducted our third release test, with another batch of eight releases to be tested. We had our first failure: one release failed to respond to its enable command after repeated attempts. Rob will check out the release tomorrow. That gives us 23 successfully tested releases, one failure, and three untested releases. We will plan to deploy with 22 of the 23 good releases and only conduct a final release test if we experience any difficulties with releases during recovery.

Tonight we were treated to our second distant view of an iceberg on the horizon, this one lit by a full moon. Later in the evening the night owls enjoyed our first view of the Aurora Borealis.

<u>29 Aug. 1996, Thursday</u>

The final push up the coast on a beautiful day: sunny, clear, with a brisk breeze and great views of the Greenland coast. We are passing 63° N. Andy has re-christened the galley, inscribing "North Seas Cafe" on the menu board. We were treated to many whale and dolphin sightings throughout the afternoon.

At 1800 we made our closest pass by an iceberg, 0.5 nm off the starboard side. All hands came up on deck and many photos were snapped. An impressive sight. The seas are nearly glassy; the sun is sinking toward the coast and casting a red-yellow shade over the glaciers.

<u>30 Aug. 1996, Friday</u>

All hands up early (before 0600) for the spectacular steam into the sound near Ammassalik. We picked our way in past the many icebergs and bergy bits, at one point passing within 20 m of one smallish berg. We rounded the horn on which the tiny village of Kap Dan is perched; a number of locals in outboard-powered skiffs came out to greet us and check out the *Ewing*. By 0715 we were anchored within sight of the airport; we could see the barge with our oil barrels. At 0800 the work boat was launched, and Lou, Smitty, and A/B John Vezina sailed over to the dock, maintaining radio contact on ch. 69. After rigging the barge to the work boat, they towed the barge slowly over to the Ewing and tied up on the port side. Twelve barrels of oil were lifted onto A deck (two at a time in a cargo net); the barge was towed back to the pier (with a slightly different shore party contingent in tow); and by 1100 the work boat was back on board. By 1130 the anchor was raised and we got underway back out to sea.

Bruce noticed that 4 of the 12 barrels contained Shellsol T oil, which he knows will work in our streamer; the other 8 contained Shellsol D70, a product he is unfamiliar with but which we hope will also do the job.

We approached our first deployment site at 2030 LT. OBS A1 was deployed at 2048. (After each OBS and OBH deployment we ranged to the instrument with the transducer to verify descent. On shallow instruments [<300 m] we ranged until the instrument was determined to be stationary at the seafloor. The OBS transducer was deployed on the port side; the OBH transducer starboard.)

We continued OBH/S deployments through the evening.

<u>31 Aug. 1996, Saturday</u>

OBH 26 was deployed in 253 m of water at 0025 LT. We continued deploying OBS/H throughout the day, finishing with OBH 23 at 2305 LT. We then turned southward and steamed to a point well off the line to begin deploying the streamer.

<u>1 Sept. 1996, Sunday</u>

MCS streamer deployment began at 0200 with deployment of the tail buoy. Streamer deployment continued at a slow but steady pace throughout the day. Deployment was time-consuming for several reasons: (1) the streamer had last been deployed in the warm waters of the South Pacific, so we anticipated the need to make the streamer much more buoyant in the cold North Atlantic waters. Therefore we had to add streamer oil and cut off the lead (Pb) plates that had been attached to each section. (2) Several sections had been identified as questionable, so we had to remove them and add spares. (3) We intended to add five sections net to lengthen the streamer to 4.2 km.

At our 2000 radio sched with the land party, we learned that the *Timmik* team had shot 20 of their intended 30 shots. We asked that they call back at 0800 tomorrow morning to check on our status, but not to shoot any more explosives until we verified that we were not firing our guns.

<u>2 Sept. 1996, Monday</u>

It's Labor Day back in the States, and we are certainly laboring today.

At 0800 we got an INMARSAT call from the onshore party to check on our status. We told them that we were proceeding a little behind schedule, and that they could continue shooting explosives until 1200 LT, at which time they should call us to check on our status again.

Streamer deployment continues, slower than we had hoped. The central part of the streamer is nearly floating on the surface, so we reeled part of the streamer back in and replaced the lead weights we had previously removed. This helped for some of the streamer, but about one-third to one-fourth of the streamer at offsets of 2000–3000 m is riding too high. At 1155 we built the streamer with 40 active sections and requested the bridge to increase speed to 5 knots, in the hope that this would enable the birds to exert more downward force on the center of the section. We were about to begin reeling the streamer back in to place more lead weights, when (after about half an hour at 5 knots), the problematic part of the streamer began to ride at 6-7 m depth. Bruce reset the target depth to 9 m (from 7 m), postulating this may bring the streamer into colder water and thus stabilize it deeper, and this also seemed to help. This looked good, so we decided not to reel in half of the streamer; rather, we decided to reel in the innermost several sections, which were also riding high, and add weight to them.

At 1200 LT we got a call from the onshore party; they had shot 29 shots, with only one to go. Since we would be delayed in coming on line until at least 1500, we told them to go ahead and shoot their last shot.

We decided to set the streamer depth to 12 m to avoid swell noise (swells are running high even though the wind is light).

We began shooting ~1700 LT. As we approached the line, the streamer was floating again in the center portions. Near-real-time displays of shot gathers showed that data were indeed far too noisy to be useful in the floating portion of the streamer. It looked like we were going to have to pull in the guns and streamer to adjust buoyancy, but after we turned and approached the starting point of the line, the birds successfully pulled the streamer down to an acceptable depth.

3 Sept. 1996, Tuesday

0400 LT. We've been getting an unacceptable rate of acquisition errors for the past hour or two. There seems to be an intermittent problem with the gun firing — a false fire command is sent, causing the guns to fire early, and acquisition times out. We are getting occasional early shots contaminating the data, and a fair number of missing shots. Bruce and Budhy are stumped by the problem, which seems to fix itself just often enough, and for just long enough, to keep us from breaking off line and reshooting a portion. Also, until Bruce and Budhy come up with an approach for troubleshooting this problem, we would not gain much by reshooting the line.

We continued shooting MCS throughout the afternoon as the weather steadily worsened. By late afternoon we were in a full gale, with sustained winds around 40 knots and gusts over 50. At 1700 we decided to turn off the line to avoid the undesirable combination of high seas, coastal icebergs, and darkness. We kept the streamer deployed but pulled the guns out of the water, turned back toward the east, staying in the trough to keep the cable tension down, and planned to turn back onto the line at first light.

4 Sept. 1996, Wednesday

By 0450 the gale had abated sufficiently for us to begin shooting again, so we began bringing the guns online two at a time. We have been having a lot of trouble keeping the streamer properly ballasted while keeping cable tension down to acceptable levels. When we speed up to allow the birds to bring the streamer down to its target depth, the cable tension increases to greater than 4000 lbs., setting off the tension alarm. The alarm was set for 3600 lbs., then increased to 4000 lbs.; the nominal cable tension limit is 5000 lbs, though we learned several times that the streamer does not part when the tension reaches as high as 5500 lbs. Nevertheless, we do not want to push the tension and thereby put the streamer in jeopardy, so we continually instructed the bridge to back off the RPMs in order to keep cable tension down. This generally resulted in streamer depths far too shallow, 1-4 m in the offset range 2500-3200 m, where we believe the streamer may be overfilled with oil. We fought this battle throughout the day, but decided to simply live with noisy data in order to keep the streamer tension down.

At 0800 Hans Christian Larsen called from DLC to discuss our possible plans for reshooting Line 2 for the OBH/S. He generally cautioned against using up contingency days early on in the program, but in the end he agreed that we should reshoot this line, in order to get the best possible wide-angle data on our highest priority transect. He agreed that the ability to look at the data shipboard, and thereby judge the desirability of re-shooting on later transects was a strong argument for doing it early on.

At 1000 we got a call from Bill Koperwhats and apprised him of our situation and ETA at the end of the line. We reconfirmed with him that the onshore team would not pick up any instruments before receiving confirmation from us that the shooting had ended.

In the late morning and afternoon we experienced numerous sytem failures and lost shots with the MCS system. At 1600 we decided that the data gaps were sufficiently serious to warrant re-shooting the inner 75 km of the line after reaching the coast end of the line. We decided to continue shooting to the end of the line now, despite the MCS gaps, for the sake of getting the wide-angle shooting in the bag. Our plan to reshoot the inner 75 km from W to E is contingent on the system settling down at that time — otherwise we will break off line, pull in the streamer, and begin shooting the line at a rep rate appropriate for the OBH/S.

We finished our westward shoot at 1730 and began turning a circle (dodging icebergs all the while). During the turn we enjoyed magnificent views of the Greenland coast at sunset. At 2000 we were back on line and began re-shooting the line toward the east.

5 Sept. 1996, Thursday

0300. We're continuing the reshoot of the shelf portion of Line 2. The MCS system has been unstable for the past several hours, even though the weather has been good. Just as we were about to pull the plug and give up on this line, the system settled down and we were able to finish the line out to OBH 27. At 0630 we declared EOL and shut down the system. We began pulling the streamer in and finished this job by 1245, when the tail buoy was brought aboard. Apart from one or two minor leaks, there was no evidence of physical damage or leakage. We remain puzzled as to why the cable tension was so high even when the sea state moderated.

At 1300 Lou begain re-rigging the small block on the main A-frame to a position farther aft, to afford us more space aft of the counter when deploying instruments. This operation was completed in an hour and we got underway to the W end of the line. The plan now is to deploy the guns only, shoot the line from W to E for the OBH/S only (using a shot rate of about 73 s), then begin recovery operations of the OBH/S from E to W. This plan will use up the remaining contingency time we had budgeted for Line 2, and in that regard it is a calculated risk, however we remain convinced that the time will prove well spent in order to provide the best possible wide-angle data on our highest priority transect.

At 1430 we received potentially very bad news from Bill Koperwhats. During recovery operations today, Bill has been to three Refteks, none of which had awakened from sleep mode. Bill is puzzled by this: the problem is not with the batteries, which check out at >12 V, and he is convinced that his programming was correct. There may be an insidious flaw in the Reftek firmware in sleep mode; we had in fact been warned that there was a 5-10% failure rate in Refteks waking up from sleep mode during a recent Canadian experiment. We have no confirmation yet that this is a problem with all of our Refteks, but Bill's gut feeling is that we will have zero Reftek data from the shooting of the past few days. We informed Bill that we had decided to reshoot the line tonight for the OBH/S and instructed him to immediately reprogram as many instruments as he could get to. Meanwhile the situation is complicated by the fact that Bill (on *Timmik*) is separated from Stefan and Peter, who are recovering instruments by helicopter. Attempts to reach Peter and Stefan via VHF radio (Ch. 16 and 71) were unsuccessful. At 1510 LT we managed to get a message through to the Ammassalik flight control, which they promised to pass on to the Alpha Helicopter pilot en route to Peter and Stefan. The message instructed Peter and Stefan that there had been a problem with the instruments, that they were to contact Bill K. ASAP, and that we would reshoot the line tonight.

The shipboard party shares responsibility for the Reftek failure because we never confirmed with the onshore party whether they had visited any of the Refteks after Sunday morning to confirm that they were recording. We had agreed with Peter and Stefan that they would confirm that the Refteks had awoken — but they did not do this, and we failed to ask whether they had.

At 1835 we began a re-shoot of the line for OBH/S and Refteks only. We were already leaning toward a re-shoot for the OBH/S only, but the decision was forced by the need to shoot the line again for the Refteks that had been restarted. We decided on a 73 s shot interval. This will afford us reasonable trace spacing (~210 m) and place the first band of previous-shot noise midway between the third and fourth bands on the primary shoot.

At 2040 the bridge notified us that we would have to detour 0.5 nm north of the line to avoid an iceberg in our path.

At 2053 we began having gun firing problems. An autofire problem was causing missed shots and double shots. Firing problems continued for several hours, and at 2253 we decided to circle back to re-shoot the part of the line affected. During this break, Bruce found the source of the problem: the control line voltage was too low in the nav-to-recording system interface box. Bruce fixed the problem by replacing a transistor.

We were back on line (now called Line 2g) by 0238 LT.

6 Sept. 96, Friday

We continued the Line 2 re-shoot all day without incident. Trine, John, and Paul began working in earnest on the nightmarish geometry and trace-editing procedures for the Line 2 MCS data.

The onshore party called at 2000 to confirm that they had 10 Refteks in place and recording the re-shoot.

7 Sept. 96, Saturday

We finished the Line 2 re-shoot at 0722. The guns were back aboard by 0830, and we got underway with our first rounds of OBH/S recoveries. We released OBH 24 at 0858, and it surfaced at 0948 -- a rise rate of 52 m/min. (This rise rate yielded accurate predictions of surface times throughout the rest of the cruise.) We recovered OBH 24 at 0957, OBH 23 at 1219, OBH 19 at 1430, OBH 21 at 1636, OBH 18 at 1925, OBS A4 at 2137, and OBS A8 at 2325.

8 Sept. 96, Saturday

During the night we took a couple of big rolls, one of which brought the monitor of Jim's computer obh2 to the deck, damaging it. Data downloading and instrument reprogramming will be significantly hampered with only obh1. Eventually Bruce managed to repair the monitor, with the only lingering effect being a halo of rainbow colors in the upper right corner.

OBH/S recoveries continued all day, working toward the coast, sometimes in thick fog. When it became clear that we would not be able to get to the innermost instruments before nightfall, we decided to skip ahead to the three coastal instruments after recovering OBH 22 at 1433, in order to have better visibility near the densest area of icebergs. The fog had lifted so we took our opportunity and picked up the inner three instruments before 2100 LT. We then worked our way back seaward, finishing up with OBH 16 at 2335, and steamed for Line 1, proceeding slowly in the darkness due to the risk of ice.

9 Sept. 96, Monday

We crossed the Arctic circle today and, as if on cue, were slowed by dense brash ice. At one point the ship was passing through what looked like nearly complete (80%) cover of brash ice -- small blocks of foundered glacial ice. The sound of the ice as the ship passes slowly by is like fragile wind chimes. Water temperature -1° C.

At 1030 Peter Kelemen called from Ammassalik and we decided on a start time of 18 Sept 96 1100 UTC for the Line 3 Refteks. Bill Koperwhats will fly back to Reykjavik today.

In the afternoon we began OBH/S deployments on Line 1. We had to forego our first OBS position altogether and move our second position 4 km seaward to avoid ice, and operations were slowed considerably by the necessity to slowly pick a path through the ice field. At this point, the cumulative delays of working through thick fog on the Line 2 recoveries and ice on Line1 were eating away our contingency time and possibly jeopardizing our chances of completing four transects. Thus we reluctantly decided to cut Line 1 short — a difficult decision, but one guided by the priorities the SIGMA PI's had agreed upon at our March meeting in Woods Hole. We decided to shoot the westernmost 280 km — out to the center of the Denmark Strait — rather than the hoped-for 400 km. This would have regrettable adverse effects on the Iceland piggyback, but we felt it a necessary step (the possibility of which the Iceland team had been forewarned of). We informed Bob White of our decision, first by phone and then reconfirming via e-mail.

OBH/S deployments continued through the day, with six instruments deployed before midnight.

10 Sept. 96, Tuesday

OBH/S deployments continued. Progress was slowed considerably by dense fog all day long; we can't make more than 5-6 knots.

We received email from Bob White imploring us to reconsider our decision to shorten Line 1. We offered a compromise we had already been considering: assuming that the deployments and shooting of Line 1 proceeded well, we would try to shoot toward Iceland after picking up the OBH/S. We would deploy several sonobuoys to provide shallow velocity control on the Greenland-Iceland Ridge. If time allowed, we would also leave several OBH/S in place for the eastern GIR shoot to record deep crustal data.

The last OBH was deployed at 2030, and we began deploying the MCS streamer.

11 Sept. 96, Wednesday

0645. Streamer deployment has gone very smoothly — out in only 10 hours. The guns were deployed in two hours, and by 0900 we began firing. At 0930 we started recording on Line 1b, which began on a northeastward approach to the main line. We encountered several tension alarms over the next few hours, perhaps due to currents and/or drag from the prevalent seaweed in the area. We reduced ship speed to keep cable tension within acceptable limits. At 1600 we turned onto the main E-W line (we did not renumber the line upon turning), and at 1633 the streamer was straight and we shot westward toward Greenland. MCS shooting continued uneventfully for the rest of the day.

12 Sept. 96, Thursday

MCS shooting continued smoothly on Line 1 throughout the day. The brash ice at the western end of the line had completely cleared, and we were able to shoot all the way to OBS A3. We declared EOL at 2013 and began pulling the guns in. The gun booms were in by 2130 and we started pulling in the streamer. This operation went quickly, with the tail buoy coming on board at 0043 LT (Friday).

During the day we experienced some severe computer network problems, which Budhy, Bruce, and Jim D. fixed.

13 Sept. 96, Friday

The captain requested that we wait for daylight to approach the first OBS recovery due to the possibility of ice. OBS A1 came on board at 0516. We turned briefly westward to recover OBS A3, then continued eastward along the line recovering instruments. By midnight we had recovered only seven instruments; our speed between stations was still held to 5 knots by the dense fog that had plagued us for days.

The slow steam through the fog was brightened somewhat by the excitement over the high data quality of the Line 2 OBH/S data, which we began plotting out systematically today.

14 Sept. 96, Saturday

OBH/S recoveries continued through the morning. We decided to leave the last (easternmost) two OBH's in place for the continuation shoot toward Iceland, in order to provide deep-crustal data on the eastern portion of the GIR. We recovered OBS A4 at 1227 and deployed the airgun array. By 1338 we were online, shooting toward Iceland. We decided to shoot the eastern GIR at 21±1 s shot interval for the benefit of closer trace spacing on the sonobuoys and Iceland Refteks (the latter will not be hampered by water-borne previous shot noise). The data from Line 2 showed that previous shot noise would not be a serious problem in the shallow water depths of the GIR. We deployed sonobuoys at four locations along the line, with a 20 km spacing.

15 Sept. 96, Sunday

The eastern GIR shoot (Line 1c) took until 0427 LT, when we recovered the airgun array. We did not approach as close to Iceland as we would have liked, due to the presence of shoals on the marine chart and our unwillingness to risk fouling the airgun gear. We steamed back to OBH 16 and recovered it at 1430. OBH 24, the last Line 1 instrument, was aboard by 1700, and we secured all OBH frames for the transit south.

We had been blessed by extremely calm weather on the whole of Line 1, with the only delays coming from brash ice at the western end and the dense fog that limited our speed. As we steamed south, the swell was growing noticeably, and we hoped this did not portend a change in our fortunes.

16 Sept. 96, Monday

0600. We have been making 11 knots all night, which feels good after the pea soup of Line 1. The seas are picking up, though. We are heading toward a low pressure system that is generating strong winds along the coast, so we expect a high sea state tomorrow. At 0845 the captain suggested that we slow down to time our arrival on Line 3 to be during daylight; he is worried that the sea state might be too severe to deploy anyway, and we don't want to approach the coast during darkness. We will slow to 9.5 knots to arrive on Line 3 at 0500.

At 1630 we conferred with the captain after receiving a new weather forecast. A large low pressure system is heading northwest toward Line 3. The seas are up now, with 10-12' swells. Winds are 45 kn sustained, 50 kn gusts. We decided to slow to 5 knots, as the weather was likely to prevent us from deploying tomorrow, and there was no point in arriving early.

17 Sept. 96, Tuesday

We spent the day riding out the gale; it is simply too rough to work. At 1500 the seas moderated somewhat, giving us hope that it might be possible to try for a 2100 deployment time, but by 1630 conditions were worsening again. Apparently the low pressure system that had passed by us toward the west had bounced off the coast and turned back east, gracing us with the same close-packed isobars we had just been through. There is no way we will deploy tonight.

The gravimeter broke today — it needs a replacement gyro. Bruce will try to replace it when the seas calm. Bruce believes it should be ship policy to shut down the gravimeter in high sea state to prevent this sort of mishap.

At 1830 Lou, Rob, Jim, and Dave went out on the fantail to re-secure OBH frames, which were moving up to 6-8" during strong rolls. Rob noticed some minor damage to the OBH frames, including 2 cracked gussets and one broken foot pad, but nothing major yet. The anchor cradle is working very well at keeping the anchors in place.

18 Sept. 96, Wednesday

0500. Seas have moderated, winds are down, and the barometer is rising. We are about 40 miles off line now and will steam for the third OBS site, check out conditions upon arrival, and deploy if sea state permits.

We deployed OBS C1 at 1120 LT. Conditions are marginal. We deployed OBS A3 at 1247, and came onto site OBS A1 at 1340, about a half mile from a large iceberg. We aborted this deployment; there is simply too much water coming over the stern. We will run back offshore and wait for the seas to come down further.

19 Sept. 96, Thursday

Over night one leg of the frame of OBH 25 came loose and was found on the fantail by A/B John Vezina. It should be repairable with four replacement gussets. Johnny D. helped Robby with fabricating some replacements. The rest of the frame is secure on deck.

0500. The weather is definitely improving. The barometer is rising, winds are down, and magnificent stars are visible for the first time in a long time. At 0530 we will turn toward the coast and try to deploy OBS A1 again.

OBH/S deployments went very smoothly throughout the day. We deployed OBS A1 without a hitch at 0748 and got another eleven instruments in before midnight.

Meanwhile we were becoming concerned that the onshore team would not have the Line 3 Refteks deployed in time for our MCS shoot. The storm that had prevented our deployments had also kept them from flying, and while we enjoyed fine weather on Line 3, Ammassalik was still draped in low clouds and rain. We are hoping that Stefan will be able to fly tomorrow.

<u>20 Sept. 96, Friday</u>

We continued with the last few OBH/S deployments in the morning hours, getting OBH 18 in the water at 0730. Immediately after breakfast we began deploying the MCS streamer. Weather conditions were perfect: sunny, calm, and warm (10°C). The streamer was deployed in eight hours flat, and by 1550 the guns were out and firing. At 1600 we were on line.

The onshore team had been unable to fly today. We decided that the only prudent course of action was to proceed with MCS shooting while the weather was good and the streamer was out, then re-shoot the line for the Refteks and OBH/S after the Refteks were deployed. As a last resort, if the onshore team were delayed for a number of days, we could also recover the OBH/S and then reshoot the line only for the Refteks.

<u>21 Sept. 96, Saturday</u>

Autumnal equinox. The last two days have been gorgeous ones, crowned by spectacular Aurora Borealis at night. The MCS shooting is proceeding very well, and we learned that the onshore team was flying today as well (confirmed by Hans Christian Larsen at 1410). We learned of one bullet dodged by Stefan: he checked one of the Refteks that had been programmed with Bill K.'s program, and it had not turned on at the appointed hour. Stefan called Bill K. in Stanford and worked out the procedure for manually starting acquisition on all six Refteks, so that they would definitely be recording upon deployment.

We decided that we would (1) stop shooting MCS tonight when the captain deemed it unwise to continue further toward the ice; (2) pull in the MCS streamer through the night, and (3) put out the guns and reshoot Line 3 for the Refteks and OBH/S. We decided on a shot interval of 50 s, as a compromise between the 20 s interval desired for the Refteks and the 70 s interval that would produce better data on the OBH/S. At 2030 Stefan confirmed that six Refteks had been deployed today.

The steel beach was crowded at 2100 by crew members enjoying a spectacular Aurora. Better than Fourth of July fireworks.

We finished the MCS shoot at 2320. Thanks to calm seas, good ice conditions, and light from the half-moon, the captain was able to guide us in as far as about OBS A3, well past the Leg 152 drill sites, leaving only about 14 km unshot at the landward end.

<u>22 Sept. 96, Sunday</u>

We began streamer recovery at midnight and finished at 0330 LT. We waited for daylight, and by 0841 we began the line 3b reshoot at a 50 s shot interval. Throughout the day the weather began to worsen; winds picked up to ~30 kn, and the seas came up gradually. The idyllic weather of the past few days was over.

<u>23 Sept. 96, Monday</u>

At 0600 Hans Christian Larsen called to ask whether it was OK for Stefan to start recovery of Refteks. Stefan is worried that if he does not take the next available weather window, the Refteks may be stuck in the field for a number of days and may get covered with new snow. At this point we had shot enough of the line to define the continental crustal structure — if our shots were still visible on the Refteks, we would at most be providing Pn under the margin — so we decided that if Stefan had a weather window today, he should take it.

The weather was still poor at 0700 (winds of 30-40 knots), though still workable for recoveries. The forecast shows two low pressure systems off to the S/SE of us, which could give us trouble later on. Conditions were expected to be worse out to sea than near the coast. Therefore we decided to stop shooting Line 3B, even though we had not yet crossed the seawardmost OBH's, and begin OBH recovery. Our rationale is as follows: (1) we have shot more than 200 km of the line, which should be sufficient for the Refteks to see Pn; (2) while it would be desirable to have the 50 s data on the outermost OBH's, it is not necessary; (3) beginning recoveries now gives us a chance to retrieve the coastal OBS's before darkness tomorrow night, which might save us 8 hours; and (4) this is a precaution against the undesirable scenario in which the weather worsens before we get our last few OBS's aboard and we burn up valuable contingency time meant for Transect 4.

Therefore at 0756 we stopped shooting and pulled the guns in. We were halfway between OBH 23 and 21, and we decided to head west to recover OBH 23 first, then turn back east to get the remaining outer OBH's. Although this was slightly less efficient, it had the virtue of keeping the OBH recoveries back-to-back, which would enable the OBH crew to get some rest between stints.

We recovered OBH 23 at 1330. The recovery went smoothly and safely despite the wind and swell.

At 1500 we released OBH 21 from its position at 2400 m depth. During recovery operations, the ship's bow struck the OBH as it came alongside, apparently damaging or severing one or two glass balls and causing the OBH to sink slowly. We spent four hours ranging to the OBH before concluding that it had come to rest on the seafloor. At 2030 we abandoned OBH 21 and proceeded with recoveries. A more complete report on the circumstances of the loss of OBH 21 is included in the Appendix.

<u>24 Sept. 96, Tuesday</u>

Recoveries proceeded throughout the day. As a result of the incident with OBH 21, the bridge crew adopted a more oblique approach to the instruments, keeping them off the bow until they passed the bridge wing. This method worked very well, and recoveries went smoothly on Line 3 from that point forward. The weather began moderating through the day, and we conducted eight recoveries before midnight (we were slowed by a long steam from the east end of the line to the first batch of OBS's).

During the day we held discussions with Bruce Francis and the captain regarding our options for dragging for the remains of OBH 21. Bruce made an estimate of the time required: a minimum of a half day and more realistically most of a day. We would also have to rig the core wire through the starboard A-frame, an operation not guaranteed to work flawlessly, since the main block on the stern A-frame is inoperable. We considered whether to make an attempt after completing recoveries on the rest of the line.

<u>25 Sept. 96, Wednesday</u>

Five OBH's were brought aboard in the wee hours. We approached the last three OBS sites near the coast against the backdrop of a beautiful sunrise. The weather was cold but calm; quite pleasant on deck actually. We had good luck with icebergs: none of those in the vicinity blocked access to the OBS sites. We finished recovery operations at 1200 and turned south for the day-long transit to Transect 4.

During the past day or two we noticed an intriguing feature on the Line 3 MCS data: a basement ridge located between anomalies 21 and 22 that seems to separate seaward-dipping reflectors from submarine oceanic crust. We traced this magnetic anomaly north to Line 2 (the correlation is somewhat equivocal) and discovered a similar basement ridge there. This led us to hypothesize that this ridge may represent a magmatic/tectonic event during the transition from subaerial to submarine volcanism along the entire margin. We thus decided to lengthen Line 4 by 60 km seaward to see if this feature exists at the distal end of the margin, and to be certain that we reach normal oceanic crust.

26 Sept. 96, Thursday

We continued our steam south to Line 4. We spent the whole day at a constant barometric pressure of 986 mPa -- we are steaming right along an isobar of the huge low pressure system that's filling the North Atlantic. Strangely, skies are clear and winds are calm.

Arrived on first station for Line 4 at 1500. Winds and seas have been picking up steadily over the past two hours, as if on cue. We slowed to a simulated approach course and went out on deck to judge whether it would be safe to deploy. No way — during ten minutes on deck several large swells broke over the stern and flooded the fantail. Decided to suspend operations until calmer seas prevailed. Throughout the afternoon winds built to 45 knots sustained and max gust of 59 knots. Not a comfortable sleeping night.

27 Sept. 96, Friday

Winds are still up around 20-30 knots, but by late morning, seas were coming down somewhat. At 1330 the captain slowed to a simulated approach and we went out on deck to judge conditions. Though it was significantly better than the previous day, we deemed it still too rough to work on deck. We decided to come back out at 1530 to check again. When we did, we deemed the situation safe for deploying and began rigging. OBH 25 was deployed at 1622 LT.

Due to the lost day and the need to keep two days of contingency in hand for OBH/S recoveries, we decided to shorten Line 4 from 460 km to 355 km. This cut slightly more than a day out of the plan and gained back the contingency day lost to the storm.

The weather forecast is for more of the same: 20-25 knot winds, continued low pressure, and slight moderation of sea state throughout the next day. If conditions stay the same or improve, we will be able to keep deploying.

We made changes to both the OBH and OBS deployment procedures improve safety (both suggestions of Bob Busby's). During OBH deployment, before moving the frame into the ready position at the roller, we first moved the anchor to the stern, connected the slip line, and hoisted it immediately over the roller and attached it to the slip line. This got the crane out of the way quickly and removed the need to maneuver the anchor around the OBH frame. During OBS deployment, we used the tugger winch on the A-frame to lift the sphere onto the anchor plate, rather than having two people lift it. This vastly improved stability and safety of the operation in less than ideal conditions.

28 Sept. 96, Saturday

Continued OBH/S deployments under continuously improving conditions. By the afternoon we were enjoying sunny skies, light winds, and calm seas. The views of Kap Farvel are magnificent: the mountains seem higher and craggier here than along most of the coast we've seen.

Finished our last OBS deployment at 1930 hrs and immediately began deploying the streamer. Once again we were fortunate to have the weather calm just in time for MCS streamer deployment.

29 Sept. 96, Sunday

Streamer and gun deployment were finished in record time and we began firing guns at 0245 LT. Both the last day of OBH/S deployment and the streamer deployment have gone significantly faster than we planned for; consequently, the last five OBH's will not begin recording until 0600 LT. Rather than have these instruments miss the end of the line, we instructed the bridge to circle back and come back on line at 0600. This miscalculation cost us approximately three hours. We circled around and began shooting Line 4 at 0600.

MCS shooting went relatively smoothly for the first several hours. We had one SLIC error that necessitated a cable rebuild and resulted in 15 lost shots. From 1200-1319 LT we turned to avoid an iceberg that was in the path of the line. Throughout the day we continued shooting MCS data over the shelf and shelf break.

30 Sept. 96, Monday

In the early morning hours we began having severe streamer ballasting problems. Throughout the shoot (and indeed through most of Line 3), the streamer near Bird 13 has been too buoyant — we should have put some weights on these streamer sections. Until now the problem has been manageable, but at 0220 LT the middle part of the streamer rose to the surface. This in turn pulled the latter part of the streamer up, and by 0229 the entire latter half of the streamer was at the surface. We believe that the natural tendency of the mid-streamer to float was exacerbated by a steady increase in sea water temperature, from 4.0°C to 7.5 °C over a six-hour period. Bruce also believes that cross-currents adversely affected streamer ballast. Efforts to adjust the streamer depth by increasing speed were limited by high streamer tension, although later experimentation showed that in fact slowing the speed through water had the desired effect of bringing the streamer down. (We are still puzzled by this counterintuitive situation.)

We monitored data quality both on Peter Buhl's splitter output and using the pseudo-real-time Sioseis processing (which enabled us to look at shot gathers), and it was clear that the latter half of the streamer was not recording useful signal. We were also passing over a thick package of seaward-dipping reflectors, an area where good data quality was crucial. Therefore, although we were reluctant to add time to our shooting operation, we decided at 0340 LT to break off line and circle back to re-shoot the portion of the line where the streamer was floating. This cost us 8 hours. During the steam back, we did not shoot the guns, but we did take the opportunity to experiment with setting bird depths to 18 or 19 m (rather than the desired 15 m) and altering ship speed to maintain the best streamer balance possible. The streamer seemed better behaved on the westward steam, but did float to the surface again at approximately the same location it had during the eastward shoot, supporting Bruce's suggestion that currents were partly to blame.

We started our turn back onto the line at 0648, and completed the final turn at 0803 LT. At this point we were still about 300 m off the track line, but Lou would close that distance gradually. During the remainder of Line 4d (as the new line segment was dubbed), it was a continual battle to keep the streamer balanced. We eventually became fairly proficient at adjusting the ship speed to about 4.0 kn through the water and adjusting bird depths to counteract anticipated streamer "humps." The streamer did occasionally rise to the surface (or near the surface) near Bird 13, but with proper monitoring we found it possible to bring the forward birds down, thus pulling Bird 13 back down and allowing the "bubble" to pass back through the streamer like a wave. The data quality for the line was thus acceptable, though some muting of noisy traces will be required, which will result in some areas with low and uneven coverage.

1 Oct. 96, Tuesday

We continued shooting Line 4d through the early morning hours as wind and sea state began gradually picking up. Another low pressure system was forecast to approach us; by 0800 the barometer had dropped to 992 mb (from 1010 mb eight hours earlier). We passed the last OBH on the line (OBH 25) at 0756 LT, and although the line was designed to continue for another 20 km eastward, the captain and Bruce suggested that it might be wise to begin streamer recovery before the weather worsened. Because we had shot through all of our instruments and had passed the location of the predicted basement high between Anomalies 21 and 22 (which we indeed saw), we readily agreed, deeming it unwise to take any unnecessary risks with the streamer. We declared EOL at 0817 LT, stopped shooting, and began streamer recovery. The sea state remained workable throughout the streamer recovery, which finished at 1200. We lost hydraulic power with the tail buoy still 50 m behind the ship, but, eager to see the streamer completely safe and buttoned up, we pulled the tail buoy in hand-over-hand.

We steamed immediately back to OBH 25 to begin recoveries, hoping to bring as many of the deep instruments as possible back on board before the weather worsened further. We recovered OBH 25 at 1535 LT, OBH 27 at 1835, and OBH 16 at 2124. Conditions were still workable but worsening. Upon arriving on site for OBH 19, we went out on deck to check conditions and decided that the sea state had become too rough to risk deck operations. We turned westward into the wind and suspended operations. The barometric pressure had dropped to 980 mb, and wind speeds were gusting to ~50 kn.

<u>2 Oct. 96, Wednesday</u>

We spent the day riding out the storm. Sea state was very rough, with 15-20' swells, occasional 25' waves, and winds steady at 50 kn and gusting to 70 kn. Impossible to work and difficult to sleep. The OBHs are secure on the fantail, forward on the port side and just aft of the MCS streamer, and seem to be riding out the storm well. We are very glad the streamer is back on board.

<u>3 Oct. 96, Thursday</u>

At 0530 the captain suggested that the swell had begun moderating and that we go out on deck to see if conditions were workable. Lou brought the ship slowly into the seas to simulate a recovery approach, and Steve and the captain went out on the waistdeck, tied in to an overhead wire. In five minutes on the waistdeck we took two substantial waves, one waist-high and one chest-high. Definitely not workable. The captain recovered a life ring that had come loose from the crane and was towed behind the ship all night. We decided to check back again in a few hours to see if conditions had improved.

The rest of the morning was frustrating, as every aspect of the weather *except* wind speed improved. Skies were sunny, the barometer was up to 1008 mb, and humidity was low (80%), but the wind just wouldn't come down below 30-40 kn. Still too rough to work. With another low brewing over Labrador and forecast to head toward Kap Farvel, we began to wonder whether our "weather window" between the storms would itself be unworkable.

During this delay we decided to abandon our hoped-for airgun-to-OBH/S shoot of the westward shelf portion of the line, which we had curtailed to regain contingency days lost during the gale of 26-27 September. Our agreed-upon sailing date for St. John's was Sunday morning (6 Oct) at 0600, which would give us three days to steam home and one day of contingency for fog. There was still a chance that we would have some time left after recovering our instruments, but the risk of leaving a few instruments on the bottom for an additional short shoot in this unstable weather area only a day before our sailing date was simply unacceptable. Once we are able to recover the last OBS, we will call it a cruise and head home.

After lunch the OBH crew went out on deck to judge conditions. Seas and wind had slowly begun moderating, though conditions were still far from ideal. However, the bridge crew was able to steer a course that seemed workable on deck, and, aware of the desirability of recovering as many instruments as possible before the next low pressure system arrived, we decided to try one recovery. We modified deck procedures by (1) clipping in to the overhead wire, (2) having a "wave spotter" call out an appropriate time to lift the OBH frame onto the deck, (3) adding two personnel to the operation to help secure the OBH frame, (4) carrying the pressure case through the CTD room instead of around the fantail, and (5) simultaneously moving the frame around to the fantail to be secured, before debriefing recovery aids. This kept the time spent on the exposed waistdeck to a minimum. OBH 19 was recovered smoothly at 1435 LT, and we decided to continue with recoveries.

Wind speed and sea state came down throughout the day, and we were able to safely recover OBS A4 at 1728, OBS A8 at 1956, and OBS C3 at 2245.

4 Oct. 96, Friday

We continued with OBH/S recoveries through the night in improving conditions. Two OBSs came up 1000 m or more from their deployment positions, but otherwise no complications occurred. OBS C9 was brought on board at 0100 LT, OBH 18 at 0306, OBH 20 at 0449, OBH 26 at 0611, OBH 23 at 0738, OBH 24 at 0910, OBS A3 at 1041, and OBS C4 at 1219.

We recovered the last instrument, OBS A1, at 1415 LT, with green water coming over the waistdeck. After a day of relatively calm recoveries, we went out "with a splash." Seas were beginning to build again. After securing the deck and wet staging area, we gave the word to the bridge to head for home. With the course set for 199°, we stole our last looks at the South Greenland coast and icebergs, and headed for St. John's.

5–6 Oct. 96, Saturday-Sunday

We continued our steam south toward Newfoundland. Weather is fine, although wind and seas are up a bit. We are cobbling away feverishly on the cruise report. There is a palpable sense of relief among the crew that we have escaped the Icy North relatively unscathed.

7 Oct. 96, Monday

We approached the steep-sided headlands of the Newfoundland coast on a sunny, windy morning. The pilot met us a mile or so off of the coast at 1430 LT (we were now back on Newfoundland time, i.e. GMT-0130) and came aboard on the starboard waistdeck. We steamed past wood-frame houses perched on the cliffs below Signal Hill, turned into the harbor and came alongside at 1455. The WHOI truck awaited us on the dock — two days earlier than expected — so we will be able to load our gear in the morning and fly home. All hands are glad to be ashore.

Shipboard Operations

The *Ewing* proved to be an entirely suitable platform for MCS and OBH/S work. Here we summarize aspects of shipboard operations that contributed to our success, as well as several areas where some improvement is warranted.

The *Ewing* facilities and crew excelled in the following regards:

- The crew were industrious, patient, positive, and helpful, and their highly professional approach to all operations contributed greatly to the success of our cruise.
- The bridge crew were very good. They helped us meet our scientific objectives by shooting as close to the coast as possible without compromising ship safety. Decisions on advisability of conducting deck operations in less-than-ideal sea states were taken in joint consultation. Ship handling was excellent.
- Deck operations went very well, and the *Ewing* crew were helpful both in rigging for operations and in conducting deployments and recoveries. Johnny D. and the gunners devised the "Johnny Jr." winch, or tugger, which greatly simplified both deployments and recoveries.
- Science and computing support were excellent. Science Officer Bruce Francis was indispensable to the success of our operation: ably assisted by ET Paul Olsgaard, Bruce oversaw the deployment, recovery, balancing, and repair of the MCS streamer; nursed the MCS shooting and acquisition systems through good times and bad; troubleshot and fixed problems in lab equipment; and even repaired PC obh2's color monitor, which hit the deck after a big roll and which we had given up for dead. System Manager "Budhy" Budhypramano gave us expert advice, cheerfully rendered, on all our computer needs. He handled our challenging network needs (we added 11 computers to the ship's network), devising novel solutions and creating new subnetworks when needed.
- The gunners really earned their pay on this leg: They toiled uncomplainingly in cold weather and rough seas to keep the guns firing reliably throughout the cruise.
- The *Ewing* is well outfitted for OBH/S work — the RDF, navigation, and deck space were all suitable for our needs. There were even special, and much appreciated, preparations for our cold-weather leg: brand-new parkas were issued to each member of the science party.

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

- The Marine Office failed to get streamer oil to St. John's in a timely way. This caused us a two-day delay, cost us substantial funds in additional chopper time (because Refteks already deployed on Transect II had to be reprogrammed), and doubtless incurred considerable expense to LDEO in shipping oil to Greenland. Some blame clearly rests with a lax shipping company and irresponsible truck driver, but there was no need for the shipment to have been timed to arrive so close to our departure date: LDEO had months of lead time since the previous MCS leg to get streamer oil delivered to St. John's. This suggests that improvements to the Marine Office's procurement and/or shipping procedures are in order. To their great credit, however, the Marine Office responded rapidly to the problem in having streamer oil delivered to a remote area of Greenland at short notice, and to granting our request for a two-day extension, thus minimizing the impact of the failed streamer oil delivery on our science operations.
- The MCS system appears to be a fragile one. We elaborate on this point in the MCS Acquisition section of this report.
- The main block on the stern A-frame was in bad repair when we sailed. We were unable to use it for OBH/S deployments and had to re-rig a smaller block on the A-frame. This cost us time and made deployments more risky, since the makeshift

block was closer to the stern of the ship. This should have been repaired before we sailed.

- Hand-held radios are extremely useful during deck operations for communicating between the bridge, lab, and deck. However, the radios on board are too few in number and too low in power. The white radios are too weak to transmit out of the dry staging area and break down frequently. Some of the breakdowns result from difficult (especially wet) deck conditions, but inconvenient breakdowns also occurred on EW-9601 in good weather conditions. It is time to replace the radios with a greater number of higher-power models. Radio Officer Peter Martin did a fantastic job of repairing broken units (even when all hope appeared lost).
- The orange Helly-Hansen work suits are excellent for working on deck in cold, wet conditions. However, the suits on board are at the end of their useful lifetime: most of them are in poor repair. It is time to replace them with new suits.
- The e-mail system on the *Ewing* is generally reliable, and the zero-cost, twice-a-day service eases both science communications and life away from home. However, the service often breaks down on weekends due to shoreside problems at Lamont. Apparently these problems are not fixed until Monday morning. It would be a great help to have someone check on the status of the email system at Lamont on the weekends.
- The gravity meter broke down in rough seas, and Bruce had to replace the gyro. Bruce recommended that the gravity meter be shut down during rough seas as a matter of course, and we agree.

Onshore Operations

In order to extend the transects beyond the continent-ocean transition (COT) and onto continental crust, we recorded the airgun shots from Transects II and III on Reftek portable seismometers on the Greenland coast. On Transect II the coverage over the COT was further extended by a series of explosive shots in Kangertittivatsiaq Fjord, covering 45 km of the landward extension of the transect. Transect I was also recorded on Iceland in a piggyback experiment by Bob White (Cambridge University) and Bryndis Brandsdottir (University of Iceland). A total of 37 Refteks was used, 35 supplied by the IRIS/PASSCAL center at Stanford and two loaned by University of Uppsala. Thirty-two instruments were used in Greenland and five in Iceland.

Transect II

A land crew of three — Stefan Bernstein (DLC), Peter Kelemen (WHOI) and Bill Koperwhats (PASSCAL) — arrived in Ammassalik, E Greenland on 17 Aug. Twenty Refteks were placed on a 130 km landward extension of the marine profile, partly by helicopter and partly from the *Timmik*, a small vessel that sailed out of Ammassalik. During 1–2 Sept., working from the *Timmik*, 32 dynamite charges were shot in Kangertitivatsiaq Fjord, from the mouth of the glacier to some 15 km offshore. (Shot locations and individual charge size were sent by Peter Kelemen on 14 Sept.)

The shooting procedure for the dynamite shots was as follows: 32kg dynamex in 4kg tubes was packed together in a cardboard box with about 2m of blasting wire, insuring good connection between the individual tubes. A Nonel detonator on Nonel tube was inserted into the central dynamex tube, and 12m of Nonel tube was paid out with the nylon string and tied to two empty 10-liter water jugs from which the charge was hanging. After the ship cleared off the site, a conventional no. 8 detonator on powder fuse was attached to the Nonel tube from Zodiac. The position of the site was measured by GPS, and then the fuse was lit. Due to high swells (about 3m) the shot sites offshore are not located exactly on the profile line. After each explosion all waste was recovered. The only damage to sea life observed was three small dead fish around shot locations 2 and 3. The charges were let off at about 10m depth, the only exception being where the charge was resting on the seafloor as in shots 1 and 21 (est. water depth 6 m). Each shot resulted in an initial dome of water, followed by a water column to 20m. From the Zodiac, many reflections (presumably from the submarine fjord sides) were noted. These reflections initially felt like a hammer hitting the deck of the Zodiac, with an estimated frequency of 2/sec, dying out over 3-5 sec. Shot times were recorded on a Reftek with a hydrophone towed behind the ship at a distance of 100–300 m from the shot site, and then picking arrival times. Bill Koperwhats kindly picked these times and mailed the information to us on the *Ewing*. The land shooting program was finished before we started the MCS shooting on the *Ewing*.

Due to programming errors on the Refteks, none of the instruments recorded the main MCS shoot on the transect or the series of 30 shots in the fjord. The offshore line was re-shot (line 2g) using a larger shot interval (73 s compared to 21 s), and ten Refteks were re-deployed and recorded this shoot. Two additional shots were fired in the fjord to be recorded on the Refteks: not a repeat of the closely 30 spaced shots, but a salvage operation. Peter and Bill K. left Greenland September 10 after the land work on Transect II was finished. Bill K. and Tine Larsen (DLC) downloaded data and logfiles from six of the Refteks used in Transect II, four of the re-deployed instruments, which all recorded data, and two instruments from the initial deployment, which did not record.

Evaluation of land program, Transect II.

The deployment of Refteks and the explosion program was carried out according to plan and went very smoothly. However, the failure of all 20 Refteks to wake up and recorde as intended was a very serious setback. Only the rapid reaction from the land crew in re-deploying 10 of the 20 instruments for the re-shoot of (Line 2g) salvaged part of the land acquisition of this transect. We lost the innermost ~70 km of the land line, and the information on upper crustal structure along the fjord, which we had planned to interpret from explosions recorded on the Refteks along the land profile. The news that the Refteks had not recorded reached us from Bill Koperwhats 5 Sept. 14:30, only a few hours before the planned re-shoot of the transect with a larger shot interval. At this time Bill was on the *Timmik* recovering instruments along the fjord, but Peter and Stefan were out recovering Refteks by helicopter on the landward end of the line. We finally got a message to them through Ammassalik flight control, and they re-programmed instruments at the two remaining helicopter sites. It was not possible to re-deploy the ten instruments furthest inland that same day.

The reason for the complete failure of the Refteks to record is at this time not clear. The log files on these instruments indicate that they woke up at the assigned time, but promptly went back to sleep 30 s later, thus failing to record. Battery power was OK on both the external battery and on the internal Ni-Cad battery, which keeps time while the instrument is in sleep mode. Bill Koperwhats is (back at the PASSCAL lab in Stanford) attempting to re-create the problem and find out what happened, but so far we have no word back from him on this topic.

Transect III

The land program on Tansect III was a DLC funded add-on to the SIGMA project. Stefan Bernstein was joined by Kent Brooks (DLC) in Ammassalik after Peter and Bill left. After over 2 weeks of waiting for a weather window enabling a helicopter flight to Kap Møsting, six instruments were deployed over a 63 km stretch from the coast on 21 Sept., while the *Ewing* shot the MCS line. The instruments recorded the landward part of the main MCS shoot and the airgun-only re-shoot of the majority of the line (line3b) with a 50 s shot interval, ending 07:56 Sept. 23. The instruments were recovered 24 Sept. Kent had left Greenland on 24 Sept., and Stefan followed with the remaining Refteks from Transect II and the instruments from Transect III and met Tine Larsen in Reykjavik. They downloaded the instruments (including the five used for the Iceland piggyback). All but two instruments were successfully downloaded. The two remaining instruments have been returned with the shipment to the IRIS/PASSCAL center, where Bill Koperwhats will attempt to extract the data. One instrument failed to establish a stable SCSI connection to the SUN for downloading, and the other reported a media error on the disk.

Evaluation of land program Transect III

It proved to be a long wait to get the instruments deployed, due to unusually bad weather in Ammassalik, but that proved to be a benefit. Stefan and Bill K. had programmed the 8 Refteks intended for Transect III, before Bill's departure to Iceland, with a start-up date of 18 Sept. The only thing Stefan needed to do for deployment was to power up the instruments. When deployment was delayed beyond the programmed start-up date, Stefan prudently powered up some of the instruments and found that they had NOT start recording. He then contacted Bill K. at the IRIS/PASSCAL center in Stanford, and they set the instruments in a continuous power, acquisition-on mode, the same used when re-deploying instruments on Transect II. If deployment had not been delayed,we would not have discovered the failure to start acquisition, and we would have gotten no data from the Refteks on Transect III.

General assessment of Refteks:

We experienced more problems with the Refteks than we thought was possible in one project. If we had deployed the Transect III Refteks on schedule, both land programs on Greenland would have failed to record data — i.e., 26 failures out of 26 deployments. Fortunately, the re-deployment of half the instruments on Transect II and the delay in deployments on Transect III saved us from that disaster, but relying on a scramble re-deployment in a few hours in the logistically demanding East Greenland environment and a 'fortunate' delay in deployments allowing a check-up is not the way to ensure acquisition. We see these problems as programming errors and/or software-hardware mismatches from PASSCAL, despite our endeavors to keep these kinds of errors to a minimum by having a PASSCAL person along. Also, we must acknowledge the failure of the shipboard PIs to check up on the instruments deployed in sleep mode on Transect II. We had planned on checking on as many instruments as possible after start-up time, as a percentage (~5-10 %) of instruments are known to fail when deployed in sleep mode, due to the internal housekeeping clock loosing track of time because of low voltage on the internal Ni-Cad battery. The land crew did not do this check-up, and the shipboard PIs failed to ensure that they did. We hope that our experience will lead to more thorough program testing prior to future Reftek deployments so a repeat failure can be avoided.

Transect I

Land recordings on Transect I were in the form of a piggyback experiment by Bob White, Cambridge University, and Bryndis Brandsdottir, University of Iceland. The SIGMA group provide five Refteks from the PASSCAL lab. Deployments, recoveries and data processing of data from these five instruments are the responsibility of Bob W. and Bryndis. They deployed the five instruments along the extension of Transect I on Iceland, to provide, together with the offshore portion of the transect, complete coverage of the Greenland-Iceland Ridge. During the cruise we decided to shorten Transect I by cutting the east end of the line. We compensated for this for the Iceland recordings by shooting an airgun-only line (line 1c) toward Iceland, supplemented by four sonobuoys to give shallow velocity control (see Appendix 6).

REFTEK positions transect 2

station no	DAS no	download status Oct. 7	latitude N degree min	longitude W degree min
9	7345	454946 sectors	66° 30.469'	36° 04.883'
10	7296	260052 sectors	66° 27.392'	35° 55.713'
13	7447	114640 sectors	66° 22.868'	35° 48.626'
14	7299	109612 sectors	66° 20.976'	35° 46.069'
15	7467	110414 sectors	66° 20.246'	35° 42.397'
16	7358	147310 sectors	66° 19.841'	35° 38.368'
17	7290	120570 sectors	66° 17.561'	35° 35.913'
18	7448	129034 sectors	66° 15.595 '	35° 34.213'
19	7346	462128 sectors	66° 14.176'	35° 28.778'
20	7295	?? disk error	66° 13.862'	35° 24.719'

Explosions Transect 2

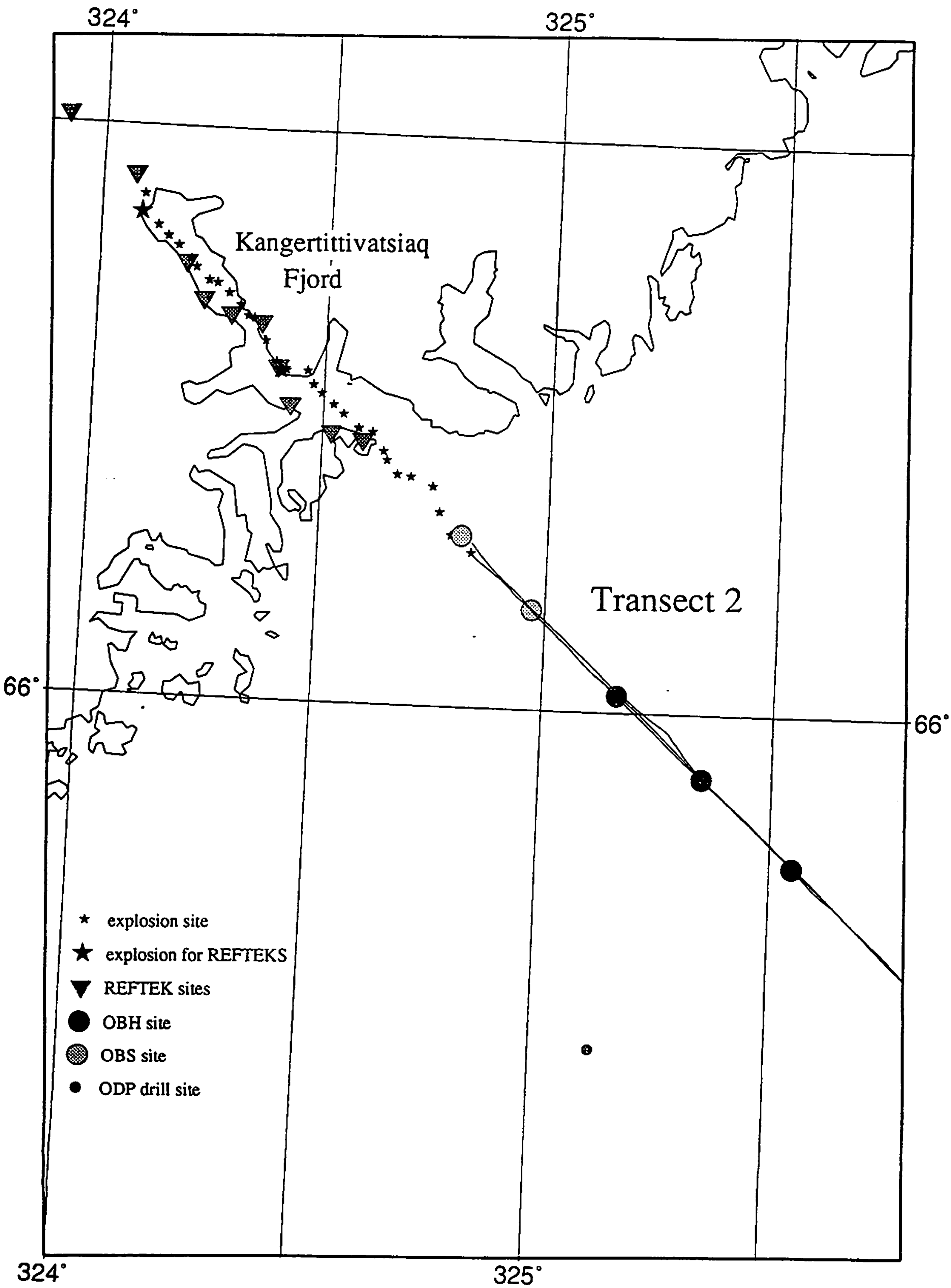
Shot no	latitude N degree min	longitude W degree min	picked time JD:h:min:sec	dist (m)	size (kg)
1	66° 26.334	35° 54.481	245:13:03:14.089	100	32
2	66° 24.698	35° 52.567	245:13:40:50.609	120	32
3	66° 24.168	35° 51.200	245:14:04:05.045	150	32
4	66° 23.678	35° 49.771	245:14:25:36.261	120	32
5	66° 22.998	35° 48.035	245:14:49:31.189	150	32
6	66° 22.583	35° 47.312	245:15:08:47.297	200	32
7	66° 21.931	35° 45.548	245:15:52:18.513	120	32
8	66° 21.820	35° 44.444	245:16:44:34.069	150	32
9	66° 21.307	35° 42.886	245:17:14:29.225	150	32
10	66° 20.724	35° 41.300	245:17:34:36.057	150	32
11	66° 20.159	35° 40.305	245:17:57:47.829	180	32
12	66° 20.043	35° 39.452	245:18:54:12.657	230	32
13	66° 18.901	35° 37.801	245:19:17:10.005	140	32
14	66° 17.830	35° 36.246	245:19:37:28.989	120	32
15	66° 17.400	35° 34.922	245:19:57:51.361	130	32
16	66° 17.407	35° 32.254	245:20:40:50.845	140	32
17	66° 16.669	35° 31.401	245:21:00:32.729	150	32
18	66°1 6.236	35° 30.274	245:21:19:49.593	130	32
19	66°1 5.659	35° 28.656	245:21:38:22.841	140	32
20	66° 15.179	35° 27.300	245:21:56:51.861	100	32
21	66° 14.460	35° 25.316	246:11:32:31.155	100	32
22	66° 14.286	35° 23.522	246:11:49:42.891	230	32
23	66° 13.297	35° 22.033	246:12:12:36.047	140	32
24	66° 12.839	35° 21.531	246:12:28:33.683	180	32
25	66° 12.103	35° 20.126	246:12:47:47.183	100	32
26	66° 12.003	35° 18.308	246:13:11:23.383	120	32
27	66° 11.536	35° 15.433	246:13:36:43.411	150	32
28	66° 10.196	35° 14.461	246:14:01:58.403	160	32
29	66° 09.010	35° 12.890	246:14:42:18.355	180	48
30	66° 08.140	35° 10.040	246:15:31:28.631	160	48
31	66° 17.401	35° 35.635	251:11:41:09.472	60	28
32	66° 25.387	35° 54.745	251:13:36:40.324	80	24

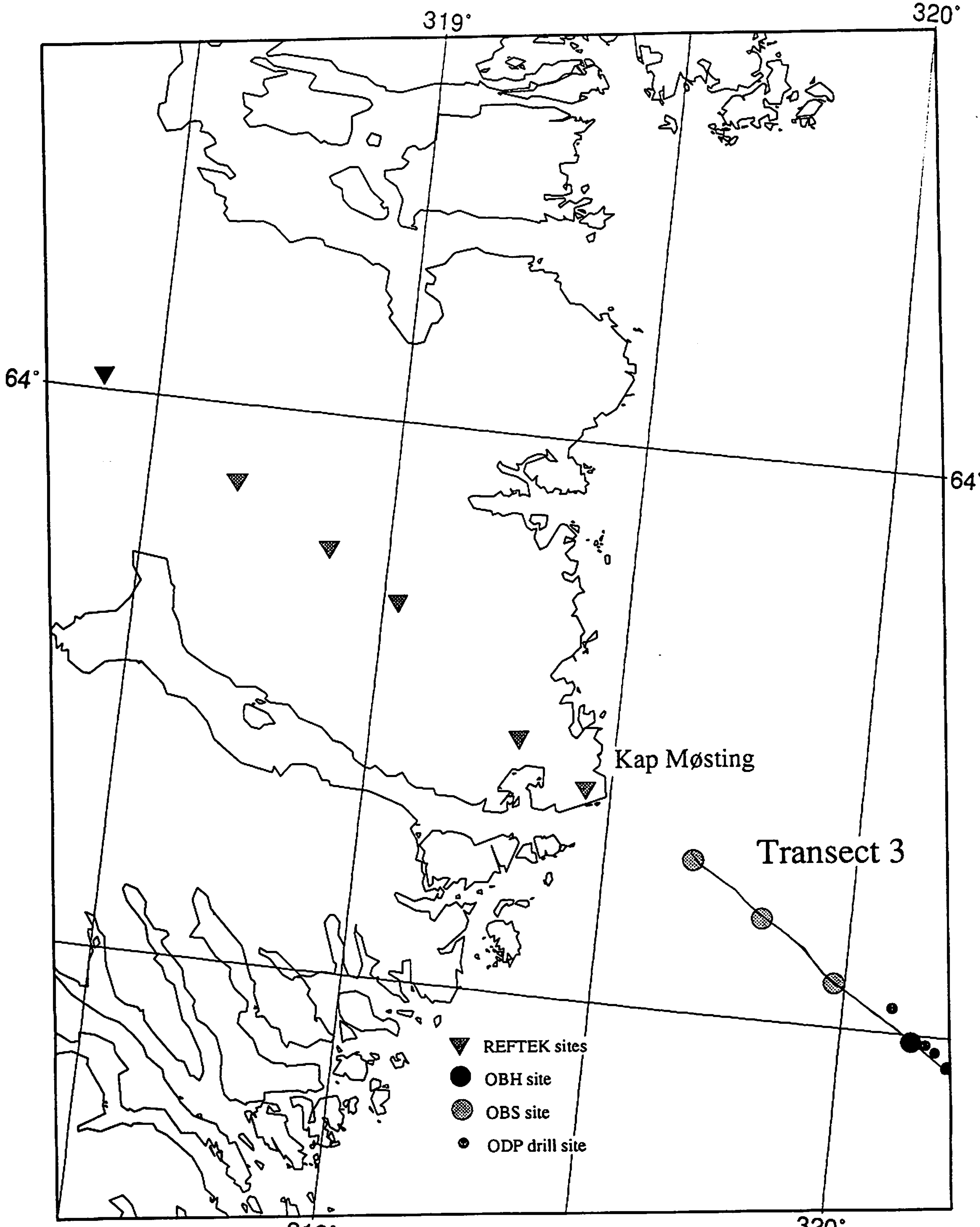
REFTEK position transect 3

station no	DAS no	download status Oct. 7	latitude N degree min	longitude W degree min
1	7277	205528 sectors	63° 41.468'	40° 33.054'
2	7350	181444 sectors	63° 43.766'	40° 41.787'
3	7316	174480 sectors	63° 50.292'	40° 58.250'
4	7359	?? / bad scsi con.	63° 52.798'	41° 07.258'
5	7347	174522 sectors	63° 55.889'	41° 19.163'
6	7454	167882 sectors	64° 00.823'	41° 36.787'

REFTEK in Iceland position transect I

station no	DAS no	download status Oct. 7	latitude N degree min	longitude W degree min
GR01	7361	250464 sectors	65° 35.227'	23° 11.261'
GR02	7360	397916 sectors	65° 37.694'	23° 21.688'
GR03	7442	412470 sectors	65° 40.827'	23° 34.347'
GR04	7348	396322 sectors	65° 43.994'	23° 49.857'
GR05	7443	511588 sectors	65° 46.851'	23° 57.439'


324°
325°
Kangertittivatsiaq
Fjord
Transect 2
66°
66°
324°
325°
explosion site
explosion for REFTEKS
REFTEK sites
OBH site
OBS site
ODP drill site


319°
320°
64°
64°
Kap Møsting
Transect 3
REFTEK sites
OBH site
OBS site
ODP drill site
319°
320°

ref2log: Version Number 96.128

State of Health 96:241:19:22:32:744 ST: 7452
241:19:22:32 SYSTEM INITIALIZED
241:19:22:32 SYSTEM POWERUP 0: UNIT 7452, CPU VER 02.71H
241:19:22:33 MEMORY USED=1, AVAILABLE=2559, TOTAL=2560
241:19:22:33 BATTERY VOLTAGE = 12.5V, TEMPERATURE = 5C
241:19:22:33 INTERNAL CLOCK PLL SET TO HARD 1HZ
241:19:22:34 SERTSK RESET, BUFFER CONTENTS CLEARED
241:19:22:35 HARDWARE CONFIGURATION: C909
241:19:22:35 ACQUISITION OFF AT POWERUP
241:19:22:35 POWERUP COMPLETE
241:19:22:37 EXTERNAL CLOCK IS UNLOCKED
241:19:22:37 BATTERY VOLTAGE = 12.3V, TEMPERATURE = 3C
241:19:22:40 POWERDOWN SEQUENCE COMPLETE
241:19:22:52 DISK FORMAT CALLED
241:19:23:23 SCSI COMMAND COMPLETE
241:19:23:39 ACQUISITION STOP REQUESTED
241:19:23:40 PARAMETERS ERASED
241:19:23:40 WS
241:19:23:40 OM
241:19:23:45 NU
241:19:23:49 NC1
241:19:23:53 NC2
241:19:23:55 YEAR SET TO 1996 FROM 1996
241:19:23:57 NC3
241:19:23:57 EXTERNAL CLOCK IS LOCKED
241:19:23:58 GPS: POSITION: N66:25:12.23 W035:54:36.72 -00022M

State of Health 96:241:19:23:58:896 ST: 7452
241:19:23:58 INTERNAL CLOCK PHASE ERROR OF 211 MSECONDS
241:19:24:00 POWERDOWN SEQUENCE COMPLETE
241:19:24:00 INTERNAL CLOCK TIME JERK # 1 OCCURRED AT 19:24:00.794
241:19:24:00 INTERNAL CLOCK RF DELAY IS 0 MSECS
241:19:24:00 INTERNAL CLOCK PHASE ERROR OF 0 USECONDS
241:19:24:01 DSP CLOCK SET: OLD=96:241:19:24:00.794, NEW=96:241:19:24:00.005
241:19:24:01 DSP CLOCK DIFFERENCE: 0 SECS AND -789 MSECS
241:19:24:01 DSP CLOCK HAS CHANGED 1 TIMES
241:19:24:14 DSP CLOCK SET: OLD=96:241:19:24:03.005, NEW=96:241:19:24:14.005
241:19:24:14 DSP CLOCK DIFFERENCE: 11 SECS AND 0 MSECS
241:19:24:14 DSP CLOCK HAS CHANGED 2 TIMES
241:19:24:14 DD1
241:19:24:17 SC
241:19:24:19 XC
241:19:24:19 INTERNAL CLOCK PLL SET TO HARD 1HZ
241:19:24:20 PARAMETERS IMPLEMENTED
241:19:24:48 SCSI COMMAND COMPLETE
241:19:24:51 FINAL AUTO DUMP CALLED

State of Health 96:241:19:25:08:214 ST: 7452
241:19:25:08 SOH LOG CLEARED
241:19:25:18 SCSI COMMAND COMPLETE
241:19:25:20 POWERDOWN SEQUENCE COMPLETE
241:19:27:45 CPU SOFTWARE V02.71H
241:19:27:45 ACQUISITION ENABLED WHILE ASLEEP
241:19:27:45 LINK PARAMETER PACKETS

Station Channel Definition 96:241:19:24:20:169 ST: 7452
Experiment Number =
Experiment Name = SIGMA '96
Comments - Ammasalik Greenland
Station Number =
Station Name =
Station Comments -
DAS Model Number =
DAS Serial Number =
Experiment Start Time =
Time Clock Type = OTHR
Clock Serial Number = NONE

Channel Number = 1
Name -
Azimuth -
Inclination -
Location
X - Y - Z -
XY Units - Z Units -
Preamplifier Gain = 32
Sensor Model -
Sensor Serial Number -
Volts per Bit = 3.882 mV
Comments -

Channel Number = 2
Name -
Azimuth -
Inclination -
Location

X - Y - Z -
XY Units - Z Units -
Preamplifier Gain = 32
Sensor Model -
Sensor Serial Number -
Volts per Bit = 3.882 mV
Comments -

Channel Number = 3
Name -
Azimuth -
Inclination -
Location
X - Y - Z -
XY Units - Z Units -
Preamplifier Gain = 32
Sensor Model -
Sensor Serial Number -
Volts per Bit = 3.882 mV
Comments -

Wake-up Sequence Definition 96:241:19:24:20:169 ST: 7452

Power State : SL
Recording Mode : SC

Sequence # :
Start time : Year 1996 Day 245 04:00:00
Repeat Duration Days 10 00:00:00
Repeat Interval Days 00 00:00:00
Number of Intervals 0001

Data Stream Definition 96:241:19:24:20:169 ST: 7452

Data Stream 1 Day 245
Channels 123
Sample rate 100 samples per second
Data Format CO
Filters
Trigger Type CON
Record Length (seconds) 3600

Calibration Definition 96:241:19:24:20:169 ST: 7452
Start time : Year Day : :
Repeat Interval Days : : Number of Repeats
Length of CAL (seconds)

Step OFF
Freq OFF
Noise OFF

State of Health 96:241:19:27:45:925 ST: 7452
241:19:27:47 SCSI COMMAND COMPLETE
241:19:27:49 FINAL AUTO DUMP CALLED

State of Health 96:245:04:00:02:194 ST: 7452
245:04:00:02 POWERUP - DATA RAM AUTOMATICALLY CLEARED
245:04:00:02 SYSTEM POWERUP 1: UNIT 7452, CPU VER 02.71H
245:04:00:02 MEMORY USED=1, AVAILABLE=2559, TOTAL=2560
245:04:00:02 BATTERY VOLTAGE = 12.6V, TEMPERATURE = 1C
245:04:00:02 INTERNAL CLOCK PLL SET TO HARD 1HZ
245:04:00:04 HARDWARE CONFIGURATION: C909
245:04:00:04 ACQUISITION OFF AT POWERUP
245:04:00:04 POWERUP COMPLETE
245:04:00:04 GPS: V02.40 (02Jun95)
245:04:00:04 GPS: POWER IS CYCLED EVERY 60 MINUTES
245:04:00:05 NO EXTERNAL CLOCK INPUT
245:04:00:05 BATTERY VOLTAGE = 12.6V, TEMPERATURE = 1C
245:04:00:13 EXTERNAL CLOCK IS UNLOCKED
245:04:00:34 FINAL AUTO DUMP CALLED

State of Health 96:249:14:42:42:194 ST: 7452
249:14:42:42 POWERUP - DATA RAM AUTOMATICALLY CLEARED
249:14:42:42 SYSTEM POWERUP 2: UNIT 7452, CPU VER 02.71H
249:14:42:42 MEMORY USED=1, AVAILABLE=2559, TOTAL=2560
249:14:42:42 BATTERY VOLTAGE = 12.5V, TEMPERATURE = 7C
249:14:42:42 INTERNAL CLOCK PLL SET TO HARD 1HZ
249:14:42:44 HARDWARE CONFIGURATION: C909
249:14:42:44 ACQUISITION OFF AT POWERUP
249:14:42:44 POWERUP COMPLETE
249:14:42:45 NO EXTERNAL CLOCK INPUT
249:14:42:45 BATTERY VOLTAGE = 12.5V, TEMPERATURE = 7C
249:14:42:45 GPS: V02.40 (02Jun95)
249:14:42:45 GPS: POWER IS CYCLED EVERY 60 MINUTES
249:14:42:53 EXTERNAL CLOCK IS UNLOCKED
249:14:43:14 FINAL AUTO DUMP CALLED

State of Health 96:253:21:23:52:194 ST: 7452
253:21:23:52 POWERUP - DATA RAM AUTOMATICALLY CLEARED
253:21:23:52 SYSTEM POWERUP 3: UNIT 7452, CPU VER 02.71H
253:21:23:52 MEMORY USED=1, AVAILABLE=2559, TOTAL=2560
253:21:23:52 BATTERY VOLTAGE = 13.0V, TEMPERATURE = 7C
253:21:23:52 INTERNAL CLOCK PLL SET TO HARD 1HZ

```
253:21:23:54 HARDWARE CONFIGURATION: C909
253:21:23:54 ACQUISITION OFF AT POWERUP
253:21:23:54 POWERUP COMPLETE
253:21:23:55 NO EXTERNAL CLOCK INPUT
253:21:23:55 BATTERY VOLTAGE = 13.0V, TEMPERATURE = 7C
253:21:23:55 GPS: V02.40     (02Jun95)
253:21:23:55 GPS: POWER IS CYCLED EVERY 60 MINUTES
253:21:24:03 EXTERNAL CLOCK IS UNLOCKED
253:21:24:24 FINAL AUTO DUMP CALLED

State of Health  96:254:09:35:21:185   ST: 7452
254:09:35:21 POWERUP - DATA RAM AUTOMATICALLY CLEARED
254:09:35:21 SYSTEM POWERUP 4: UNIT 7452, CPU VER 02.71H
254:09:35:21 MEMORY USED=1, AVAILABLE=2559, TOTAL=2560
254:09:35:21 BATTERY VOLTAGE = 11.9V, TEMPERATURE = 11C
254:09:35:21 INTERNAL CLOCK PLL SET TO HARD 1HZ
254:09:35:23 HARDWARE CONFIGURATION: C909
254:09:35:23 ACQUISITION OFF AT POWERUP
254:09:35:23 POWERUP COMPLETE
254:09:35:24 NO EXTERNAL CLOCK INPUT
254:09:35:24 BATTERY VOLTAGE = 11.9V, TEMPERATURE = 11C
254:09:35:24 GPS: V02.40     (02Jun95)
254:09:35:24 GPS: POWER IS CYCLED EVERY 60 MINUTES
254:09:35:32 EXTERNAL CLOCK IS UNLOCKED
254:09:35:53 FINAL AUTO DUMP CALLED
--===========_-1369054795==_===========--
```

Communications

Reliable communication with both the land crew in Greenland and the piggyback crew in Iceland was necessary in order to coordinate shooting and ensure that the land instruments were deployed and recording when the *Ewing* was shooting.

Greenland land crew.

The crew was provided with a portable HF radio with a series of fixed frequencies allocated to the Danish and Greenland Geological Survey (GEUS). A HF radio was also available on the *Timmik*. As a backup facility, the crew also had a battery powered portable Inmarsat telephone with them. The crews base was in Ammassalik, where there was access to a telephone/fax, and when they were in Ammassalik we relied on the *Ewing* Inmarsat telephone and fax. When the crew were out of Ammassalik onboard the *Timmik*, we had a schedule of 2 different radio frequencies, VHF ch. 16 and finally Inmarsat telephone. We found that it was difficult to keep a regular schedule by HF radio, as the *Ewing* often was too far away for good radio communication on the rather noisy frequencies we used. Our main communication throughout was by telephone between the *Ewing* Inmarsat and either the normal telephone/fax in Ammassalik or the portable Inmarsat telephone. While this clearly is the expensive option it proved reliable.

Iceland Piggyback.

The main communication to the Iceland crew was via E-mail to Bob White and Bryndis Brandsdottir, and on a few occasions by the *Ewing* Inmarsat telephone to Bob White. This proved to work fine, as the Iceland experiments only needed a fairly broad time window for when the Refteks should record.

Weather and Ice Information

Weather

The weather in the area offshore E Greenland and S Greenland is dominated by lows, often forming over Newfoundland or Labrador and moving westward to Greenland. In addition lows form in the area. Gales are frequent, and towards the end of the cruise we were getting close to the autumn season of storms. Fog is a common occurrence, due to the cold coastal waters (1-3 °C).

The Danish Meteorological Institution (DMI) provided weather service for R/V *Ewing* while in East Greenland. DMI daily provided 2 marine forecasts (in Danish, translated on board) for the area the ship was working in, and a daily 24 h forecast map. In addition to this, the on-duty Greenland meteorologist at DMI kept a severe weather watch for the ships position. The forecasts and maps were faxed to the ship via the Inmarsat. The location of the Ewing was always known to DMI as Ewing is a weather reporting vessel.

In total R/V Ewing received 64 out of 77 requested marine forecasts, 31 out of 38 requested 24 h forecast maps and no severe weather warnings.

Evaluation of weather information

In view of the sparse data available from the area (the R/V Ewing being one) the information we received was reasonably reliable, but we often found the surface analysis received by HF marine fax from the US National Meterological Center very useful to combine with DMI's information. The forecasts were valid 'only' 24 h ahead, and thus were less useful for long-range planning. Here the surface analysis maps proved useful, as they cover a larger area, and allowed us to follow the development of lows over a few days. On occasion we talked directly to the 'Greenland meteorologist' on duty at DMI in Copenhagen, and she/he could provide an outlook a couple of days ahead. We received no severe weather warnings during the cruise. The threshhold for issuing a severe weather warning at windspeed over 32 m/s (over 62 kn or force 12), windspeeds that we saw only in gusts in the two storms we encountered. Looking back, we would have gained by setting this threshold lower, say at windspeeds over 24 m/s (47 kn or force 10 and above). This would have given us warning twice during the cruise, both times when it was absolutely necessary to recover the streamer.

The choice of weather services was based on selections from an offer from DMI, and on the pre-cruise meeting June 15 1996 it was agreed between the SIGMA group and the Marine Office to split the costs for weather information.

Ice information

There are two main types of ice likely to be present in the E Greenland offshore area. Polar ice (multi-year pack ice), drifting down with the E Greenland polar current, and icebergs, produced by the glaciers along the E Greenland coast. Both represent a hazard to the ship and the in-water equipment (streamer in particular). 1996 was a very light ice year, and during the cruise we encountered no polar ice and a limited number of icebergs, allowing us to shoot all the way into the coast on transects 2, 3 and 4. During deployments on transect 1 we encountered an area of brash ice (small (<1m) pieces of ice, here glacial ice) and bergy bits (larger bits of glacial ice, < 5m height) prohibiting deployment of instruments at the inner most OBS site and forcing us to move the next site seawards by 4 km. The entire inner 24 km were abandoned.

Before the cruise we had arranged with DMI's ice information group that they could provide us with dedicated ice maps on a request basis. The ice maps are based on several passes of weather satellite pictures, combined to give as large a cloud free area as possible. The satellite pictures are then interpreted, and a map is drawn up outlining the extent, concentration and nature of ice. Individual icebergs are not mapped, but areas of high iceberg concentrations are indicated.

We requested two ice maps, one immediately before the cruise started (25 Sept.), and one on 11 or 12 Sept., when we expected to return to the Greenland coast for mcs shooting and recovery of OBS/H on transect 1.

We did not receive the first ice map, as cloud cover made it impossible, however, DMI could inform us that the SIGMA area was free of polar ice. The second ice map showed us that we had encountered a small area of 1/10 - 3/10 concentration ice. We also received several additional ice maps, faxed to us by DMI on a 'this is what we have basis', for information.

Weather report from DMI 26 September 1996 18:00 utc

Galewarning for Kap Farvel and Julianehåb.

Overview 12:00 utc
A low, under 970 hpa, S of Iceland is moving a bit N, while a low, c. 975 hPa, SE of Ammassalik is moving a bit E to just S of Iceland.

Forecasts valid until Friday 27 September 1996 18:00 utc

Kap Farvel
Gale from W and NW, 13-18 m/s, in the SW part up to 20 m/s. Friday eventually decreasing a bit. Locally rain, otherwise mainly good vis.

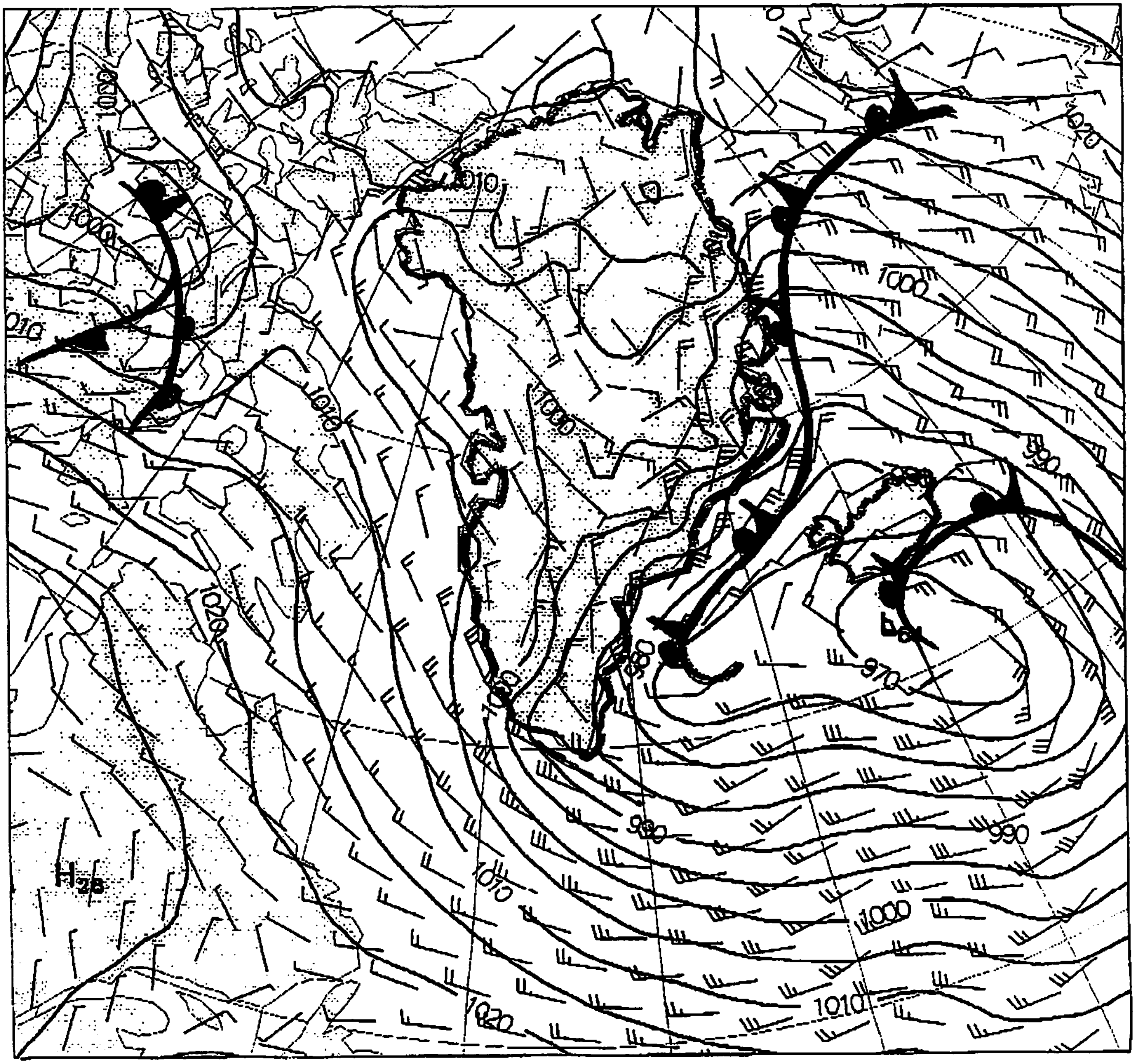
Julianehåb
Gale from around NW 15-20 m/s. A few showers, otherwise mainly good vis.

Vis:	poor	less than 1 km
	moderate	between 1 and 5 km
	good	more than 5 km

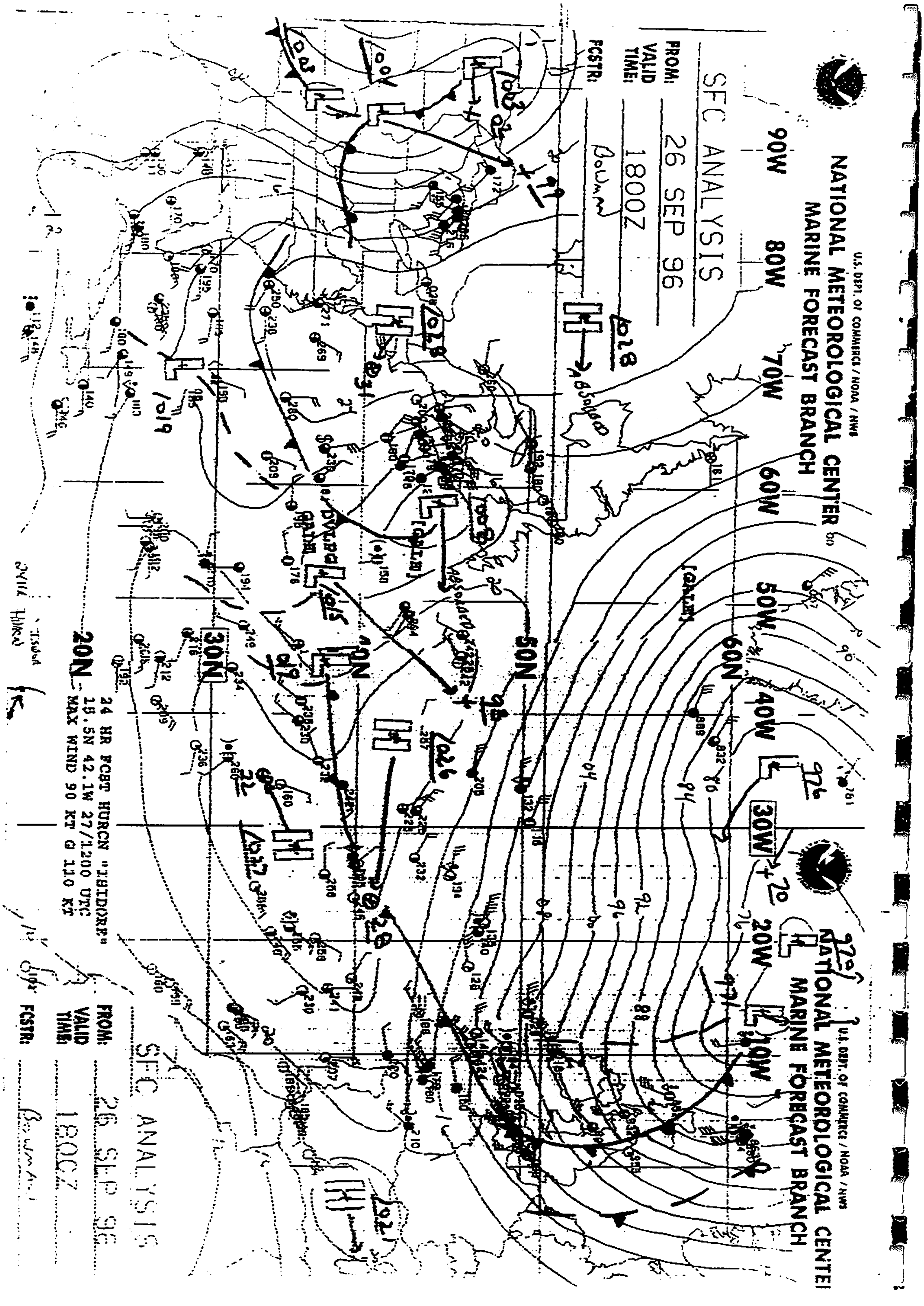
SIGMA

Forecast issued 20UTC Wed 25 Sep 96

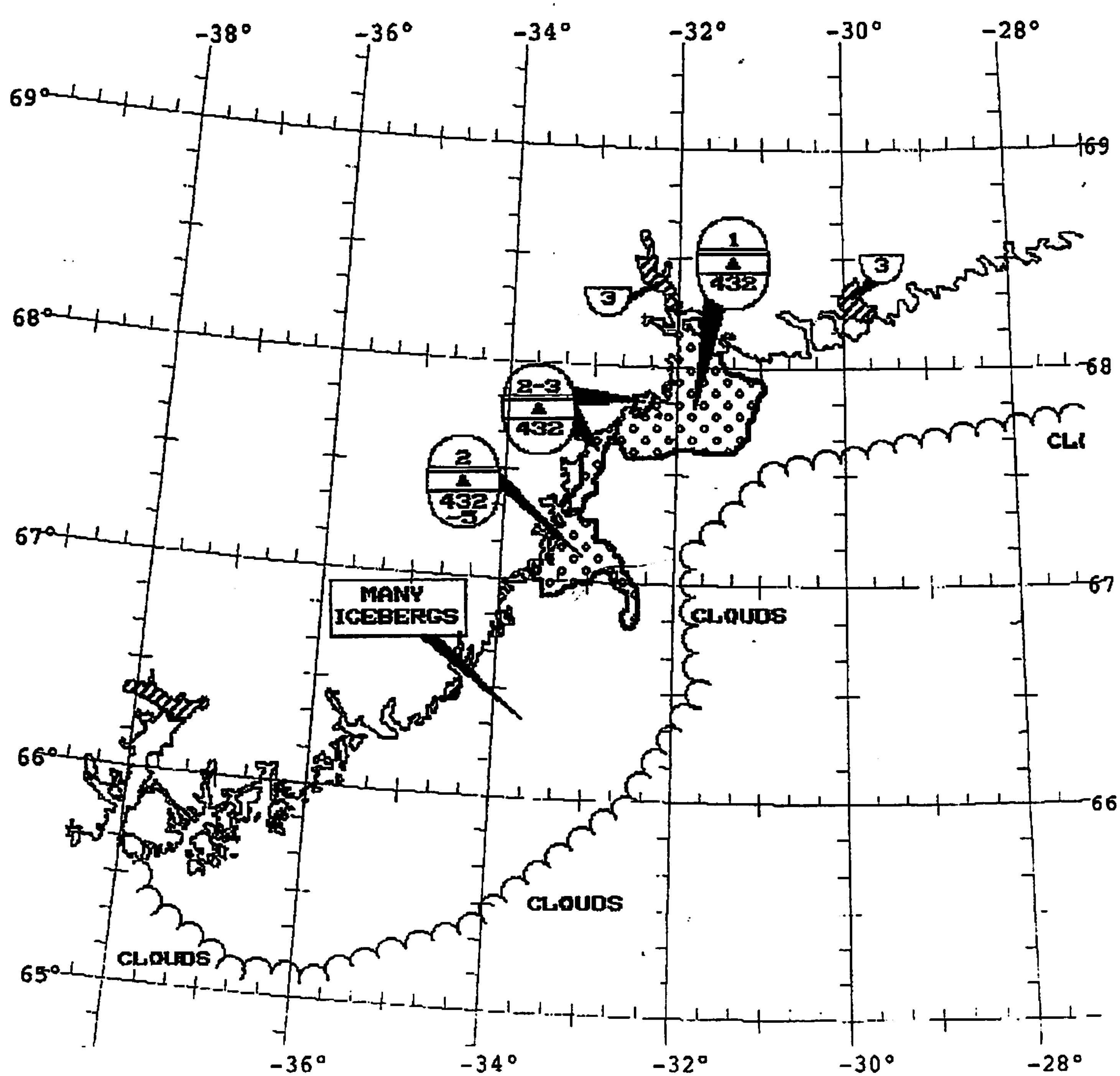
DMI



Valid 12UTC Thu 26 Sep 96


U.S. DEPT. OF COMMERCE / NOAA / NWS
NATIONAL METEOROLOGICAL CENTER
MARINE FORECAST BRANCH
FROM: SFC ANALYSIS
VALID: 26 SEP 96
TIME: 1800Z
FCSTR:
90W
80W
70W
60W
50W
40W
30W
20W
10W
60N
50N
40N
30N
20N
24 HR FCST HURCN "ISIDORE"
15.5N 42.1W 27/1200 UTC
MAX WIND 90 KT G 110 KT
U.S. DEPT. OF COMMERCE / NOAA / NWS
NATIONAL METEOROLOGICAL CENTER
MARINE FORECAST BRANCH
FROM: SFC ANALYSIS
VALID: 26 SEP 96
TIME: 1800Z
FCSTR:

10 SEPTEMBER 1996
SATELLITE BASED ICE-CHART
GREENLAND EAST COAST
Section KX (x,y: 301,130)
DANISH METEOROLOGICAL INSTITUTE



Shipboard Computing

Because the WHOI group had recently sailed on the *R/V Ewing* with OBH operations on New Zealand experiment, lab setup was familiar and straightforward. WHOI computer resources occupied three basic areas of the ship, separated primarily by function and task. In the main lab were **orizaba** and **hekla**, two HP workstations which were used for MCS and OBH/OBS data processing and display. An HP Laserjet was also set up in the main lab. The analytical lab was used to set up the three SUN workstations, **alpamayo, jade,** and **indigo**. Their primary function was to serve as the archival center for the OBH data, and for converting the raw data to SEG-Y format. A second HP Laserjet printer was set up in the analytical lab, along with a MacIntosh SE for document processing. Two PC systems, **obh1** and **obh2**, used mainly for OBH instrument programming and bench testing, were located in dry staging. The main part of the MCS processing was done on the HP workstation **orizaba** (near-real time processing), and on DLC's SUN sparc 20 workstation **mimer** (non-real time processing). Additional MCS processing and software modifications to siosies was done on the SIO Tatung SUN clone **sioseis.** WHOI, DLC and SIO computer resources are tabulated below.
All computers, with the exception of the Mac, were ethernetted and shared disk and print resources. PC-NFS was used to give the PC's access to the SUN data disks.

During the early part of the cruise, it was found that the non-realtime network, on which all of our computers resided, was experiencing delays thought to be a result of the additional traffic placed on the network by the WHOI systems. Some of our standard operations, including NFS shared-mounting of disks and raw data offloading, do in fact heavily load the network, and can cause problems for other users of the network. In order to circumvent this problem, the computers in the analytical lab and in dry staging were put on a separate sub-net, in order to minimize the impact of their network operations on other systems on the ship. A statement by System Manager S. Budhypramono on this topic is attached.

Recommendations:

An additional PC should be available as a spare / fallback position. During a particularly rough stretch of weather, one of the PC monitors was thrown off the bench it had been secured to, suffering some damage, and rendering one the PC's unusable. This happened at a time when the instruments were being turned around between deployments. During this "turn around" period, having two PC's is extremely useful, as one machine can be downloading data while the other is used to debrief instruments. Although the monitor was eventually repaired by Bruce Francis the down time caused some delay in the time it took to "turn around" the instruments after that deployment. It is recommended that a laptop be acquired for this purpose.

In order to more fully utilize and share system resources, 100MBit ethernet cards should be installed in the PC's and in the SUN workstations.

Print spooling software for the HP printers, currently installed only on the SUN systems, should be purchased and installed on the HP workstations, eliminating the necessity of spooling all HP workstation print jobs through the SUN workstations.

Shipboard Computer Resources:

PC NFS drives mounted on PC's

PC drive	SUN drive
E:	indigo:/indigo0/grnlnd
F:	indigo:/indigo1/grnlnd
G:	indigo:/indigo2/grnlnd
H:	indigo:/indigo3/grnlnd
I:	indigo:/indigo4/grnlnd
J:	jade:/jade0/grnlnd
K:	jade:/jade1/grnlnd
L:	alpamayo:/alpamayo0

NAME	Type	Function and Resources
obh1	PC	PC-NFS mounted drives E through L on SUN systems Primary interface to the OBH instruments for programming and diagnostics Backup system for Shot instant logger Backup system for downloading raw OBH data
obh2	PC	PC-NFS mounted drives E through L on SUN systems Backup interface for instrument programming and diagnostics Shot instant logger Primary computer for downloading raw OBH data
alpamayo	SUN	SPARCStation LX used primarily for conversion of raw OBH data to SEG-Y format, and archiving of same Resources: c0t0d0 mounted on /alpamayo0 9.0 Gbyte disk drive used for storage of OBH segy files st5 Exabyte 8505 tape drive for archiving of SEGY data
jade	SUN	SPARCStation ELC used primarily for archival of raw OBH data. Jade also served as print spooler for HP systems. Resources: sd1c mounted on /jade0 1 Gbyte data disk sd2c mounted on /jade1 1 Gbyte data disk above used for raw OBH data storage st1 Mirroring/Dual Exabyte 8505 tape drive which simultaneously made two archival copies of raw OBH data files
indigo	SUN	SPARCStation 1+ used as data storage platform for raw OBH data and backup system for data archival tasks and print spooling Resources: sd2g mounted on /indigo0 1.2 Gbyte data disk sd1g mounted on /indigo1 670 Mbyte data disk sd2h mounted on /indigo2 480 Mbyte data disk sd5a mounted on /indigo3 1 Gbyte data disk sd6a mounted on /indigo4 1 Gbyte data disk above used for raw OBH data storage

hekla	HP	HP 715/85 system used for processing and display of OBH SEGY data and archival of same. Resources: c201d0s0 mounted on /mcs c201d1s0 mounted on /optical c201d2s0 mounted on CD-ROM	 4.0 Gbyte data disk 1.3 Gbyte optical disk tunes
orizaba	HP	HP 715/75 system used for processing and display of MCS data and for archiving MCS data to DAT tape. Resources: c201d5s0 mounted on /orizaba1 c201d3 DAT / DDS-II 4 mm tape drive c201d4 Fujitsu 3480 tape drive with 10 tape autoloader	
mimer	SUN	SPARCStation 20 used for MCS data processing (PROMAX data processing SW) and for producing copies of field data. Resources: DDS-II 4 mm DAT tape drive Exabyte 8505 8 mm tape drive t2d0s0 mounted on /mimer/home t2d0s4 mounted on /mimer/data3 t0d0s0 mounted on /mimer/advance t0d0s3 mounted on /mimer/data t0d0s4 mounted on /mimer/data2	 800 MBytes system disk 6.7 Gbytes data disk 962 Mbyte PROMAX SW 1.9 Gbyte data disk 5.5 Gbyte data disk
sioseis	Tatung	SUN-clone used for MCS data processing using SIOSEIS data processing SW Resources: sd4c mounted on /data1 Exabyte 8200 8 mm tape drive	 1.7 Gbytes data disk
k2	HP	Network laser printer (Analytical Lab)	
pumori	HP	Network laser printer (Main Lab)	

Network problems during EW-9607

We found early in the cruise that the non-real time segment of our network was very slow and unreliable. After careful examination, we discovered that is was caused by WHOI computer network activity when downloading and processing data across the NSF mounted filesystem in 1 MB chunks. This in turn caused the network traffic to slow down to an unaccaptable level. It also caused 'connection timed out' failures on telnet and rlogin connections.

Several steps were taken to address this problem.

1. The WHOI Transceivers had the SQE (heartbeat) turned on. This was turned off so they were in sync with the rest of the computers in the network.

2. We reconfigured the way the network wire was run, and reduced the length by 1/3.

3. In an attempt to isolate the network load caused by WHOI computers from affecting the rest of the non-real time network, we installed a second ethernet card on the SUN IPX computer **squid**. With **squid** acting as a gateway, we managed to put WHOI computers located aft of the main lab into their own semi-private network. This served to isolate the problem to a smaller network, and relieved the rest of the computers from having to share the network load caused by some of the WHOI computers.

S. Budhypramono

MCS and Shooting Operations

Throughout the cruise we used a 4.2 km streamer with 160 channels. Group spacing was 25 m. Shot spacing varied, as we shot with a time interval, but for the MCS lines the 21 +/- 1 s interval gives a nominal shot interval of 50 m (@ 4.7 kn), which in reality varied between 35 and 65 m. The airgun array consisted of 20 airguns between 875 cu. in. and 145 cu. in.,with a total volume of 8460 cu. in. Data were recorded on the Ewing DMS 2000 acquisition system and written to 3480 cartridges. Navigation was GPS.

Airgun system

We had very few problems with the airgun system, and the preliminary processing of the data shows that the source spectrum is well behaved and clean.

Streamer

Streamer balance was a problem, in particular on Transects II and IV. The middle part of the streamer had a tendency to ride high, floating the streamer out on the surface on several occasions, resulting in intervals of limited offset coverage. The variable sea water temperature (1-10°C) along the transects exacerbated streamer ballasting problems. There were several bad traces: on Transect II ch. 89 and 92 were dead, and ch. 42 and 49 were at times contaminated by ringing. Several channels were plagued by spikes (ch. 1, 2, 17, 38, 42 in particular). We were able to remove most of the spikes by despiking routines in either Sioseis or ProMAX.

Acquisition system

Transect II, which was shot first, was a multitude of acquisition woes. We had many autofires, where guns fired while recording the previous shot, subsequent missed shots, large spikes over entire shots, blocks of traces with no data, numerous cable re-builds, partial shots, and bogus header values written. The section on Onboard Processing and Appendix 3 describe these errors and our attempts to deal with them in more detail, but the number of acquisition errors resulted in a dataset for this transect where no 2D processes are expected to work in the CDP domain, due to uneven and variable coverage. This seriously affects our options for removing multiples, which dominate data from the entire area. Our attempts to improve the coverage by re-shooting parts of the line several times helped, but as we were shooting on time (not distance), it is impossible to 'fill holes' in a consistent manner. While re-shooting Transect II with airguns only for OBS/H and Refteks, Bruce and Budhy discovered an error in the shot-release box, which was giving a faulty signal. After repairing the box, the majority of the problems disappeared, and Transects I, III and IV were acquired with far fewer problems. We still had a number of SQTP 84 errors, and occasional SLIC errors causing lost shots, but the datasets are far more consistent. Due to the 'real time' Sioseis system we were running, we had the option to continously monitor data quality on shot gathers, delayed 15-20 min. We would like to suggest that the *Ewing's* splitter system be modified so shotgathers can be monitored in real-time, as that would be a great help in evaluating data quality.

Fragility of MCS system:

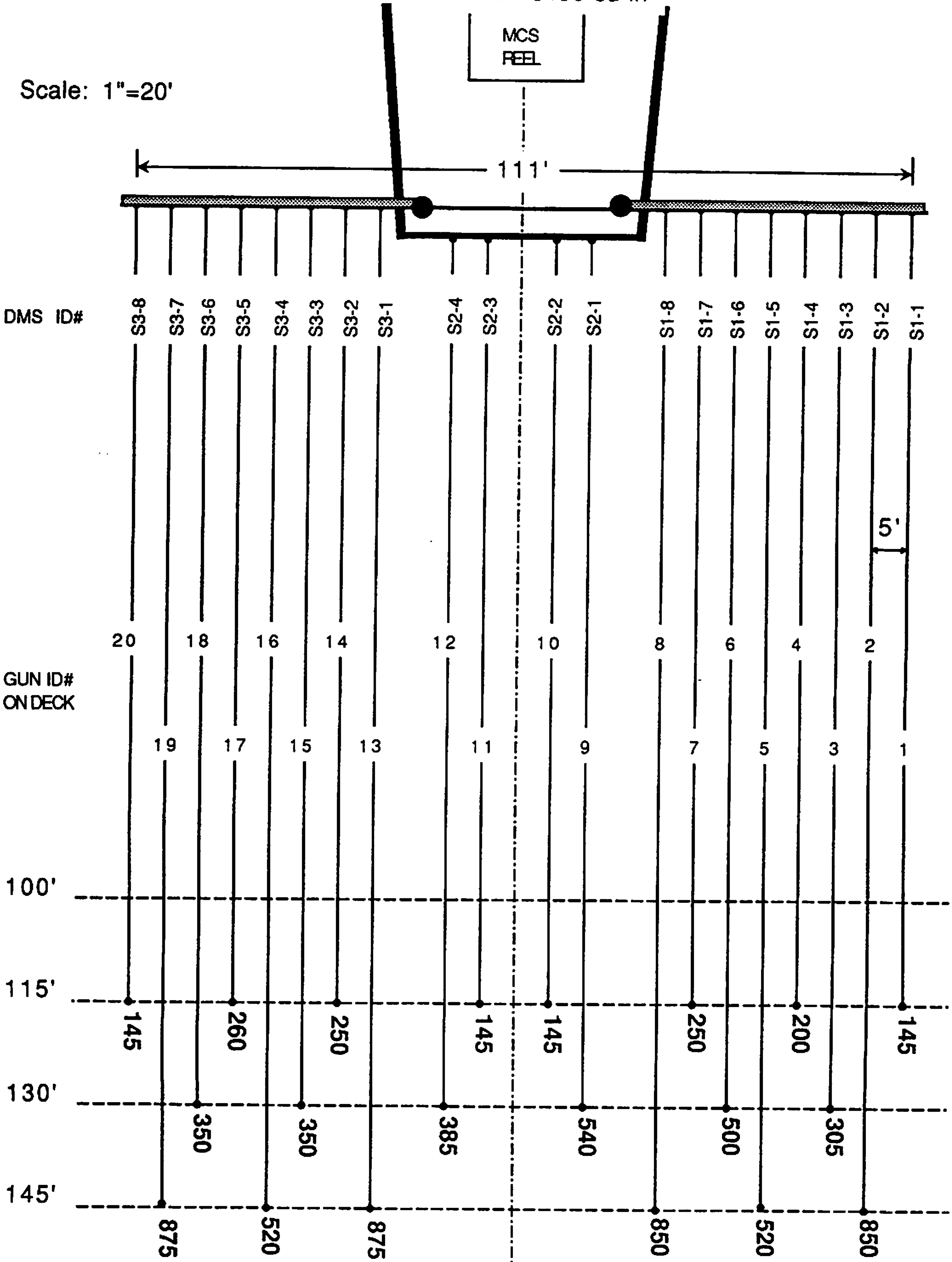
The *Ewing* MCS acquisition system seems in rather delicate condition — the system may work fine for hours at a time, then fail repeatedly for hours. The failure rate increases significantly with sea state, but even in calm weather there is always a feeling that the streamer is being deployed on a wing and a prayer. This is not a reflection on the *Ewing* science staff, who do a fine job with limited resources, but rather the result of having an undermanned, out-of-date system (the only one of its kind in operation) with many Digicon components (especially software) whose inner workings are unknown to the *Ewing* staff. In our opinion there is a real risk that someone will have an unsuccessful

MCS cruise in the near future: the system is too fragile to be so understaffed and undersupplied in spares. In situations where the streamer is failing repeatedly, the Science Officer gets very little sleep and cannot maintain optimal efficiency. Reportedly there are no spares for several key systems, including the CSRU board, the cable subsystem board, the digi board, and the modem for the birds. If any of the first three of these items were to fail irreparably, MCS operations would cease for the remainder of the cruise. We encourage the Marine Office to supply spares for these critical components before it adversely affects an MCS cruise.

Line overview

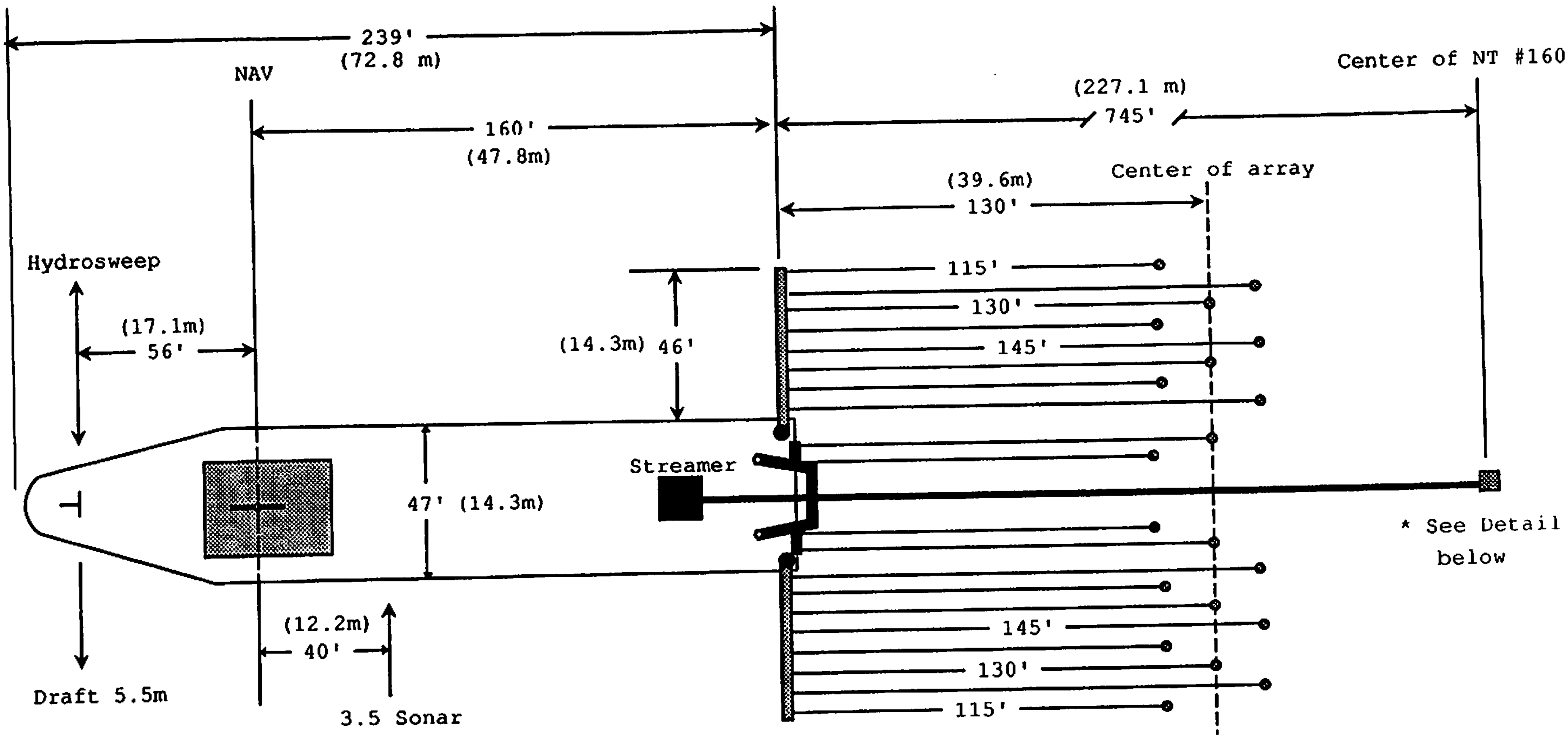
	shot interval	record length	SOL shot	EOL shot	comments
Transect II					
line2	21 +/- 1 s	16 s	1	4042	EOL due to weather
line2c	21 +/- 1 s	16 s	10007	12127	
line2e	21 +/- 1 s	16 s	20000	21842	shot in opposite dir., W-E
line2f	73 +/- 1 s	-	30000	30104	No streamer, airguns only
line 2g	73+/- 1 s	-	30241	31658	No streamer, airguns only
Transect I					
line1b	21 +/- 1 s	16 s	1	5987	
line1c	21 +/- 1 s	-	6000	8538	No streamer, airguns only
Transect III					
line3	21 +/- 1 s	16 s	100	5452	
line3b	50 +/- 1 s	-	6001	7676	No streamer, airguns only
Transect IV					
line4	21 +/- 1 s	16 s	100	3821	EOL due to streamer probl.
line4d	21 +/- 1 s	16 s	5000	9127	

EWING AIRGUN ARRAY- 20 GUN FOR 9607 MCS PROJECT
VOLUME= 8460 cu in



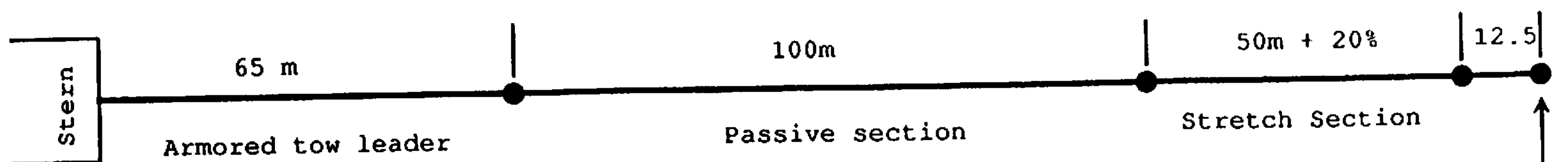
29 Aug 96- baf

MAURICE EWING SETBACK AND OFFSET DIAGRAM-EW9607



Line # 2- Source to NT offset = 198 M

Line # 1,3,4 Source to NT offset = 138 M



CABLE = 160 CHANNEL- 40 ACTIVE SECTIONS- 4264 METERS TOTAL LENGTH

Note: Deck measurements were scaled from frame drawing and are approx.
Stretch section was removed after line #2- hence the offset change.

5 OCT, 96- baf

DATE: 9/1/96						CRUISE:	EW9607 line 3
CHANNELS:	160					GROUP:	25M
SECTION NUMBER	CHAN #	CAN SERIAL #	SECTION SERIAL#	LENGTH	BIRD #	BIRD SERIAL#	COMMENTS
1	1-4	798	1531	100			birds are closest to 1st channel of can
2	5-8	1029	1486	100	1	12197	
3	9-12	61	9409	100	3	12138	
4	13-16	3237	9456	100			
5	17-20	3255	1348	100	4	12327	
6	21-24	L1150	1523	100	5	11802	
7	25-28	1141	1246	100			
8	29-32	1498	L9569	100			
9	33-36	1254	1593	100	6	9507	COMPASS BIRD
10	37-40	803	1105	100			
11	41-44	1449	1460	100	7	11787	bad group
12	45-48	3102	9466	100	9	12385	COMPASS BIRD
13	49-52	1239	9442	100			collars
14	53-56	1046	9453	100	10	11358	
15	57-60	3109	L9573	100			
16	61-64	1248	9450	100			
17	65-68	158	9140	100	11	11843	
18	69-72	3047	9318	100			
19	73-76	3328	9451	100	12	12395	COMPASS BIRD
20	77-80	L963	L9571	100			
21	81-84	1345	9529	100			
22	85-88	3302	9564	100	13	12268	
24	89-93	3139	9109	100	14	11294	
25	94-97	471	L9568	100			
26	98-101	3202	L9572	100	15	11783	
27	102-105	1429A	L9570	100			collars
28	106-109	1521A	L9574	100	16	12065	
SECTION		CAN	SECTION		BIRD	BIRD	

9/29/56

cable.confg.9607.line1

NUMBER		SERIAL #	SERIAL#	LENGTH	NUMBER	SERIAL#	COMMENTS
29	110-113	1352	9575	100			
Power adapter section				3			old one
30	114-117	8450	2021	100			
31	118-120	8204	2015	100	17	9602	COMPASS BIRD
32	121-124	8223	2053	100			collars
33	125-128	8217	2055	100			
34	129-132	8240	2012	100			
35	133-136	8220	2028	100	18	11898	
36	137-140	8212	2022	100			collars
37	141-144	8216	2041	100	8	11811	
38	145-148	8202	2008	100			
39	149-152	8209	2005	100	2	13065	
	153-156		2029	100			new section
40	157-160		2009	100			
41	161-164	8240	6205	100			
ARMORED TOW LEADER				64.61			64.61m from strn to 1st passive
TOTAL LENGTH				4167.61			
SETBACK FROM STRN TO CENTER OF TRACE 160=227.1m							
42		8318	0				Can located inside reel
43	165-168	8370	0				OBAD UNIT-(AUX chan) Located in lab
	169-172						

DATE: 9/1/96						CRUISE:	EW9607 Line 2
CHANNELS:	160					GROUP:	25M
SECTION NUMBER	CHAN #	CAN SERIAL #	SECTION SERIAL#	LENGTH	BIRD #	BIRD SERIAL#	COMMENTS
1	1-4	798	1531	100	1	12197	birds are placed near the first channel
2	5-8	1029	1486	100	3	12138	of the can. e.g. bird 1 = channel 1
3	9-12	61	9409	100			
4	13-16	3237	9456	100	4	12327	
5	17-20	3255	1348	100			collars
6	21-24	L1150	1523	100	5	11802	
7	25-28	1141	1246	100			
8	29-32	1498	L9569	100	6	9507	COMPASS BIRD
9	33-36	1254	1593	100			
10	37-40	803	1105	100	7	11787	
11	41-44	1449	1460	100			collars - bad group
12	45-48	3102	9466	100	9	12385	COMPASS BIRD
13	49-52	1239	9442	100			
14	53-56	1046	9453	100	10	11358	
15	57-60	3109	L9573	100			
16	61-64	1248	9450	100	11	11843	
17	65-68	158	9140	100			
18	69-72	3047	9318	100	12	12395	COMPASS BIRD
19	73-76	3328	9451	100			
20	77-80	L963	L9571	100			
21	81-84	1345	9529	100	13	12268	
22	85-88	3302	9564	100			
23	89-92	3150	9335	100	14	11294	2- bad groups
24	93-96	3139	9109	100			
25	97-100	471	L9568	100	15	12065	
26	101-104	3202	L9572	100			collars
27	105-108	1429A	L9570	100			collars
28	109-112	1521A	L9574	100	16	11783	

9/29/56 cable.confg.9607.line2

SECTION NUMBER		CAN SERIAL #	SECTION SERIAL#	LENGTH	BIRD NUMBER	BIRD SERIAL#	COMMENTS
29	113-116	1352	9575	100			
Power adapter section				3			old one
30	117-120	8450	2021	100			
31	121-124	8204	2015	100	17	9602	COMPASS BIRD
32	125-128	8223	2053	100			collars
33	129-132	8217	2055	100			
34	133-136	8240	2012	100			flat
35	137-140	8220	2028	100	18	11898	flat
36	141-144	8212	2022	100			collars
37	145-148	8216	2041	100			
38	149-152	8202	2008	100	8	11767	
39	153-156	8209	2005	100			
40	157-160			100			
41	161-164	8240	6205	100	2	13065	
42	165-168	8220	6001	60			50m+20%
ARMORED TOW LEADER				64.61			64.61m from strn to 1st passive
TOTAL LENGTH				4227.61			
SETBACK FROM STRN TO CENTER OF TRACE 160=227.1m							
43	169-172	8318	0				Can located inside reel
44	173-176	8370	0				OBAD UNIT-(AUX chan) Located in lab

DATE: 9/1/96						CRUISE:	EW9607 line 3
CHANNELS:	160					GROUP:	25M
SECTION NUMBER	CHAN #	CAN SERIAL #	SECTION SERIAL#	LENGTH	BIRD #	BIRD SERIAL#	COMMENTS
1	1-4	798	1531	100			birds are closest to 1st channel of can
2	5-8	1029	1486	100	1	12197	
3	9-12	61	9409	100	3	12138	
4	13-16	3237	9456	100			
5	17-20	3255	1348	100	4	12327	
6	21-24	L1150	1523	100			
7	25-28	1141	1246	100	5	11802	
8	29-32	1498	L9569	100			
9	33-36	1254	1593	100	6	9507	COMPASS BIRD
10	37-40	803	1105	100			
11	41-44	1449	1460	100	7	11787	bad group
12	45-48	3102	9466	100	9	12385	COMPASS BIRD
13	49-52	1239	9442	100			collars
14	53-56	1046	9453	100	10	11358	
15	57-60	3109	L9573	100			
16	61-64	1248	9450	100			
17	65-68	158	9140	100	11	11843	
18	69-72	3047	9318	100			
19	73-76	3328	9451	100	12	12395	COMPASS BIRD
20	77-80	L963	L9571	100			
21	81-84	1345	9529	100			
22	85-88	3302	9564	100	13	12268	
24	89-93	3139	9109	100			
25	94-97	471	L9568	100			
26	98-101	3202	L9572	100	14	11294	
27	102-105	1429A	L9570	100			collars
28	106-109	1521A	L9574	100	15	12065	
SECTION		CAN	SECTION		BIRD	BIRD	

NUMBER		SERIAL #	SERIAL#	LENGTH	NUMBER	SERIAL#	COMMENTS
29	110-113	1352	9575	100			
Power adapter section				3			old one
30	114-117	8450	2021	100			
31	118-120	8204	2015	100	16	12065	
32	121-124	8223	2053	100			collars
33	125-128	8217	2055	100	17	9602	COMPASS BIRD
34	129-132	8240	2012	100			
35	133-136	8220	2028	100	18	11898	
36	137-140	8212	2022	100			collars
37	141-144	8216	2041	100	8	11811	
38	145-148	8202	2008	100			
39	149-152	8209	2005	100	2	13065	
	153-156		2029	100			new section
40	157-160		2009	100			
41	161-164	8240	6205	100			
ARMORED TOW LEADER				64.61			64.61m from strn to 1st passive
TOTAL LENGTH				4167.61			
SETBACK FROM STRN TO CENTER OF TRACE 160=227.1m							
42		8318	0				Can located inside reel
43	165-168	8370	0				OBAD UNIT-(AUX chan) Located in lab
	169-172						

DATE: 9/1/96						CRUISE:	EW9607 line 4
CHANNELS:	160					GROUP:	25M
SECTION NUMBER	CHAN #	CAN SERIAL #	SECTION SERIAL#	LENGTH	BIRD #	BIRD SERIAL#	COMMENTS
1	1-4	798	1531	100			birds are closest to 1st channel of can
2	5-8	1029	1486	100	1	12197	
3	9-12	61	9409	100	3	12138	
4	13-16	3237	9456	100			
5	17-20	3255	1348	100	4	12327	
6	21-24	L1150	1523	100			
7	25-28	1141	1246	100	5	11802	
8	29-32	1498	L9569	100			
9	33-36	1254	1593	100	6	9507	COMPASS BIRD
10	37-40	803	1105	100			
11	41-44	1449	1460	100	7	11787	bad group
12	45-48	3102	9466	100	9	12385	COMPASS BIRD
13	49-52	1239	9442	100			collars
14	53-56	1046	9453	100	10	11358	
15	57-60	3109	L9573	100			
16	61-64	1248	9450	100			
17	65-68	158	9140	100	11	11843	
18	69-72	3047	9318	100			
19	73-76	3328	9451	100	12	12395	COMPASS BIRD
20	77-80	L963	L9571	100			
21	81-84	1345	9529	100			
22	85-88	3302	9564	100	13	12268	
24	89-93	3139	9109	100			
25	94-97	471	L9568	100			
26	98-101	3202	L9572	100	14	11294	
27	102-105	1429A	L9570	100			collars
28	106-109	1521A	L9574	100			
SECTION		CAN	SECTION		BIRD	BIRD	

9/29/56

cable.confg.9607.line4

NUMBER		SERIAL #	SERIAL#	LENGTH	NUMBER	SERIAL#	COMMENTS
29	110-113	1352	9575	100			
Power adapter section				3			old one
30	114-117	8450	2021	100			
31	118-120	8204	2015	100	16	12065	
32	121-124	8223	2053	100			collars
33	125-128	8217	2055	100	17	9602	COMPASS BIRD
34	129-132	8240	2012	100			
35	133-136	8220	2028	100	18	11898	
36	137-140	8212	2022	100			collars
37	141-144	8216	2041	100	8	11811	
38	145-148	8202	2008	100			
39	149-152	8209	2005	100	2	13065	
	153-156		2029	100			new section
40	157-160		2009	100			
41	161-164	8240	6205	100			
ARMORED TOW LEADER				64.61			64.61m from strn to 1st passive
TOTAL LENGTH				4167.61			
SETBACK FROM STRN TO CENTER OF TRACE 160=227.1m							
42		8318	0				Can located inside reel
43	165-168	8370	0				OBAD UNIT-(AUX chan) Located in lab
	169-172						

OBH Electronics

Prior to EW9607, 10 new disk drives were purchased as spares / upgrades for the instruments. These new disk drives were of a different model than those used previously for data recording, the new disks being Toshiba model MK1926 810MByte disks. One disk was purchased through Onset computer, which cold tested and certified the disk for suitability for ocean bottom recording. The remaining disks, of the same manufacturer and model, were purchased from a PC mail order house at a considerable savings, but at the expense of having to be cold room tested in house by WHOI engineers. During the dismantling and reassembly required to install and cold test the new disks, some instruments exhibited faulty behavior previously not seen in that instrument. These problems were diagnosed and remedied prior to shipment to St. John's and the instruments and spares were all tested and found to be functional before the ship sailed from St. John's. During the cruise however, some instruments failed, either partially or completely, to record usable data, as detailed below.

Instrument 22 was deployed on two transects, SIGMA2 and SIGMA3. On both deployments, the instrument failed to record any usable data. Prior to its first deployment, the instrument was checked out and found to be operating nominally during predeployment tests. Nothing was found, while conducting the predeployment tests, or under close review later to indicate there was anything wrong with the electronics package. Post recovery checks indicated that the instrument was still in acquisition mode, with its clock still running, and had recorded the correct number of tracks. All data values recorded, except for a period of about 30 seconds on the first track, were zero exactly. The instrument was subsequently tested both on the bench, and in its pressure case and again found to be performing nominally. In addition, the hydrophone on the instrument was bench tested and found also to be functional. The hydrophone leads were then suspected as the source of the problem, and swapped out. Although the leads were found to have electrical continuity, it was suspected that the Burton to Mecca splice had been salt water invaded, shorting the two poles of the instruments input. On its second deployment, the instrument again recorded zeros after a brief startup signature, again recovered with its clock running, in acquisition mode and having recorded the correct number of tracks. It is now thought that the model 6 had a cold temperature intolerance and has been swapped out, but as yet not redeployed.

Instrument 24 was deployed on all four transects, and performed well with the exception of having a single write error on track 74 during experiment SIGMA3. For SIGMA4, the instrument was programmed to record on tracks 100 to 809, avoiding writing to suspect track 74. However, bench testing indicates that track 74 can be written to and read from.

Although the battery quality overall was very good, some of the brass terminals on the main (digital) battery packs had to be re-inserted into the plastic harness in order to ensure electrical contact with the instrument battery connector. The same was true for the analog battery packs. Care must be exercised when installing new batteries in the instruments.

OBH Deck Operations

OBH deck operations proceeded smoothly on EW-9607. Several modifications to our prior rigging and deck procedures were made and are described below.

Release Test

Two days out of St. John's we conducted the first wireline test of the EG&G releases. Eight releases were tested and checked out fine. The next day a second rosette with eight releases was lowered, and again all eight checked out at 800 m depth. On 28 Aug the third rosette was lowered; this time release 14165 did not respond to an enable command, but all other releases worked fine. The bad release was taken apart, checked out, and reassembled, and it then passed an air acoustics test. We left release 14165 as a spare, leaving us with one spare release that was tested to 800 m.

Deck Unit

We used the EG&G 8011A deck unit throughout the cruise. The EG&G 8011 was along as a backup but was not used. The 8011A performed adequately throughout.

Deck Procedures

We re-learned an important lesson from the New Zealand cruise the hard way: OBH frames should be secured as far forward as possible, on the port side of the fantail just aft of wet staging, and directly behind the MCS reel. Positions farther aft on deck are simply too exposed to rough seas. We also found that the OBH frames can be well secured with aircraft straps tied low around the aluminum release base posts (in addition to the top eyes); this allows tight tie-down without torqueing the gussets.

The new nylon foot pads make moving the OBH frames much easier: we can push the frame around the deck instead of lifting it with a Johnson bar. This is a much safer way of moving the frame around on a rolling deck.

The new anchor ready rack proved very effective both in keeping anchors in place on the rolling deck and in speeding deployment operations.

During bad weather on the transit to Transect III, three frames were damaged by waves washing across the deck. Frame 25 had four gussets replaced after a leg broke off the frame. We were fortunate that AB John Vezina found the severed leg before it washed overboard. Frame 16 had one broken gusset replaced. Frame 22 had two legs that cracked at the bottom where the foot pads attach. We have no replacement legs on board, so the legs will not be replaced until after the cruise.

Deployments

After the first few deployments, we used the "Johnny Jr." tugger winch, with a wire run through a small block on the stern A-frame. The initial position of this block was too far forward, leaving an uncomfortably narrow clearance of the OBH frame during deployment. Calm seas during Transect II deployments allowed us to continue, but before the next transect the block was repositioned farther aft on the A-frame. The tugger winch made deployments much simpler, safer, and quicker, since it obviated the need for a core winch operator and merged the tasks of operating the A-frame and winch into a single operator, thus reducing (if not entirely eliminating) the risk of uncoordinated deployments.

Toward the end of the cruise we simplified the procedure for attaching and deploying the OBH anchors. Rather than lift it aft after the OBH frame was in place, we moved the anchor first to the stern, placed it briefly on deck while the slip line was attached, then lifted it directly over the roller and secured it to the deck cleat with the slip line. The anchor line was tied off to the rail until the OBH frame was moved aft. This procedure made lifting and moving of the anchor quicker and safer, since it did not have to be precision-dropped into a tight space between the OBH frame, the MCS roller, and Jim (or Robbie).

The new pelican hook quick release was used for the first time on this cruise for deploying the OBHs. The new release hook works fine and is much easier to attach to the lifting bale than the old release hook was.

Recoveries

With the single, prominent exception of OBH 21 on Line 3, recoveries went very smoothly. (The loss of OBH 21 is discussed in a separate section of this report.) Recoveries were conducted forward on the starboard waistdeck using the A-frame and Johnny Jr. tugger. The tugger improved recovery operations as effectively as it did deployment operations, since it eliminated the need for a long bull rope running along the waistdeck to the aft capstan. In contrast to the New Zealand cruise, the waistdeck bulwark was left in place. This added no difficulties to the recovery operation and provided a much improved sense of security during recovery operations; we recommend that the bulwark be left in place on future OBH cruises. During rough weather on Transect IV we adopted a streamlined post-recovery procedure designed to increase safety and minimize time spent on the waistdeck: (1) all personnel wore safety belts and clipped in to the overhead wire; (2) we added one tie-down line from the frame to the bulwark; (3) we added two deck hands to the operation, allowing the frame to be better steadied during lifting out of the water and allowing the OBH frame to be moved aft off the waistdeck while the pressure case was being carried into the lab; (4) we carried the pressure case in through the CTD room to avoid the slick, rolling fantail; and (5) recovery aid checkout was conducted only after the frame was secured on the fantail.

One important modification was made to the approach used by the bridge crew during recoveries: after the loss of OBH 21, they adopted a more oblique approach line, keeping the instrument well off the bow until past the bridge wing.

Recovery Aids

Three flashers failed; two had bad pressure switches and one had salt deposits on the contact surface. One radio failed due to faulty electronics. At the end of the cruise we had three remaining spare flashers and zero spare radios.

Notes for OBS Deck Operations
R/V Ewing

24 August 1996

The USGS Ocean Bottom Seismometer is an orange sphere 17 inches in diameter. It weighs 230 pounds plus a 70 pound circular plate anchor that is attached to the sphere bottom just prior to launch over the side. The sphere encloses recording electronics, clock, acoustic release and a triaxial seismometer mounted on an oil-damped gimbal. Outside the sphere a hydrophone, radio direction beacon, and strobe are attached to the upper bale.

Below is a general description of the deck operations and some useful information for the bridge and crew of the Ewing regarding the USGS OBS instrument.

Highlights for SIGMA

For the SIGMA cruise, we expected (and received) more rough weather than usual cruises so we made a few modifications to our procedure which are highlighted here first.

1) The positioning of the OBS on top of the anchor is a vulnerable moment in deck operations. We revised this procedure in two important ways. First, the stand on which the anchor is placed was secured to the deck using a two-by-four across the bottom ring and bolted to the deck with eyebolts. The anchor was lashed to these eyebolts until just prior to the instrument launch. This prevents the anchor from washing about on deck and possibly injuring someone. Second, we lifted the OBS from the rolling cart, used to transport the instrument around on deck, onto the anchor using the lifting wire and held fast with two tag lines. While this is requires a winch operator, it is far easier than two people trying to lower the OBS onto the center of the anchor. This is a much safer procedure in rough seas because the OBS is held by the wire and tag lines which are not disturbed by sudden rolls or big waves.

2) Instead of using the core winch for deployment and the starboard capstan for recoveries, we used a portable tugger winch for both operations. This allowed the same operator to run the wire and A-frame which produced much smoother movement of the instrument. This was especially helpful on recoveries to control the swing of the OBS and reduce hull slams.

3) All OBS were stored on deck inside the wet staging room allowing access to the instruments in all weather and preventing any damage to the instruments from the seas on deck.

Deployment:

A sequence of predeployment preparations begins 4 to 12 hours prior to launch. This includes loading fresh batteries (80 Alkaline D cells which keep the instrument powered for ten days and the release powered for 3 months), checking the sensor electronics, testing the release, and pulling a vacuum on the sphere case. This takes about 30 minutes per sphere and is done in the wet staging area just near the doorway to the dry staging area (in order for cabling to reach the computers there). We usually prepare all spheres well before reaching any OBS station. Just before reaching a station we test the release a few times and attach a small hook to the release. This hook bolts the anchor to the sphere.

The fantail preparations for an OBS launch require about 10 to 15 minutes. A small stand is secured under the aft A-frame using a 2x4 across the bottom of the stand and bolted to the deck with eyebolts. A circular anchor plate is secured on top of this stand with some short nylon rope lashed through the eyebolts. A piece of rubber is centered on the anchor plate and the OBS sphere lowered onto the anchor so that the release hook pokes through hole in the center of the anchor. In rough weather the OBS is raised onto the anchor with the lifting wire and tag lines manned from each side. A spring and nut are attached to the hook now dangling beneath the anchor. This requires laying on the deck and reaching under the OBS while it is sitting on the stand.

When the station position is reached the A-frame raises the OBS over the side, swings out and then wires down rapidly. When the OBS is just submerged the slip ring is pulled and the instrument sinks. It is best not to let the OBS dangle over the water because dipping in and out of waves pulls on the anchor and the release pin and can conceivably pull the sphere halves open. There is also a danger the OBS can swing and hit the stern of the ship. Once lifted from the deck the OBS should be dropped into the water without delay.

The Chief scientist notes the position and water depth of each drop, it helps if the bridge can also make a note of this.

While the instrument is sinking, we may lower a transducer over the PORT side (just aft of wet staging) to check the acoustic release communication is working and range on the depth.

Recovery

Arriving on station we drop a transducer over the PORT side (just aft of wet staging) to range on the instrument and check the range against the depth. A release command is given and the instrument will confirm it has received the command. The OBS rises at about 1.1 meters/second. The radio direction beacon and strobe are enabled upon release. The strobe is illuminated only at night. See table below for radio frequencies for each OBS.

The sphere sits very low in the water with only about ten inches above waterline and maybe 18 inches to the strobe.

We hook the OBS off the waist deck using a snap hook to attached directly to the lifting line. Two tag lines are also clipped to a d-ring sliding up or down the lifting line to provide some lateral control. The instrument must be brought right alongside the ship on the starboard side. The only place to hook it is through the top bale which is somewhat obstructed by the recovery aids. We use the portable winch and A-frame to lift the OBS. The sphere should not be dragged up the side of the ship or swing and bang into the ship, if possible.

It is possible to use the acoustic transponder to get a range on the instrument while it is on the surface. This can aid in locating an instrument but is not normally done so the ship can maneuver without concern about the transducer over the side.

USGS OBS Frequencies

The OBS acoustic transponder replies at 12 KHz. and receives at a frequency between 10-14 KHz. Occasionally the hydrosweep may interfere with communication in adverse conditions and may require a short interlude in its operation to talk to the OBS.

OBS	Radio Frequency	Novatek Code
A1	159.480 MHz.	B
A3	160.725 MHz.	C
A4	160.725 MHz.	C
A8	154.585 MHz.	A
C1	159.480 MHz.	B
C3	160.725 MHz.	C
C4	160.725 MHz.	C
C9	159.480 MHz.	B

Shipboard Data Processing

Here we summarize briefly the major data processing activities that took place shipboard for MCS, OBH, and OBS data. More detailed accounts of the procedures used are included in the Appendices.

MCS Processing

We had two processing systems onboard the *Ewing* for the cruise: sioseis software running on three of the computers on board and a ProMAX system. In addition, the 'splittter' real-time stacking program of Peter Buhl ran on a *Ewing* SUN workstation, and the stack was displayed on a chart recorder. We found it very useful to have access to our own on-board processing. We were able to look at problems in a timely way and diagnose acquisition errors by analysing the data and the header information written. We defined, for example, what effect the SQTP 84 error had on the data written to tape (see Appendix 3). We could monitor data quality closely in near-real time, a valuable addition to the splitter displays of single race and stack. Both the 'real time' stack produced by sioseis and the brute stack produced over the next couple of days with picked velocities through ProMAX contributed to lively discussions onboard and caused us to alter the extent of one of our transects to pursue an interesting feature. This particular piece of data was carefully re-stacked and migrated (several times) so we could evaluate and interpret this bit of line (see figure in Appendix 3). The tape copy we made on board became much more useful through analysis (and solution) of problems and making sure all necessary information was present in the traceheaders. We were able to define a consistent CDP system on all four transects, which in particular for Transect II was a complicated task due to the re-shoots, one of them in the reverse direction. The PI's for the SIGMA project are spread out over (at least) three institutions in two continents, and it is very useful to have tapes distributed with the same CDP system defined already before we leave the ship.

OBH Processing

Data recorded on the WHOI OBHs followed this basic processing sequence: (1) data were downloaded to a disk with offld6; (2) archive the data from disk to tape; (3) convert the near offset data to SEGY format; (4) reposition the instruments based on analysis of the near traces; (5) produce a SEGY file for the whole record section using the repositioned instrument and clock drifts; and (6) process the SEGY data. Typical late-stage processing included bandpass filtering, source wavelet deconvolution, and plotting.

This cruise marked the first time we implemented shipboard the final instrument repositioning and drift corrections.

In Appendix 4 OBH data processing procedures are discussed in more detail and examples of the data are shown.

OBS Processing

Data recorded on the USGS OBSs followed a processing sequence that is documented in Appendix 5. The data reduction software used on this cruise included for the first time clock corrections and a reduction velocity.

Examples of four record sections from OBSs are included in Appendix 5.

TABLE 1
OBH/S DEPLOYMENTS

Deployment #1 - Transect II

SITE	OBH/S	EID #/ TTID #	H S/N	DATE/TIME	DEPLOYMENT LAT.	DEPLOYMENT LON.	INSTRUMENT DEPTH(m)	START TIME	RECOVERY DATE/TIME	RECOVERY LAT.	RECOVERY LON.
2.1	A1	132		8/30/96 22:48	66° 09.00' N	35° 11.44' W	243	9/1/0400	9/08/96 20:20	66° 08.86' N	35° 11.59' W
2.2	A3	133		8/30/96 23:43	66° 05.320' N	35° 01.681' W	245	9/1/0400	9/08/96 21:28	66° 05.39' N	35° 01.69' W
2.3	20	20	151	8/31/96 00:53	66° 00.89 N	34° 50.19' W	241	9/1/0400	9/08/96 22:52	66° 00.89' N	34° 50.24' W
2.4	26	26	GF-9	8/31/96 02:25	65° 56.48' N	34° 38.44' W	248	9/1/0400	9/09/96 00:14	65° 56.54' N	34° 38.48' W
2.5	16	16	GF-15	8/31/96 03:32	65° 52.06' N	34° 26.83' W	293	9/1/0400	9/09/96 01:35	65° 52.12' N	34° 26.96' W
2.6	22	22	GF-6	8/31/96 04:37	65° 47.515' N	34° 15.520' W	223	9/1/0400	9/08/96 16:33	65° 47.538' N	34° 15.653' W
2.7	25	25	G10	8/31/96 05:57	65° 41.910' N	34° 01.315' W	270	9/1/0400	9/08/96 14:58	65° 41.903' N	34° 01.627' W
2.8	27	27	GF-2	8/31/96 07:21	65° 36.270' N	33° 47.187' W	287	9/1/0400	9/08/96 12:51	65° 36.27' N	33° 47.34' W
2.9	C3	134		8/31/96 08:24	65° 30.628' N	33° 33.131' W	275	9/1/0400	9/08/96 10:24	65° 30.64' N	33° 33.17' W
2.10	C9	131		8/31/96 09:41	65° 24.977' N	33° 19.300' W	329	9/1/0400	9/08/96 08:47	65° 24.92' N	33° 19.50' W
2.11	C4	491		8/31/96 11:25	65° 18.087' N	33° 02.796' W	940	9/1/0400	9/08/96 07:21	65° 17.490' N	33° 04.229' W
2.12	C1	239		8/31/96 12:49	65° 11.213' N	32° 46.363' W	1483	9/1/0400	9/08/96 03:49	65° 11.118' N	32° 46.620' W
2.13	A8	381		8/31/96 14:13	65° 04.332' N	32° 30.080' W	1769	9/1/0400	9/08/96 01:25	65° 04.37' N	32° 30.01' W
2.14	A4	7299		8/31/96 15:35	64° 57.439' N	32° 13.937' W	2025	9/1/0400	9/07/96 23:37	64° 57.36' N	32° 14.32' W
2.15	18	17	1385	8/31/96 17:14	64° 50.472' N	31° 58.024' W	2177	9/1/0400	9/07/96 21:25	64° 50.496' N	31° 59.664' W
2.16	21	21	1326	8/31/96 18:30	64° 43.491' N	31° 42.132' W	2327	9/1/0400	9/07/96 18:36	64° 43.546' N	31° 42.417' W
2.17	19	19	1387	8/31/96 19:53	64° 36.485' N	31° 26.390' W	2356	9/1/0400	9/07/96 16:30	64° 36.669' N	31° 25.741' W
2.18	23	23	GF-7	9/1/96 01:05	64° 29.433' N	31° 10.78' W	2517	9/1/0400	9/07/96 14:19	64° 29.350' N	31° 10.489' W
2.19	24	24	GF-11	8/31/96 23:21	64° 20.778' N	30° 51.963' W	2571	9/1/0400	9/07/96 11:57	64° 20.740' N	30° 52.06' W

Deployment #2 - Transect I

SITE	OBH/S	EID #/ TTID #	H S/N	DATE/TIME	DEPLOYMENT LAT.	DEPLOYMENT LON.	INSTRUMENT DEPTH(m)	START TIME	RECOVERY DATE/TIME	RECOVERY LAT.	RECOVERY LON.
1.1	A3	133		9/09/96 15:50	67° 34.320' N	32° 47.154' W	375	9/11/1000	9/13/96 09:30	67° 02.25' N	32° 46.97' W
1.2	A1	132		9/09/96 18:32	66° 59.7647' N	32° 26.1255' W	374	9/11/1000	9/13/96 07:16	66° 59.610' N	32° 26.089' W
1.3	18	17	1385	9/09/96 20:09	66° 56.3395' N	32° 00.0034' W	278	9/11/0200	9/13/96 12:35	66° 56.367' N	32° 00.107' W
1.4	27	27	GF-2	9/09/96 21:28	66° 52.832' N	31° 33.915' W	262	9/11/0200	9/13/96 14:48	66° 52.821' N	31° 34.123' W
1.5	20	20	151	9/09/96 23:01	66° 49.264' N	31° 08.072' W	464	9/11/0200	9/13/96 17:45	66° 49.222' N	31° 08.242' W
1.6	25	25	G10	9/10/96 00:47	66° 45.650' N	30° 42.350' W	491	9/11/0200	9/13/96 20:28	66° 45.62' N	30° 42.32' W
1.7	21	21	1326	9/10/96 03:45	66° 41.922' N	30° 16.647' W	391	9/11/0200	9/14/96 00:01	66° 42.01' N	30° 16.49' W
1.8	19	19	1387	9/10/96 06:05	66° 38.105' N	29° 51.038' W	285	9/11/0200	9/14/96 03:29	66° 37.910' N	29° 51.685' W
1.9	A8	381		9/10/96 08:03	66° 34.266' N	29° 25.803' W	319	9/11/0200	9/14/96 06:32	66° 34.284' N	29° 26.795' W
1.10	C4	491		9/10/96 10:25	66° 30.367' N	29° 00.344' W	334	9/11/0200	9/14/96 07:58	66° 30.423' N	29° 00.243' W
1.11	C9	131		9/10/96 13:14	66° 26.39' N	28° 35.300' W	327	9/11/0200	9/14/96 09:35	66° 26.442' N	28° 35.213' W
1.12	C3	134		9/10/96 15:47	66° 22.324' N	28° 10.255' W	351	9/11/0200	9/14/96 11:47	66° 22.42' N	28° 09.97' W
1.13	A4	7299		9/10/96 17:53	66° 18.201' N	27° 45.469' W	392	9/11/0200	9/14/96 14:27	66° 18.150' N	27° 45.643' W
1.14	24	24	GF-11	9/10/96 20:17	66° 14.001' N	27° 20.772' W	503	9/11/0200	9/15/96 18:51	66° 13.681' N	27° 21.397' W
1.15	16	16	GF-15	9/10/96 22:33	66° 10.157' N	26° 58.629' W	629	9/11/0200	9/15/96 16:28	66° 09.636' N	27° 00.569' W

Note: Instrument Depth for OBHs is water depth at deployment minus 5m for the anchor line (15'); for OBSs it is the water depth at deployment.

Deployment #3 - Transect III

3.1	A1	132		9/19/96 09:48	63° 38.44' N	40° 19.233' W	179	9/18/2000	9/25/96 13:22	63° 38.104' N	40° 19.014' W
3.2	A3	133		9/18/96 14:47	63° 35.841' N	40° 10.608' W	263	9/18/2000	9/25/96 11:31	63° 35.335' N	40° 10.420' W
3.3	C1	239		9/18/96 13:23	63° 32.473' N	40° 01.362' W	545	9/18/2000	9/25/96 10:19	63° 31.947' N	40° 01.178' W
3.4	24	24	GF-11	9/19/96 11:44	63° 29.73' N	39° 51.61' W	515	9/19/1400	9/25/96 08:56	63° 29.391' N	39° 51.566' W
3.5	25	25	G10	9/19/96 13:20	63° 26.56' N	39° 41.78' W	485	9/19/1400	9/25/96 07:41	63° 26.365' N	39° 41.762' W
3.6	19	19	1387	9/19/96 14:35	63° 22.76' N	39° 30.10' W	379	9/19/1400	9/25/96 06:28	63° 22.691' N	39° 30.092' W
3.7	16	16	GF-15	9/19/96 16:18	63° 18.94' N	39° 18.46' W	817	9/19/1400	9/25/96 05:09	63° 18.744' N	39° 18.870' W
3.8	27	27	GF-2	9/19/96 17:38	63° 13.85' N	39° 02.95' W	1840	9/19/1400	9/25/96 03:20	63° 13.473' N	39° 04.284' W
3.9	22	22	GF-6	9/19/96 19:07	63° 08.07' N	38° 45.62' W	1757	9/19/1400	9/25/96 01:07	63° 07.62' N	38° 46.42' W
3.10	C4	491		9/19/96 20:32	63° 02.26' N	38° 28.42' W	1919	9/20/1400	9/24/96 22:48	63° 02.07' N	38° 28.93' W
3.11	C3	380		9/19/96 21:51	63° 56.40' N	38° 11.30' W	2050	9/20/1400	9/24/96 20:34	62° 55.51' N	38° 11.39' W
3.12	C9	131		9/19/96 23:17	63° 50.57' N	37° 54.39' W	2173	9/20/1400	9/24/96 17:49	62° 50.556' N	37° 54.554' W
3.13	A4	7299		9/20/96 00:33	63° 44.64' N	37° 37.44' W	2130	9/20/1400	9/24/96 15:29	62° 44.802' N	37° 36.424' W
3.14	A8	381		9/20/96 01:50	63° 38.71' N	37° 20.77' W	2115	9/20/1400	9/24/96 12:58	62° 38.122' N	37° 20.723' W
3.15	23	23	GF-7	9/20/96 03:13	62° 32.745' N	37° 04.121' W	2271	9/20/1600	9/23/96 15:32	62° 32.255' N	37° 05.237' W
3.16	21	21	1326	9/20/96 04:44	62° 26.682' N	36° 47.630' W	2435	9/20/1600	Not Recovered		
3.17	26	26	GF-9	9/20/96 06:15	62° 19.628' N	36° 28.530' W	2602	9/20/1600	9/24/96 00:51	62° 19.55' N	36° 28.82' W
3.18	20	20	151	9/20/96 07:46	62° 12.898' N	36° 10.395' W	2716	9/20/1600	9/24/96 03:25	62° 13.072' N	36° 10.673' W
3.19	18	17	1385	9/20/96 09:16	62° 06.178' N	35° 52.364' W	2784	9/20/1600	9/24/96 06:11	62° 06.529' N	35° 52.784' W

Deployment #4 - Transect IV

4.1	A1	132		9/28/96 21:18	59° 52.89' N	45° 21.80' W	131	9/29/0500	10/4/96 15:04	59° 53.047' N	45° 22.373' W
4.2	C4	491		9/28/96 19:49	59° 46.77' N	44° 57.80' W	135	9/29/0500	10/4/96 14:19	59° 47.004' N	44° 58.037' W
4.3	A3	133		9/28/96 18:32	59° 42.010' N	44° 38.626' W	147	9/29/0500	10/4/96 12:41	59° 41.978' N	44° 38.727' W
4.4	24	24	GF-11	9/28/96 17:12	59° 37.100' N	44° 19.760' W	175	9/29/0800	10/4/96 11:10	59° 37.169' N	44° 19.958' W
4.5	23	23	GF-7	9/28/96 15:47	59° 32.150' N	44° 00.732' W	192	9/29/0800	10/4/96 09:38	59° 32.204' N	44° 00.593' W
4.6	26	26	GF-9	9/28/96 14:15	59° 27.134' N	43° 41.895' W	249	9/29/0800	10/4/96 08:11	59° 27.104' N	43° 42.052' W
4.7	20	20	151	9/28/96 12:51	59° 22.080' N	43° 23.313' W	1047	9/29/0800	10/4/96 06:49	59° 22.197' N	43° 23.173' W
4.8	18	17	1385	9/28/96 11:14	59° 16.882' N	43° 04.555' W	1386	9/28/1300	10/4/96 05:06	59° 16.580' N	43° 05.435' W
4.9	C9	131		9/28/96 09:30	59° 11.789' N	42° 46.091' W	1805	9/28/1300	10/4/96 03:00	59° 11.411' N	42° 47.584' W
4.10	C3	380		9/28/96 07:52	59° 06.617' N	42° 27.530' W	2129	9/28/1300	10/4/96 00:45	59° 05.87' N	42° 28.78' W
4.11	A8	381		9/28/96 05:10	59° 00.077' N	42° 04.648' W	2527	9/28/1300	10/3/96 21:56	58° 59.91' N	42° 05.30' W
4.12	A4	7299		9/28/96 02:49	58° 53.459' N	41° 41.870' W	2743	9/28/1300	10/3/96 19:28	58° 53.756' N	41° 40.881' W
4.13	19	19	1387	9/28/96 00:37	58° 46.79' N	41° 19.12' W	2960	9/28/1300	10/3/96 16:35	58° 47.018' N	41° 17.707' W
4.14	16	16	GF-15	9/27/96 22:35	58° 39.85' N	40° 56.52' W	3075	9/28/1300	10/1/96 23:24	58° 40.17' N	40° 57.32' W
4.15	27	27	GF-2	9/27/96 20:26	58° 33.24' N	40° 34.12' W	3131	9/28/1300	10/1/96 20:35	58° 33.42' N	40° 34.86' W
4.16	25	25	G10	9/27/96 18:22	58° 26.362' N	40° 12.095' W	3142	9/28/1300	10/1/96 17:35	58° 26.633' N	40° 11.377' W

Note: Instrument Depth for OBHs is water depth at deployment minus 5m for the anchor line (15'); for OBSs it is the water depth at deployment.

TABLE 2
OBH/S DATA QUALITY

Deployment #1 - Transect II

OBH/S	TRACKS RECORDED	TRACKS ARCHIVED	INSTRUMENT CORRECTION (s) DATE/TIME	PREDEPL	DATE/TIME	POSTRECOV	COMMENTS
A1	544	544	8/30/09:20	+0.00294	9/09/04:15	-0.00256	OK
A3	541	541	8/30/09:11	+0.00488	9/09/03:00	+0.00920	OK
20	287-1	234	8/30/13:08:23	-0.023018	9/09/14:31:44	-0.046752	OK
26	301-0	234	8/30/16:15:03	-0.078753	9/10/00:00:14	-0.169977	OK. Finback whalesongs present.
16	306-1	234	8/30/15:08:04	-0.006137	9/10/03:59:30	-0.009308	OK
22	285-0	234	8/30/21:45:43	-0.029349	9/09/12:45:38	-0.071902	No data. Voltages bad on return. Look unipolar. No negative values. Postrecovery WHOOPS are peggeg positive. Data on Track #1 starts pegged positive, then fluctuates to zero with a few negative spikes, then goes to zero for duration of deployment.
25	282-1	234	8/30/23:28:07	-0.003842	9/09/11:26:03	-0.017767	OK
27	266-1	234	8/30/17:06:13	-0.044566	9/08/23:48:33	-0.102172	OK
C3	494	494	8/30/09:12	+0.00392	9/08/11:15	+0.00243*	Reset on recovery. Lost postrecovery clock offset. Value given is estimate based on bench drift. Data corrupted by segments which repeat in approximately 20% of the traces.
C9	518	477	8/30/09:14	+0.00216	9/08/19:10	+0.00066	OK
C4	537	537	8/30/09:21	+0.00276	9/09/01:26	+0.00342	OK
C1	0	0	8/30/09:16	+0.00792			Failed to record any data.
A8	477	477	8/30/09:18	+0.00334	9/08/04:35	+0.0384	OK
A4	462	462	8/30/09:10	+0.00204	9/07/23:10	-0.00730*	Reset on recovery. Lost postrecovery clock offset. Value given is estimate based on bench drift.
18	260-1	234	8/31/02:53:03	+0.055038	9/08/20:32:34	+0.097517	OK. Hard hit against ship during recovery.
21	255-1	255	8/31/05:20:09	-0.014537	9/08/15:54:43	-0.042743	OK
19	232-0	232	8/31/17:40:23	-0.002819	9/07/23:29:13	-0.020743	OK
23	227-1	227	8/31/22:11:17	+0.005964	9/07/20:15:29	-0.022568	OK. Prior to deployment, piggyback resistors were hot. Voltages unipolar positive. System reconfigured. Swap out tattletale board.
24	224-0	224	8/31/16:01:10	+0.109578	9/07/17:46:01	+0.179618	OK

Deployment #2 - Transect I

OBH/S	TRACKS RECORDED	TRACKS ARCHIVED	INSTRUMENT CORRECTION (ms) DATE/TIME	PREDEPL	DATE/TIME	POSTRECOV	COMMENTS
A3	136	136	9/09/03:39	+0.01030	9/13/10:20	+0.01220	OK
A1	131	131	9/09/12:26	+0.00744	9/13/08:37	+0.00528	OK
18	118-1	118	9/09/16:44:15	+0.006118	9/14/13:37:25	+0.029788	OK
27	120-1	120	9/09/17:53:09	-0.106801	9/14/14:48:03	-0.136752	OK
20	122-1	120	9/09/20:54:33	-0.047410	9/14/16:08:43	-0.056563	OK
25	123-1	120	9/09/22:08:29	-0.018518	9/14/16:52:30	-0.025444	OK
21	124-1	120	9/09/18:35:04	+0.006508	9/14/17:37:13	-0.009343	OK
19	127-1	120	9/09/22:39:04	-0.023291	9/14/19:08:03	-0.034959	OK
A8	217	217	9/09/21:17	+0.00616	9/14/07:03	+0.0350	Bad hydrophone.
C4	223	223	9/09/02:25	+0.00342	9/14/08:48	+0.00220	OK
C9	227	227	9/09/18:14	+0.00056	9/14/10:21	-0.00013	Bad hydrophone.
C3	233	233	9/09/00:39	+0.00232	9/14/12:40	-0.00160	Same data corruption as on Transect II.
A4	239	239	9/09/17:09	+0.00119	9/14/14:52	-0.00320	OK
24	388-0	184	9/10/16:18:15	+0.208625	9/16/14:34:33	+0.267242	OK
16	184-1	184	9/10/18:45:26	-0.009971	9/16/12:07:36	-0.009606	OK

Deployment #3 - Transect III

OBH/S	TRACKS RECORDED	TRACKS ARCHIVED	INSTRUMENT CORRECTION (ms) DATE/TIME	PREDEPL	DATE/TIME	POSTRECOV	COMMENTS
A1	461	461	9/16/19:04	+0.00282	9/25/15:00	-0.00452	OK
A3	453	453	9/16/21:34	+0.00158	9/25/12:15	+0.00644	OK
C1	449	449	9/16/20:28	+0.00504	9/25/10:46	+0.0123	OK
24	217-1	205	9/17/16:49:09	+0.278190	9/25/23:08:54	+0.360510	At first, could not view raw data past track 74. No errors in track headers. Track 74 length is 31 blocks instead of 32. Two raw data files were created: a) tracks 1-74, b) tracks 75-205. Data is OK.
25	216-1	200	9/17/17:33:03	-0.030737	9/25/22:24:05	-0.044270	OK
19	215-0	195	9/18/11:12:06	-0.040059	9/25/21:21:23	-0.057690	OK
16	213-1	193	9/17/18:12:25	-0.010842	9/25/20:39:43	-0.015191	OK
27	211-0	190	9/18/13:01:03	-0.161574	9/25/18:50:06	-0.205390	OK
22	210-0	160	9/18/12:26:04	-0.000070	9/25/17:49:58	-0.032207	No data. Track #1 shows same characteristics as those from SIGMA Line 2. Unipolar full positive followed by rapid fluctuations to zero with some negative spikes to slightly more than 2 volts negative, then flat line at zero volts.
C4	303	303	9/16/22:07	-0.00005	9/25/01:00	-0.00468	OK
C3	289	289	9/19/16:20	+0.00516	9/24/20:00	+0.00739*	Lost time on recovery. Postrecovery offset is an estimate. Bad hydrophone.
C9	282	282	9/19/21:25	-0.00160	9/24/18:00	-0.00231*	Lost time on recovery. Postrecovery offset is an estimate. Same hydrophone problem as on Transect I.
A4	293	293	9/19/15:42	+0.00484	9/24/21:19	+0.00856	OK
A8	269	269	9/19/18:43	+0.00644	9/24/13:19	+0.0154	Horizontal 2 channel is weak.
23	151-1	150	9/19/18:06:03	+0.009106	9/25/02:33:43	-0.013279	OK
21			9/19/18:33:43	+0.009437			OBH was struck by ship during recovery and now rests on the bottom.
26	154-1	150	9/20/03:44:13	-0.279367	9/25/04:43:11	-0.326551	OK
20	156-1	150	9/20/04:17:11	-0.078179	9/25/06:13:33	-0.096147	OK
18	158-1	150	9/20/07:20:37	+0.054613	9/25/07:31:38	+0.078773	OK

Deployment #4 - Transect IV

OBH/S	TRACKS RECORDED	TRACKS ARCHIVED	INSTRUMENT CORRECTION (ms) DATE/TIME	PREDEPL	DATE/TIME	POSTRECOV	COMMENTS
A1	374	374	9/27/19:11	+0.00412	10/4/17:12	+0.00440	OK
C4	368	368	9/26/18:15	-0.00700	10/4/14:49	-0.01460	OK
A3	363	363	9/27/20:48	+0.00224	10/4/13:19	+0.00528	OK
24	313-1*	181	9/28/14:52:00	+0.386729	10/5/15:28:03	+0.456382	OBH struck side of ship during recovery. Data is OK.
23	212-1	180	9/28/13:17:00	-0.028203	10/5/13:57:27	-0.057854	OK
26	211-1	175	9/27/23:27:07	-0.357508	10/5/12:58:48	-0.431978	OK
20	209-1	170	9/27/21:50:03	-0.106007	10/5/11:32:26	-0.132168	OK
18	234-1	210	9/27/19:02:32	+0.088568	10/5/10:27:21	+0.125813	OK
C9	380	380	9/26/17:25	+0.00322	10/4/03:19	+0.00012	Bad channels on vertical and hydrophone.
C3	0	0	9/26/18:50	+0.00516	10/3/23:55	+0.00000	Did not record any data. Reset on deployment.
A8	367	367	9/26/13:59	+0.00066	10/3/22:49	+0.03400	Bad channels on vertical, hydrophone, and horizontal 2; horizontal 1 channel is OK.
A4	357	357	9/26/14:44	+0.00896	10/3/19:20	+0.01400*	Lost time on recovery. Offset here is an estimate from earlier deployments. Time discrepancy of 290 msec at near offsets.
19	197-1	190	9/26/16:48:07	-0.058797	10/4/08:03:53	-0.076413	OK
16	193-1	120	9/26/16:08:03	-0.016020	10/4/05:28:40	-0.018435	OK
27	177-1	130	9/26/13:11:49	-0.209976	10/3/18:06:09	-0.253603	OK
25	175-0	120	9/26/13:44:36	-0.045420	10/3/17:00:00	-0.057880	OK

*Tracks recorded were 100-313:1. Tracks archived were 100-280.

TABLE 3
OBH ELECTRONICS CONFIGURATION

EID	PRE-AMP	Filter	LG GRA	HG GRA	P. S. I.*	Tattletale	Disk	Kato	Piggyback	Vectron Oscillator	WET
16	16	5	8	2	5	145 Rev E TT6	No S/N	No S/N	6	317Y1322 1218027	176
17	17	8	4	16	17	082 Rev C TT6	26841631G MK1926FCV	76393	7	317Y1322 1218025	238
19	19	4	9	13	6	144 Rev E TT6A	26841638G MK1926FCV	81618 Rev B	4	318Y0467 1167150	174
20	20	15	5	26	4	166 Rev E TT6A	26841613G MK1926FCV	76394 Rev B	3	317Y1322 1218026	173
21	21	6	1	20	3	467	13022264A MK1926FCV	103 Rev A	8	318Y0467 1167157	206
22	22	16	10	25	7	149 Rev E TT6A	36T13653P MK1926FCV	42 Rev A	2	317Y1322 1218024	229
23	23	2	14	24	12	139 Rev E TT6A	N/A	N/A	10	318Y0467 1167160	177
24	24	9	19	17	11	167 Rev E TT6A	24043482A MK2326FC	34 Rev A	11	318Y0467 1167159	204
25	25	17	11	12	8	165 Rev E TT6A	No S/N MK1926FCV	N/A	12	318Y0467 1167161	203
26	26	13	15	22	9	143 Rev E TT6A	26841627G MK1926FCV	117 Rev B	13	317Y1322 1218030	172
27	27	14	28	21	10	146 Rev E TT6A	24042781A MK2326FC	116 Rev A	5	317Y1322 1218028	175

*Power Supply Interface.
Pre-amp gain is +20dB.
Filter cutoff freq./type is 80Hz DEK 6 Pole LP with a gain of 1.
Low Gain GRA 1 (Channel 1) gain is 9.4 dB, attenuation is 7, type DEK.
High Gain GRA 0 (Channel 2) gain is 35.5 dB, attenuation is 7, type DEK.
Power Supply Interface Type is May 1991 with jumper positions W1 and W2 both set to 'A'.
Piggyback Board Type is KRP May 1991.
Program Version is 26 (24 July 1994).
Threshold value is 16300 A/D # (0-32000), 0.122 volts.
Sample rate is 200 samples/s.

In OBH 23, prior to SIGMA2, piggyback resistors were hot. Tattletale S/N 139 was replaced by S/N 138 for SIGMA2 and subsequent deployments.
In OBH 25, after SIGMA2 and SIGMA4, the plastic sleeves holding the disk mounting screws popped out. Only a few threads holding them in place.
In OBH 18, EID 17, prior to SIGMA3, the gland seal O-ring was replaced

TABLE 4
OBH FRAME CONFIGURATION

OBH	EID	9 kHz Release	11 kHz Release	Flasher #1	Flasher #2	Radio	Freq.	Hydrophone	Leads
16	16	14748	14148	F03013	18110	18042	159.480 (B)	GF-15	16BB
18	17	18332	14159	18063	18111	18048	160.725 (C)	1385	36BM
19	19	14511	14153	18073	18065	18051	160.725 (C)	1387	19BB
20	20	14737	14164	F03015	18089	18053	160.725 (C)	151	30BM
21	21	13652	14127	18098	18094	18036	154.585 (A)	1326	32BM
22	22	14745	14129	18077	18106	18052	160.725 (C)	GF-6	34BM
23	23	14118	14125	18123	18117	18054	160.785 (D)	GF-7	39BM
24	24	14113	14160	18125	18068	18033	154.585 (A)	GF-11	35MB
25	25	14738	14152	18107	18112	18046	160.725 (C)	G10	15BB
26	26	14734	14157	105787	F03007	18038	159.480 (B)	GF-9	37BM
27	27	13653	14150	18080	18118	18058	160.785 (D)	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.

During SIGMA2 deployment, OBH #23 anchor slip line got hung up. Ship took a pitch as OBH was released. Some concern that it came close to prop, but upon recovery, no damage was found.
After SIGMA2 recovery, flasher S/N 18112 did not work. Bad switch was swapped out. Same unit will be used for subsequent deployments.
During SIGMA2 recovery, flasher S/N F03007 on OBH #26 did not appear to be working in the water. However, on deck it worked OK. Sticky switch? Left on frame for subsequent deployments.
Flasher S/N 18073 (OBH #19) did not work just prior to deployment on SIGMA1. The seal showed evidence of salt deposits. The switch was later cleaned up and works OK. The unit itself will need further work. Flasher S/N 18078 was swapped in for deployment on SIGMA1.
Damage to frames 9/16-9/18:
- OBH 16 - One cracked gusset. Replaced.
- OBH 22 - Broken base of leg, foot pad hanging from pieces. Deployed as is.
- OBH 25 - Three cracked gussets. Leg broke off. Two gussets and leg replaced.

Prior to SIGMA3 deployment, radio S/N 18038 on OBH #26 looked like it needed some work. Cleaned up, DC-4 liberally applied, and reused.
Prior to SIGMA3 deployment, hydrophone leads S/N 34 on OBH #22 were tested for continuity and found to be OK. However, the splice in the leads was suspect. In fact, the tape around the splices on other BM-type leads seemed to be pulling away. To keep it from unraveling further, Scotchkote was applied. The leads on OBH #22 were replaced with S/N 21, having Burton connectors at both ends (BB). The resistance of hydrophone S/N GF-6 on OBH #22 was measured at 10MegOhms; low relative to others that are off scale on a meter that has a maximum of 20MegOhms.
During SIGMA3 recovery, flasher S/N 105787 on OBH #26 did not work. The switch was replaced and the unit will be reused.
During SIGMA3 recovery, radio S/N 18058 on OBH #27 did not work. Replaced it with radio S/N E05003.

Table 5 X-range, SP and CDP values for OBS/H positions

Calculation of common reference points, great circles, and projections.

Note All longitudes are in degress W and all latitudes are in degrees N. For the gmt shell scripts, longitudes were converted to 0-360 format and then converted back again for the tables.

The purpose of this excercise is to find a common coordinate point and great circle for each transect to which the 2-D crustal models can be referenced. The common reference point serves as the origin and the x-ranges increase towards the east. Recording stations and shots that do not fall on the great circle defined here are projected onto it using GMT's `project` command. The great circle is defined by the first and last shot point of a transect. A point that lies on this circle but beyond the westernmost recording station is chosen for the origin.

In a cshell script, the following commands will do this (excerpted from line 2):

```
set refpt1="329.20239000/64.31752667"
set heading="316.85"
set edist="350"
set refpt2=`project -C$refpt1 -A$heading -L0/$edist -G1 -M -Dg | \
      tail -1 | nawk '{printf("%11.8f/%11.8f\n",$1,$2)}'`
```

where `refpt1` is the longitude and latitude of the first shot point on the line, `heading` is the ships heading during the shoot, `edist` is a distance in km well beyond the last recording station. The heading is found from the navigation files using a subroutine written by Rob Blaes and Joanne Stock for caculating distances and bearings between points on the globe. The routine uses corrections from Bowditch's "The Practical Navigator". The heading between the first and last shot point is used to project the great circle beyond the recording stations. The last line is where the new reference point, `refpt2`, is calculated.

The project command can then be used to calculate the x and y ranges along the specified great circle as follows:

```
project refteks/site.xy -C$refpt2 -E$refpt1 -W-500/500 -Fpqrs -M -Dg \
      > refteks.proj
```

where the file `refteks/site.xy` contains the reftek locations and `refpt1` and `refpt2` are variables set as above.

The `project` command from GMT appears to only calculate distances for a spherical earth. From what we have been able to determine, it does not make corrections of the non-spherical shape of the earth (i.e., this particular command ignores the ELLIPSOID variable in the defaults file). To correct the distances found using `project`, we use a rather crude method that assumes a simple scale factor can be constructed using the GMT calculated distance and the actual distance between the two points. The actual distance is calculated using Rob Blaes and Joanne Stock's subroutine, and then the scale factor is (act dist)/(gmt dist). The X-ranges that GMT `project` calculates are multiplied by this factor to approximate the actual range. Though not a perfect method, it should come closer to the actual distances than GMT's spherical approximation.

The final tables contain the following columns:

Inst.:	The instrument number or reference name
Long:	The actual longitude of the instrument
Lat:	The actual latitude of the instrument
X-Range:	The instrument is projected onto the great circle and this is the distance from the origin to the point where the station projects
X-Corr:	The distance using the correction explained above
Y-Range:	This is how far away from the great circle the station lies
P.Long:	The longitude of the projection (lies on the great circle)
P.Lat:	The latitude of the projection (lies on the great circle)
Depth:	Water depth -- as provided by the obs and obh people
SP:	Nearest shotpoint to the station
CDP:	Nearest CDP location to the station

The end of the table contains the reference points, distances and scalings.

Transect 1

Inst.	Long	Lat	X-Range	X-Corr	Y-Range	P.Long.	P.Lat.	Depth	SP	CDP
16	26.9840	66.1695	289.4307	290.6855	-0.1680	26.9825	66.1709	629	923	1045
17	32.0020	66.9394	51.5722	51.7958	-0.3090	31.9997	66.9420	278	5332	20157
19	29.8520	66.6354	151.6736	152.3311	-0.2007	29.8504	66.6371	285	3448	12114
20	31.1370	66.8218	91.5379	91.9348	-0.2347	31.1352	66.8238	464	4573	16946
21	30.2810	66.6992	131.4920	132.0621	-0.2027	30.2794	66.7009	391	3822	13735
24	27.3470	66.2336	271.6522	272.8299	-0.0472	27.3466	66.2340	503	1207	2474
25	30.7070	66.7612	111.5489	112.0325	-0.1921	30.7055	66.7628	491	4202	15338
27	31.5670	66.8809	71.6259	71.9364	-0.2813	31.5649	66.8833	262	4941	18546
a3	32.7860	67.0412	15.6652	15.7332	-0.3532	32.7835	67.0442	375	beyond	EOL
a1	32.4370	66.9965	31.6110	31.7481	-0.3299	32.4346	66.9993	374	5705	21761
a8	29.4290	66.5713	171.6648	172.4091	-0.1695	29.4276	66.5727	319	3069	10508
c4	29.0070	66.5065	191.6877	192.5188	-0.0740	29.0064	66.5071	334	2709	8899
c9	28.5900	66.4405	211.5985	212.5159	-0.0320	28.5897	66.4408	327	2338	7299
c3	28.1720	66.3721	231.6965	232.7010	-0.0686	28.1714	66.3727	351	1958	5684
a4	27.7600	66.3038	251.5896	252.6803	-0.0447	27.7596	66.3042	392	1571	4086

Reference points: Start 33.12745249 W 67.08758785 N
End 26.970885 W 66.16885167 N
Heading: 293.4231
GMT-distance: 290000
Actual Distance: 291257.29
Scaling Factor: 1.00433548

Transect 2

Inst.	Long	Lat	X-Range	X-Corr	Y-Range	P.Long.	P.Lat.	Depth	SP	CDP
16	34.4520	65.8675	107.1892	107.6142	-0.0030	34.4520	65.8675	293	11170	20502
17	31.9690	64.8416	269.2435	270.3111	-0.1929	31.9661	64.8428	2177	1445	7486
19	31.4410	64.6081	305.3336	306.5444	-0.1775	31.4383	64.6092	2456	820	4588
20	34.8370	66.0148	83.2547	83.5849	-0.0769	34.8358	66.0153	241	11662	22424
21	31.7030	64.7257	287.2677	288.4068	-0.1083	31.7014	64.7264	2327	1137	6039
23	31.1770	64.4893	323.5997	324.8828	-0.1552	31.1746	64.4903	2517	489	3121
24	30.8650	64.3454	345.5188	346.8888	-0.2460	30.8613	64.3469	2571	86	1360
25	34.0280	65.6978	134.2079	134.7400	-0.2705	34.0239	65.6996	270	10632	18332
26	34.6470	65.9432	94.9740	95.3506	0.0210	34.6473	65.9431	248	11409	21483
27	33.7890	65.6048	149.2730	149.8649	-0.0900	33.7876	65.6054	287	3647	17122
a1	35.1910	66.1500	61.3305	61.5736	0.0259	35.1914	66.1498	243		
a3	35.0290	66.0878	71.3808	71.6638	-0.0705	35.0279	66.0883	245	11939	23364
c3	33.5520	65.5109	164.3695	165.0213	0.0392	33.5526	65.5106	275	3364	15910
c9	33.3220	65.4164	179.3097	180.0207	-0.0221	33.3217	65.4165	329	3079	14710
c4	33.0640	65.2943	197.3623	198.1449	-1.2638	33.0448	65.3024	940	2745	13260
c1	32.7730	65.1869	215.3906	216.2447	-0.1474	32.7708	65.1878	1483	did not record	
a8	32.5010	65.0722	233.4035	234.3290	-0.1128	32.4993	65.0729	1789	2079	10365
a4	32.2300	64.9532	251.7631	252.7614	-0.3298	32.2250	64.9553	2025	1747	8891
reftek 9	36.0810	66.5078	5.1609	5.1814	2.5621	36.1197	66.4907			
reftek 10	35.9290	66.4565	13.9893	14.0447	2.8535	35.9721	66.4375			
reftek 13	35.8100	66.3811	23.5443	23.6377	0.2047	35.8131	66.3797			
reftek 14	35.7680	66.3496	27.2867	27.3949	-1.1251	35.7510	66.3571			
reftek 15	35.7070	66.3374	30.2119	30.3317	-0.2937	35.7026	66.3394			
reftek 16	35.6390	66.3307	32.9551	33.0857	1.2036	35.6572	66.3227			
reftek 17	35.5990	66.2927	37.1261	37.2733	-0.7067	35.5883	66.2974			
reftek 18	35.5700	66.2599	40.5466	40.7074	-2.5193	35.5319	66.2766			
reftek 19	35.4800	66.2363	45.2906	45.4702	-1.7264	35.4539	66.2477			
reftek 20	35.4120	66.2310	47.9318	48.1219	-0.0963	35.4105	66.2316			

Reference points:	Start 36.20624638 W	66.52172224 N
	End 30.79761 W	64.31752667 N
Heading:	316.85	
GMT-distance:	350000	
Actual Distance:	351387.82	
Scaling factor:	1.0039652	

Transect 2: Explosive Shots

Shot	Long	Lat	X-Range	X-Corr	Y-Range	P.Long.	P.Lat.	Depth	SP	CDP
exp 1	35.9080	66.4389	15.9950	16.0584	2.0302	35.9387	66.4254			
exp 2	35.8761	66.4116	19.0854	19.1611	0.7353	35.8872	66.4067			
exp 3	35.8533	66.4028	20.4944	20.5757	0.6931	35.8638	66.3982			
exp 4	35.8295	66.3946	21.8918	21.9786	0.7309	35.8405	66.3897			
exp 5	35.8006	66.3833	23.6894	23.7833	0.6674	35.8107	66.3789			
exp 6	35.7885	66.3764	24.6045	24.7021	0.4629	35.7955	66.3733			
exp 7	35.7591	66.3655	26.3894	26.4940	0.4491	35.7659	66.3625			
exp 8	35.7407	66.3637	27.1305	27.2380	0.8538	35.7536	66.3580			
exp 9	35.7148	66.3551	28.6281	28.7416	0.9255	35.7288	66.3490			
exp 10	35.6883	66.3454	30.2283	30.3482	0.9258	35.7023	66.3393			
exp 11	35.6718	66.3360	31.4769	31.6017	0.6507	35.6816	66.3317			
exp 12	35.6575	66.3341	32.0905	32.2178	0.9254	35.6715	66.3280			
exp 13	35.6300	66.3150	34.4300	34.5665	0.1868	35.6328	66.3138			
exp 14	35.6041	66.2972	36.6200	36.7652	-0.4917	35.5967	66.3005			
exp 15	35.5820	66.2900	37.8894	38.0396	-0.4147	35.5757	66.2927			
exp 16	35.5376	66.2901	39.3450	39.5010	0.9353	35.5517	66.2839			
exp 17	35.5233	66.2778	40.7410	40.9025	0.3602	35.5287	66.2754			
exp 18	35.5046	66.2706	41.8987	42.0649	0.3364	35.5097	66.2684			
exp 19	35.4776	66.2610	43.5108	43.6833	0.3682	35.4832	66.2586			
exp 20	35.4550	66.2530	44.8577	45.0356	0.3985	35.4610	66.2504			
exp 21	35.4219	66.2410	46.8522	47.0379	0.4209	35.4283	66.2382			
exp 22	35.3920	66.2381	48.0558	48.2463	1.0916	35.4085	66.2309			
exp 23	35.3672	66.2216	50.1167	50.3155	0.4965	35.3747	66.2183			
exp 24	35.3589	66.2140	50.9634	51.1654	0.1279	35.3608	66.2132			
exp 25	35.3354	66.2017	52.6657	52.8745	-0.1618	35.3330	66.2028			
exp 26	35.3051	66.2001	53.7850	53.9982	0.6302	35.3146	66.1959			
exp 27	35.2572	66.1923	55.9519	56.1737	1.4536	35.2792	66.1827			
exp 28	35.2410	66.1699	58.1781	58.4088	0.1206	35.2428	66.1691			
exp 29	35.2148	66.1502	60.5308	60.7708	-0.6856	35.2044	66.1547			
exp 30	35.1673	66.1357	63.1934	63.4440	-0.4143	35.1610	66.1384			
exp 31	35.5939	66.2900	37.4970	37.6457	-0.7741	35.5822	66.2951			
exp 32	35.9124	66.4231	17.0302	17.0978	0.5973	35.9214	66.4191			

Reference points:	Start 36.20624638 W	66.52172224 N
	End 30.79761 W	64.31752667 N
Heading:	316.85	
GMT-distance:	350000	
Actual Distance:	351387.82	
Scaling factor:	1.0039652	

Transect 3

Inst.	Long	Lat	X-Range	X-Corr	Y-Range	P.Long.	P.Lat.	Depth	SP	CDP
16	39.3100	63.3147	164.1851	164.8440	-0.2804	39.3067	63.3167	817	4385	19137
17	35.8790	62.1054	384.7694	386.3136	0.1142	35.8804	62.1046	2784	199	1420
19	39.5020	63.3796	152.1952	152.8061	-0.0785	39.5011	63.3802	379	4601	20100
20	36.1760	62.2168	364.9887	366.4535	0.0221	36.1763	62.2166	2716	571	3009
23	37.0690	62.5458	306.1904	307.4193	-0.0157	37.0688	62.5459	2271	1683	7732
24	39.8580	63.4932	130.4486	130.9721	-0.1843	39.8558	63.4945	515	5045	21847
25	39.6970	63.4416	140.2911	140.8541	-0.1768	39.6949	63.4429	485	4384	21056
26	36.4770	62.3273	345.1532	346.5384	-0.1509	36.4752	62.3284	2602	940	4602
27	39.0530	63.2315	180.0202	180.7427	-0.1458	39.0513	63.2326	1840	4101	17865
a1	40.3230	63.6366	102.4489	102.8601	-0.5317	40.3168	63.6405	179	6015	-----
a3	40.1770	63.5906	111.2930	111.7397	-0.5402	40.1707	63.5946	263	6075	-----
c1	40.0210	63.5395	120.8792	121.3644	-0.6961	40.0128	63.5446	545	5257	22615
c4	38.4790	63.0397	215.8904	216.7569	-0.0679	38.4782	63.0402	1919	3436	14984
c3	38.1950	62.9387	234.1032	235.0427	-0.4097	38.1901	62.9416	2050	3121	13522
c9	37.9150	62.8428	251.8513	252.8620	-0.3136	37.9113	62.8450	2173	2787	12096
a4	37.6220	62.7398	270.6418	271.7280	-0.3333	37.6180	62.7422	2130	2405	10587
a8	37.3420	62.6437	288.4779	289.6357	-0.0380	37.3415	62.6440	2115	2043	9154
reftek	40.5510	63.6911	89.7626	90.1229	-2.0433	40.5272	63.7061			
reftek	40.6960	63.7294	81.4696	81.7966	-2.6427	40.6653	63.7489			
reftek	40.9710	63.8382	63.4744	63.7292	-0.4039	40.9663	63.8412			
reftek	41.1210	63.8800	54.7860	55.0059	-0.7455	41.1124	63.8855			
reftek	41.3190	63.9315	43.5605	43.7353	-1.4934	41.3018	63.9426			
reftek	41.6130	64.0137	26.5583	26.6649	-1.9931	41.5901	64.0285			

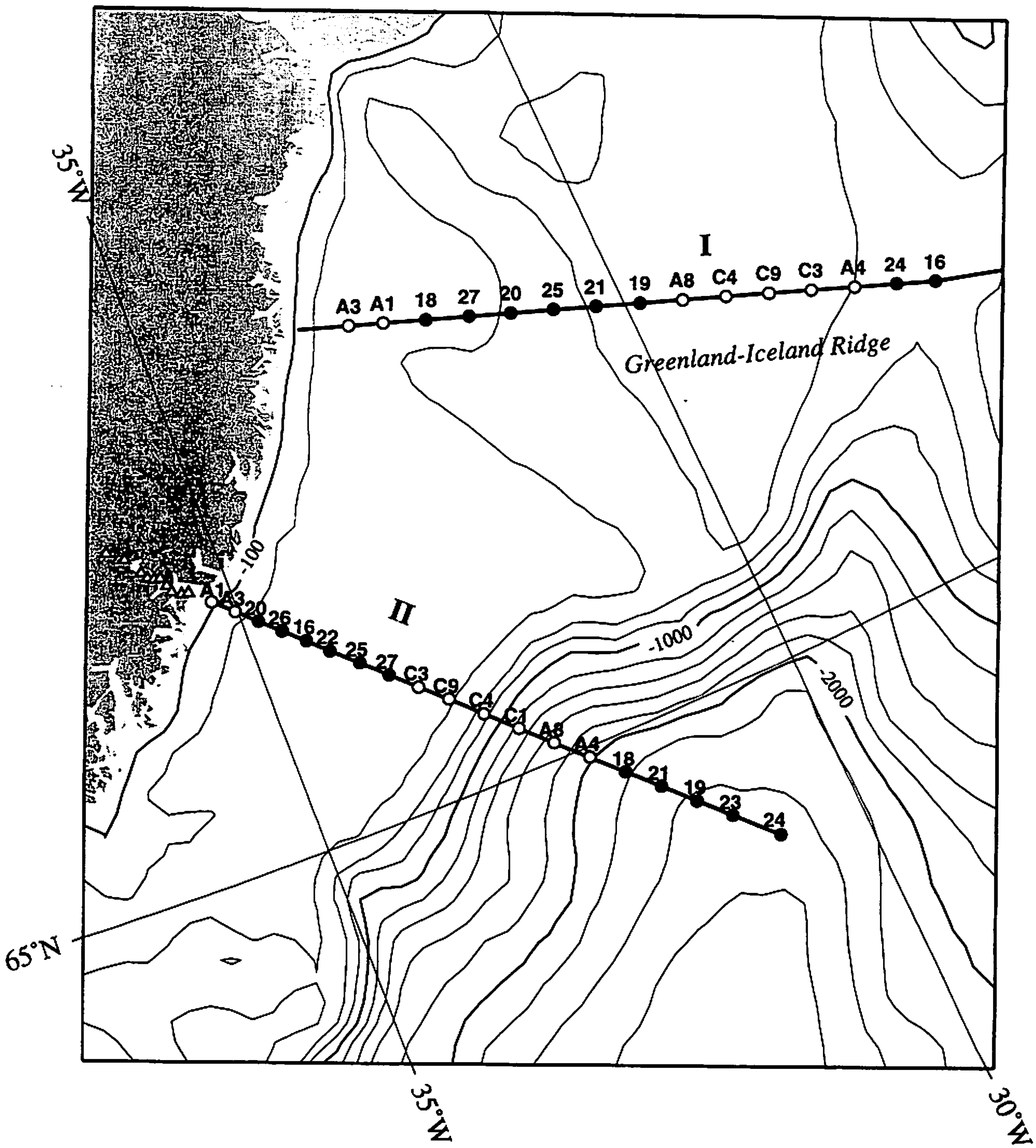
Reference points:	Start	42.04400203 W	64.16166713 N
	End	35.80251167 W	62.07487167 N
Heading:	309.237		
GMT-distance:	390000		
Actual distance:	391565.20		
Scale factor:	1.0040133		

Transect 4

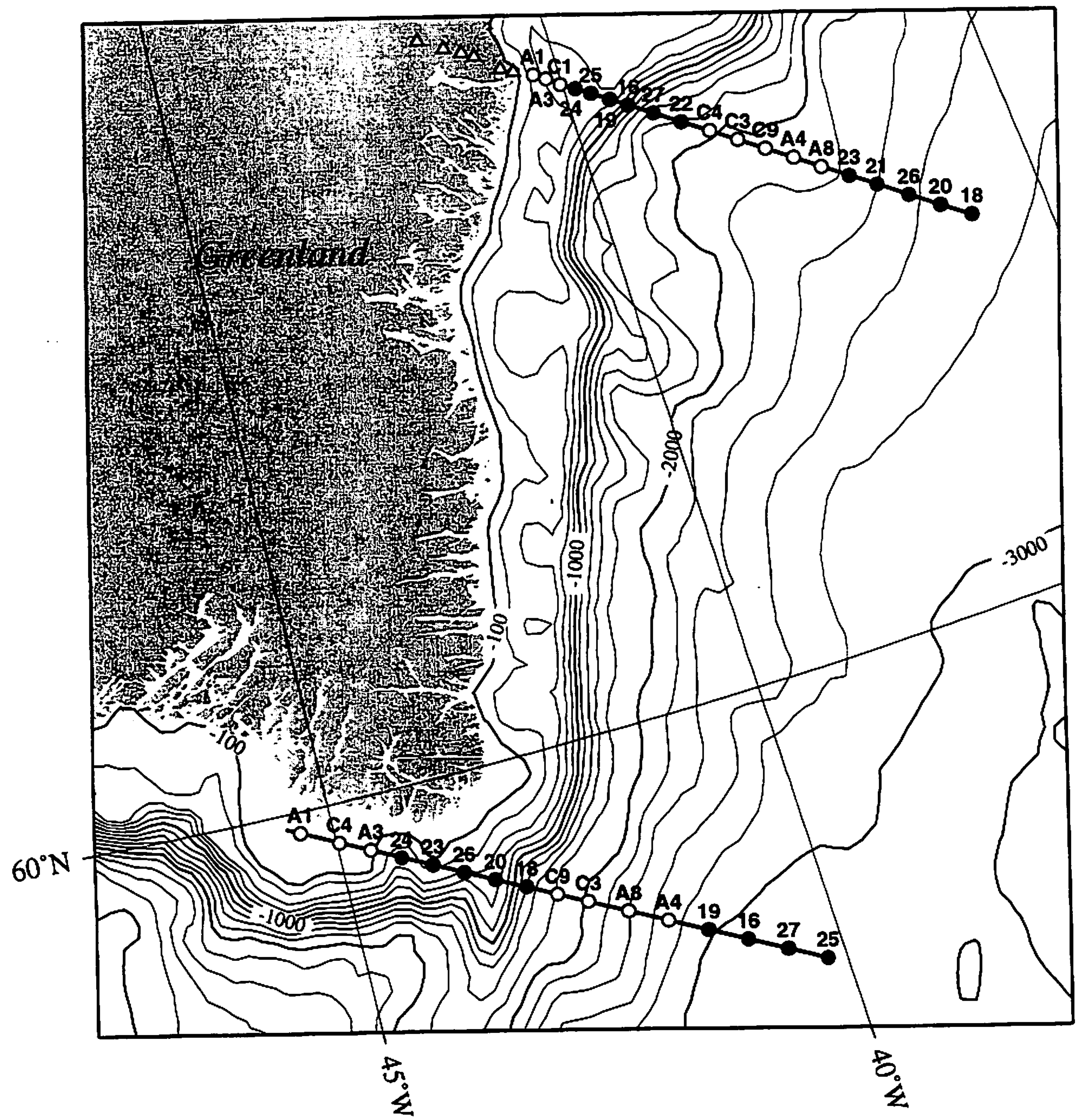
Inst.	Long	Lat	X-Range	X-Corr	Y-Range	P.Long.	P.Lat.	Depth	SP	CDP
16	40.9480	58.6625	294.6623	295.7248	-0.5629	40.9431	58.6669	3075	7806	24658
17	43.0790	59.2818	154.4565	155.0134	-0.2155	43.0772	59.2835	1386	3287	13401
19	41.3150	58.7796	269.8022	270.7750	0.1083	41.3159	58.7788	2960	7328	22662
20	43.3890	59.3679	134.4339	134.9186	-0.0963	43.3882	59.3687	1047	2826	11793
23	44.0120	59.5359	94.5758	94.9169	-0.0081	44.0119	59.5360	192	1994	8601
24	44.3280	59.6179	74.5829	74.8518	-0.1073	44.3271	59.6188	175	1600	6988
25	40.2010	58.4397	344.5762	345.8186	0.0874	40.2018	58.4390	3142	9069	28665
26	43.6960	59.4512	114.7467	115.1604	-0.0592	43.6955	59.4517	249	2419	10212
27	40.5710	58.5559	319.4945	320.6465	0.2383	40.5731	58.5541	3131	8419	26651
a1	45.3640	59.8815	9.5675	9.6020	-0.1495	45.3628	59.8827	131	314	1768
c4	44.9640	59.7788	34.6678	34.7928	-0.3698	44.9610	59.7818	135	799	3783
a3	44.6420	59.7002	54.7130	54.9103	-0.0109	44.6419	59.7003	147	1177	5393
c9	42.7760	59.1901	174.4669	175.0959	-0.9580	42.7679	59.1977	1805	3692	15007
c3	42.4590	59.1103	194.5818	195.2834	-0.0425	42.4586	59.1106	2129	did not record	
a8	42.0720	59.0028	219.7293	220.5216	0.2543	42.0742	59.0008	2527	6259	18641
a4	41.6980	58.8906	244.5430	245.4248	-0.0924	41.6972	58.8913	2743	6818	20633

Reference points: Start 314.48340167 W 59.920855 N
End 319.83784333 W 58.426645 N
Heading: Not used. No points were projected beyond the transect.
GMT-distance: 347261.70
Actual distance: 348513.82
Scaling factor: 1.0036057

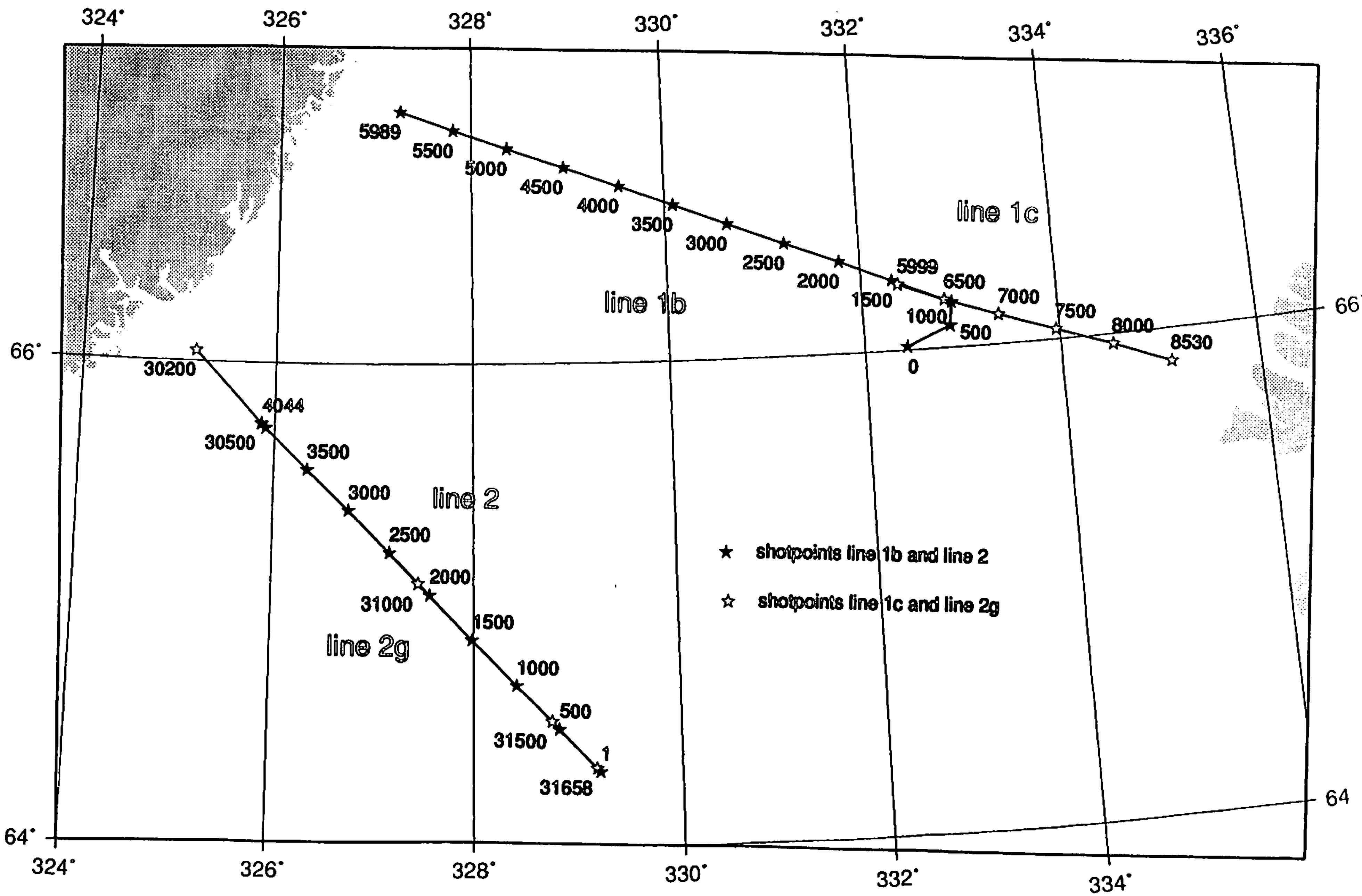
Appendix 1 MCS track line and OBS/H positions



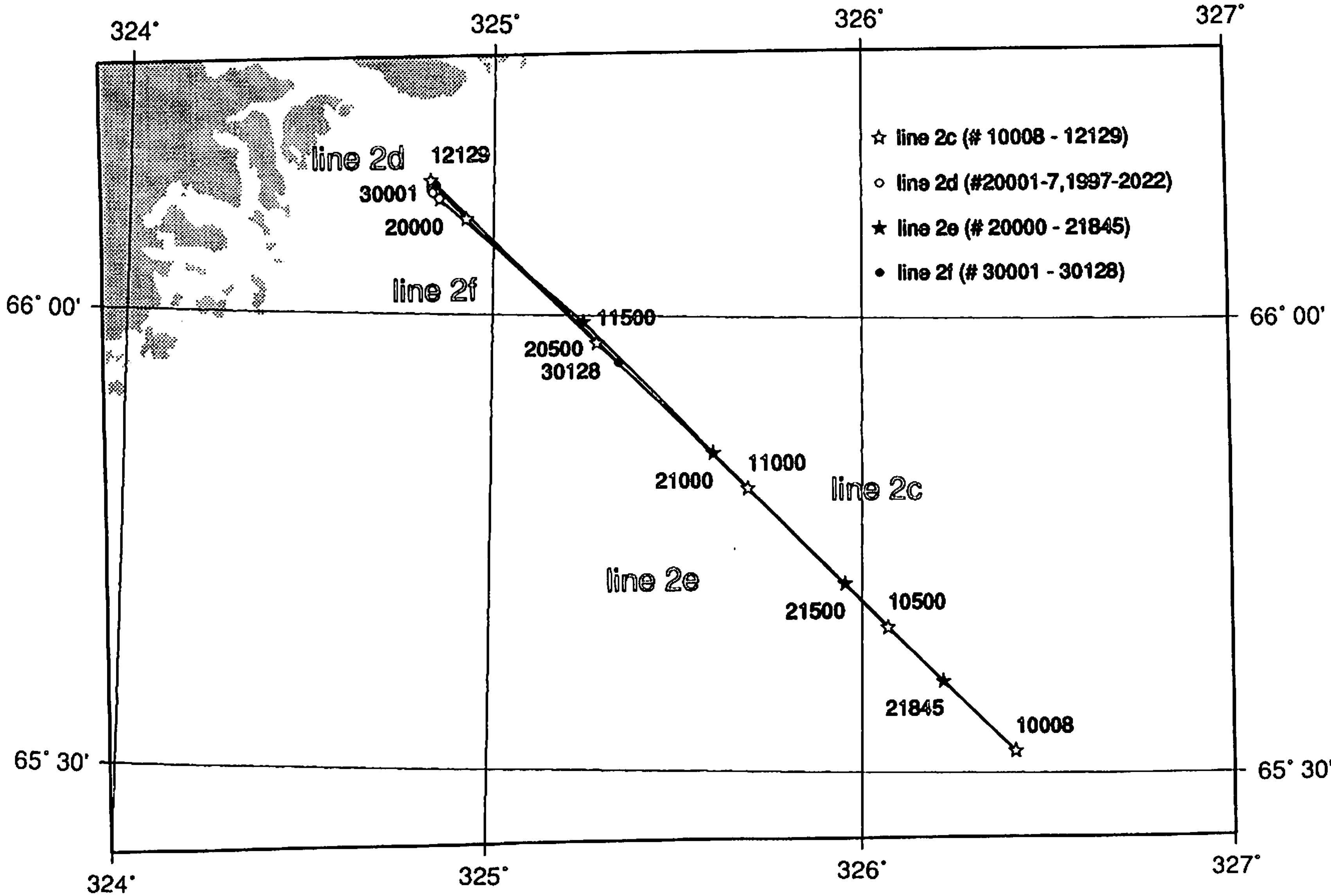
35°W
I
A3 A1 18 27 20 25 21 19 A8 C4 C9 C3 A4 24 16
Greenland-Iceland Ridge
-100
A1 A3 20 26 16 22 25 27 C3 C9 C4 C1 A8 A4 18 21 19 23 24
II
-1000
-2000
65°N
35°W
30°W


Greenland
A1
C1
A3
24
25
19
16
27
22
C4
C3
C9
A4
A8
23
21
26
20
18
-2000
-1000
-100
-3000
-100
-1000
A1
C4
A3
24
23
26
20
18
C9
C3
A8
A4
19
16
27
25
60°N
45°W
40°W

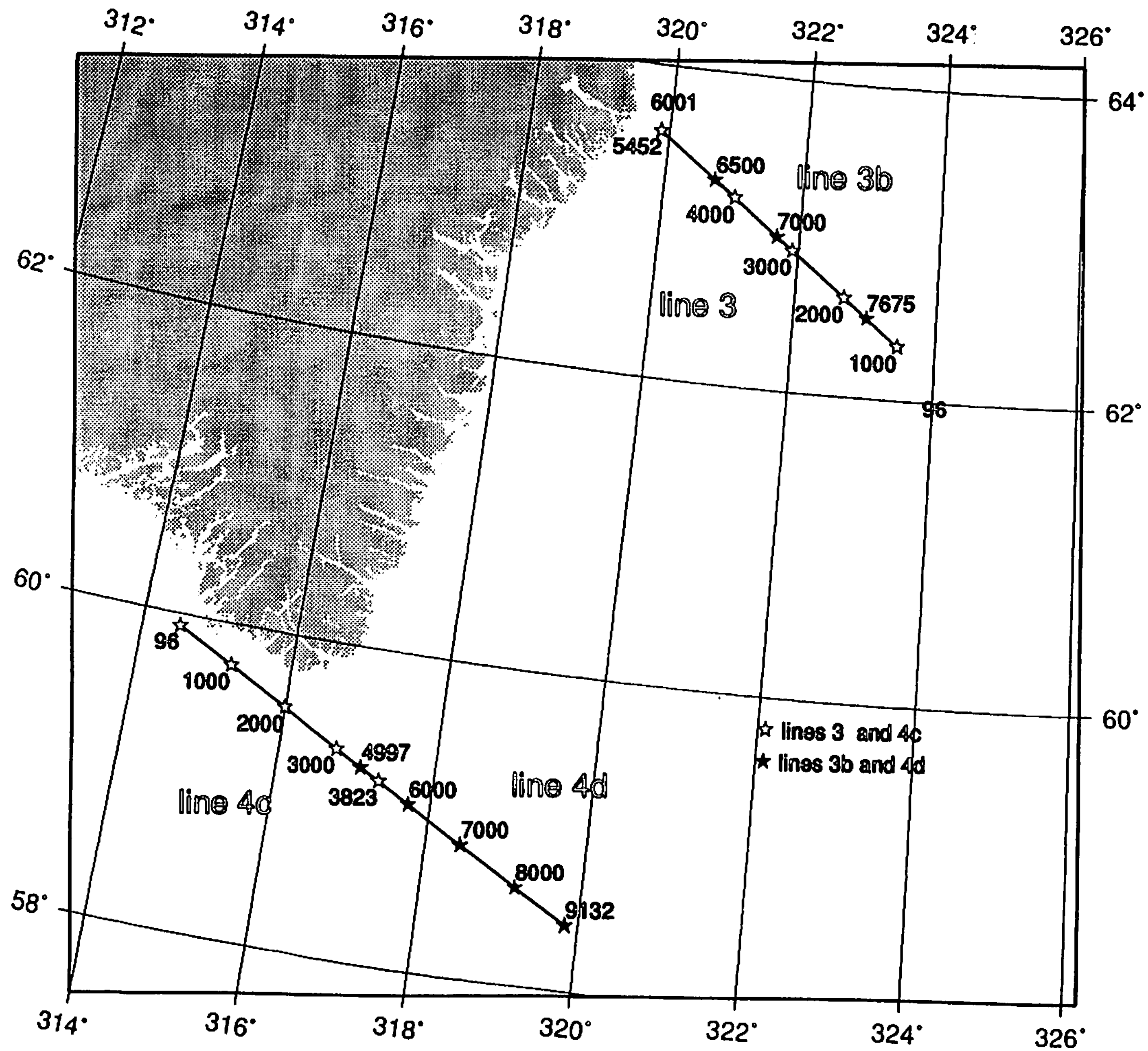
Shotno. on line 1 and 2



Inner part of line 2



Shotno. on line 3 and 4



APPENDIX 2: Data List

Deployment #1 - SIGMA Transect II

11 OBH Receiver Books - OBHs 16, 18-27

22 SONY 112m 8mm tapes, dd format archive copies 1 and 2 (8200 density mode) - OBHs 16, 18-27; 9/7/96-9/10/96

2 EXABYTE 160m 8mm tapes, tar format - copies 1 and 2 (8505 density mode) each of logdir & rawdir - OBHs 16, 18-27; *.log, WHOOPS *.dat, and *.raw files; 9/11/96

2 SONY 112m 8mm tapes, tar format - copies 1 and 2 (WHOI), (8200 density mode) each of segydir - OBHs 16, 18-27; final corrected SEGY data files, (includes both 20s and 60s trace lengths of OBH 16 data); 10/6/96

1 EXABYTE 112m 8mm tape, tar format - copy #3 (DLC), (8505 density mode) of segydir - OBHs 16, 18-27; final corrected SEGY data files, (includes both 20s and 60s trace lengths of OBH 16 data); 10/6/96

2 EXABYTE 160m 8mm tapes, tar format - copies 1 and 2 (WHOI), (8505 density mode) each of segydir - OBHs 16, 18-27; final corrected SEGY data files; 9/22/96

1 EXABYTE 112m 8mm tape, tar format - copy #3 (DLC), (8505 density mode) of segydir - OBHs 16, 18-27; final corrected SEGY data files; 9/23/96

2 copies of 2 EXABYTE 160m 8mm tapes (WHOI copy and USGS copy), tar format (8505 density mode) - USGS OBS raw data; part1/2 - OBSs A8, C3, C4, C9, part 2/2 - OBSs A3, A1, A4

2 copies of 1 EXABYTE 160m 8mm tape (WHOI copy and USGS copy), tar format (8505 density mode) - USGS OBS near offset SEGY data for use in relocating instrument positions, Lines 2A and 2G

3 copies of 1 EXABYTE 160m 8mm tape (WHOI, USGS, and DLC copies), tar format (8505 density mode) - USGS OBS SEGY format data, Lines 2A - 20s. shot interval, 2G - 70s. shot interval, 2T - land shots

1 SONY 112m 8mm tape, tar format (8200 density mode) negrange output OBS SEGY data, Lines 2A, 2G, and 2T

1 EXABYTE 160m 8mm tape, tar format (8505 density mode) negrange output OBS SEGY data, (DLC copy), Lines 2A, 2G, and 2T

1 Notebook, SIGMA2 OBH Datafile Headers (obh_rec_hdrs output)

Deployment #2 - SIGMA Transect I

9 OBH Receiver Books - OBHs 16, 18-21, 23 (not deployed), 24-25, 27

16 SONY 112m 8mm tapes, dd format archive copies 1 and 2 (8200 density mode) - OBHs 16,18-21, 24-25, 27; 9/14/96,9/16/96

2 SONY 112m 8mm tapes, tar format - copies 1 and 2 (8505 density mode) each of logdir & rawdir - OBHs 16, 18-21, 24-25, 27; *.log, WHOOPS *.dat, and *.raw files; 9/18/96

2 SONY 112m 8mm tapes, tar format - copies 1 and 2 (WHOI), (8200 density mode) each of segydir - OBHs 16, 18-21, 24-25, 27; final corrected SEGY data files; 10/6/96

2 SONY 112m 8mm tapes, tar format - copies 1 and 2 (WHOI), (8505 density mode) each of segydir - OBHs 16, 18-21, 24-25, 27; final corrected SEGY data files; 9/23/96

1 EXABYTE 112m 8mm tape, tar format - copy #3 (DLC), (8505 density mode) of segydir - OBHs 16, 18-21, 24-25, 27; final corrected SEGY data files; 9/24/96

2 EXABYTE 160m 8mm tapes (WHOI copy and USGS copy), tar format (8505 density mode) - USGS OBS raw data; OBSs C1, A1, A3, A8, C4, C9, C3, A4

3 EXABYTE 160m 8mm tapes (WHOI, USGS, and DLC copies), tar format (8505 density mode) - USGS OBS SEGY data, L1 - 8 km/s reduced 20s records, X1 - unreduced 5s records; 9/15/96

1 SONY 112m 8mm tape, tar format (8200 density mode) negrange output OBS SEGY data, L1 - OBSs A1, A3, A4, A8, C3, C4, C9

1 EXABYTE 160m 8mm tape, tar format (8505 density mode) negrange output OBS SEGY data, (DLC copy), L1 - OBSs A1, A3, A4, A8, C3, C4, C9

2 SONY 112m 8mm tapes (WHOI copy and DLC copy), tar format (8200 density mode) of Sonobuoy SEGY format data Line 1C; 10/6/96

1 Notebook, SIGMA1 OBH Datafile Headers (obh_rec_hdrs output)

Deployment #3 - SIGMA Transect III

11 OBH Receiver Books - OBHs 16, 18-27

22 SONY 112m 8mm tapes, dd format archive copies 1 and 2 (8200 density mode) - OBHs 16, 18-20, 22-23, 24a, 24b, 25-27; 9/25/96-9/26/96

2 EXABYTE 160m 8mm tapes, tar format - copies 1 and 2 (8505 density mode) each of logdir & rawdir - OBHs 16, 18-20, 22-23, 24a, 24b, 25-27; *.log, WHOOPS *.dat, and *.raw files; 9/29/96, 9/30/96

2 SONY 112m 8mm tapes, tar format - copies 1 and 2 (WHOI), (8200 density mode) each of segydir - OBHs 16, 18-20, 23, 24a, 24b, 25-27; final corrected SEGY data files; 10/6/96

1 EXABYTE 112m 8mm tape, tar format - copy #3 (DLC), (8505 density mode) of segydir - OBHs 16, 18-20, 23, 24a, 24b, 25-27; final corrected SEGY data files; 10/6/96

2 EXABYTE 160m 8mm tapes (WHOI copy and USGS copy), tar format (8505 density mode) - USGS OBS raw data; OBSs A1, A3, C1, C4, C3, C9, A4, A8; 9/25/96

3 EXABYTE 160m 8mm tapes (WHOI, USGS, and DLC copies), tar format (8505 density mode) - USGS OBS SEGY data, L3, L3B - 8 km/s reduced 20s records; 9/26/96

1 SONY 112m 8mm tape, tar format (8200 density mode) negrange output OBS SEGY data, L3, L3B - OBSs A1, A3, A4, A8, C1, C3, C4, C9

1 EXABYTE 160m 8mm tape, tar format (8505 density mode) negrange output OBS SEGY data, (DLC copy), L3, L3B - OBSs A1, A3, A4, A8, C1, C3, C4, C9

1 Notebook, SIGMA3 OBH Datafile Headers (obh_rec_hdrs output)

Deployment #4 - SIGMA Transect IV

9 OBH Receiver Books - OBHs 16, 18-20, 23-27

18 SONY 112m 8mm tapes, dd format archive copies 1 and 2 (8200 density mode) - OBHs 16, 18-20, 23-27; 10/3/96-10/5/96

2 EXABYTE 160m 8mm tapes, tar format - copies 1 and 2 (8505 density mode) each of logdir & rawdir - OBHs 16, 18-20, 23-27; *.log, WHOOPS *.dat, and *.raw files; 10/7/96

2 SONY 112m 8mm tapes, tar format - copies 1 and 2 (WHOI), (8200 density mode) each of segydir - OBHs 16, 18-20, 23-27; final corrected SEGY data files; 10/6/96

1 EXABYTE 112m 8mm tape, tar format - copy #3 (DLC), (8505 density mode) of segydir - OBHs 16, 18-20, 23-27; final corrected SEGY data files; 10/7/96

2 EXABYTE 160m 8mm tapes (WHOI copy and USGS copy), tar format (8505 density mode) - USGS OBS raw data; OBSs C1, A4, A8, C9, A3, C4, A1; 10/4/96

3 EXABYTE 160m 8mm tapes (WHOI, USGS, and DLC copies), tar format (8505 density mode) - USGS OBS SEGY data, L4, X4 - OBS C1 as shotphone on Line 4, X1 - OBS C1 as shotphone on Line 1, Xt - test signal into OBS C3 vertical

1 Notebook, SIGMA4 OBH Datafile Headers (obh_rec_hdrs output)

Miscellaneous Cruise Data

Tar file of EW9607 MCS Shooting Logs (/alpamayo0/grnlnd/ew9607_logs.tar). Four files each line:
*.RUL (recording log), *.RUE (recording error log), *.TAL (gun log), and *.TAE (gun error log). Lines 1A, 1B, 1C; 2, 2A, 2B, 2C, 2D, 2E; 3; 4, 4B, 4C, 4D, and PICK-UP-; Also, EW9607-1.XT5 and EW9607-1.XT7

2 MacIntosh floppy copies of Main Lab Mac EW9607 SIGMA files; MCS Log, etc.; includes NZ stuff folder

1 Optical disk of final archived SEGY format OBH data from Transects I-IV

MCS Nav and Data cartridges

DAT tape copies of MCS data

20 8mm tapes of MCS gather data and brute stack data

Mainlab Log (original and one copy)

Seismic Recording Log (original and one copy)

6 Rolls of EW9607 3.5kHz Records; Z-folded into data envelopes:
1A of 4, 1B of 4, 2A of 4, 2B of 4, 3 of 4, and 4 of 4

1 Roll of EW9607 'Profiler A' Single Channel Seismic Record from Splitter; Z-folded into data envelope

1 Roll of EW9607 'Profiler B' Stacked Section from Splitter and Sonobuoy Records; Z-folded into data envelope

2 8mm Underway Geophysics tapes (Mag, Bathy - Hydrosweep centerbeam, Nav, Grav) St. John's - St. John's; includes final gravity tie in St. John's; 10/7/96

2 copies of the looseleaf "R/V Ewing Cruise Report EW9607"

SIGMA/EW9607
Tape Copy Log (3480 SEG-D to DAT SEG-Y with SioSeis)

DAT 1:

Date of copy	5,6 September 1996
Field Tapes	1-36
Shot Points	2-1965
Line #	2
Field file record #	1-1908
Notes	

DAT 2:

Date of copy	6 September 1996
Field Tapes	37-72
Shot Points	1966-3949
Field file record #	1906-3816
Line #	2
Notes	Reel # 43 is repeated, DAT file #'s 7&8 are the same.

DAT 3:

Date of copy	6,7 September 1996
Field Tapes	73-111
Shot Points	3950-20211
Field file record #	3817-4711
Line #	2
Notes	Reel # 97b (DAT file # 25) copied out of order. On the DAT tape, it is between reels 96 and 97, but should be between 98 and 98b to get the shot points in the correct order. Input the DAT files in the following order: 1-24,26,27,25,28-41. Field file record numbers have little meaning from here to EOL. See original mcslog.

DAT 4:

Date of copy	7 September 1996, 12 September 1996
Field Tapes	112-138, 140-151
Shot Points	20212-21842, 1-632
Field file record #	4712-5127, 1-632
Line #	1,2
Notes	This tape contains the end of transect II (up to reel 138, DAT file # 27) and the beginning of transect I (reel 140, DAT file # 28).

DAT 5:

Date of copy	12,13 September 1996
Field Tapes	152-184
Shot Points	633-2480
Field file record #	633-2480
Line #	1
Notes	Cable depths were added to the trace headers (bytes 53-56) beginning with reel 181 (SP 2257).

DAT 6:

Date of copy	13 September 1996
Field Tapes	185-222
Shot Points	2481-4388
Field file record #	2481-4387
Line #	1
Notes	Reels 193-196 do not exist. See mcslog.

DAT 7:

Date of copy	13,14 September 1996
Field Tapes	223-251
Shot Points	4389-5987
Field file record #	4388-5982
Line #	1
Notes	

DAT 8:

Date of copy	20,21 September 1996
Field Tapes	260-294
Shot Points	100-2062
Field file record #	1-1960
Line #	3
Notes	

DAT 9:

Date of copy	21 September 1996
Field Tapes	295-328
Shot Points	2063-3966
Field file record #	1961-3864
Line #	3
Notes	

DAT 10:

Date of copy	21,22 September 1996
Field Tapes	329-355
Shot Points	3967-5452
Field file record #	3865-5349
Line #	3
Notes	

DAT 11:

Date of copy	29 September 1996
Field Tapes	356-389
Shot Points	100-2006
Field file record #	1-1904
Line #	4
Notes	

DAT 12:

Date of copy	29,30 September
Field Tapes	390-422
Shot Points	2007-3821
Field file record #	1905-3718
Line #	4
Notes	

DAT 13:

Date of copy	30 September 1996
Field Tapes	423-456
Shot Points	5000-6904
Field file record #	5000-6903
Notes	

DAT 14:

Date of copy	30 September, 1 October 1996
Field Tapes	457-493
Shot Points	6905-8865
Field file record #	6904-8864
Notes	End of tape errors on last reel (493). This reel recopied onto DAT 15. End of line also on DAT 15, files 11-16.

DAT 15:

Miscellaneous SEG-Y Files	
File 1	Sonobuoys on line 1. Channel 1
File 2	Sonobuoys on line 1. Channel 2
File 3	Real time stack of line 1
File 4	Real time stack of line 2
File 5	Real time stack of line 3
File 6	f-k migration of stack, line 3
File 7	Reread of reel 292, line 3
File 8	Reread of reel 247, line1
File 9	Real time stack of line 4
File 10	f-k migration of stack, line 4
File 11	Reel number 494
File 12	Reel number 495
File 13	Reel number 496
File 14	Reel number 497
File 15	Reel number 498
File 16	Reel number 493

SIGMA/EW9607
ProMAX Archive Tapes

Tape 1:

Date of Archive	9 September 1996
Area/Line archived	sigma/line21
Field Tapes	1-72
Shot Points	5-3940
CDPs	850-18400
Notes	

Tape 2:

Date of Archive	9 September 1996
Area/Line archived	sigma/line21
Field Tapes	1-72
Shot Points	5-3940
CDPs	850-18400
Notes	Continuation of ProMAX tape 1.

Tape 3:

Date of Archive	16 September 1996
Area/Line archived	sigma/line22
Field Tapes	73-107
Shot Points	3950-4042, 10008-12126
CDPs	15902-24089
Notes	

Tape 4:

Date of Archive	17 September 1996
Area/Line archived	sigma/line23
Field Tapes	108-138
Shot Points	20000-21842
CDPs	16973-23971
Notes	

Tape 5:

Date of Archive	16 September 1996
Area/Line archived	sigma/line11tieline
Field Tapes	140-153
Shot Points	1-743
CDPs	835-3677
Notes	

Tape 6:

Date of Archive	18 September 1996
Area/Line archived	sigma/line12
Field Tapes	157-206
Shot Points	913-3492
CDPs	835-12295
Notes	

Tape 7:

Date of Archive	20 September 1996
Area/Line archived	sigma/line13
Field Tapes	207-251
Shot Points	12137-22940
CDPs	3493-5987
Notes	

Tape 8:

Date of Archive	23 September 1996
Area/Line archived	sigma/line31
Field Tapes	260-277
Shot Points	100-1103
CDPs	835-5286
Notes	

Tape 9:

Date of Archive	23 September 1996
Area/Line archived	sigma/line32
Field Tapes	277-314
Shot Points	1104-3182
CDPs	5131-13800
Notes	Shots 1909-1932 ignored on input for unknown reasons.

Tape 10:

Date of Archive	23 September 1996
Area/Line archived	sigma/line33
Field Tapes	315-352
Shot Points	3183-5311
CDPs	13645-22751
Notes	Last 3 reels not included during DAT read for unknown reasons.

Tape 11:

Date of Archive	25 September 1996
Area/Line archived	sigma/line12
Field Tapes	157-206
Shot Points	913-3452
CDPs	835-12295
Notes	Water and cable depths inserted into trace headers.

Tape 12:

Date of Archive	27 September 1996
Area/Line archived	sigma/line13
Field Tapes	207-251
Shot Points	3493-5987
CDPs	12137-22940
Notes	Water and cable depths inserted into trace headers.

Tape 13:

Date of Archive	28 September 1996
Area/Line archived	sigma/line33
Field Tapes	315-355
Shot Points	3183-5452
CDPs	13645-23127
Notes	Last 3 reels of data appended to dataset (see tape 10).

Tape 14:

Date of Archive	28 September 1996
Area/Line archived	sigma/line13
Field Tapes	--
Shot Points	--
CDPs	19000-22897
Notes	fk demult CDPs

Tape 15:

Date of Archive	28 September 1996
Area/Line archived	sigma/line32
Field Tapes	277-314
Shot Points	1104-3182
CDPs	5131-13800
Notes	SPs 1909-1932 appended to data set. (See tape 9).

Tape 16:

Date of Archive	29 September 1996
Area/Line archived	sigma/line21
Field Tapes	1-72
Shot Points	5-3940
CDPs	850-18400
Notes	Water and cable depths inserted into trace headers. Tape 1 of 2.

Tape 17:

Date of Archive	29 September 1996
Area/Line archived	sigma/line21
Field Tapes	1-72
Shot Points	5-3940
CDPs	850-18400
Notes	Water and cable depths inserted into trace headers. Tape 2 of 2.

Tape 18:

Date of Archive	29 September 1996
Area/Line archived	sigma/line22
Field Tapes	73-107
Shot Points	3950-4042,10008-12126
CDPs	15902-24089
Notes	Water and cable depths inserted into trace headers.

Tape 19:

Date of Archive	4 October 1996
Area/Line archived	sigma/line23
Field Tapes	108-138
Shot Points	20000-21842
CDPs	17148-24146
Notes	Water and cable depths inserted into trace headers. Geometry problem with CDP numbers and azimuth fixed.

Tape 20:

Date of Archive	2 October 1996
Area/Line archived	sigma/line41
Field Tapes	356-398
Shot Points	100-2510
CDPs	835-10550
Notes	

Tape 21:

Date of Archive	2 October 1996
Area/Line archived	sigma/line42
Field Tapes	399-422
Shot Points	2511-3821
CDPs	10402-15434
Notes	

Tape 22:

Date of Archive	2 October 1996
Area/Line archived	sigma/line43
Field Tapes	423-461
Shot Points	5000-7184
CDPs	13973-22069
Notes	

Tape 23:

Date of Archive	3 October 1996
Area/Line archived	sigma/line44
Field Tapes	462-498
Shot Points	7185-9127
CDPs	21914-28875
Notes	

SIGMA/EW9607
SEG-Y CDP Gather Tapes

Tape		
Tape 3/1:	Date of Copy CDPs	24 September 1996 835-7500
Tape 3/2:	Date of Copy CDPs	24 September 1996 7501-14500
Tape 3/3:	Date of Copy CDPs	25 September 1996 14501-20000
Tape 3/4:	Date of Copy CDPs	25 September 1996 20001-23127
Tape 1B/1:	Date of Copy CDPs	26 September 1996 835-7500
Tape 1B/2:	Date of Copy CDPs	27 September 1996 7501-14500
Tape 1B/3:	Date of Copy CDPs	27 September 1996 14501-20000
Tape 1B/4:	Date of Copy CDPs	27 September 1996 20001-22940
Tape 1A/1:	Date of Copy CDPs	29 September 1996 835-3677
Tape 2/1:	Date of Copy CDPs	30 September 1996 850-7500
Tape 2/2:	Date of Copy CDPs	30 September 1996 7501-14500
Tape 2/3:	Date of Copy CDPs	30 September 1996 14501-18000
Tape 2/4:	Date of Copy CDPs	30 September 1996 18001-21000
Tape 2/5:	Date of Copy CDPs	30 September 1996 21001-24089
Tape 4/1:	Date of Copy CDPs	2 October 1996 835-7500
Tape 4/2:	Date of Copy CDPs	2 October 1996 7501-14500
Tape 4/3:	Date of Copy CDPs	3 October 1996 14501-20500

Tape 4/4:

Date of Copy	4 October 1996
CDPs	20501-27000

Tape 4/5:

Date of Copy	4 October 1996
CDPs	27001-28875

Appendix 3 MCS data processing

I 'Real time' stack and shot QC

The 'real time' QC and stacking processing was carried out by Sioseis software running on orizaba - a HP 9000/715. This processing was conducted in pseudo-real time during acquisition and was seldom more than a tape or two behind acquisition. The goal of this processing was to

a) Provide quality control so that acquisition errors could be corrected as soon as possible, and

b) Provide a stacked section that could be used for geological interpretation.

SIOSEIS processing was divided into parts:

1) The brute stack (with SEG-Y DAT tape output) immediatedly after reading the SEG-D 3480 tapes. Every 15th shot is written to a"circular" file.
2) A plot of the current shot in the circular file.
3) A plot of the stacked data every two hours on 8.5x11 paper.
4) A fk migration and plot of the stacked data every four hours.
5) Final plot on the NovaJet.

The brute stack runs on the HP 715 in 15-20 minutes and is designed to:
1) Read SEG-D 20 bit binary tapes and decimate to 4 mils.
2) Write shots for QC (quality control)
3) Retrieve streamer depth and assign streamer geometry
4) Write a SEG-Y shot tape with trace 0 (tape copy)
5) Trace gather according to nominal common midpoint
6) NMO and MUTE based on Hydrosweep water depth
7) Stack
8) Despike
9) Disk output for other use

A subtle processing trick was used in the NMO process in order to laterally vary the NMO velocity function. Earlier work in the area showed that a velocity function could be designed for the area. The velocity varied with water depth. Graham Kent had modified NMO such that the parameter vtrkwb (velocity track water bottom) modifies the normal SIOSEIS spatial interpolation by changing the RP number into the water depth determined by Hydrosweep. The velocity function was described by water depth so that the spatial interpolation is done by water depth. SEGDIN has always put the Hydrosweep depth in the SEG-Y trace header. The processing was done with a series of scripts (scripts included below).

The shot plot script generates a Sun rasterfile with the latest shot from the "circular" shot file. The raster file is display on the screen using xloadimage and is converted to PostScipt so it can be sent to a printer. With filter and gain, this scripts runs quickly on the HP without a noticable impact on the stack script.

The stack plot script generates a Sun rasterfile of 2 hours of data and sends it to the screen using xloadimage. The rasterfile is also converted to PostScript and can be sent to a printer. These 8.5x11 plots were then taped together for a fast permanent display. With filter and gain, this scripts runs quickly on the HP without a noticable impact on the stack script.

The fk script performs FK filtering and migration of 2048 traces (2000 stacked traces and 48 pad traces), each trace having 2048 samples (8 seconds). Successive FK segments overlapped by 50 traces so that the segments would appear seamless when spliced together. Initially a separate computer (hekla) was used to perform a 4096 trace FK transformation, but this took anywhere from 15 minutes to an hour and caused "contention" on hekla. By line 4 it was discovered that the 2048x2048 FK took 3-4 minutes and could be done on the same computer as the stack while the stack is waiting for a new input tape from the acquisition system.

A final plot was made by plotting several FK migrated segments on the NovaJet plotter. The NovaJet plotter is similar to to HP DesignJet plotters, so the PLOT parameter nibs 2859 can be used. The resulting SIOSEIS rasterfile can be translated to an HP-RTL file by using program SIO2HP. The RTL file is then sent to the Ewing Sun computer (hess) with the NovaJet plotter using the binary mode of ftp. On hess, the plot is sent to to NovaJet using the Unix cat command: cat RTL-file > /dev/bpp0.

II Tapecopy and further basic (non-real time) processing

Following acquisition, tape copying, preliminary editing and sorting through acquisition errors, and geometry assignment was done. The data were then output in CDP gathers to segy tape and a brute stack produced after picking velocities and mutes. Preliminary processing was done using a combination of SIOSEIS and ProMAX.

1) Tape copy with SIOSEIS. 3480 SEG-D tapes --> DAT SEG-Y tapes. The data were resampled from 2 ms to 4 ms sample interval. After testing, we decided we could do this without an anti-alias filter, as only frequencies above 90 Hz were affected. Each 3480 tape was written to the DAT tapes as a separate file, to ease extraction to the SIO 2TB mass store. The SEGY files are written as IEEE values, which is a SEGY standard violation. A challenge to the tape copy procedure was that we only had 15 DAT tapes availible for tape copying. See MCS watch logs and tape copy logs for lists of shots on tape. On Transect II and the first half of Transect I, trace 0 was output to a separate file in order to recover cable depth. By the mid part of Transect I, SIOSEIS was modified to do this during the tape copy. See below for the (long) list of acquisition errors and a transect by transect overview of edits and the modifications made to Sioseis during the cruise to cope with these problems.

2) Data read into ProMAX from the SIOSEIS SEG-Y DAT tapes.

3) Geometry assignment based on navigation files. Geometry is calculated by Promax in the standard way and is really a CMP sort based on the streamer and gun configurations and the actual source locations from the navigation files. Lists of source locations and CDP locations are available in xy files. The specific CDP/SP tie point used for geometry assignment is in the individual transect notes.

4) Brute stack. For each transect, velocities where picked, a top mute and an inside mute (for multiples) were picked, and a bandpass filter chosen. A true amplitude recovery process was applied, the data were filtered, muted, NMO corrected and stacked. A large scale plot was produced giving an overview of each transect.

7) SEG-Y output. The data were output to a SEG-Y tape as cdp gathers. Note that ProMAX and SIOSEIS place the shot point numbers and file numbers in opposite byte locations. The byte locations of headers from ProMAX are listed in below.

III Further processing tests carried out

Selected bits of data were processed further than described above. An interesting feature found on Transect III (see figure) was re-stacked with carefully picked velocities and migrated, ending a discussion on the timing of the event causing the basement high.

Multiples are an ever-present problem in data from E Greenland, and the SIGMA data are no exception. An initial test on de-multiple procedures showed that a combination of pre-stack prediction decon and an FK multiple removal technique can impove considerably on the data.

Acquisition errors and what we did to deal with them in the tape copy process

These notes are common to all transects and should be consulted first since they include explanations of the various acquisition errors that were encountered and what was done with the data in these locations.

1) Shots that do not have exactly 160 channels flagged. Problems with the number of channels on tape relate to one of several problems:

a) Shot point with only the first channel. In several cases only a single channel was copied from the field tape to the DAT. These appear to be related to botched headers correlated to streamer re-builds. We went back to the original shots on the 3480 tapes to find out if only a single trace was really on tape. Most of these appeared to be OK except that several consecutive traces beginning with channel 2 have bogus channel numbers and bad header info. The bogus channel number converted to an integer much greater than 160, prompting SIOSEIS to think that the rest of the traces in the shot were auxiliary channels. It then advanced to the end of the shot, hence only a single channel was read in. These shots were flagged and then re-read from the original field tapes to extract the channels with good data. Sioseis was modified by Transect IV to retain the good channels.

b) Incomplete shots that occur in pairs. It was found that a pair of shots would both contain missing channels, but that the sum of the two together would contain 160 channels and the channels missing from one shot appear on the next. These pairs of shots correspond to "SQTP Error 84" on the CSRU system during acquisition. This is a tape write error that occurred on the first of the two shots and a proper end of file mark was not written at the end of the shot. SIOSEIS SEG-D input uses the file mark to determine a new shot and thus skipped over the the first few channels of the second shot until it reached the channel number it was expecting based on the last channel it saw on the first shot. The channels missing on the first shot of the pair are really missing, but it should be possible to recover the missing channels for the second shot from the 3480 tapes. Between Transects III and IV a modification was added to Sioseis to detect 'unexpected SEG-D General Header' and start a new shot.

c) 161 channels. These only seemed to occur on the shots listed under section 2 (shots with same SP number). Though we are not 100% certain, we believe that this error occurs because the shots have botched headers and trace 0 on the SEG-D tape is not flagged with ID 28 properly. The data is passed through both SIO SEIS and ProMAX as a non-seismic trace. This is not a problem, however, since the channel number is 0 and ProMAX and Sioseis only accept channels 1-160 as live traces.

2) Shots with the same shot point number flagged. These were accompanied by a "SLIC data not received in xxxxx mseconds" error on the CSRU cable. The data within these shots appear to be different, however. Only the headers are the same. In the interval between the last known good shot and the next good shot recorded, there are more missing shots than the number put on tape with bad header info. Thus, there really is data loss associated with this error. Because the fix for this error is a reboot and a complete rebuilding of the streamer, it is assumed that the data loss is during the streamer rebuild and thus is just before the next good shot recorded. The duplicate shots are assigned shot point numbers sequentially beginning with the last good shot before the error. Thus, if there are 6 shot SP 5's on tape followed by a SP16, the extra shots are numbered sequentially from 6-10 and SP's 11-15 are assumed to be lost during the streamer rebuild. Between Transect III and IV a modification was made to Sioseis to detect this error and automatically increment the shot number. The shot time, however, is still wrong. This error appears to be connected to a 'communication' error between the DMS 2000 and the outside navigation program, because the outside information is constant. The seismic data is OK, and the nav files are OK.

3) Shots with shot number 0. These shots are not in the nav file so they cannot be assigned a geometry. Sioseis was modified before Transect II tape copying to discard these shots.

4) Lines 2 and first half of line 1: Cable depths and water depths extracted from trace 0 file and imported into the database and then transferred to the trace headers. Many shots that were read into the database did not have an associated trace 0 file. This problem was not investigated thoroughly, but according to Paul Henkart, the SEG-D to SEG-Y copy program will only output trace 0 if it is flagged with trace ID 28 on the SEG-D tape. However, it will still copy the shot even if trace 0 is bad. In these cases, cable depths and water depths were assigned using the last shot where trace 0 had good data. No interpolation was done. Note also that Paul and John independently adopted different sign conventions for dealing with the cable depth information. This was discovered after line 1 was completed. Paul treats the information as an elevation and thus uses negative numbers, whereas John treated these as depths and used positive numbers. Within any given line, the headers have been modified to ensure the same sign convention throughout, but the sign conventions are different between lines. Lines 1 and 2 have these as depths (jrh standard) and lines 3 and 4 have these as elevations (ph standard).

Other modifications made to Sioseis during the cruise:

The first line shot turned out to have a myriad of problems, one of which was an unbalanced streamer. It was deemed that a static correction for the streamer depth would help the stack since part of the streamer was floating and part of it was 20m deep. The streamer depth is available in the trace 0 of each shot, but neither ProMAX nor SIOSEIS extracted it. To further complicate the problem, ProMAX ignores trace 0 totally. Some mechanism for getting depth into a ProMAX and SIOSEIS form had to be established before tape copying could commence.

To accomplish these goals, modifications were made to SIOSEIS:

1) Parameter OFFLINE was added to SEGDIN to automatically eject the 3480 after it has been read.
2) Parameter REWIND was added to DISKOA to make "circular" disk files (useful for realtime QC).
3) Had SEGDIN set a signal on each new tape so that process OUTPUT would start a new SEG-Y file on every new 3480 tape.
4) Modified the tape change routine to write only 1 EOF when OUTPUT parameter REWIND is used.
5) Parameter TR0 was added to SEGDIN to write the LDGO/DIGICON trace 0 to disk since ProMAX ignores the SEG-Y trace 0. This disk write was removed after 7 and 8 below were completed.
6) Made OUTPUT write trace 0 before each trace when SEGDIN parameter TR0 is used.
7) Add parameters BGP and CGP (bird-group pairs and compass-group pairs) to GEOM to define where the birds are on the streamer (varies on each streamer deployment). The bird (depth sensor) location varies each time the streamer is deployed and these locations must be entered into the parameters before the tape copying.
8) Write the "receiver elevation" in the SEG-Y trace header when BGP is used.

Streamer depth extraction from trace 0 uses a subroutine by John Hopper that parsesd the bird ids and depths and then given the ranges, interpolates and/or extrapolates to the other traces. This was incorporated into SIOSEIS process GEOM before lines 3 and 4. SIOSEIS uses the SEG-Y trace header location "receiver elevation" for the streamer depth.

The bird locations had to be entered into the processing parameters prior to the "realtime" tape copy so that ProMAX could get it from the trace header since it ignores trace 0. This is problematic because shooting starts immediately after the streamer is deployed and the bird locations are not readily available. The bird positions were probably off a can (4 sections) or two on Transect I and III because cans and sections were swapped out during redeployments.

Program list.disk was modified to dump the cdp fold.

The tape copying started out being done during the brute stack during line 2, but there were significant tape rewrites on the last file which caused the stacking to fall far behind the acquisition. All of the 3480s were reread after the line was stacked for the tape copy. The stand alone tape copy required about 75% again as long as the acquisition itself. The tape rewrite problem was not addressed until after line 1 was completed because Henkart was consumed by the streamer depth extraction coding and error recovery from line 2.

The solution to the rewrites was to simply change the output tape after 34 3480s were written. This however causes the last file not to be closed with a file mark and causes ProMAX some trouble. (SIOSEIS treats tape read errors like file marks!)

Program list.ewing was modified to dump ALL the different "sections" of trace 0. This program was also installed as list.3480 on the Ewing's Sun computer, hess, that has a 3480 attached to it. The user documentation along with a brief description of the 3480 data format was installed as part of the Ewing WWW home page for the benefit of future MCS users aboard the Ewing.

Transect by Transect overview of edits and problems:

SIGMA/EW9607
On-board Data Processing Notes: Transect 2

The general sequence for preliminary processing and editing of line 2 is summarized below. Following that are comprehensive lists of specific edits. They flag the areas of the data set where there were many acquisition problems. Many of these shots may have to be edited out at a later stage even though our first quick look did not note anything obviously wrong. In the event that a serious problem arises during data processing -- these lists should be consulted first. Line 2 was a nightmare so the usual caveats apply -- mistakes were undoubtedly made during the initial processing of line 2, let the processor beware...

1) Tape copy: Shots not recorded and/or not on the SEG-Y tape are listed in Appendix A.

2) Data read into ProMAX. Several shots had no shot-point number associated with them. These shots were ignored on input. In the areas where this occurs, at least two shot points are missing and the correct shot point of these non-labeled shots cannot be determined. A list of the field tape number and field file number is provided (Appendix B).

3) Geometry assignment based on navigation files. There are two problems to be aware of with geometry on this line. First is that during the main shoot go in towards the coast, the line was cut off due to bad weather and we had to do a circle. Acquisition after the circle had many problems resulting in large gaps in coverage and loss of fold. The line was re-shot going out to sea in order to fill these gaps. Tie points for each of the three shoots were found such that the CDP bin numbers for all three should be in the same locations. The data sets can be merged by sorting on CDP bin number. Errors in bin point locations are difficult to estimate, but spot checks indicate that they ought to agree to within 10 meters or so. Traces should not be more than one or two bins out of place by merging the data set in this way. More thorough checks on this will be completed later. For calculating geometry, SP 1 is tied to CDP 1000. On the circle, SP 10021 is tied to CDP 16114. On the reshoot, the location of SP 21539 is approximately the same as SP 3931 and is tied to CDP 18347. The azimuths for calculating positions along track are 180° opposite to the first shoot and the circle.

4) Shots that did not have exactly 160 channels flagged (Appendix C).

5) Shots with the same shot point number. This was found on two occasions. The first occurrence is at SP 130. The second one of these two is assumed to be SP 131 and has been kept. The second occurrence was at SP 3862. There are 20 consecutive shots with this shot-point number. Following this, the next good shot recorded is 3893. So somewhere in this sequence 10 shots are missing. We numbered these shots sequentially from 3862 to 3882. See section 5 of the general notes.

6) Shot by shot editing. Bad shots and traces edited out. Bad shots are listed in Appendix D and individual trace edits are listed in Appendix E. Bad shots include the following: Shots with no data; shots with bogus amplitudes (usually an increase in overall amplitude throughout the trace. Its not clear if real data is hidden on these trends, but probably not.); shots with obvious timing errors -- i.e. sea floor arrivals prior to time 0 or major discontinuities in the seafloor and direct arrivals. Reasons for specific shot kills are not included in the appendix (sorry) but the bad shots are on the original ProMAX archive tapes (and obviously the SEG-Y

tapes) and can be provided on request. Channels 89 and 92 are bad and were killed on all shots and are not listed in Appendix E. Channels 137-161 are bad on shots 11817-12126 and were also killed (but again are not in Appendix E).

7) Channel 2, 42, 49 editing. These are flaky channels. They come and go. Single channel displays were produced and the bad ones added to the kill files. Noise burst editing may prove useful to try and revive some of those that were killed. The edits in this category are included in the trace kill files listed in Appendix E.

8) Gun misfires spotted and muted out of the data set. All data below the direct arrival of the misfire is killed. Copies of the mute tables are in Appendix F.

9) Cable depths and water depths extracted from trace 0 file and imported into the database and then transferred to the trace headers.

10) SEG-D reread. Shots that had only a single trace make it through the tape copy were re-read from the 3480 onto a new SEG-Y tape. These were then edited as above. These edits are listed in the above mute and edit files. Appendix G contains all the shots reread whether or not they were killed again later. However, shots that were killed again are marked.

APPENDIX A: Shots not recorded or did not survive SEG-D to SEG-Y copy.

57	1610	2324	2752 - 2857
111	1615	2327	2936
131 - 129	1618 - 1578	2404	2950
131	1580 - 1619	2414	2954
226	1621	2430	2972
322 - 323	1638	2438 - 2363	2979 - 2868
1275	1654	2366 - 2438	2871 - 2981
1279	1695 - 1651	2440 - 2366	2984
1322	1653 - 1695	2368 - 2442	2988
1344	1719	2451	3003 - 3004
1351 - 1352	1723 - 1678	2558	3007
1377	1681 - 1725	2564 - 2565	3010
1381	1730 - 1684	2609	3097
1386	1686 - 1731	2626	3108
1395	1748	2642 - 2560	3344
1438 - 1439	1761 - 1762	2562 - 2643	3863 - 3861
1441 - 1420	1789 - 1791	2670	3863 - 3861
1422 - 1442	1796	2721	3863 - 3861
1447	1828	2724 - 2639	3863 - 3861
1464	1952	2641 - 2725	3863 - 3861
1485	1955	2756 - 2758	3863 - 3861
1499	1964	2764 - 2767	3863 - 3861
1509	1972	2769	3863 - 3861
1516	2005	2780 - 2686	3863 - 3861
1537	2037	2688 - 2783	3863 - 3861
1539	2095 - 2096	2787	3863 - 3861
1556	2109	2791	3863 - 3861
1561 - 1530	2119 - 2055	2800	3863 - 3861
1532 - 1562	2057 - 2120	2809 - 2709	3863 - 3861
1566	2134 - 2069	2711 - 2812	3863 - 3861
1569	2071 - 2135	2827 - 2828	3863 - 3861
1586	2207	2843 - 2738	3863 - 3861
1592	2209 - 2210	2740 - 2844	3863 - 3861
1605 - 1606	2213	2856 - 2750	3863 - 3861

3863 - 3861	10862 - 10864	11414	20405
3863 - 3892	10874	11431	20669 - 20671
3901 - 3903	10955	11438 - 4168	20696 - 20698
4043 - 3909	10991 - 10993	4170 - 11440	20747 - 20749
3913 - 10007	11005 - 11007	11444	20751 - 20760
10293	11011 - 11012	11457 - 11458	20774 - 20787
10297	11014	11466	20790 - 20796
10300	11021 - 11022	11470	20798 - 20806
10303	11045 - 11062	11474	20821 - 20823
10355 - 10356	11067 - 11088	11481 - 11483	20829 - 20834
10392 - 10394	11091	11487	20840 - 20841
10396 - 10397	11100 - 11101	11489 - 11566	20844 - 20860
10402 - 10404	11103 - 11104	11578 - 11580	20862 - 20863
10408 - 10410	11115 - 11151	11586 - 11588	20887 - 20889
10414 - 10415	11160 - 11162	11657 - 11662	20895 - 20897
10418 - 10420	11206 - 3960	11665	20917 - 20922
10433 - 10438	3962 - 11207	11671 - 11672	20928 - 20960
10450 - 10456	11209 - 3962	11702	20984 - 20985
10458 - 10460	3964 - 11209	11705	20987 - 20989
10462 - 10467	11213	11722	20992 - 21007
10472 - 10476	11215	11726 - 11728	21017 - 21019
10539	11224 - 11225	11748 - 11753	21044 - 21064
10672	11238 - 3987	11761 - 11763	21122 - 21124
10685	3989 - 11239	11772 - 11774	21130 - 21132
10689 - 10690	11262	11786 - 11791	21135 - 21165
10711	11273 - 4020	11800 - 11802	21181 - 21186
10722 - 10724	4022 - 11274	11805 - 11807	21190
10732 - 10733	11351	11810 - 11816	21195 - 21203
10740 - 10742	11360 - 11499	20248 - 20251	21205 - 21207
10750 - 10752	11502	20292	21448 - 21453
10762 - 4600	11504 - 11506	20314 - 4808	21457 - 21459
4602 - 10765	11509	4810 - 20315	21469 - 21471
10771 - 10773	11511 - 11513	20317	21483 - 21485
10775 - 10777	11516 - 11518	20333 - 20334	21492 - 21495
10782 - 10784	11528 - 11530	20356	21498 - 21502
10790 - 10796	11567 - 11359	20358 - 20359	21558 - 21560
10801 - 10803	11362	20364	21569
10823	11396 - 11398	20371	21613 - 21614
10830 - 10831	11400 - 11408	20397 - 20398	

APPENDIX B: Shots on tape with no shot point number in trace headers. These were ignored on input into ProMAX and are not in the data set.

Reel #:	27	File #:	1421	Reel #:	45	File #:	2365	Reel #:	75	File #:	3910
Reel #:	29	File #:	1531	Reel #:	45	File #:	2367	Reel #:	75	File #:	3911
Reel #:	30	File #:	1579	Reel #:	49	File #:	2561	Reel #:	75	File #:	3912
Reel #:	32	File #:	1652	Reel #:	50	File #:	2640	Reel #:	88	File #:	4601
Reel #:	32	File #:	1679	Reel #:	51	File #:	2687	Reel #:	94	File #:	3961
Reel #:	32	File #:	1680	Reel #:	52	File #:	2710	Reel #:	94	File #:	3963
Reel #:	32	File #:	1685	Reel #:	52	File #:	2739	Reel #:	94	File #:	3988
Reel #:	39	File #:	2056	Reel #:	52	File #:	2751	Reel #:	95	File #:	4021
Reel #:	40	File #:	2070	Reel #:	55	File #:	2869	Reel #:	98	File #:	4169
Reel #:	45	File #:	2364	Reel #:	55	File #:	2870	Reel #:	113	File #:	4809

APPENDIX C: Shots without exactly 160 channels.

110:	nchan =	94
130:	nchan =	161
131:	nchan =	159
2216:	nchan =	152
2217:	nchan =	8
3054:	nchan =	52
3055:	nchan =	108
3075:	nchan =	128
3076:	nchan =	32
3381:	nchan =	54
3382:	nchan =	106
3862:	nchan =	161
3863:	nchan =	161
3864:	nchan =	161
3865:	nchan =	161
3866:	nchan =	161
3867:	nchan =	161
3868:	nchan =	161
3869:	nchan =	161
3870:	nchan =	161
3871:	nchan =	161
3872:	nchan =	161
3873:	nchan =	161
3874:	nchan =	161
3875:	nchan =	161
3876:	nchan =	161
3877:	nchan =	161
3878:	nchan =	161
3879:	nchan =	161
3880:	nchan =	161
3881:	nchan =	161
3882:	nchan =	140
3949:	nchan =	151
3954:	nchan =	63
3955:	nchan =	97
10357:	nchan =	1
10359:	nchan =	1
10395:	nchan =	1
10398:	nchan =	1
10399:	nchan =	1
10405:	nchan =	1
10407:	nchan =	1
10411:	nchan =	1
10413:	nchan =	1
10421:	nchan =	1
10423:	nchan =	1
10425:	nchan =	1
10427:	nchan =	1
10439:	nchan =	1
10440:	nchan =	1
10441:	nchan =	1
10442:	nchan =	1
10443:	nchan =	1
10461:	nchan =	1
10468:	nchan =	1
10469:	nchan =	1
10470:	nchan =	1
10471:	nchan =	1
10734:	nchan =	1
10736:	nchan =	1
10738:	nchan =	1
10743:	nchan =	1
10745:	nchan =	1
10747:	nchan =	1
10749:	nchan =	1
4601:	nchan =	1
10774:	nchan =	1
10778:	nchan =	1
10780:	nchan =	1
10785:	nchan =	1
10787:	nchan =	1
10789:	nchan =	1
10804:	nchan =	1
10806:	nchan =	1
10808:	nchan =	1
10865:	nchan =	1
10867:	nchan =	1
10869:	nchan =	1
10871:	nchan =	1
10994:	nchan =	1
10996:	nchan =	1
11008:	nchan =	1
11010:	nchan =	1
11013:	nchan =	1
11015:	nchan =	1
11017:	nchan =	1
11019:	nchan =	1
11023:	nchan =	1
11044:	nchan =	100
11063:	nchan =	60
11099:	nchan =	76
11102:	nchan =	84
11105:	nchan =	1
11107:	nchan =	1
11109:	nchan =	1
11111:	nchan =	1
11113:	nchan =	1
11163:	nchan =	1
11192:	nchan =	136
11507:	nchan =	1
11514:	nchan =	1
11519:	nchan =	1
11520:	nchan =	1
11521:	nchan =	1
11522:	nchan =	1
11523:	nchan =	1
11524:	nchan =	1
11525:	nchan =	1
11531:	nchan =	1
11533:	nchan =	1
11535:	nchan =	1
11537:	nchan =	1
11399:	nchan =	117
11409:	nchan =	43
11484:	nchan =	1
11486:	nchan =	1
11488:	nchan =	1
11581:	nchan =	1
11583:	nchan =	1
11585:	nchan =	1
11589:	nchan =	1
11602:	nchan =	146
11603:	nchan =	14
11655:	nchan =	74
11656:	nchan =	86
11663:	nchan =	1
11664:	nchan =	1
11666:	nchan =	1
11667:	nchan =	1
11673:	nchan =	1
11675:	nchan =	1
11677:	nchan =	1
11679:	nchan =	1
11681:	nchan =	1
11729:	nchan =	1
11731:	nchan =	1
11754:	nchan =	1
11755:	nchan =	1
11756:	nchan =	1
11757:	nchan =	1
11758:	nchan =	1
11759:	nchan =	1
11764:	nchan =	1
11766:	nchan =	1
11768:	nchan =	1
11770:	nchan =	1
11775:	nchan =	1
11777:	nchan =	1
11779:	nchan =	1
11781:	nchan =	1
11783:	nchan =	1
11785:	nchan =	1
11792:	nchan =	1
11793:	nchan =	1
11794:	nchan =	1
11795:	nchan =	1
11796:	nchan =	1
11797:	nchan =	1
11798:	nchan =	1
11799:	nchan =	1
11808:	nchan =	1
11817:	nchan =	1
20672:	nchan =	1
20699:	nchan =	1
20750:	nchan =	1
20797:	nchan =	1
20824:	nchan =	1
20826:	nchan =	1
20828:	nchan =	1
20835:	nchan =	1
20837:	nchan =	1
20839:	nchan =	1
20842:	nchan =	1
20843:	nchan =	1
20864:	nchan =	1
20866:	nchan =	1
20868:	nchan =	1
20870:	nchan =	1
20872:	nchan =	1
20890:	nchan =	1
20892:	nchan =	1
20894:	nchan =	1
20898:	nchan =	1

20900: nchan = 1	21133: nchan = 1	21456: nchan = 1
20914: nchan = 56	21187: nchan = 1	21472: nchan = 1
20916: nchan = 20	21188: nchan = 1	21496: nchan = 1
20923: nchan = 140	21189: nchan = 1	21561: nchan = 1
20986: nchan = 44	21191: nchan = 1	21563: nchan = 1
20990: nchan = 116	21204: nchan = 1	21565: nchan = 1
21020: nchan = 1	21208: nchan = 1	21574: nchan = 84
21043: nchan = 144	21454: nchan = 1	21575: nchan = 76
21125: nchan = 1	21455: nchan = 1	21615: nchan = 1

APPENDIX D: Bad shots. This list includes only those shots that have been entirely killed. Shots with traces edited out are listed in Appendix E.

910	11196	11797	20244	20916
10044	11208	11798	20245	20986
10045	11468	11799	20246	21133
10046	11486	20225	20247	21180
10047	11488	20234	20750	21454
10206	11561	20235	20882	21455
10411	11616	20236	20894	21496
10736	11664	20237	20909	21497
10857	11679	20238	20910	21514
10889	11792	20239	20911	21574
10891	11793	20240	20912	21619
11015	11794	20241	20913	21620
11111	11795	20242	20914	21631
11192	11796	20243	20915	

APPENDIX E: Individual trace kills. The format specifies the minimum and maximum channels to kill in a shot and the channel increment. For single trace kills, min == max and increment == 0.

ProMAX Data Export

SOURCE	CHANMIN	CHANMAX	INC
9	2.00	2.00	0.00
51	2.00	2.00	0.00
55	2.00	2.00	0.00
73	2.00	2.00	0.00
84	2.00	2.00	0.00
107	2.00	2.00	0.00
116	2.00	2.00	0.00
	42.00	42.00	0.00
147	2.00	2.00	0.00
164	2.00	2.00	0.00
169	2.00	2.00	0.00
189	2.00	2.00	0.00
190	42.00	42.00	0.00
192	42.00	42.00	0.00
193	42.00	42.00	0.00
194	42.00	42.00	0.00
200	42.00	42.00	0.00
219	42.00	42.00	0.00
220	2.00	2.00	0.00
	42.00	42.00	0.00
228	42.00	42.00	0.00
248	42.00	42.00	0.00
249	42.00	42.00	0.00
256	2.00	2.00	0.00
260	2.00	2.00	0.00
263	2.00	2.00	0.00
265	2.00	2.00	0.00
355	2.00	2.00	0.00
393	2.00	2.00	0.00
403	42.00	42.00	0.00
404	42.00	42.00	0.00
422	2.00	2.00	0.00
440	42.00	42.00	0.00
447	42.00	42.00	0.00
449	42.00	42.00	0.00
466	42.00	42.00	0.00
468	42.00	42.00	0.00
475	42.00	42.00	0.00
489	42.00	42.00	0.00
503	42.00	42.00	0.00
520	2.00	2.00	0.00
558	42.00	42.00	0.00
559	42.00	42.00	0.00
560	42.00	42.00	0.00
566	42.00	42.00	0.00
581	2.00	2.00	0.00
582	42.00	42.00	0.00
583	42.00	42.00	0.00
593	42.00	42.00	0.00
594	42.00	42.00	0.00
597	42.00	42.00	0.00
598	42.00	42.00	0.00
600	42.00	42.00	0.00
623	42.00	42.00	0.00
637	42.00	42.00	0.00
645	2.00	2.00	0.00
657	42.00	42.00	0.00
659	42.00	42.00	0.00
663	2.00	2.00	0.00
677	42.00	42.00	0.00
718	42.00	42.00	0.00
719	42.00	42.00	0.00
755	42.00	42.00	0.00
765	42.00	42.00	0.00
766	42.00	42.00	0.00
778	42.00	42.00	0.00
779	42.00	42.00	0.00
781	42.00	42.00	0.00
784	42.00	42.00	0.00
790	42.00	42.00	0.00
793	42.00	42.00	0.00
795	42.00	42.00	0.00
796	42.00	42.00	0.00
797	42.00	42.00	0.00
805	42.00	42.00	0.00
817	42.00	42.00	0.00
827	42.00	42.00	0.00
834	42.00	42.00	0.00
835	42.00	42.00	0.00
839	42.00	42.00	0.00
846	2.00	2.00	0.00
851	42.00	42.00	0.00
855	42.00	42.00	0.00
859	2.00	2.00	0.00

860	2.00	2.00	0.00
866	42.00	42.00	0.00
875	42.00	42.00	0.00
881	2.00	2.00	0.00
891	2.00	2.00	0.00
894	42.00	42.00	0.00
925	42.00	42.00	0.00
928	42.00	42.00	0.00
935	42.00	42.00	0.00
953	2.00	2.00	0.00
1000	2.00	2.00	0.00
1006	2.00	2.00	0.00
1079	42.00	42.00	0.00
1087	42.00	42.00	0.00
1088	42.00	42.00	0.00
1089	42.00	42.00	0.00
1116	42.00	42.00	0.00
1129	42.00	42.00	0.00
1130	42.00	42.00	0.00
1131	42.00	42.00	0.00
1139	42.00	42.00	0.00
1140	42.00	42.00	0.00
1189	42.00	42.00	0.00
1274	42.00	42.00	0.00
1343	2.00	2.00	0.00
1362	2.00	2.00	0.00
1367	42.00	42.00	0.00
1387	2.00	2.00	0.00
1394	2.00	2.00	0.00
	42.00	42.00	0.00
	49.00	49.00	0.00
1400	2.00	2.00	0.00
1404	2.00	2.00	0.00
1416	2.00	2.00	0.00
1431	2.00	2.00	0.00
1448	42.00	42.00	0.00
1449	42.00	42.00	0.00
1461	2.00	2.00	0.00
1462	2.00	2.00	0.00
1463	2.00	2.00	0.00
	42.00	42.00	0.00
1469	42.00	42.00	0.00
1475	2.00	2.00	0.00
1476	2.00	2.00	0.00
1484	2.00	2.00	0.00
	42.00	42.00	0.00
	49.00	49.00	0.00
1498	2.00	2.00	0.00
1505	42.00	42.00	0.00
1507	2.00	2.00	0.00
1508	42.00	42.00	0.00
	49.00	49.00	0.00
1510	2.00	2.00	0.00
1511	42.00	42.00	0.00
1536	2.00	2.00	0.00
	49.00	49.00	0.00
1538	2.00	2.00	0.00
	49.00	49.00	0.00
1565	2.00	2.00	0.00
	49.00	49.00	0.00
1568	2.00	2.00	0.00
	42.00	42.00	0.00
	49.00	49.00	0.00
1585	49.00	49.00	0.00

1591	2.00	2.00	0.00
1609	2.00	2.00	0.00
1614	2.00	2.00	0.00
	49.00	49.00	0.00
1637	2.00	2.00	0.00
	49.00	49.00	0.00
1653	49.00	49.00	0.00
1655	2.00	2.00	0.00
1718	2.00	2.00	0.00
1729	2.00	2.00	0.00
1738	42.00	42.00	0.00
1747	2.00	2.00	0.00
	49.00	49.00	0.00
1795	2.00	2.00	0.00
	49.00	49.00	0.00
1840	42.00	42.00	0.00
1842	2.00	2.00	0.00
1847	2.00	2.00	0.00
1854	2.00	2.00	0.00
1894	42.00	42.00	0.00
1951	2.00	2.00	0.00
	49.00	49.00	0.00
1954	2.00	2.00	0.00
	42.00	42.00	0.00
	49.00	49.00	0.00
1962	42.00	42.00	0.00
1963	2.00	2.00	0.00
1970	2.00	2.00	0.00
1971	49.00	49.00	0.00
2004	2.00	2.00	0.00
	42.00	42.00	0.00
	49.00	49.00	0.00
2014	2.00	2.00	0.00
2015	2.00	2.00	0.00
2018	1.00	1.00	0.00
	2.00	2.00	0.00
2036	2.00	2.00	0.00
	42.00	42.00	0.00
	49.00	49.00	0.00
2043	1.00	1.00	0.00
2063	1.00	1.00	0.00
	42.00	42.00	0.00
2065	2.00	2.00	0.00
2067	1.00	1.00	0.00
2070	42.00	42.00	0.00
2094	2.00	2.00	0.00
	49.00	49.00	0.00
2110	42.00	42.00	0.00
2112	42.00	42.00	0.00
2113	1.00	1.00	0.00
	42.00	42.00	0.00
2118	2.00	2.00	0.00
2132	43.00	43.00	0.00
2139	2.00	2.00	0.00
2148	1.00	1.00	0.00
2212	2.00	2.00	0.00
2248	42.00	42.00	0.00
2275	28.00	28.00	0.00
	29.00	29.00	0.00
	30.00	30.00	0.00
	31.00	31.00	0.00
	32.00	32.00	0.00
2323	2.00	2.00	0.00
	42.00	42.00	0.00

	49.00	49.00	0.00
2413	2.00	2.00	0.00
	42.00	42.00	0.00
	49.00	49.00	0.00
2422	7.00	7.00	0.00
2426	1.00	1.00	0.00
2427	7.00	7.00	0.00
2428	7.00	7.00	0.00
2434	7.00	7.00	0.00
2435	7.00	7.00	0.00
2437	2.00	2.00	0.00
	42.00	42.00	0.00
	49.00	49.00	0.00
2439	2.00	2.00	0.00
2450	2.00	2.00	0.00
	42.00	42.00	0.00
	49.00	49.00	0.00
2471	7.00	7.00	0.00
2483	7.00	7.00	0.00
2485	7.00	7.00	0.00
2486	7.00	7.00	0.00
2489	7.00	7.00	0.00
2492	7.00	7.00	0.00
2502	7.00	7.00	0.00
2504	87.00	87.00	0.00
	88.00	88.00	0.00
2505	7.00	7.00	0.00
2524	1.00	1.00	0.00
2533	42.00	42.00	0.00
2534	1.00	1.00	0.00
2546	2.00	2.00	0.00
	42.00	42.00	0.00
2547	2.00	2.00	0.00
	42.00	42.00	0.00
2554	2.00	2.00	0.00
2557	2.00	2.00	0.00
	42.00	42.00	0.00
	49.00	49.00	0.00
2566	42.00	42.00	0.00
2567	2.00	2.00	0.00
2574	2.00	2.00	0.00
2582	2.00	2.00	0.00
2583	2.00	2.00	0.00
2585	1.00	1.00	0.00
2586	42.00	42.00	0.00
2598	81.00	81.00	0.00
2607	2.00	2.00	0.00
2613	81.00	81.00	0.00
	82.00	82.00	0.00
2614	87.00	87.00	0.00
2615	80.00	80.00	0.00
	81.00	81.00	0.00
	82.00	82.00	0.00
	83.00	83.00	0.00
	84.00	84.00	0.00
2621	81.00	81.00	0.00
	82.00	82.00	0.00
2624	42.00	42.00	0.00
	84.00	84.00	0.00
2625	2.00	2.00	0.00
	42.00	42.00	0.00
	49.00	49.00	0.00
2645	2.00	2.00	0.00
2653	1.00	1.00	0.00

2654	1.00	1.00	0.00
	2.00	2.00	0.00
2662	89.00	89.00	0.00
2663	89.00	89.00	0.00
2664	1.00	1.00	0.00
	89.00	89.00	0.00
2669	2.00	2.00	0.00
	49.00	49.00	0.00
2671	17.00	17.00	0.00
2672	17.00	17.00	0.00
2673	89.00	89.00	0.00
2674	89.00	89.00	0.00
2677	17.00	17.00	0.00
2678	2.00	2.00	0.00
2679	2.00	2.00	0.00
2683	17.00	17.00	0.00
2688	17.00	17.00	0.00
2690	17.00	17.00	0.00
2692	42.00	42.00	0.00
2696	2.00	2.00	0.00
	17.00	17.00	0.00
2697	17.00	17.00	0.00
2703	42.00	42.00	0.00
2706	17.00	17.00	0.00
2707	1.00	1.00	0.00
	2.00	2.00	0.00
2712	2.00	2.00	0.00
2715	42.00	42.00	0.00
2720	2.00	2.00	0.00
	49.00	49.00	0.00
2722	42.00	42.00	0.00
2727	17.00	17.00	0.00
2728	1.00	1.00	0.00
2732	1.00	1.00	0.00
2736	42.00	42.00	0.00
2738	17.00	17.00	0.00
2744	17.00	17.00	0.00
2751	18.00	18.00	0.00
2752	17.00	17.00	0.00
2753	17.00	17.00	0.00
2754	2.00	2.00	0.00
2755	2.00	2.00	0.00
	17.00	17.00	0.00
	42.00	42.00	0.00
	49.00	49.00	0.00
2760	17.00	17.00	0.00
2768	2.00	2.00	0.00
	49.00	49.00	0.00
2771	42.00	42.00	0.00
2778	1.00	1.00	0.00
2784	42.00	42.00	0.00
2785	18.00	18.00	0.00
2788	1.00	1.00	0.00
2789	2.00	2.00	0.00
2790	17.00	17.00	0.00
2796	17.00	17.00	0.00
2798	17.00	17.00	0.00
2799	2.00	2.00	0.00
	17.00	17.00	0.00
	49.00	49.00	0.00
2803	17.00	17.00	0.00
2807	2.00	2.00	0.00
2808	2.00	2.00	0.00
	49.00	49.00	0.00
2813	2.00	2.00	0.00
	17.00	17.00	0.00
2814	1.00	1.00	0.00
2817	42.00	42.00	0.00
2818	1.00	1.00	0.00
2819	42.00	42.00	0.00
2821	2.00	2.00	0.00
2830	17.00	17.00	0.00
2834	42.00	42.00	0.00
2837	42.00	42.00	0.00
2838	42.00	42.00	0.00
2839	17.00	17.00	0.00
2840	17.00	17.00	0.00
2842	2.00	2.00	0.00
	49.00	49.00	0.00
2848	17.00	17.00	0.00
2850	17.00	17.00	0.00
2854	42.00	42.00	0.00
2855	17.00	17.00	0.00
	42.00	42.00	0.00
2858	1.00	1.00	0.00
	17.00	17.00	0.00
	42.00	42.00	0.00
2859	17.00	17.00	0.00
2873	42.00	42.00	0.00
2876	17.00	17.00	0.00
2880	2.00	2.00	0.00
	17.00	17.00	0.00
	18.00	18.00	0.00
2883	1.00	1.00	0.00
	2.00	2.00	0.00
	42.00	42.00	0.00
2884	2.00	2.00	0.00
	42.00	42.00	0.00
2885	2.00	2.00	0.00
	21.00	21.00	0.00
2887	2.00	2.00	0.00
2888	2.00	2.00	0.00
2904	7.00	7.00	0.00
2906	7.00	7.00	0.00
2941	38.00	38.00	0.00
2942	38.00	38.00	0.00
2945	18.00	18.00	0.00
2949	2.00	2.00	0.00
	42.00	42.00	0.00
2961	49.00	49.00	0.00
2963	18.00	18.00	0.00
	21.00	21.00	0.00
	38.00	38.00	0.00
	49.00	49.00	0.00
	50.00	50.00	0.00
2965	49.00	49.00	0.00
	50.00	50.00	0.00
2966	21.00	21.00	0.00
	49.00	49.00	0.00
	50.00	50.00	0.00
2967	18.00	18.00	0.00
	21.00	21.00	0.00
	38.00	38.00	0.00
	49.00	49.00	0.00
	50.00	50.00	0.00
2969	18.00	18.00	0.00
	21.00	21.00	0.00
	38.00	38.00	0.00
	49.00	49.00	0.00
	50.00	50.00	0.00
2977	42.00	42.00	0.00
2978	42.00	42.00	0.00
	49.00	49.00	0.00
2982	42.00	42.00	0.00
2983	2.00	2.00	0.00
	42.00	42.00	0.00
	49.00	49.00	0.00
2986	49.00	49.00	0.00
2987	2.00	2.00	0.00
	42.00	42.00	0.00
	49.00	49.00	0.00
2989	49.00	49.00	0.00
2991	49.00	49.00	0.00
2993	49.00	49.00	0.00
2994	49.00	49.00	0.00
2996	49.00	49.00	0.00
	50.00	50.00	0.00
2997	49.00	49.00	0.00
	50.00	50.00	0.00
2998	49.00	49.00	0.00
	50.00	50.00	0.00
2999	49.00	49.00	0.00
3000	49.00	49.00	0.00
3001	49.00	49.00	0.00
3005	49.00	49.00	0.00
3006	2.00	2.00	0.00
	42.00	42.00	0.00
	49.00	49.00	0.00
3008	2.00	2.00	0.00
3009	2.00	2.00	0.00
	42.00	42.00	0.00
	49.00	49.00	0.00
3037	38.00	38.00	0.00
3042	55.00	55.00	0.00
	59.00	59.00	0.00
	67.00	67.00	0.00
	79.00	79.00	0.00
	83.00	83.00	0.00
	91.00	91.00	0.00
	103.00	103.00	0.00
	111.00	111.00	0.00
3128	49.00	49.00	0.00
	50.00	50.00	0.00
3343	2.00	2.00	0.00
	42.00	42.00	0.00
	49.00	49.00	0.00
3699	122.00	122.00	0.00
3723	38.00	38.00	0.00

ProMAX Data Export

SOURCE	CHANMIN	CHANMAX	INC
10043	49.00	49.00	0.00
10044	49.00	49.00	0.00
10045	49.00	49.00	0.00
10079	49.00	49.00	0.00
10206	49.00	49.00	0.00
10292	2.00	2.00	0.00
	49.00	49.00	0.00
10296	2.00	2.00	0.00
	49.00	49.00	0.00
10299	2.00	2.00	0.00
	49.00	49.00	0.00

10312	49.00	49.00	0.00
10370	2.00	2.00	0.00
10400	141.00	144.00	1.00
10401	141.00	144.00	1.00
10406	117.00	160.00	1.00
10416	125.00	160.00	1.00
10417	125.00	160.00	1.00
10422	149.00	156.00	1.00
10424	149.00	156.00	1.00
10426	149.00	156.00	1.00
10428	149.00	156.00	1.00
10429	149.00	156.00	1.00
10430	149.00	156.00	1.00
10431	149.00	156.00	1.00
10432	149.00	156.00	1.00
10445	117.00	160.00	1.00
10447	49.00	49.00	0.00
10469	1.00	1.00	0.00
	42.00	42.00	0.00
10477	42.00	42.00	0.00
10478	42.00	42.00	0.00
10479	42.00	42.00	0.00
10480	42.00	42.00	0.00
10481	42.00	42.00	0.00
10482	42.00	42.00	0.00
10483	42.00	42.00	0.00
10484	42.00	42.00	0.00
10485	42.00	42.00	0.00
10486	42.00	42.00	0.00
10487	42.00	42.00	0.00
10488	42.00	42.00	0.00
10489	42.00	42.00	0.00
10490	42.00	42.00	0.00
10496	42.00	42.00	0.00
10497	42.00	42.00	0.00
10498	42.00	42.00	0.00
10499	42.00	42.00	0.00
10507	42.00	42.00	0.00
10508	42.00	42.00	0.00
10509	42.00	42.00	0.00
10510	42.00	42.00	0.00
10511	42.00	42.00	0.00
10529	42.00	42.00	0.00
10530	42.00	42.00	0.00
10630	42.00	42.00	0.00
10631	42.00	42.00	0.00
10632	42.00	42.00	0.00
10671	2.00	2.00	0.00
	42.00	42.00	0.00
	49.00	49.00	0.00
10673	42.00	42.00	0.00
10674	42.00	42.00	0.00
10675	42.00	42.00	0.00
10676	42.00	42.00	0.00
10677	42.00	42.00	0.00
10678	42.00	42.00	0.00
10679	42.00	42.00	0.00
10680	42.00	42.00	0.00
10681	42.00	42.00	0.00
10682	42.00	42.00	0.00
10683	42.00	42.00	0.00
10684	2.00	2.00	0.00
	42.00	42.00	0.00
	49.00	49.00	0.00
10686	42.00	42.00	0.00
10687	42.00	42.00	0.00
10688	42.00	42.00	0.00
10691	42.00	42.00	0.00
10692	42.00	42.00	0.00
10693	42.00	42.00	0.00
10694	42.00	42.00	0.00
10695	42.00	42.00	0.00
10696	42.00	42.00	0.00
10697	42.00	42.00	0.00
10698	42.00	42.00	0.00
10699	42.00	42.00	0.00
10700	42.00	42.00	0.00
10701	42.00	42.00	0.00
10702	42.00	42.00	0.00
10703	42.00	42.00	0.00
10704	42.00	42.00	0.00
10705	42.00	42.00	0.00
10706	42.00	42.00	0.00
10707	42.00	42.00	0.00
10708	42.00	42.00	0.00
10709	42.00	42.00	0.00
10710	2.00	2.00	0.00
	42.00	42.00	0.00
10712	42.00	42.00	0.00
10713	42.00	42.00	0.00
10714	42.00	42.00	0.00
10715	42.00	42.00	0.00
10716	42.00	42.00	0.00
10717	42.00	42.00	0.00
10718	42.00	42.00	0.00
10719	42.00	42.00	0.00
10720	42.00	42.00	0.00
10721	42.00	42.00	0.00
10725	42.00	42.00	0.00
10726	42.00	42.00	0.00
10727	42.00	42.00	0.00
10728	42.00	42.00	0.00
10729	42.00	42.00	0.00
10730	42.00	42.00	0.00
10731	42.00	42.00	0.00
10734	141.00	144.00	1.00
10735	42.00	42.00	0.00
	141.00	144.00	1.00
10737	42.00	42.00	0.00
	141.00	144.00	1.00
10738	141.00	144.00	1.00
10739	42.00	42.00	0.00
	141.00	144.00	1.00
10743	125.00	132.00	1.00
	149.00	160.00	1.00
10744	42.00	42.00	0.00
	125.00	132.00	1.00
	149.00	160.00	1.00
10745	42.00	42.00	0.00
	125.00	132.00	1.00
	149.00	160.00	1.00
10746	42.00	42.00	0.00
	125.00	132.00	1.00
	149.00	160.00	1.00
10747	125.00	132.00	1.00
	149.00	160.00	1.00
10748	42.00	42.00	0.00
	125.00	132.00	1.00
	149.00	160.00	1.00
10749	125.00	132.00	1.00
	149.00	160.00	1.00
10753	42.00	42.00	0.00
	141.00	160.00	1.00
10754	42.00	42.00	0.00
	141.00	160.00	1.00
10755	42.00	42.00	0.00
	141.00	160.00	1.00
10756	42.00	42.00	0.00
	141.00	160.00	1.00
10757	42.00	42.00	0.00
	141.00	160.00	1.00
10758	42.00	42.00	0.00
	141.00	160.00	1.00
10759	42.00	42.00	0.00
	141.00	160.00	1.00
10760	42.00	42.00	0.00
	49.00	49.00	0.00
	141.00	160.00	1.00
10761	42.00	42.00	0.00
	141.00	160.00	1.00
10766	42.00	42.00	0.00
10767	42.00	42.00	0.00
10768	42.00	42.00	0.00
10769	42.00	42.00	0.00
10770	42.00	42.00	0.00
10774	157.00	157.00	0.00
	158.00	158.00	0.00
	159.00	159.00	0.00
	160.00	160.00	0.00
10779	42.00	42.00	0.00
10780	157.00	157.00	0.00
	159.00	159.00	0.00
	160.00	160.00	0.00
10781	42.00	42.00	0.00
10786	42.00	42.00	0.00
10788	42.00	42.00	0.00
10797	42.00	42.00	0.00
10798	42.00	42.00	0.00
10821	42.00	42.00	0.00
10822	2.00	2.00	0.00
	42.00	42.00	0.00
	49.00	49.00	0.00
10824	42.00	42.00	0.00
10857	42.00	42.00	0.00
10861	141.00	152.00	1.00
10870	42.00	42.00	0.00
10872	42.00	42.00	0.00
10873	42.00	42.00	0.00
10875	42.00	42.00	0.00
10884	42.00	42.00	0.00
10885	42.00	42.00	0.00
10889	2.00	2.00	0.00
	42.00	42.00	0.00
10891	42.00	42.00	0.00
10944	44.00	44.00	0.00
10954	2.00	2.00	0.00
	42.00	42.00	0.00
	49.00	49.00	0.00
10970	49.00	49.00	0.00
10987	49.00	49.00	0.00
11013	149.00	160.00	1.00
11016	149.00	160.00	1.00

11017	149.00	160.00	1.00
11018	149.00	160.00	1.00
11019	149.00	160.00	1.00
11020	149.00	160.00	1.00
11023	149.00	160.00	1.00
11024	149.00	160.00	1.00
11025	149.00	160.00	1.00
11026	149.00	160.00	1.00
11027	149.00	160.00	1.00
11028	148.00	160.00	1.00
11031	149.00	160.00	1.00
11032	148.00	160.00	1.00
11033	149.00	160.00	1.00
11034	149.00	160.00	1.00
11035	149.00	160.00	1.00
11036	149.00	160.00	1.00
11037	149.00	160.00	1.00
11038	149.00	160.00	1.00
11039	149.00	160.00	1.00
11040	148.00	160.00	1.00
	149.00	160.00	1.00
11041	149.00	160.00	1.00
11042	149.00	160.00	1.00
11044	2.00	2.00	0.00
11063	157.00	157.00	0.00
	159.00	159.00	0.00
	160.00	160.00	0.00
11066	49.00	49.00	0.00
11089	149.00	160.00	1.00
11090	2.00	2.00	0.00
	42.00	42.00	0.00
	49.00	49.00	0.00
	149.00	160.00	1.00
11092	149.00	160.00	1.00
11093	149.00	160.00	1.00
11094	149.00	160.00	1.00
11095	149.00	160.00	1.00
11096	149.00	160.00	1.00
11097	149.00	160.00	1.00
11098	149.00	160.00	1.00
11105	157.00	160.00	1.00
11106	157.00	160.00	1.00
11107	157.00	160.00	1.00
11108	157.00	160.00	1.00
11109	157.00	160.00	1.00
11110	157.00	160.00	1.00
11112	49.00	49.00	0.00
	157.00	160.00	1.00
11113	157.00	160.00	1.00
11114	2.00	2.00	0.00
	42.00	42.00	0.00
	157.00	160.00	1.00
11152	49.00	49.00	0.00
11180	2.00	2.00	0.00
11191	2.00	2.00	0.00
11208	42.00	42.00	0.00
11212	2.00	2.00	0.00
	42.00	42.00	0.00
	49.00	49.00	0.00
11214	2.00	2.00	0.00
	42.00	42.00	0.00
	49.00	49.00	0.00
11216	42.00	42.00	0.00
11222	42.00	42.00	0.00

	49.00	49.00	0.00
11223	2.00	2.00	0.00
	42.00	42.00	0.00
	49.00	49.00	0.00
11226	42.00	42.00	0.00
11227	2.00	2.00	0.00
11230	2.00	2.00	0.00
11234	2.00	2.00	0.00
11235	2.00	2.00	0.00
11236	2.00	2.00	0.00
11237	2.00	2.00	0.00
11240	2.00	2.00	0.00
11242	2.00	2.00	0.00
11243	2.00	2.00	0.00
	42.00	42.00	0.00
11244	2.00	2.00	0.00
11245	2.00	2.00	0.00
11248	42.00	42.00	0.00
11250	2.00	2.00	0.00
11251	2.00	2.00	0.00
	42.00	42.00	0.00
11252	42.00	42.00	0.00
11253	42.00	42.00	0.00
11254	2.00	2.00	0.00
	42.00	42.00	0.00
11255	2.00	2.00	0.00
	42.00	42.00	0.00
11256	2.00	2.00	0.00
	42.00	42.00	0.00
11257	2.00	2.00	0.00
	42.00	42.00	0.00
11258	2.00	2.00	0.00
	42.00	42.00	0.00
11259	42.00	42.00	0.00
11260	42.00	42.00	0.00
11261	2.00	2.00	0.00
	42.00	42.00	0.00
	49.00	49.00	0.00
11263	2.00	2.00	0.00
	42.00	42.00	0.00
11264	2.00	2.00	0.00
	42.00	42.00	0.00
11265	2.00	2.00	0.00
	42.00	42.00	0.00
11266	2.00	2.00	0.00
	42.00	42.00	0.00
11267	2.00	2.00	0.00
	42.00	42.00	0.00
11268	2.00	2.00	0.00
	42.00	42.00	0.00
11269	2.00	2.00	0.00
	42.00	42.00	0.00
11270	2.00	2.00	0.00
	42.00	42.00	0.00
11271	2.00	2.00	0.00
	42.00	42.00	0.00
11272	2.00	2.00	0.00
	42.00	42.00	0.00
11275	2.00	2.00	0.00
	42.00	42.00	0.00
11276	2.00	2.00	0.00
	42.00	42.00	0.00
11277	2.00	2.00	0.00
	42.00	42.00	0.00

11278	2.00	2.00	0.00
	42.00	42.00	0.00
11279	42.00	42.00	0.00
11280	42.00	42.00	0.00
11281	42.00	42.00	0.00
11282	42.00	42.00	0.00
11283	42.00	42.00	0.00
11284	42.00	42.00	0.00
11285	42.00	42.00	0.00
11286	2.00	2.00	0.00
	42.00	42.00	0.00
11287	42.00	42.00	0.00
11288	42.00	42.00	0.00
11289	42.00	42.00	0.00
11290	42.00	42.00	0.00
11291	42.00	42.00	0.00
11292	42.00	42.00	0.00
11293	42.00	42.00	0.00
11294	42.00	42.00	0.00
11295	42.00	42.00	0.00
11296	42.00	42.00	0.00
11297	42.00	42.00	0.00
11298	42.00	42.00	0.00
11299	42.00	42.00	0.00
11300	42.00	42.00	0.00
11301	42.00	42.00	0.00
11302	42.00	42.00	0.00
11303	42.00	42.00	0.00
11304	42.00	42.00	0.00
11305	42.00	42.00	0.00
11306	42.00	42.00	0.00
11307	42.00	42.00	0.00
11308	42.00	42.00	0.00
11309	42.00	42.00	0.00
11310	42.00	42.00	0.00
11311	42.00	42.00	0.00
11312	42.00	42.00	0.00
11313	42.00	42.00	0.00
11314	42.00	42.00	0.00
11315	42.00	42.00	0.00
11316	42.00	42.00	0.00
11317	42.00	42.00	0.00
11318	42.00	42.00	0.00
11319	42.00	42.00	0.00
11320	42.00	42.00	0.00
11321	42.00	42.00	0.00
11322	42.00	42.00	0.00
11323	42.00	42.00	0.00
11324	42.00	42.00	0.00
11325	42.00	42.00	0.00
11326	42.00	42.00	0.00
11327	42.00	42.00	0.00
11328	42.00	42.00	0.00
11329	42.00	42.00	0.00
11330	42.00	42.00	0.00
11331	42.00	42.00	0.00
11332	42.00	42.00	0.00
11333	42.00	42.00	0.00
	129.00	160.00	1.00
11334	42.00	42.00	0.00
11335	42.00	42.00	0.00
11336	42.00	42.00	0.00
11337	42.00	42.00	0.00
11338	42.00	42.00	0.00

11339	42.00	42.00	0.00
11340	42.00	42.00	0.00
11341	42.00	42.00	0.00
11342	42.00	42.00	0.00
11343	42.00	42.00	0.00
11344	42.00	42.00	0.00
11345	42.00	42.00	0.00
11346	42.00	42.00	0.00
11347	42.00	42.00	0.00
11348	42.00	42.00	0.00
11349	42.00	42.00	0.00
11350	2.00	2.00	0.00
	42.00	42.00	0.00
	49.00	49.00	0.00
11352	42.00	42.00	0.00
11353	42.00	42.00	0.00
11354	42.00	42.00	0.00
11355	42.00	42.00	0.00
11356	42.00	42.00	0.00
11357	42.00	42.00	0.00
11358	42.00	42.00	0.00
11359	42.00	42.00	0.00
11360	42.00	42.00	0.00
11361	42.00	42.00	0.00
11363	42.00	42.00	0.00
11364	42.00	42.00	0.00
11365	42.00	42.00	0.00
11366	42.00	42.00	0.00
11367	42.00	42.00	0.00
11368	42.00	42.00	0.00
11369	42.00	42.00	0.00
11370	42.00	42.00	0.00
11371	2.00	2.00	0.00
	42.00	42.00	0.00
11372	42.00	42.00	0.00
11373	42.00	42.00	0.00
11374	42.00	42.00	0.00
11375	42.00	42.00	0.00
11376	42.00	42.00	0.00
11377	42.00	42.00	0.00
11378	42.00	42.00	0.00
11379	2.00	2.00	0.00
	42.00	42.00	0.00
11380	2.00	2.00	0.00
	42.00	42.00	0.00
11381	2.00	2.00	0.00
	42.00	42.00	0.00
11382	42.00	42.00	0.00
11383	42.00	42.00	0.00
11384	42.00	42.00	0.00
11385	42.00	42.00	0.00
11386	2.00	2.00	0.00
	42.00	42.00	0.00
11387	2.00	2.00	0.00
	42.00	42.00	0.00
11388	2.00	2.00	0.00
	42.00	42.00	0.00
	49.00	49.00	0.00
11389	2.00	2.00	0.00
	42.00	42.00	0.00
11390	2.00	2.00	0.00
	42.00	42.00	0.00
11391	2.00	2.00	0.00
	42.00	42.00	0.00
11392	2.00	2.00	0.00
	42.00	42.00	0.00
11393	2.00	2.00	0.00
	42.00	42.00	0.00
	49.00	49.00	0.00
	105.00	160.00	1.00
11394	2.00	2.00	0.00
	42.00	42.00	0.00
	49.00	49.00	0.00
11395	2.00	2.00	0.00
	42.00	42.00	0.00
	49.00	49.00	0.00
	105.00	160.00	1.00
11399	2.00	2.00	0.00
	42.00	42.00	0.00
11410	2.00	2.00	0.00
	42.00	42.00	0.00
11411	2.00	2.00	0.00
	42.00	42.00	0.00
11412	42.00	42.00	0.00
11413	2.00	2.00	0.00
	42.00	42.00	0.00
	49.00	49.00	0.00
11415	42.00	42.00	0.00
11416	42.00	42.00	0.00
11417	42.00	42.00	0.00
11418	42.00	42.00	0.00
11419	42.00	42.00	0.00
11420	42.00	42.00	0.00
11421	42.00	42.00	0.00
11422	42.00	42.00	0.00
11423	42.00	42.00	0.00
11424	42.00	42.00	0.00
11425	42.00	42.00	0.00
11426	42.00	42.00	0.00
11427	42.00	42.00	0.00
11428	42.00	42.00	0.00
11429	42.00	42.00	0.00
11430	2.00	2.00	0.00
	42.00	42.00	0.00
	49.00	49.00	0.00
11432	42.00	42.00	0.00
11433	2.00	2.00	0.00
	42.00	42.00	0.00
	49.00	49.00	0.00
11434	42.00	42.00	0.00
11435	42.00	42.00	0.00
11436	42.00	42.00	0.00
11437	42.00	42.00	0.00
11441	42.00	42.00	0.00
11442	42.00	42.00	0.00
11443	2.00	2.00	0.00
	42.00	42.00	0.00
	49.00	49.00	0.00
11445	42.00	42.00	0.00
11446	42.00	42.00	0.00
11447	42.00	42.00	0.00
11448	2.00	2.00	0.00
	42.00	42.00	0.00
11449	42.00	42.00	0.00
11450	42.00	42.00	0.00
11451	2.00	2.00	0.00
	42.00	42.00	0.00
11452	2.00	2.00	0.00
	42.00	42.00	0.00
11453	2.00	2.00	0.00
	42.00	42.00	0.00
11454	2.00	2.00	0.00
	42.00	42.00	0.00
11455	2.00	2.00	0.00
	42.00	42.00	0.00
11456	2.00	2.00	0.00
	42.00	42.00	0.00
	49.00	49.00	0.00
11459	2.00	2.00	0.00
	42.00	42.00	0.00
11460	2.00	2.00	0.00
	42.00	42.00	0.00
11461	2.00	2.00	0.00
	42.00	42.00	0.00
11462	42.00	42.00	0.00
11463	42.00	42.00	0.00
11464	42.00	42.00	0.00
11465	2.00	2.00	0.00
	42.00	42.00	0.00
	49.00	49.00	0.00
11467	2.00	2.00	0.00
	42.00	42.00	0.00
11468	2.00	2.00	0.00
	42.00	42.00	0.00
	49.00	49.00	0.00
11469	2.00	2.00	0.00
	42.00	42.00	0.00
	49.00	49.00	0.00
11471	2.00	2.00	0.00
	42.00	42.00	0.00
11472	2.00	2.00	0.00
	42.00	42.00	0.00
11473	2.00	2.00	0.00
	42.00	42.00	0.00
	49.00	49.00	0.00
11475	42.00	42.00	0.00
11476	42.00	42.00	0.00
11477	2.00	2.00	0.00
	42.00	42.00	0.00
11478	2.00	2.00	0.00
	42.00	42.00	0.00
11479	2.00	2.00	0.00
	42.00	42.00	0.00
11480	2.00	2.00	0.00
	42.00	42.00	0.00
	49.00	49.00	0.00
11485	2.00	2.00	0.00
	42.00	42.00	0.00
	49.00	49.00	0.00
	105.00	160.00	1.00
11500	2.00	2.00	0.00
	42.00	42.00	0.00
	49.00	49.00	0.00
	117.00	124.00	1.00
11501	2.00	2.00	0.00
	42.00	42.00	0.00
	49.00	49.00	0.00
	117.00	124.00	1.00
11503	2.00	2.00	0.00
	42.00	42.00	0.00
	117.00	124.00	1.00
11508	2.00	2.00	0.00

	42.00	42.00	0.00
	49.00	49.00	0.00
11510	2.00	2.00	0.00
	42.00	42.00	0.00
11514	149.00	149.00	0.00
	150.00	150.00	0.00
	151.00	151.00	0.00
	152.00	152.00	0.00
11515	2.00	2.00	0.00
	42.00	42.00	0.00
	149.00	152.00	1.00
11519	125.00	160.00	1.00
11520	125.00	160.00	1.00
11521	125.00	160.00	1.00
11522	125.00	160.00	1.00
11523	125.00	160.00	1.00
11524	125.00	160.00	1.00
11525	125.00	160.00	1.00
11526	2.00	2.00	0.00
	42.00	42.00	0.00
	125.00	160.00	1.00
11527	2.00	2.00	0.00
	42.00	42.00	0.00
	125.00	160.00	1.00
11532	42.00	42.00	0.00
11533	18.00	18.00	0.00
	42.00	42.00	0.00
11534	2.00	2.00	0.00
	42.00	42.00	0.00
11536	42.00	42.00	0.00
11537	18.00	18.00	0.00
11538	2.00	2.00	0.00
	42.00	42.00	0.00
11539	2.00	2.00	0.00
	42.00	42.00	0.00
11540	2.00	2.00	0.00
	42.00	42.00	0.00
11541	2.00	2.00	0.00
	42.00	42.00	0.00
11542	2.00	2.00	0.00
	42.00	42.00	0.00
11543	2.00	2.00	0.00
	42.00	42.00	0.00
11544	2.00	2.00	0.00
	42.00	42.00	0.00
11545	42.00	42.00	0.00
11546	2.00	2.00	0.00
	42.00	42.00	0.00
11547	42.00	42.00	0.00
11548	2.00	2.00	0.00
	42.00	42.00	0.00
11549	2.00	2.00	0.00
	42.00	42.00	0.00
11550	2.00	2.00	0.00
	42.00	42.00	0.00
11551	2.00	2.00	0.00
	42.00	42.00	0.00
11552	2.00	2.00	0.00
	42.00	42.00	0.00
11553	2.00	2.00	0.00
	42.00	42.00	0.00
11554	1.00	1.00	0.00
	2.00	2.00	0.00
	42.00	42.00	0.00

11555	2.00	2.00	0.00
	42.00	42.00	0.00
11556	42.00	42.00	0.00
11557	2.00	2.00	0.00
	42.00	42.00	0.00
11558	2.00	2.00	0.00
	42.00	42.00	0.00
11559	2.00	2.00	0.00
	42.00	42.00	0.00
11560	2.00	2.00	0.00
	42.00	42.00	0.00
11561	2.00	2.00	0.00
	42.00	42.00	0.00
11562	2.00	2.00	0.00
	42.00	42.00	0.00
11563	42.00	42.00	0.00
11564	42.00	42.00	0.00
11565	2.00	2.00	0.00
	42.00	42.00	0.00
11566	2.00	2.00	0.00
	42.00	42.00	0.00
11567	42.00	42.00	0.00
11568	42.00	42.00	0.00
11569	2.00	2.00	0.00
	42.00	42.00	0.00
11570	42.00	42.00	0.00
11571	2.00	2.00	0.00
	42.00	42.00	0.00
11572	42.00	42.00	0.00
11573	2.00	2.00	0.00
	42.00	42.00	0.00
11574	2.00	2.00	0.00
	42.00	42.00	0.00
11575	2.00	2.00	0.00
	42.00	42.00	0.00
11576	2.00	2.00	0.00
	42.00	42.00	0.00
11577	2.00	2.00	0.00
	42.00	42.00	0.00
11582	42.00	42.00	0.00
	133.00	144.00	1.00
11584	2.00	2.00	0.00
	42.00	42.00	0.00
11590	2.00	2.00	0.00
	42.00	42.00	0.00
11591	2.00	2.00	0.00
	42.00	42.00	0.00
11592	42.00	42.00	0.00
11593	2.00	2.00	0.00
	42.00	42.00	0.00
11594	2.00	2.00	0.00
	42.00	42.00	0.00
11595	2.00	2.00	0.00
	42.00	42.00	0.00
11596	42.00	42.00	0.00
	49.00	49.00	0.00
11597	2.00	2.00	0.00
	42.00	42.00	0.00
11598	42.00	42.00	0.00
11599	42.00	42.00	0.00
11600	42.00	42.00	0.00
11601	2.00	2.00	0.00
	42.00	42.00	0.00
11602	42.00	42.00	0.00

11604	2.00	2.00	0.00
	42.00	42.00	0.00
11605	2.00	2.00	0.00
	42.00	42.00	0.00
11606	2.00	2.00	0.00
	42.00	42.00	0.00
11607	2.00	2.00	0.00
	42.00	42.00	0.00
11608	42.00	42.00	0.00
11609	42.00	42.00	0.00
11610	2.00	2.00	0.00
	42.00	42.00	0.00
11611	2.00	2.00	0.00
	42.00	42.00	0.00
11612	2.00	2.00	0.00
	42.00	42.00	0.00
11613	2.00	2.00	0.00
	42.00	42.00	0.00
11614	42.00	42.00	0.00
11615	2.00	2.00	0.00
	42.00	42.00	0.00
11616	42.00	42.00	0.00
11617	2.00	2.00	0.00
	42.00	42.00	0.00
11618	42.00	42.00	0.00
11619	2.00	2.00	0.00
	42.00	42.00	0.00
11620	42.00	42.00	0.00
11621	2.00	2.00	0.00
	42.00	42.00	0.00
11622	42.00	42.00	0.00
11623	2.00	2.00	0.00
	42.00	42.00	0.00
11624	2.00	2.00	0.00
	42.00	42.00	0.00
11625	2.00	2.00	0.00
	42.00	42.00	0.00
11626	42.00	42.00	0.00
11627	2.00	2.00	0.00
	42.00	42.00	0.00
11628	42.00	42.00	0.00
11629	2.00	2.00	0.00
	42.00	42.00	0.00
11630	42.00	42.00	0.00
11631	2.00	2.00	0.00
	42.00	42.00	0.00
11632	2.00	2.00	0.00
	42.00	42.00	0.00
11633	2.00	2.00	0.00
	42.00	42.00	0.00
11634	2.00	2.00	0.00
	42.00	42.00	0.00
11635	2.00	2.00	0.00
	42.00	42.00	0.00
11636	2.00	2.00	0.00
	42.00	42.00	0.00
11637	42.00	42.00	0.00
11638	42.00	42.00	0.00
11639	42.00	42.00	0.00
11640	2.00	2.00	0.00
	42.00	42.00	0.00
11641	42.00	42.00	0.00
11642	42.00	42.00	0.00
11643	42.00	42.00	0.00

11644	2.00	2.00	0.00
	42.00	42.00	0.00
11645	2.00	2.00	0.00
	42.00	42.00	0.00
11646	42.00	42.00	0.00
11647	42.00	42.00	0.00
11648	2.00	2.00	0.00
	42.00	42.00	0.00
11649	42.00	42.00	0.00
11650	42.00	42.00	0.00
11651	2.00	2.00	0.00
	42.00	42.00	0.00
11652	2.00	2.00	0.00
	42.00	42.00	0.00
11653	2.00	2.00	0.00
	42.00	42.00	0.00
11654	42.00	42.00	0.00
11655	42.00	42.00	0.00
11668	2.00	2.00	0.00
	42.00	42.00	0.00
11669	2.00	2.00	0.00
	42.00	42.00	0.00
11670	2.00	2.00	0.00
	42.00	42.00	0.00
11674	2.00	2.00	0.00
	42.00	42.00	0.00
11676	2.00	2.00	0.00
	42.00	42.00	0.00
11678	42.00	42.00	0.00
11680	2.00	2.00	0.00
	42.00	42.00	0.00
11682	2.00	2.00	0.00
	42.00	42.00	0.00
11683	2.00	2.00	0.00
	42.00	42.00	0.00
11684	42.00	42.00	0.00
11685	42.00	42.00	0.00
11686	42.00	42.00	0.00
11687	42.00	42.00	0.00
11688	42.00	42.00	0.00
11689	42.00	42.00	0.00
11690	42.00	42.00	0.00
11691	42.00	42.00	0.00
11692	42.00	42.00	0.00
11693	42.00	42.00	0.00
11694	42.00	42.00	0.00
11695	42.00	42.00	0.00
11696	42.00	42.00	0.00
11697	42.00	42.00	0.00
11698	42.00	42.00	0.00
11699	42.00	42.00	0.00
11700	42.00	42.00	0.00
11701	42.00	42.00	0.00
11703	42.00	42.00	0.00
11704	42.00	42.00	0.00
11706	42.00	42.00	0.00
11707	42.00	42.00	0.00
11708	42.00	42.00	0.00
11709	2.00	2.00	0.00
	42.00	42.00	0.00
11710	42.00	42.00	0.00
11711	2.00	2.00	0.00
	42.00	42.00	0.00
11712	42.00	42.00	0.00
11713	2.00	2.00	0.00
	42.00	42.00	0.00
11714	42.00	42.00	0.00
11715	42.00	42.00	0.00
11716	2.00	2.00	0.00
	42.00	42.00	0.00
11717	2.00	2.00	0.00
	42.00	42.00	0.00
11718	2.00	2.00	0.00
	42.00	42.00	0.00
11719	2.00	2.00	0.00
	42.00	42.00	0.00
11720	2.00	2.00	0.00
	42.00	42.00	0.00
	49.00	49.00	0.00
11721	2.00	2.00	0.00
	42.00	42.00	0.00
	49.00	49.00	0.00
11723	42.00	42.00	0.00
11724	2.00	2.00	0.00
	42.00	42.00	0.00
11725	2.00	2.00	0.00
	42.00	42.00	0.00
11730	2.00	2.00	0.00
	42.00	42.00	0.00
11732	2.00	2.00	0.00
	42.00	42.00	0.00
11733	42.00	42.00	0.00
11734	42.00	42.00	0.00
11735	42.00	42.00	0.00
11736	42.00	42.00	0.00
11737	2.00	2.00	0.00
	42.00	42.00	0.00
11738	2.00	2.00	0.00
	42.00	42.00	0.00
11739	42.00	42.00	0.00
11740	2.00	2.00	0.00
	42.00	42.00	0.00
11741	42.00	42.00	0.00
11742	42.00	42.00	0.00
11743	42.00	42.00	0.00
11744	42.00	42.00	0.00
11745	2.00	2.00	0.00
	42.00	42.00	0.00
	117.00	160.00	1.00
11746	42.00	42.00	0.00
11747	42.00	42.00	0.00
11754	42.00	42.00	0.00
11755	42.00	42.00	0.00
11756	42.00	42.00	0.00
11757	42.00	42.00	0.00
11758	42.00	42.00	0.00
11759	42.00	42.00	0.00
11760	42.00	42.00	0.00
11764	42.00	42.00	0.00
11765	2.00	2.00	0.00
	42.00	42.00	0.00
11766	42.00	42.00	0.00
11767	2.00	2.00	0.00
	42.00	42.00	0.00
11768	42.00	42.00	0.00
11769	2.00	2.00	0.00
	42.00	42.00	0.00
11770	42.00	42.00	0.00
11771	42.00	42.00	0.00
11775	42.00	42.00	0.00
11776	2.00	2.00	0.00
	42.00	42.00	0.00
11777	42.00	42.00	0.00
11778	2.00	2.00	0.00
	42.00	42.00	0.00
11779	42.00	42.00	0.00
11780	2.00	2.00	0.00
	42.00	42.00	0.00
11781	42.00	42.00	0.00
11782	2.00	2.00	0.00
	42.00	42.00	0.00
11783	42.00	42.00	0.00
11784	1.00	1.00	0.00
	2.00	2.00	0.00
	42.00	42.00	0.00
11785	42.00	42.00	0.00
11792	42.00	42.00	0.00
11793	42.00	42.00	0.00
11794	42.00	42.00	0.00
11795	42.00	42.00	0.00
11796	42.00	42.00	0.00
11797	42.00	42.00	0.00
11798	42.00	42.00	0.00
11799	42.00	42.00	0.00
11803	2.00	2.00	0.00
	42.00	42.00	0.00
11804	2.00	2.00	0.00
	42.00	42.00	0.00
11808	42.00	42.00	0.00
11809	2.00	2.00	0.00
	42.00	42.00	0.00
11817	42.00	42.00	0.00
11818	42.00	42.00	0.00
11819	42.00	42.00	0.00
11820	42.00	42.00	0.00
11821	42.00	42.00	0.00
11822	42.00	42.00	0.00
11823	42.00	42.00	0.00
11824	42.00	42.00	0.00
11825	42.00	42.00	0.00
11826	42.00	42.00	0.00
11827	42.00	42.00	0.00
11828	42.00	42.00	0.00
11829	42.00	42.00	0.00
11830	42.00	42.00	0.00
11831	42.00	42.00	0.00
11832	42.00	42.00	0.00
11833	42.00	42.00	0.00
11834	42.00	42.00	0.00
11835	42.00	42.00	0.00
11836	42.00	42.00	0.00
11837	42.00	42.00	0.00
11838	42.00	42.00	0.00
11839	42.00	42.00	0.00
11840	42.00	42.00	0.00
11841	42.00	42.00	0.00
11842	42.00	42.00	0.00
11843	42.00	42.00	0.00
11877	42.00	42.00	0.00
11900	42.00	42.00	0.00
11904	42.00	42.00	0.00
11922	42.00	42.00	0.00

11940	42.00	42.00	0.00
12043	42.00	42.00	0.00
12053	65.00	65.00	0.00
12054	65.00	65.00	0.00
12062	42.00	42.00	0.00
12063	42.00	42.00	0.00

ProMAX Data Export

SOURCE	CHANMIN	CHANMAX	INC
20046	49.00	49.00	0.00
20047	49.00	49.00	0.00
20048	42.00	42.00	0.00
	49.00	49.00	0.00
20049	49.00	49.00	0.00
20071	49.00	49.00	0.00
20225	2.00	2.00	0.00
20234	2.00	2.00	0.00
20235	2.00	2.00	0.00
20236	2.00	2.00	0.00
20237	2.00	2.00	0.00
20238	2.00	2.00	0.00
20239	2.00	2.00	0.00
20240	2.00	2.00	0.00
20241	2.00	2.00	0.00
20242	2.00	2.00	0.00
20243	2.00	2.00	0.00
20244	2.00	2.00	0.00
20245	2.00	2.00	0.00
20246	2.00	2.00	0.00
20247	2.00	2.00	0.00
20288	42.00	42.00	0.00
20291	2.00	2.00	0.00
	42.00	42.00	0.00
	49.00	49.00	0.00
20313	2.00	2.00	0.00
	49.00	49.00	0.00
20316	2.00	2.00	0.00
	42.00	42.00	0.00
	49.00	49.00	0.00
20355	42.00	42.00	0.00
20357	2.00	2.00	0.00
	42.00	42.00	0.00
	49.00	49.00	0.00
20361	42.00	42.00	0.00
20363	49.00	49.00	0.00
20370	49.00	49.00	0.00
20404	42.00	42.00	0.00
	49.00	49.00	0.00
20416	2.00	2.00	0.00
20466	42.00	42.00	0.00
20467	42.00	42.00	0.00
20480	2.00	2.00	0.00
20485	42.00	42.00	0.00
20497	2.00	2.00	0.00
20498	2.00	2.00	0.00
20499	2.00	2.00	0.00
20500	2.00	2.00	0.00
20502	2.00	2.00	0.00
20508	2.00	2.00	0.00
20511	2.00	2.00	0.00
20512	2.00	2.00	0.00
20513	2.00	2.00	0.00
20514	2.00	2.00	0.00
20516	2.00	2.00	0.00
20517	42.00	42.00	0.00
20521	2.00	2.00	0.00
20524	42.00	42.00	0.00
20525	2.00	2.00	0.00
	42.00	42.00	0.00
20526	2.00	2.00	0.00
20527	2.00	2.00	0.00
	42.00	42.00	0.00
20528	42.00	42.00	0.00
20537	2.00	2.00	0.00
20555	2.00	2.00	0.00
20558	42.00	42.00	0.00
20562	2.00	2.00	0.00
20563	2.00	2.00	0.00
20564	2.00	2.00	0.00
20567	2.00	2.00	0.00
20572	2.00	2.00	0.00
20573	2.00	2.00	0.00
20576	2.00	2.00	0.00
20586	2.00	2.00	0.00
20590	2.00	2.00	0.00
20593	2.00	2.00	0.00
20594	2.00	2.00	0.00
20606	42.00	42.00	0.00
20608	2.00	2.00	0.00
20609	2.00	2.00	0.00
20610	2.00	2.00	0.00
20618	2.00	2.00	0.00
20619	2.00	2.00	0.00
20621	2.00	2.00	0.00
20622	2.00	2.00	0.00
20625	2.00	2.00	0.00
20626	2.00	2.00	0.00
20627	2.00	2.00	0.00
20628	2.00	2.00	0.00
20629	2.00	2.00	0.00
20630	2.00	2.00	0.00
20632	2.00	2.00	0.00
20633	2.00	2.00	0.00
20634	2.00	2.00	0.00
20635	2.00	2.00	0.00
20636	2.00	2.00	0.00
20642	2.00	2.00	0.00
20643	2.00	2.00	0.00
20644	2.00	2.00	0.00
20645	2.00	2.00	0.00
20646	2.00	2.00	0.00
20653	2.00	2.00	0.00
20660	49.00	49.00	0.00
20663	2.00	2.00	0.00
20665	2.00	2.00	0.00
20672	1.00	1.00	0.00
20675	42.00	42.00	0.00
20689	18.00	18.00	0.00
20690	18.00	18.00	0.00
20694	25.00	25.00	0.00
	26.00	26.00	0.00
20766	42.00	42.00	0.00
20770	2.00	2.00	0.00
20771	2.00	2.00	0.00
20772	2.00	2.00	0.00
	3.00	3.00	0.00
20807	157.00	157.00	0.00
	158.00	158.00	0.00
	159.00	159.00	0.00
	160.00	160.00	0.00
20808	157.00	157.00	0.00
	158.00	158.00	0.00
	159.00	159.00	0.00
	160.00	160.00	0.00
20809	157.00	157.00	0.00
	158.00	158.00	0.00
	159.00	159.00	0.00
	160.00	160.00	0.00
20810	49.00	49.00	0.00
	157.00	157.00	0.00
	158.00	158.00	0.00
	159.00	159.00	0.00
	160.00	160.00	0.00
20811	157.00	157.00	0.00
	158.00	158.00	0.00
	159.00	159.00	0.00
	160.00	160.00	0.00
20812	157.00	157.00	0.00
	158.00	158.00	0.00
	159.00	159.00	0.00
	160.00	160.00	0.00
20813	157.00	157.00	0.00
	158.00	158.00	0.00
	159.00	159.00	0.00
	160.00	160.00	0.00
20814	42.00	42.00	0.00
	157.00	157.00	0.00
	158.00	158.00	0.00
	159.00	159.00	0.00
	160.00	160.00	0.00
20815	157.00	157.00	0.00
	158.00	158.00	0.00
	159.00	159.00	0.00
	160.00	160.00	0.00
20816	157.00	157.00	0.00
	158.00	158.00	0.00
	159.00	159.00	0.00
	160.00	160.00	0.00
20817	157.00	157.00	0.00
	158.00	158.00	0.00
	159.00	159.00	0.00
	160.00	160.00	0.00
20818	157.00	157.00	0.00
	158.00	158.00	0.00
	159.00	159.00	0.00
	160.00	160.00	0.00
20819	2.00	2.00	0.00
	42.00	42.00	0.00
	86.00	86.00	0.00
	89.00	89.00	0.00
	90.00	90.00	0.00
	92.00	92.00	0.00
	94.00	94.00	0.00
	98.00	98.00	0.00
	102.00	102.00	0.00
	106.00	106.00	0.00
	110.00	110.00	0.00
	114.00	114.00	0.00
	118.00	118.00	0.00
	119.00	119.00	0.00
	120.00	120.00	0.00
	122.00	122.00	0.00

	123.00	123.00	0.00
	124.00	124.00	0.00
	126.00	126.00	0.00
	127.00	127.00	0.00
	128.00	128.00	0.00
	130.00	130.00	0.00
	131.00	131.00	0.00
	132.00	132.00	0.00
	134.00	134.00	0.00
	135.00	135.00	0.00
	136.00	136.00	0.00
	157.00	157.00	0.00
	158.00	158.00	0.00
	159.00	159.00	0.00
	160.00	160.00	0.00
20820	42.00	42.00	0.00
	89.00	89.00	0.00
	92.00	92.00	0.00
	157.00	157.00	0.00
	158.00	158.00	0.00
	159.00	159.00	0.00
	160.00	160.00	0.00
20824	1.00	1.00	0.00
20826	1.00	1.00	0.00
20828	1.00	1.00	0.00
20835	1.00	1.00	0.00
20837	1.00	1.00	0.00
20839	1.00	1.00	0.00
20842	1.00	1.00	0.00
20843	1.00	1.00	0.00
20861	42.00	42.00	0.00
	141.00	141.00	0.00
	142.00	142.00	0.00
	143.00	143.00	0.00
	144.00	144.00	0.00
	145.00	145.00	0.00
	146.00	146.00	0.00
	147.00	147.00	0.00
	148.00	148.00	0.00
	149.00	149.00	0.00
	150.00	150.00	0.00
	151.00	151.00	0.00
	152.00	152.00	0.00
	153.00	153.00	0.00
	154.00	154.00	0.00
	155.00	155.00	0.00
	156.00	156.00	0.00
	157.00	157.00	0.00
	158.00	158.00	0.00
	159.00	159.00	0.00
	160.00	160.00	0.00
20864	1.00	1.00	0.00
20865	49.00	49.00	0.00
20866	1.00	1.00	0.00
20868	1.00	1.00	0.00
20870	1.00	1.00	0.00
20871	141.00	141.00	0.00
	142.00	142.00	0.00
	143.00	143.00	0.00
	144.00	144.00	0.00
	145.00	145.00	0.00
	146.00	146.00	0.00
	147.00	147.00	0.00
	148.00	148.00	0.00
	149.00	149.00	0.00
	150.00	150.00	0.00
	151.00	151.00	0.00
	152.00	152.00	0.00
	153.00	153.00	0.00
	154.00	154.00	0.00
	155.00	155.00	0.00
	156.00	156.00	0.00
	157.00	157.00	0.00
	158.00	158.00	0.00
	159.00	159.00	0.00
	160.00	160.00	0.00
20872	1.00	1.00	0.00
20874	2.00	2.00	0.00
20890	1.00	1.00	0.00
20892	1.00	1.00	0.00
20893	42.00	42.00	0.00
20894	1.00	1.00	0.00
20898	1.00	1.00	0.00
20900	1.00	1.00	0.00
20916	1.00	1.00	0.00
	2.00	2.00	0.00
	3.00	3.00	0.00
	4.00	4.00	0.00
	5.00	5.00	0.00
	6.00	6.00	0.00
	7.00	7.00	0.00
	8.00	8.00	0.00
	9.00	9.00	0.00
	10.00	10.00	0.00
	11.00	11.00	0.00
	12.00	12.00	0.00
	13.00	13.00	0.00
	14.00	14.00	0.00
	15.00	15.00	0.00
	16.00	16.00	0.00
	17.00	17.00	0.00
	18.00	18.00	0.00
	19.00	19.00	0.00
	20.00	20.00	0.00
20923	133.00	133.00	0.00
	134.00	134.00	0.00
	135.00	135.00	0.00
	136.00	136.00	0.00
	137.00	137.00	0.00
	138.00	138.00	0.00
	139.00	139.00	0.00
	140.00	140.00	0.00
	141.00	141.00	0.00
	142.00	142.00	0.00
	143.00	143.00	0.00
	144.00	144.00	0.00
	145.00	145.00	0.00
	146.00	146.00	0.00
	147.00	147.00	0.00
	148.00	148.00	0.00
	149.00	149.00	0.00
	150.00	150.00	0.00
	151.00	151.00	0.00
	152.00	152.00	0.00
	153.00	153.00	0.00
	154.00	154.00	0.00
	155.00	155.00	0.00
	156.00	156.00	0.00
20924	133.00	133.00	0.00
	134.00	134.00	0.00
	135.00	135.00	0.00
	136.00	136.00	0.00
	137.00	137.00	0.00
	138.00	138.00	0.00
	139.00	139.00	0.00
	140.00	140.00	0.00
	141.00	141.00	0.00
	142.00	142.00	0.00
	143.00	143.00	0.00
	144.00	144.00	0.00
	145.00	145.00	0.00
	146.00	146.00	0.00
	147.00	147.00	0.00
	148.00	148.00	0.00
	149.00	149.00	0.00
	150.00	150.00	0.00
	151.00	151.00	0.00
	152.00	152.00	0.00
	153.00	153.00	0.00
	154.00	154.00	0.00
	155.00	155.00	0.00
	156.00	156.00	0.00
20925	133.00	133.00	0.00
	134.00	134.00	0.00
	135.00	135.00	0.00
	136.00	136.00	0.00
	137.00	137.00	0.00
	138.00	138.00	0.00
	139.00	139.00	0.00
	140.00	140.00	0.00
	141.00	141.00	0.00
	142.00	142.00	0.00
	143.00	143.00	0.00
	144.00	144.00	0.00
	145.00	145.00	0.00
	146.00	146.00	0.00
	147.00	147.00	0.00
	148.00	148.00	0.00
	149.00	149.00	0.00
	150.00	150.00	0.00
	151.00	151.00	0.00
	152.00	152.00	0.00
	153.00	153.00	0.00
	154.00	154.00	0.00
	155.00	155.00	0.00
	156.00	156.00	0.00
20926	133.00	133.00	0.00
	134.00	134.00	0.00
	135.00	135.00	0.00
	136.00	136.00	0.00
	137.00	137.00	0.00
	138.00	138.00	0.00
	139.00	139.00	0.00
	140.00	140.00	0.00
	141.00	141.00	0.00
	142.00	142.00	0.00
	143.00	143.00	0.00
	144.00	144.00	0.00
	145.00	145.00	0.00
	146.00	146.00	0.00
	147.00	147.00	0.00
	148.00	148.00	0.00

	149.00	149.00	0.00
	150.00	150.00	0.00
	151.00	151.00	0.00
	152.00	152.00	0.00
	153.00	153.00	0.00
	154.00	154.00	0.00
	155.00	155.00	0.00
	156.00	156.00	0.00
20927	125.00	125.00	0.00
	126.00	126.00	0.00
	127.00	127.00	0.00
	128.00	128.00	0.00
	133.00	133.00	0.00
	134.00	134.00	0.00
	135.00	135.00	0.00
	136.00	136.00	0.00
	137.00	137.00	0.00
	138.00	138.00	0.00
	139.00	139.00	0.00
	140.00	140.00	0.00
	141.00	141.00	0.00
	142.00	142.00	0.00
	143.00	143.00	0.00
	144.00	144.00	0.00
	145.00	145.00	0.00
	146.00	146.00	0.00
	147.00	147.00	0.00
	148.00	148.00	0.00
	149.00	149.00	0.00
	150.00	150.00	0.00
	151.00	151.00	0.00
	152.00	152.00	0.00
	153.00	153.00	0.00
	154.00	154.00	0.00
	155.00	155.00	0.00
	156.00	156.00	0.00
	157.00	157.00	0.00
	158.00	158.00	0.00
	159.00	159.00	0.00
	160.00	160.00	0.00
20986	42.00	42.00	0.00
21015	49.00	49.00	0.00
21020	1.00	1.00	0.00
21180	2.00	2.00	0.00
	42.00	42.00	0.00
	49.00	49.00	0.00
21235	2.00	2.00	0.00
21239	2.00	2.00	0.00
21404	117.00	117.00	0.00
	118.00	118.00	0.00
	119.00	119.00	0.00
	120.00	120.00	0.00
	121.00	121.00	0.00
	122.00	122.00	0.00
	123.00	123.00	0.00
	124.00	124.00	0.00
	125.00	125.00	0.00
	126.00	126.00	0.00
	127.00	127.00	0.00
	128.00	128.00	0.00
	129.00	129.00	0.00
	130.00	130.00	0.00
	131.00	131.00	0.00
	132.00	132.00	0.00
	133.00	133.00	0.00
	134.00	134.00	0.00
	135.00	135.00	0.00
	136.00	136.00	0.00
	137.00	137.00	0.00
	138.00	138.00	0.00
	139.00	139.00	0.00
	140.00	140.00	0.00
	141.00	141.00	0.00
	142.00	142.00	0.00
	143.00	143.00	0.00
	144.00	144.00	0.00
	145.00	145.00	0.00
	146.00	146.00	0.00
	147.00	147.00	0.00
	148.00	148.00	0.00
	149.00	149.00	0.00
	150.00	150.00	0.00
	151.00	151.00	0.00
	152.00	152.00	0.00
	153.00	153.00	0.00
	154.00	154.00	0.00
	155.00	155.00	0.00
	156.00	156.00	0.00
	157.00	157.00	0.00
	158.00	158.00	0.00
	159.00	159.00	0.00
	160.00	160.00	0.00
21436	38.00	38.00	0.00
21440	49.00	49.00	0.00
21442	145.00	145.00	0.00
	146.00	146.00	0.00
	147.00	147.00	0.00
	148.00	148.00	0.00
	149.00	149.00	0.00
	150.00	150.00	0.00
	151.00	151.00	0.00
	152.00	152.00	0.00
21479	122.00	122.00	0.00
21514	2.00	2.00	0.00
	42.00	42.00	0.00
	49.00	49.00	0.00
21526	38.00	38.00	0.00
21619	2.00	2.00	0.00
	42.00	42.00	0.00
	49.00	49.00	0.00
21620	2.00	2.00	0.00
	42.00	42.00	0.00
	49.00	49.00	0.00
21624	2.00	2.00	0.00
21631	2.00	2.00	0.00
	42.00	42.00	0.00
	49.00	49.00	0.00
21635	2.00	2.00	0.00
21659	42.00	42.00	0.00
20049	32.00	32.00	0.00
	93.00	93.00	0.00
20093	18.00	18.00	0.00
20140	101.00	101.00	0.00
20416	2.00	2.00	0.00
20480	2.00	2.00	0.00
20508	2.00	2.00	0.00
20556	2.00	2.00	0.00
20558	2.00	2.00	0.00
20587	2.00	2.00	0.00
20611	2.00	2.00	0.00
20620	2.00	2.00	0.00
20631	2.00	2.00	0.00
20649	2.00	2.00	0.00
20651	2.00	2.00	0.00
20659	2.00	2.00	0.00
20664	2.00	2.00	0.00
20666	2.00	2.00	0.00
20681	2.00	2.00	0.00
20685	21.00	21.00	0.00
	22.00	22.00	0.00
20689	18.00	18.00	0.00
20692	23.00	23.00	0.00
20709	19.00	19.00	0.00
	20.00	20.00	0.00
	21.00	21.00	0.00
20772	2.00	2.00	0.00
	3.00	3.00	0.00
	7.00	7.00	0.00
	11.00	11.00	0.00
	15.00	15.00	0.00
	19.00	19.00	0.00

APPENDIX F: Mute files for shots with gun misfires. The third column gives the start time of the mute for the given shot and channel and the fouth column is the end time of the mute.

ProMAX Data Export

SOURCE	CHAN	TIME	TIME
1274	1.00	8141.19	16000.00
	160.00	5277.45	16000.00
1278	85.00	16057.50	16000.00
	160.00	14646.00	16000.00
1343	1.00	8284.38	16000.00
	160.00	5461.55	16000.00
1376	1.00	8223.01	16000.00
	160.00	5543.37	16000.00
1380	1.00	8243.46	16000.00
	160.00	5297.91	16000.00
1394	1.00	13520.91	16000.00

	160.00	10820.81	16000.00
1446	1.00	8529.84	16000.00
	160.00	5297.91	16000.00
1463	1.00	8898.03	16000.00
	160.00	6674.88	16000.00
1484	1.00	12395.88	16000.00
	160.00	10145.81	16000.00
1498	1.00	15505.06	16000.00
	160.00	12682.28	16000.00
1508	1.00	10861.75	16000.00
	160.00	8775.31	16000.00
1515	1.00	15852.75	16000.00
	160.00	13255.00	16000.00
1536	1.00	8427.56	16000.00
	160.00	6607.03	16000.00
1538	1.00	9736.69	16000.00
	160.00	7363.94	16000.00
1565	1.00	12804.98	16000.00
	160.00	10841.27	16000.00
1568	1.00	9859.38	16000.00
	160.00	7323.00	16000.00
1585	1.00	14564.12	16000.00
	160.00	12150.41	16000.00
1591	1.00	9061.75	16000.00
	160.00	6934.38	16000.00
1609	1.00	8223.01	16000.00
	160.00	6238.85	16000.00
1614	1.00	9388.94	16000.00
	160.00	6995.69	16000.00
1620	34.00	16049.88	16000.00
	160.00	13786.75	16000.00
1637	1.00	13930.03	16000.00
	160.00	11066.31	16000.00
1653	1.00	9409.41	16000.00
	160.00	7363.88	16000.00
1718	1.00	8816.21	16000.00
	160.00	6893.42	16000.00
1722	1.00	7282.06	16000.00
	160.00	5277.44	16000.00
1729	1.00	7752.54	16000.00
	160.00	6157.02	16000.00
1747	1.00	12436.78	16000.00
	160.00	10309.44	16000.00
1795	1.00	12395.88	16000.00
	160.00	9982.16	16000.00
1827	1.00	15934.62	16000.00
	160.00	13705.02	16000.00
1951	1.00	9307.15	16000.00
	160.00	7261.62	16000.00
1954	1.00	13684.50	16000.00
	160.00	10902.50	16000.00
1963	1.00	10125.44	16000.00
	160.00	7609.38	16000.00
1971	1.00	8673.03	16000.00
	160.00	6913.88	16000.00
2004	1.00	13090.90	16000.00
	160.00	10652.04	16000.00
2036	1.00	14382.05	16000.00
	160.00	11638.34	16000.00
2094	1.00	9378.83	16000.00
	160.00	7065.50	16000.00
2108	91.00	15995.88	16000.00
	160.00	14525.50	16000.00
2118	1.00	8966.38	16000.00
	160.00	6796.50	16000.00
2133	123.00	16013.88	16000.00
	160.00	15153.12	16000.00
2206	50.00	15942.21	16000.00
	160.00	13951.67	16000.00
2212	1.00	7836.75	16000.00
	160.00	5774.25	16000.00
2323	1.00	14417.92	16000.00
	160.00	11781.81	16000.00
2326	1.00	7729.00	16000.00
	160.00	5541.50	16000.00
2403	1.00	8561.24	16000.00
	160.00	7537.17	16000.00
2413	1.00	8950.39	16000.00
	160.00	6902.25	16000.00
2429	30.00	15978.25	16000.00
	160.00	13743.00	16000.00
2437	1.00	10636.75	16000.00
	160.00	8857.12	16000.00
2439	125.00	15996.00	16000.00
	160.00	15259.50	16000.00
2450	1.00	13336.75	16000.00
	160.00	10820.81	16000.00
2557	1.00	13029.99	16000.00
	160.00	10698.09	16000.00
2591	1.00	14564.13	16000.00
	160.00	12579.98	16000.00
2608	22.00	16081.91	16000.00
	160.00	14011.84	16000.00
2623	103.00	16114.19	16000.00
	160.00	15034.61	16000.00
2625	1.00	10923.00	16000.00
	160.00	8223.00	16000.00
2662	1.00	15055.03	16000.00
	160.00	12723.16	16000.00
2669	1.00	8754.75	16000.00
	160.00	6157.25	16000.00
2720	1.00	8284.37	16000.00
	160.00	6013.84	16000.00
2755	1.00	13848.19	16000.00
	160.00	11352.66	16000.00
2768	1.00	7977.50	16000.00
	160.00	5850.25	16000.00
2786	63.00	15975.50	16000.00
	160.00	13889.12	16000.00
2790	93.00	15995.97	16000.00
	160.00	14482.31	16000.00
2799	1.00	11761.88	16000.00
	160.00	8509.50	16000.00
2807	80.00	15955.00	16000.00
	160.00	13971.00	16000.00
2808	1.00	7404.00	16000.00
	160.00	5482.00	16000.00
2842	1.00	10473.06	16000.00
	160.00	7854.81	16000.00
2869	1.00	12948.16	16000.00
	160.00	11025.38	16000.00
2870	90.00	15996.00	16000.00
	160.00	13950.50	16000.00
2890	1.00	12927.75	16000.00
	160.00	11516.31	16000.00
2898	112.00	15955.12	16000.00
	160.00	14870.88	16000.00
2899	1.00	14687.00	16000.00

	160.00	11986.50	16000.00
2904	96.00	15934.62	16000.00
	160.00	11966.32	16000.00
2935	83.00	15996.00	16000.00
	160.00	14441.41	16000.00
2947	93.00	15955.09	16000.00
	160.00	12211.81	16000.00
2949	1.00	8326.00	16000.00
	160.00	6116.00	16000.00
2978	1.00	15627.81	16000.00
	160.00	13541.31	16000.00
2983	1.00	12539.00	16000.00
	160.00	10166.38	16000.00
2987	1.00	10902.75	16000.00
	160.00	8652.62	16000.00
2995	108.00	15975.75	16000.00
	160.00	12866.38	16000.00
3006	1.00	13743.04	16000.00
	160.00	11620.10	16000.00
3009	1.00	7967.50	16000.00
	160.00	5653.00	16000.00
3096	1.00	7373.32	16000.00
	160.00	5345.65	16000.00
3107	1.00	7619.09	16000.00
	160.00	5509.51	16000.00

ProMAX Data Export

SOURCE	CHAN	TIME	TIME
10077	1.00	9307.14	16000.00
	160.00	6954.78	16000.00
10079	1.00	13296.00	16000.00
	160.00	11128.00	16000.00
10292	1.00	13582.28	16000.00
	160.00	11414.03	16000.00
10296	1.00	8428.00	16000.00
	160.00	6178.00	16000.00
10299	1.00	7998.00	16000.00
	160.00	5870.75	16000.00
10302	55.00	15954.00	16000.00
	160.00	14606.00	16000.00
10370	1.00	6893.42	16000.00
	160.00	6913.87	16000.00
10671	1.00	12678.45	16000.00
	160.00	10580.31	16000.00
10684	1.00	10006.50	16000.00
	160.00	7980.25	16000.00
10710	1.00	14400.00	16000.00
	160.00	12355.62	16000.00
10822	1.00	7752.56	16000.00
	160.00	5482.06	16000.00
10873	82.00	15914.12	16000.00
	160.00	14809.62	16000.00
10954	1.00	12539.06	16000.00
	160.00	10800.36	16000.00
11090	1.00	13377.72	16000.00
	160.00	12027.69	16000.00
11112	1.00	9327.50	16000.00
	160.00	9389.00	16000.00
11152	1.00	7200.25	16000.00
	160.00	7282.12	16000.00
11196	1.00	5072.90	16000.00
	160.00	5195.63	16000.00
11208	1.00	8243.50	16000.00
	160.00	8325.50	16000.00
11212	1.00	12048.00	16000.00
	160.00	9348.00	16000.00
11214	1.00	10432.00	16000.00
	160.00	7773.00	16000.00
11223	1.00	10882.19	16000.00
	160.00	8959.38	16000.00
11261	1.00	7323.00	16000.00
	160.00	5359.25	16000.00
11350	1.00	9613.97	16000.00
	160.00	7670.72	16000.00
11361	1.00	15771.00	16000.00
	160.00	14482.00	16000.00
11413	1.00	10739.00	16000.00
	160.00	9307.12	16000.00
11430	1.00	10268.53	16000.00
	160.00	9307.14	16000.00
11443	1.00	12804.75	16000.00
	160.00	11487.62	16000.00
11456	1.00	7098.00	16000.00
	160.00	5236.50	16000.00
11465	1.00	11291.50	16000.00
	160.00	10207.00	16000.00
11468	1.00	3458.00	16000.00
	160.00	3498.00	16000.00
11469	1.00	7732.00	16000.00
	160.00	5482.00	16000.00
11473	1.00	[illegible]	16000.00
	160.00	[illegible]	16000.00
11480	1.00	8254.75	16000.00
	160.00	6464.00	16000.00
11501	1.00	10063.94	16000.00
	160.00	8918.50	16000.00
11508	1.00	7180.00	16000.00
	160.00	6034.50	16000.00
11577	1.00	7282.07	16000.00
	160.00	7282.06	16000.00
11612	1.00	7650.26	16000.00
	160.00	7670.71	16000.00
11721	1.00	11393.56	16000.00
	160.00	9695.80	16000.00

ProMAX Data Export

SOURCE	CHAN	TIME	TIME
20034	1.00	15135.23	16000.00
	160.00	12875.70	16000.00
20052	1.00	12893.50	16000.00
	160.00	11961.12	16000.00
20071	2.00	15316.50	16000.00
	160.00	15767.75	16000.00
20108	1.00	10723.75	16000.00
	160.00	10634.00	16000.00
20207	1.00	9716.23	16000.00
	160.00	9757.14	16000.00
20291	1.00	11352.66	16000.00
	160.00	10350.34	16000.00
20313	1.00	6341.00	16000.00
	160.00	5277.50	16000.00
20316	1.00	7159.00	16000.00
	160.00	6177.50	16000.00
20355	85.00	15914.00	16000.00
	160.00	15178.00	16000.00
20357	1.00	13686.00	16000.00
	160.00	12744.00	16000.00
20363	1.00	6730.00	16000.00

	160.00	5564.00	16000.00
20370	1.00	15524.00	16000.00
	160.00	14504.00	16000.00
20404	1.00	7487.00	16000.00
	160.00	6464.00	16000.00
20471	1.00	15586.75	16000.00
	160.00	14216.25	16000.00
20485	1.00	12498.50	16000.00
	160.00	11823.75	16000.00
20494	1.00	14809.50	16000.00
	160.00	14891.50	16000.00
20496	1.00	10064.00	16000.00
	160.00	10084.00	16000.00
20499	1.00	14052.00	16000.00
	160.00	14114.00	16000.00
20504	1.00	15280.00	16000.00
	160.00	15320.50	16000.00
20518	1.00	9000.00	16000.00
	160.00	9082.00	16000.00
20527	1.00	10207.25	16000.00
	160.00	10309.50	16000.00
20536	1.00	14830.00	16000.00
	160.00	14973.00	16000.00
20537	1.00	14094.00	16000.00
	160.00	15014.12	16000.00
20538	1.00	10360.00	16000.00
	160.00	11064.00	16000.00
20547	1.00	13643.50	16000.00
	160.00	16651.00	16000.00
20553	1.00	12048.50	16000.00
	160.00	13992.00	16000.00
20574	1.00	13480.00	16000.00
	160.00	15993.00	16000.00
20636	1.00	13476.78	16000.00
	160.00	13906.88	16000.00
20654	1.00	13640.64	16000.00
	160.00	13599.69	16000.00
20660	1.00	6820.00	16000.00
	160.00	6860.00	16000.00
20715	1.00	12800.75	16000.00
	160.00	12842.00	16000.00
20732	1.00	7496.00	16000.00
	160.00	7395.00	16000.00
20765	1.00	15361.00	16000.00
	160.00	15340.50	16000.00
20767	1.00	15484.00	16000.00
	160.00	14214.00	16000.00
20768	1.00	15238.50	16000.00
	160.00	15156.00	16000.00
20772	1.00	15311.75	16000.00
	160.00	15317.31	16000.00
20773	1.00	14132.00	16000.00
	160.00	14132.00	16000.00
20816	1.00	12616.00	16000.00
	160.00	12596.00	16000.00
20819	1.00	7376.00	16000.00
	160.00	7396.00	16000.00
20820	1.00	7906.00	16000.00
	160.00	7865.00	16000.00
20837	1.00	12000.00	16000.00
	160.00	12000.00	16000.00
20861	1.00	8254.02	16000.00
	160.00	8274.48	16000.00
21220	1.00	14480.31	16000.00
	160.00	14787.56	16000.00
21440	1.00	9974.44	16000.00
	160.00	9953.97	16000.00
21606	1.00	13790.28	16000.00
	160.00	13790.28	16000.00

APPENDIX G: Shots skipped in original tape copy that were reread afterwards. Shots marked with an asterisk are bad and were re-killed.

10357	10734	11010	11524	11755
10359	10736 *	11013	11525	11756
10395	10738	11015 *	11531	11757
10398	10743	11017	11533	11758
10399	10745	11019	11535	11759
10405	10747	11023	11537	11764
10407	10749	11044	11581	11766
10411 *	10774	11063	11583	11768
10413	10778	11105	11585	11770
10421	10780	11107	11589	11775
10423	10785	11109	11602	11777
10425	10787	11113	11663	11779
10427	10789	11163	11664 *	11781
10439	10804	11192 *	11665	11783
10440	10806	11486 *	11666	11785
10441	10808	11488 *	11667	11792 *
10442	10865	11507	11673	11793 *
10443	10867	11514	11675	11794 *
10461	10869	11519	11677	11795 *
10468	10871	11520	11681	11796 *
10469	10994	11521	11729	11797 *
10470	10996	11522	11731	11798 *
10471	11008	11523	11754	11799 *

11808	20842	20898	21187	21561
11817	20843	20900	21188	21563
20699	20864	20916 *	21189	21565
20750 *	20866	20923	21191	21574 *
20797	20868	20986 *	21204	21575
20826	20870	20990	21208	21615
20828	20872	20991	21454 *	
20835	20890	21043	21455 *	
20837	20892	21125	21472	
20839	20894 *	21133 *	21496 *	

SIGMA/EW9607
On-board Data Processing Notes: Transect 1

Transect 1 went relatively smoothly. Note that there are two parts to this line. Streamer deployment went quickly and smoothly and we began shooting and recording approximately 4.5 hours before the planned start of line. The first 743 shots are a small line perpendicular to the main transect. Our best guess (erring on the safe side) for when the streamer was straight after the turn is SP 913. The shots in the turn (~744 - 912) were ignored. The first part of the line (1A) consists of shots 1-743 and the second part (1B) consists of shots 913-5987. The section with channels 89 and 92 was swapped out during deployment. Channels 2, 42, and 49 are still flaky, but have not been edited out at this stage.

1) Tape copy.

2) Data read into ProMAX. Shots not recorded, not on tape, etc. are listed in Appendix A.

3) Geometry assignment. Tie points are 1A: SP 1 with CDP 1000; and 1B: SP 913 with CDP 1000. Note that 1B was divided into two pieces on disk and geometry was assigned separately to these pieces. It was discovered after the fact that the geometry on the second piece has a 39 meter error relative to the first piece. SP 3495 was tied to CDP 12310 but should have been tied to CDP 12307. Subtracting 3 from the CDP number on all traces in shots 3493 to the end will fix this problem if that becomes necessary.

4) Checks on the data set performed. Shots with an incorrect number of channels are listed in Appendix B. Shots with a single channel and that were subsequently re-read from the 3480 tapes are listed in Appendix C. No duplicate shot point numbers were found.

5) Up to SP 3492, cable depth and water depth information were imported to the database from trace 0 and assigned to the trace headers. By SP 3493, SIO SEIS tape copy had been modified to include cable depth and water depth information in the SEG-Y trace headers. This step of retrieving the info from a separate trace 0 file was no longer necessary. Note that the following error was made in both SIO SEIS and in the ProMAX import for cable depths: the bird offsets were incorrectly assigned the same offsets as those used on transect 2. The streamer configuration was not exactly the same however. The streamer was well behaved on this line and the bird offsets not significantly different so depth errors of more than a meter are highly unlikely. The error, at least, is consistent between to the two pieces of line 1B, so this could be fixed in a relatively simple way should the need arise.

APPENDIX A: Shots not recorded or did not survive SEG-D to SEG-Y copy.

14	2929 - 2932	4640	5752 - 5753
17	3121	5456	5784 - 5786

Appendix B: Shots without exactly 160 channels.

9: nchan = 142	1991: nchan = 113	5229: nchan = 159
10: nchan = 18	2221: nchan = 125	5754: nchan = 1
34: nchan = 119	2222: nchan = 35	5756: nchan = 1
35: nchan = 41	2326: nchan = 72	5758: nchan = 1
662: nchan = 84	2590: nchan = 118	5760: nchan = 1
663: nchan = 76	2591: nchan = 42	5762: nchan = 1
1630: nchan = 105	3689: nchan = 68	5764: nchan = 1
1631: nchan = 55	3690: nchan = 92	5771: nchan = 67
1655: nchan = 54	3994: nchan = 129	5772: nchan = 93
1656: nchan = 106	3995: nchan = 31	5782: nchan = 62
1988: nchan = 93	3996: nchan = 36	5783: nchan = 98
1989: nchan = 67	4036: nchan = 29	5936: nchan = 117
1990: nchan = 47	4037: nchan = 131	5937: nchan = 43

Appendix C: Shots reread into the data set from 3480 tapes.

5754	5758	5762
5756	5760	5764

SIGMA/EW9607
On-board Data Processing Notes: Transect 3

1) Tape copy.

2) Data read into ProMAX. Shots not recorded, not on tape, etc. are listed in Appendix A.

3) Geometry assignment. The tie point for geometry assignment is SP 100 CDP 1000.

4) Checks on the data set performed. Shots with an incorrect number of channels are listed in Appendix B. Shots with single traces were not found and no data had to be re-read from the 3480 tapes. SP 1909 was on tape 24 times and is the "SLIC data not recieved" error in the general notes. The "extra" shots were numbered sequentially from 1910 - 1932 and 1933 - 1935 are assumed to be missing shots during the streamer rebuild. See general notes section 5.

APPENDIX A: Shots not recorded or did not survive SEG-D to SEG-Y copy.

```
missing shots:  1933   -   1936
missing shots:  2060   -   2062
missing shot:   3081
missing shot:   3126
missing shot:   4541
```

Appendix B: Shots without exactly 160 channels. See general notes about 1909-1932,

shot	975:	nchan = 69		shot	1911:	nchan = 161		shot	1924:	nchan = 161
shot	976:	nchan = 16		shot	1912:	nchan = 161		shot	1925:	nchan = 161
shot	977:	nchan = 75		shot	1913:	nchan = 161		shot	1926:	nchan = 161
shot	1201:	nchan = 100		shot	1914:	nchan = 161		shot	1927:	nchan = 161
shot	1202:	nchan = 60		shot	1915:	nchan = 161		shot	1928:	nchan = 161
shot	1535:	nchan = 137		shot	1916:	nchan = 161		shot	1929:	nchan = 161
shot	1536:	nchan = 23		shot	1917:	nchan = 161		shot	1930:	nchan = 161
shot	1633:	nchan = 110		shot	1918:	nchan = 161		shot	1931:	nchan = 161
shot	1634:	nchan = 50		shot	1919:	nchan = 161		shot	1932:	nchan = 161
shot	1650:	nchan = 100		shot	1920:	nchan = 161		shot	3080:	nchan = 159
shot	1651:	nchan = 60		shot	1921:	nchan = 161		shot	3125:	nchan = 122
shot	1909:	nchan = 161		shot	1922:	nchan = 161		shot	3826:	nchan = 13
shot	1910:	nchan = 161		shot	1923:	nchan = 161		shot	3827:	nchan = 147

SIGMA/EW9607
On-board Data Processing Notes: Transect 4

1) Tape copy.

2) Data read into ProMAX. Shots not recorded, not on tape, etc. are listed in Appendix A.

3) Geometry assignment. The tie point for geometry assignment is SP 100 CDP 1000.

4) Checks on the data set performed. Shots with an incorrect number of channels are listed in Appendix B. Shots with single traces were not found and no data had to be re-read from the 3480 tapes.

APPENDIX A: Shots not recorded or did not survive SEG-D to SEG-Y copy.

1107 - 1110	5846
3667	8305 - 8306

Appendix B: Shots without exactly 160 channels.

```
shot  1104: nchan =  31
shot  2007: nchan = 156
shot  2507: nchan = 107
shot  2509: nchan =  38
shot  2510: nchan =  45
shot  2798: nchan = 159
shot  5335: nchan = 130
shot  9088: nchan =  31
shot  9089: nchan = 103
```

Over view of header info locations in ProMAX.
Note that ProMAX andSioseis use opposite locations for shot number and file number, and cable depths are stored in different locations (cable depth (ProMAX) vs. Cable elevation (Sioseis).

Bytes	Description
1 - 4	Trace sequence number within line. Internal reference number for ProMAX.
5 - 8	Trace sequence number on reel -- assigned on output while tape is being made
9 - 12	File number from original field tape (3480)
13 - 16	Channel number
17 - 20	Shot point number
21 - 24	CDP number
25 - 28	Trace sequence number with in CDP ensemble
29 - 30	Trace id code
31 - 32	*ignored*
33 - 34	Fold of data (for stacked data only)
35 - 36	*ignored*
37 - 40	Source-receiver offset
41 - 44	*ignored*
45 - 48	*ignored*
49 - 52	Depth of source array
53 - 56	Depth of receiver (interpolated from cable depths in trace 0)
57 - 60	*ignored*
61 - 64	Water depth at source (also in bytes 213 - 216)
65 - 68	*ignored*
69 - 70	Scalar for bytes 41-68 -- computed on output
71 - 72	Scalar for bytes 73-88 -- computed on output
73 - 76	X coordinate of source
77 - 80	Y coordinate of source (=0)
81 - 84	X coordinate of receiver
85 - 88	Y cooridinate of receiver
89 - 90	Coordinate units (should 1 - length in meters)
91 - 92	*ignored*
93 - 94	*ignored*
95 - 96	*ignored*
97 - 98	*ignored*
99 - 100	Source static correction
101 - 102	Receiver static correction
103 - 104	Total static applied
105 - 106	*ignored*
107 - 108	*ignored*
109 - 110	*ignored*
111 - 112	*ignored*
113 - 114	*ignored*
115 - 116	Number of samples this trace
117 - 118	Sample interval this trace
119 - 120	*ignored*
121 - 122	*ignored*
123 - 124	*ignored*
125 - 126	*ignored*
127 - 128	*ignored*
129 - 130	*ignored*
131 - 132	*ignored*
133 - 134	*ignored*
135 - 136	*ignored*
137 - 138	*ignored*
139 - 140	*ignored*
141 - 142	Alias filter frequency -- output from database if it exists
143 - 144	Alias filter slope -- output from database if it exists
145 - 146	Notch filter frequency -- output from database if it exists

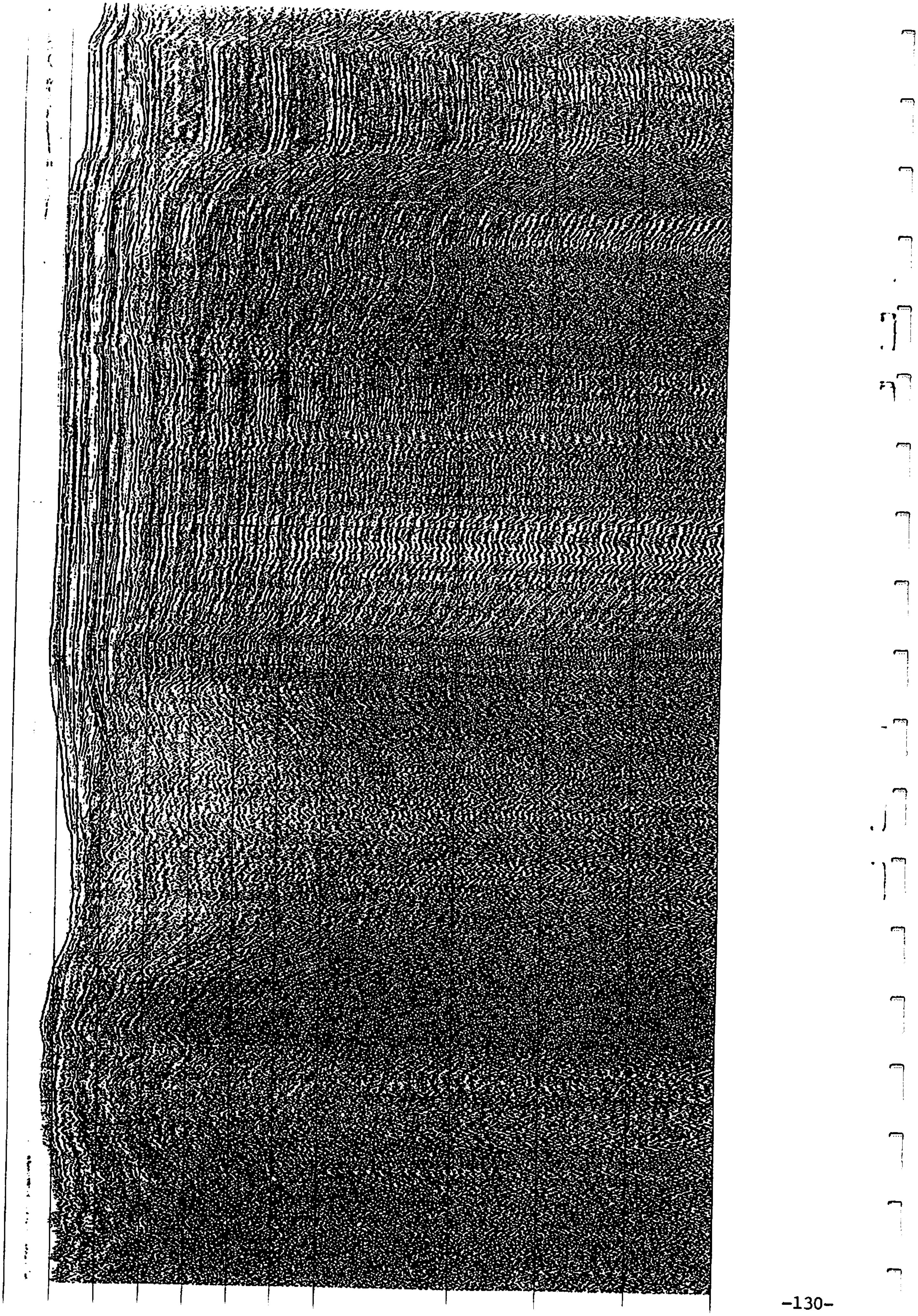
147 - 148	Notch filter slope -- output from database if it exists
149 - 150	Low cut frequency -- output from database if it exists
151 - 152	High cut frequency -- output from database if it exists
153 - 154	Low cut slope -- output from database if it exists
155 - 156	High cut slope -- output from database if it exists
157 - 158	Year recorded
159 - 160	Day of year recorded
161 - 162	Hour of day recorded
163 - 164	Minute of hour recorded
165 - 166	Second of minute recorded
167 - 168	*ignored*
169 - 170	Trace weighting factor (for integer formats)
171 - 172	*ignored*
173 - 174	*ignored*
175 - 176	*ignored*
177 - 178	*ignored*
179 - 180	*ignored*
181 - 184	*ignored*
185 - 188	*ignored*
189 - 192	*ignored*
193 - 196	*ignored*
197 - 200	*ignored*
201 - 204	*ignored*
205 - 208	*ignored*
209 - 212	*ignored*
213 - 216	Hydrosweep center beam depth at shot point location
217 - 220	*ignored*
221 - 224	*ignored*
225 - 228	*ignored*
229 - 232	*ignored*
233 - 236	*ignored*
237 - 240	*ignored*

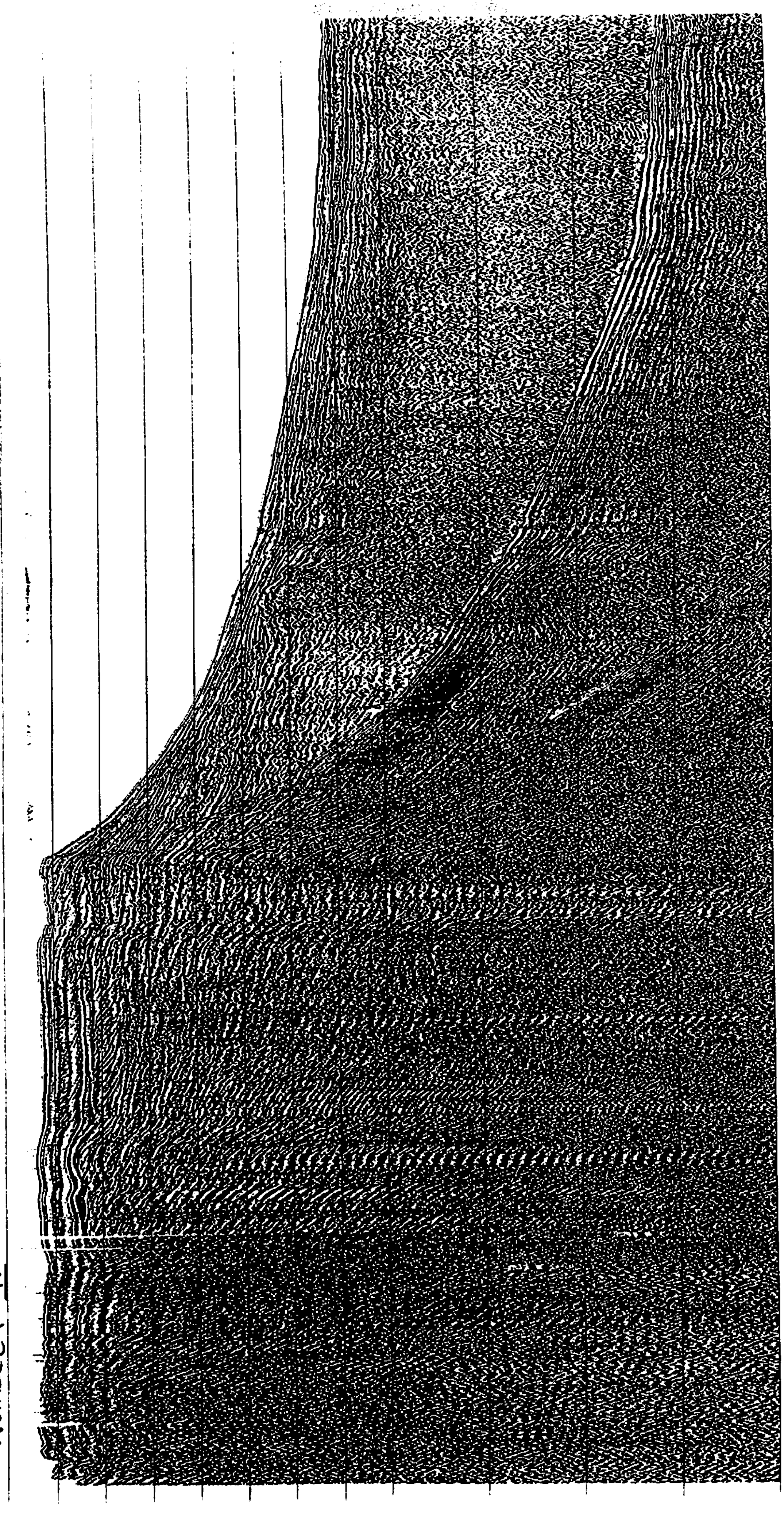
Over view of header info locations in ProMAX.
Note that ProMAX andSioseis use opposite locations for shot number and file number, and cable depths are stored in different locations (cable depth (ProMAX) vs. Cable elevation (Sioseis).

Bytes	Description
1 - 4	Trace sequence number within line. Internal reference number for ProMAX.
5 - 8	Trace sequence number on reel -- assigned on output while tape is being made
9 - 12	File number from original field tape (3480)
13 - 16	Channel number
17 - 20	Shot point number
21 - 24	CDP number
25 - 28	Trace sequence number with in CDP ensemble
29 - 30	Trace id code
31 - 32	*ignored*
33 - 34	Fold of data (for stacked data only)
35 - 36	*ignored*
37 - 40	Source-receiver offset
41 - 44	*ignored*
45 - 48	*ignored*
49 - 52	Depth of source array
53 - 56	Depth of receiver (interpolated from cable depths in trace 0)
57 - 60	*ignored*
61 - 64	Water depth at source (also in bytes 213 - 216)
65 - 68	*ignored*
69 - 70	Scalar for bytes 41-68 -- computed on output
71 - 72	Scalar for bytes 73-88 -- computed on output
73 - 76	X coordinate of source
77 - 80	Y coordinate of source (=0)
81 - 84	X coordinate of receiver
85 - 88	Y cooridinate of receiver
89 - 90	Coordinate units (should 1 - length in meters)
91 - 92	*ignored*
93 - 94	*ignored*
95 - 96	*ignored*
97 - 98	*ignored*
99 - 100	Source static correction
101 - 102	Receiver static correction
103 - 104	Total static applied
105 - 106	*ignored*
107 - 108	*ignored*
109 - 110	*ignored*
111 - 112	*ignored*
113 - 114	*ignored*
115 - 116	Number of samples this trace
117 - 118	Sample interval this trace
119 - 120	*ignored*
121 - 122	*ignored*
123 - 124	*ignored*
125 - 126	*ignored*
127 - 128	*ignored*
129 - 130	*ignored*
131 - 132	*ignored*
133 - 134	*ignored*
135 - 136	*ignored*
137 - 138	*ignored*
139 - 140	*ignored*
141 - 142	Alias filter frequency -- output from database if it exists
143 - 144	Alias filter slope -- output from database if it exists
145 - 146	Notch filter frequency -- output from database if it exists

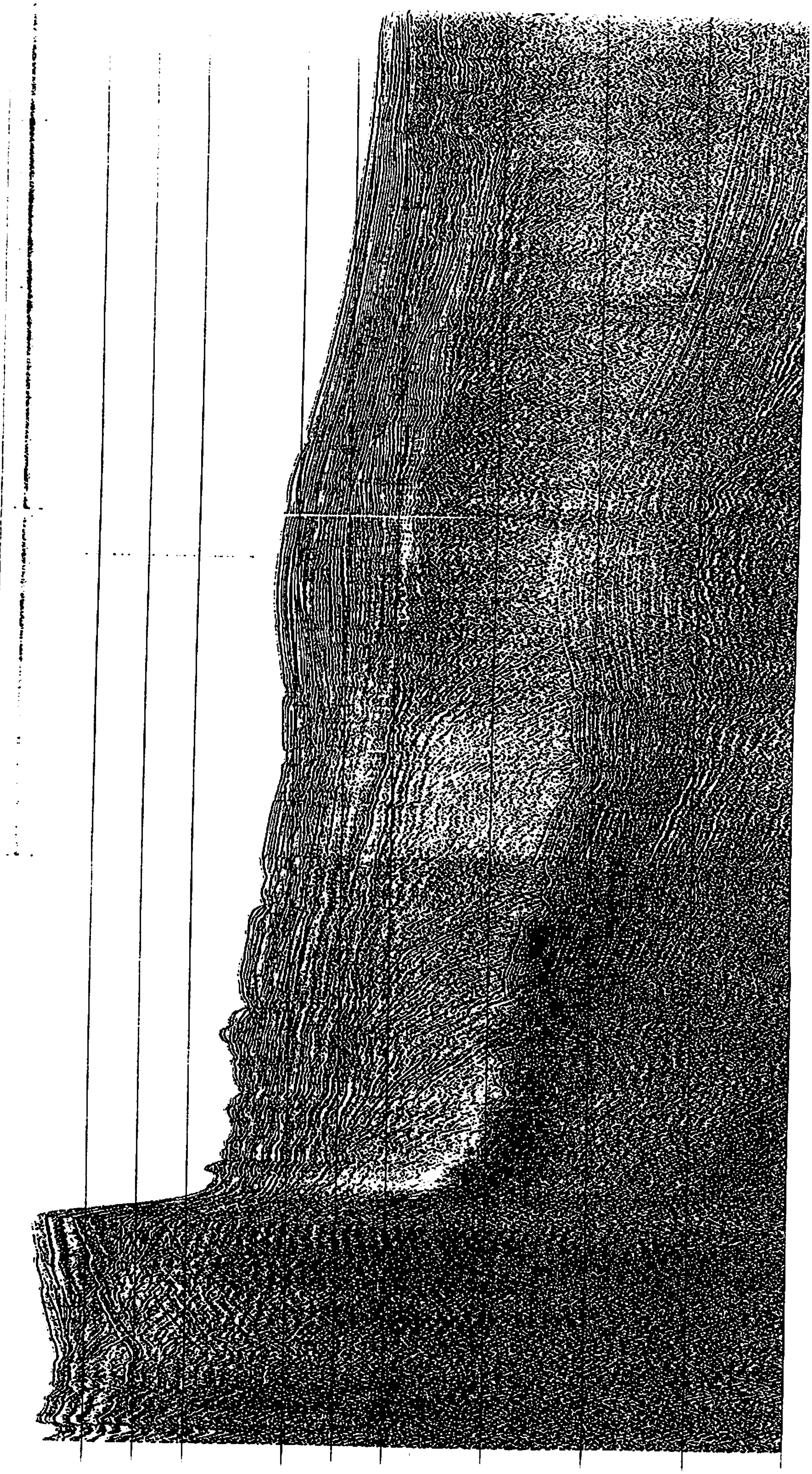
147 - 148	Notch filter slope -- output from database if it exists
149 - 150	Low cut frequency -- output from database if it exists
151 - 152	High cut frequency -- output from database if it exists
153 - 154	Low cut slope -- output from database if it exists
155 - 156	High cut slope -- output from database if it exists
157 - 158	Year recorded
159 - 160	Day of year recorded
161 - 162	Hour of day recorded
163 - 164	Minute of hour recorded
165 - 166	Second of minute recorded
167 - 168	*ignored*
169 - 170	Trace weighting factor (for integer formats)
171 - 172	*ignored*
173 - 174	*ignored*
175 - 176	*ignored*
177 - 178	*ignored*
179 - 180	*ignored*
181 - 184	*ignored*
185 - 188	*ignored*
189 - 192	*ignored*
193 - 196	*ignored*
197 - 200	*ignored*
201 - 204	*ignored*
205 - 208	*ignored*
209 - 212	*ignored*
213 - 216	Hydrosweep center beam depth at shot point location
217 - 220	*ignored*
221 - 224	*ignored*
225 - 228	*ignored*
229 - 232	*ignored*
233 - 236	*ignored*
237 - 240	*ignored*

Transect I



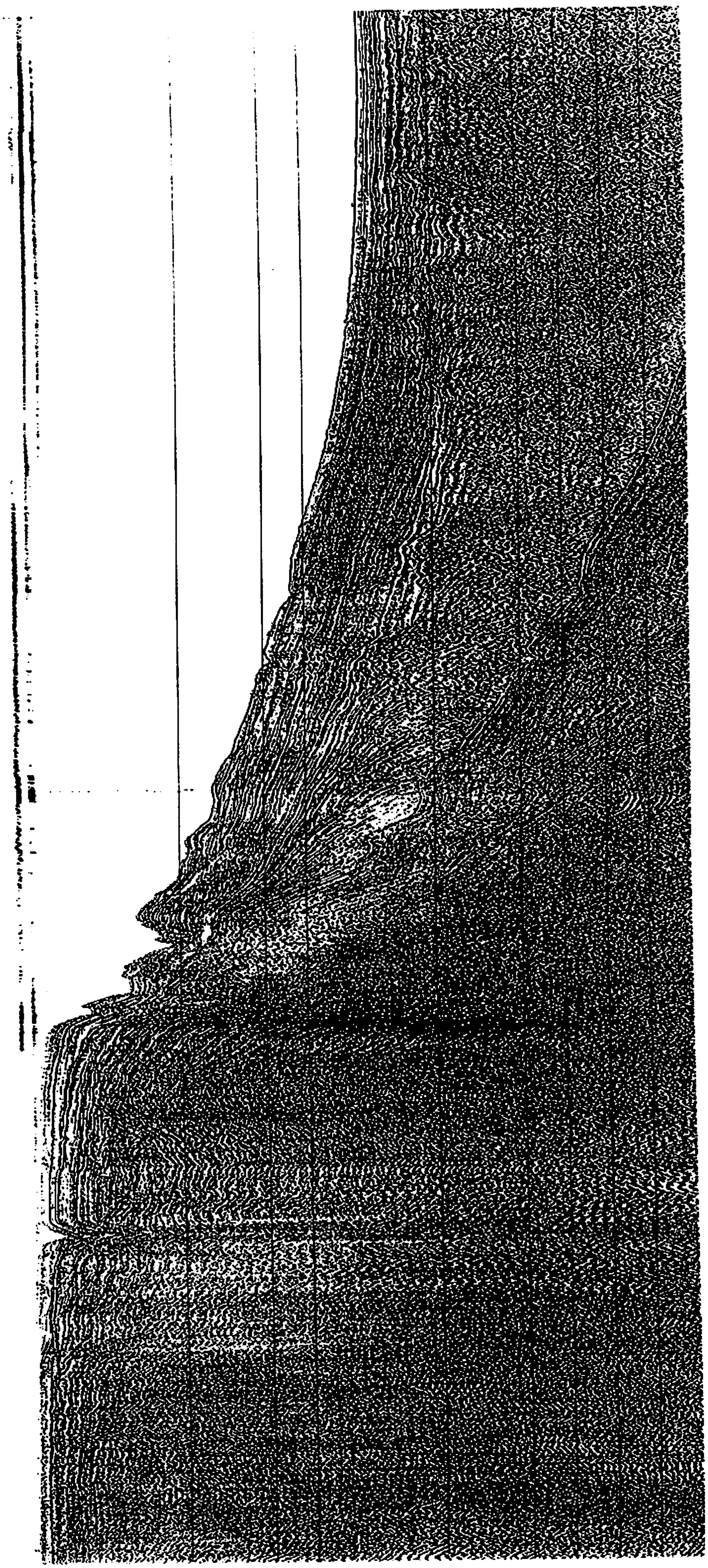


Transect II

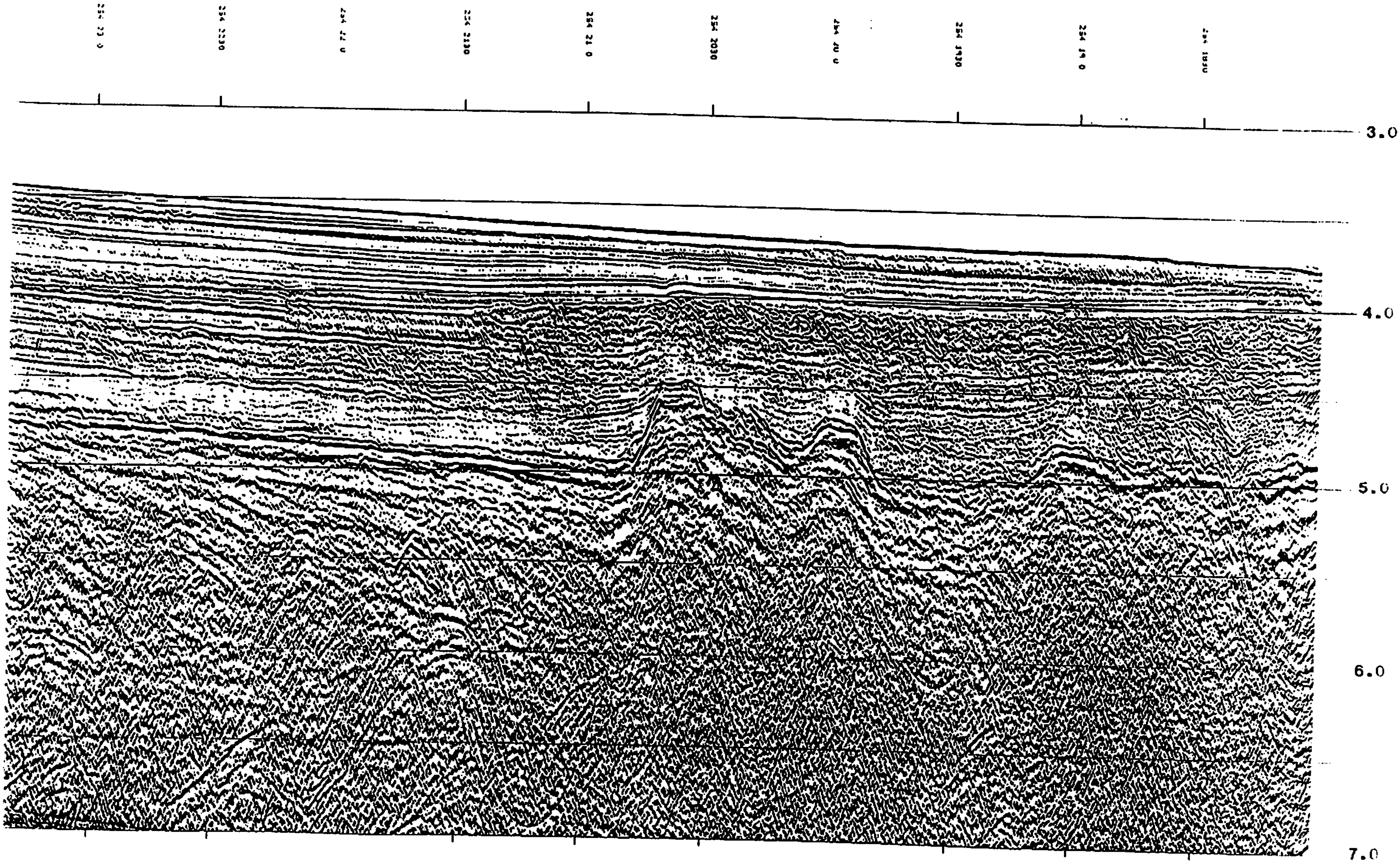


Transect III

Transect IV



Seaward end of Transect III. Restacked and migrated.



Appendix 4: OBH Data Processing

This section contains three parts. In the first, we summarize the data processing sequence used to create final archive SEGY data for OBH data, including instrument repositioning. Steps 7 through 13 of this procedure were also applied to OBS data.

The second section lists modifications made to the obh_to_segy processing flow.

The third section shows four examples of OBH record sections: two from OBH 27 on Transect II (one for the shoot at 21 s interval and one for the shoot at 70 s interval), and two from OBH 23 on Transect III (one for the shoot at 21 s interval and one for the shoot at 50 s interval). The record sections show clear refractions and reflections from the middle and deep crust. In addition, the examples clearly demonstrate the reduction in ambient noise and the elimination of several bands of previous shot noise during the reshoots at greater shot intervals. The longer shot interval is more important for the deep OBH than for the shallow OBH.

Wide Angle Data
Processing Procedure
EW9607

1) Run **offld6** on PC. May require multiple runs if error tracks are present.

offld6 -s 1 -e 175 -m K:\SIGMA1\OBH20/OBH20S1.RAW

2) Run **obh_rec_hdrs** on whole or partial image files and print output.

obh_rec_hdrs obh20s1.raw obh20s1.hdrs 1 175

3) Archive data to 8mm tape. Run 'dd' on jade to mirroring tape drive.

dd if=obh20s1.raw of=/dev/rst1 bs=1015808

4) Create list of instrument #s and shot number at nearest approach from the watchstander's log.

5) Construct shot files for the line from processed day files. Trim shot files to near approach shot files for each instrument which will contain only the 100 or so shots closest to the instrument using the shot number from the list of closest approach shots.

6) Run **obh_to_segy** to create a small SEGY format file that can be used to pick the traveltime of the shot at closest approach. Start_record and end_record can include all datafiles. Start offset (soffset) in seconds from receiver book predeployment clock check. Start_time from receiver book time of predeployment clock check ("OBH time"). End offset (eoffset) in seconds from receiver book postrecovery clock check. End_time from receiver book time of postrecovery clock check ("OBH time"). Create receiver location file with deployment lat. and long. and instrument depth (not water depth). Remember, this file requires a specific format. Single digit minutes of position must be padded with zeros to two digits, degrees of longitude must be padded to three digits, and instrument depth must be padded to five digits. Reduction velocity will be 0.0km/s. Time_shift for this cruise is a static shift of 0.0s. Use the above parameters in addition to filenames of raw input data and output drift-corrected SEGY format data to create the obh_to_segy parameter file.

7) Run **pltsegy** on drift-corrected SEGY format files from OBHs and hydrophone channel of OBSs. Plots will show approximately 100 equispaced traces with no reduction velocity applied.

8) Pick traveltime of closest approach shot to nearest sample.

9) Select reference shot along line and get position (degrees, minutes) from shot file.

10) Create input file for repositioning program, **reposition**. Instrument ID, instrument deployment depth, traveltime (seconds) of closest approach shot, shot number and position of closest approach shot and reference shot.

11) Run **reposition** program and write standard output to disk file.

reposition < repos.in > repos.out

The standard output file contains a new OBH position in decimal degrees. A more useful output file 'new_positions.dat' written by the program contains the same new OBH position written in degrees and minutes.

12) The adjusted instrument position goes into a table for the cruise report and is used in a new receiver location file to create a SEGY format file that is suitable for archiving and contains adjusted instrument location and shot slant ranges in the headers. For the OBHs and OBSs, these final SEGY files should be reduced with the same reduction velocity; typically 8.0 km/s.

13) For plotting and other purposes, the SEGY files are often required to have monotonically increasing ranges. The ranges in SEGY headers were edited by the program **segy_edit** such that shots to the west of each instrument have negative ranges (while shots to the east of each instrument retain positive ranges).

Modifications to Shipboard *obh_to_segy* Procedure

During EW9601, the New Zealand OBH experiment, some flaws in our OBH processing scheme came to light which we attempted to rectify with modifications implemented on EW9607. In terms of the *obh_to_segy* code, it was recommended that a clock drift correction be implemented to adjust the individual trace start times to account for the instrument clock drift relative to GPS time. The instruments clock is measured against GPS time both before and after each deployment and a linear clock drift rate can be calculated from the before and after clock offsets measured and logged in the receiver books. This assumed linear drift rate is then applied to the data in the following way:

1. Start and end clock offsets and their corresponding times are supplied as input parameters to the program *obh_to_segy*

2. A linear drift rate is calculated using the following relationship

drift_rate = (end_offset - start_offset) / (end_time - start_time)

3. This drift rate is used to adjust the individual trace start times to GPS time by an amount equal to:

correction = [drift_rate * (shot_time - start_time)] + start_offset

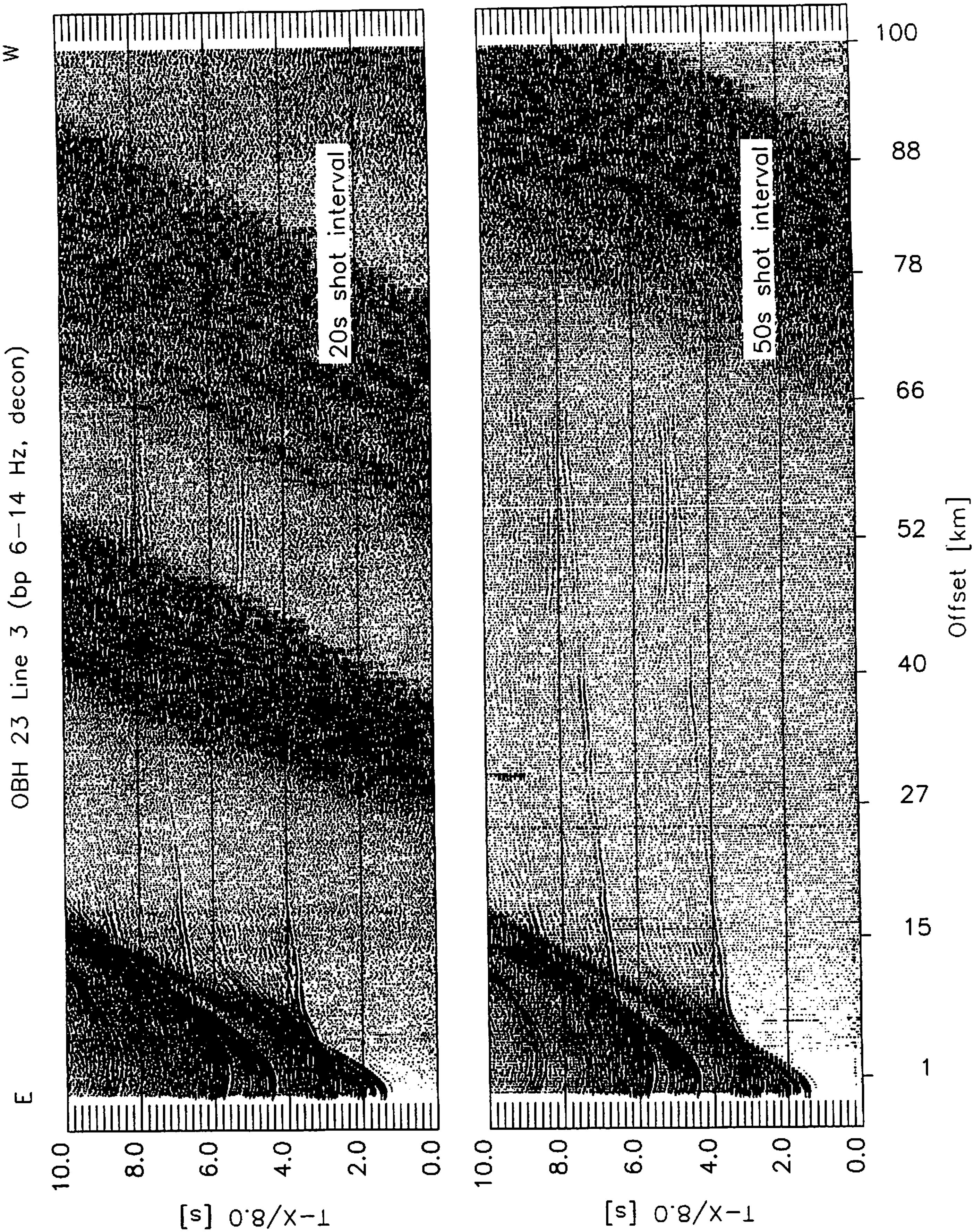
This adjustment is made such that if the OBH clock is gaining time relative to GPS, i.e., its clock is running faster than GPS, the correction is subtracted (negative), and if the OBH clock is losing time to GPS, the correction is added (positive). Note that the starting offset value is automatically incorporated into the drift rate correction.

Theexample parameter file shown below contains an entry of 11.0 seconds for the **time_shift** parameter. This was necessary on the New Zealand cruise, EW9601, because the OBH clocks were set to GPS time instead of UTC time, the Ewing's standard time reference, and there is an 11.0 second differential between the two time reference systems. For EW9607, the OBH time reference was UTC.

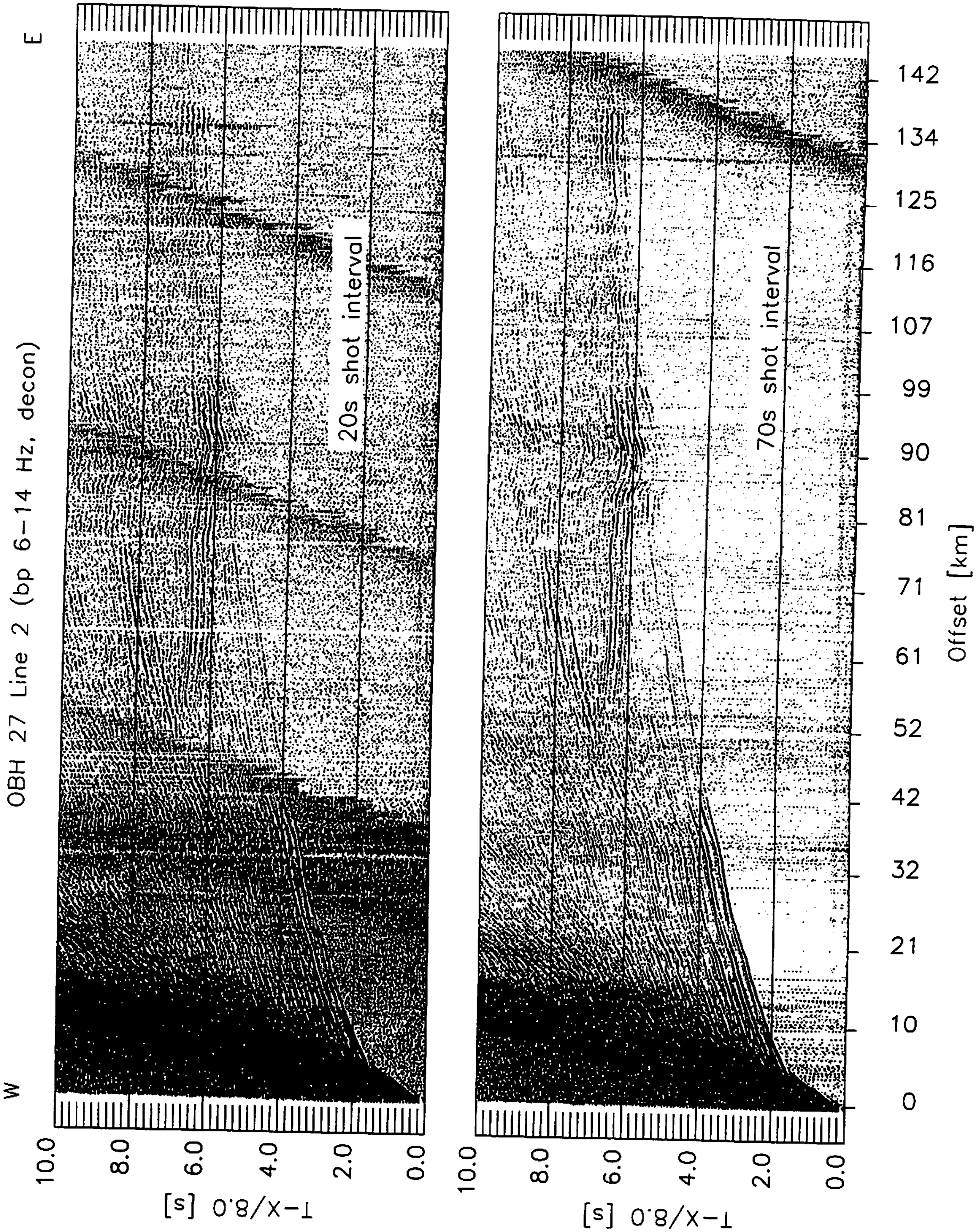
The addition of four new input parameters to the eight already in use required that an input parameter file be used instead of the heretofore command-line parameter approach. The following is an example of a parameter file used with the newer version of the *obh_to_segy* code:

```
/*
/*
/* start_record       = first 1MB record of raw data to use as input     (int)
/* end_record         = last...                                          (int)
/* soffset            = start time OFFSET in seconds                     (float)
/* start_time         = TIME of starting offset measurement              [yy+ddd:hh:mm:ss]
/* eoffset            = ending time OFFSET in seconds                    (float)
/* end_time           = TIME of ending offset measurement                [yy+ddd:hh:mm:ss]
/* times_fname        = name of shottimes file (ewing standard format)   (char)
/* in_fname           = name of raw OBH input data file                  (char)
/* segy_fname         = name of SEG-Y output file                        (char)
/* receiver_fname     = name of receiver location file                   (char)
/* vel_red            = reduction velocity in km/sec; 0.0=none           (float)
/* time_shift         = static time shift in seconds                     (float)
```

```
/*
/*
start_record        = 1
end_record          = 200
soffset             = -0.010615
start_time          = 96+053:23:44:06
eoffset             = 0.033618
end_time            = 96+065:05:43:33
times_fname         = /alpamayo0/nz/NZ1/line_1e.shots
in_fname            = /alpamayo0/nz/east/obh16/obh16e1.raw
segy_fname          = /alpamayo0/nz/east/obh16/obh16e1.sgy
receiver_fname      = /alpamayo0/nz/east/nav/obh16.receiver
vel_red             = 8.0
time_shift          = 11.0
```



OBH 23 Line 3 (bp 6–14 Hz, decon)
W
E
20s shot interval
50s shot interval
T−X/8.0 [s]
T−X/8.0 [s]
10.0
8.0
6.0
4.0
2.0
0.0
Offset [km]
100
88
78
66
52
40
27
15
1


OBH 27 Line 2 (bp 6–14 Hz, decon)
W
E
20s shot interval
70s shot interval
T−X/8.0 [s]
10.0
8.0
6.0
4.0
2.0
0.0
Offset [km]
0
10
21
32
42
52
61
71
81
90
99
107
116
125
134
142

Appendix 5: OBS Data Processing and Examples

This section contains three parts. The first is a summary of the data processing sequence used to create SEGY data for USGS OBS data. Steps for instrument repositioning can be found in Appendix 4.

The second section is a summary of USGS OBS data quality.

The third section shows four examples of OBS record sections: two from OBS A8 on Transect II (one for the shoot at 21 s interval and one for the shoot at 70 s interval), and two from OBS C1 on Transect III (one for the shoot at 21 s interval and one for the shoot at 50 s interval). The record sections show clear refractions and reflections from the middle and deep crust. In addition, the examples clearly demonstrate the reduction in ambient noise and the elimination of several bands of previous shot noise during the reshoots at greater shot intervals. As we saw for the OBH data in Appendix 4, the longer shot interval yields a much more marked improvement for the deep OBS than for the shallow OBS.

USGS OBS Data Processing Sequence

The USGS OBS data processing software runs on a PC using Windows95. The present machine is a 166 Mhz. Pentium with 16 Mbytes RAM, 9 GBytes of disk and an Exabyte 8505 8mm tape drive. The USGS software was written by Greg Miller (gmiller@obs.er.usgs.gov).

The software was enhanced prior to the SIGMA cruise to automatically apply clock corrections and, if desired, apply a reduction velocity. The SEGY trace header now has a few more entries and the user defined portion (bytes 180-240) has been modified to conform with IRIS PASSCAL conventions. Additional detailed information regarding the file format and header value calculation is available in a RFC "Time Labels for Segy Traces: Application to Wide Angle Refraction".

As with most newly released software, we found a few bugs;
1) A rounding error causes the first sample time to occasionally be off by 1 millisecond, causing a discrepency in the value of delay =(shot_time - first_sample_time).
2) The use of signed offsets causes the reduction velocity to advance the window delay rather than delay it. As a result **we did not sign the offsets in the SEGY volumes.**
3) The clock corrections written into total_static do not include the beginnng shift. To correct this, the value of Bshift (in the deployment table) should be added to the value of total_static. Note that the clock correction APPLIED to the traces DOES include the beginning shift. Thus total_static is the only inaccuracy. We use total_static to accumulate all time label shifts applied to the trace. To return the trace time labels to the original instrument labels subtract total_static from the first sample time.

Data Processing Summary:
Data processing consists of six steps;
1) Upload the raw data files from the dataloggger.
2) Construct the receiver table. This includes the OBS positions and the OBS clock corrections for a single deployment of a group of OBS. These files have the extension .pos.
3) Construct the shot file. This is a file listing each shot, one per line, including the shot number, shot latitude and longitude and the time of the shot. Each file contains all shots for a single line.
4) Construct the source table. A program combines the shot file and receiver table to produce a source file containing the trace header values for Source-Receiver distance (options include signed offsets).
5) Build the SEGY Reel files using the USGS program OBS2SEGY. This program requests a raw file, a receiver table, and a source file as well as a template file to build the EBCDIC header. Trace files are time corrected and a reduction velocity is applied if desired.
6) Archive the raw and SEGY files to tape using a DOS program that writes UNIX compatible tar files.

In the SIGMA experiment, the OBS positions were relocated using the arrival times and shot locations of the nearest shots. This required producing a source file using the deployment position for the OBS. The 100 nearest shots were cut and pasted to a new file. SEGY files of just these 100 traces were made, the new positions calculated and the receiver table revised. The final SEGY files used the revised tables.

Raw Data Files:
The USGS Ocean Bottom Seismometer system uses a Tattletale 6 datalogger manufactured by Onset Computer. The data is a continuous record of 1 to 4 channels that begins at a programmed time and continues until acquisition is terminated. Data is written to an IDE disk in 1 Megabyte tracks that includes a header with time labels and some associated channel information followed by data samples. The raw data is transferred from the datalogger's IDE disk to a PC by connecting the disk directly to a special IDE bus card provided by Onset and using the Onset program offld6.

Typical transfer rate is about 5 minutes for 300 Mbytes. The raw file is checked for readability using a USGS program OBS2SEGY, raw header test, because occasionally tracks are garbled in the transfer and must be manually retransmitted.

Receiver Table:
A text editor is used to create a tab separated table containing the OBS number, the datalogger serial number, the latitude and longitude, depth, and the time referenced to UTC before and after deployment. Lines without tabs are ignored. All OBS in a single deployment are entered in the same table. This table is often called a deployment table as well. A special data entry program is available to correctly format the output but this was not used.

The timekeeping of the datalogger is compared to a GPS clock before and after deployment so that time labels for the data can be corrected to a UTC time reference. A simple linear fit is assumed between the two reference points. The time of the measurement and difference from UTC is entered in the OBS .pos table as Bshift or Eshift (in milliseconds). The sign of the shift is defined as (UTC-Datalogger) = shift. This means corrections should be added to the OBS time to yield a trace time-corrected to UTC. The processing software corrects the 1 Mbyte track headers to UTC time rather than each shot time. The amount of correction applied to each trace is stored in the SEGY trace header under total_static as a signed integer (in milliseconds). To undo our corrections, subtract the total_static from the trace start time.

Shot File:
The R/V Ewing acquisition system automatically logs the shot instant. The MCS processing team patches together a list of shots to define a line; removing loops, reshoots, and end of line turns. The Ewing format shot file is rearranged slightly using an awk script to sign the lat and long and change a plus sign between the day number and time into a space. The file is then ftp'd to the OBS computer. It is usually given the extension .nvd.

Source File:
The USGS program NAVD converts the receiver table and shot file into a source file (extension .src) with a single line for each shot (or trace) containing values to be inserted into the trace header. It is a simple tab separated text table. The ability for a human to read this table and therefore check what has been put into the binary trace headers is useful for debugging sessions. This file can also be processed to build updates to SEGY files or generate other database entry formats. The program NAVD plots the shot points and the OBS locations in map view to insure all the geometry has been entered correctly.

Building SEGY files:
The program OBS2SEGY uses the source file to select portions of the raw file and convert them into segy format trace files. These trace files are concatenated together into a SEGY reel file. This reel file begins with an EBCDIC header (3200 bytes) and a binary block (400 bytes), which describe the format of the trace files. In our case, the reel file contains SEGY traces for a single channel of one OBS for one entire line.

The program requests a source file, a raw file, and a receiver table and produces a time-corrected, reduced SEGY Reel file for each OBS channel. The program also uses a small text file (.hdr) to fill in the EBCDIC header with experiment information and to choose the trace length and reduction velocity. This header file is usually the same for all OBS in a line. The output files are specified as, for example, "L2A3" (for Line 2 OBS A3) which produces files named L2A3_h1.sgy, L2A3_h2.sgy, L2A3_hy.sgy and L2A3_vt.sgy corresponding to the two horizontals, the hydrophone and the vertical channels of the OBS.

Archive the Data:
Data is written to Exabyte tape using an 8505 (high density) compressing drive and a DOS tar

program from Polytape, version 4.21. The tar files are readable with a UNIX machine. The program translates some filename characters automatically. All upper case a reverted to lower case, backslashes are converted to forward slashes. DOS treats binary files differently than text and a special option (-u) is used to identify the extension of binary files. To create a volume, type;
>tar -cvu sgy *.sgy
A tar volume of the raw files and a volume for the SEGY files is provided to the Chief Scientist usually within 36 hours of recovery. The USGS also retains a copy of these volumes.

Standard filenaming for various file types:

a3d4.raw	A raw file uploaded from OBS A3 after deployment 4
a3d4.log	A text capture of programming sequence for OBS A3 before deployment 4
L10.nvd	Ship navigation file for line 10, three character limit for Line ID
D4.pos	Deployment table for deployment 4, contains all OBS positions and clock info
L10.tmp	Temporary file created from L10.nvd by NAVD
L10a3.src	Output file of NAVD which includes trace header values for Source-Receiver distance, shot number, location, line number.
L10.hdr	The EBCDIC header used in the SEGY reel file
L10A3_vt.sgy	The SEGY reel file for OBS A3, vertical channel for line L10.

USGS OBS Data Quality Summary:

Channel quality is indicated in the table below with a single character grade for each channel for each deployment. Most of the record sections are of exceptional quality; see the data plots in the cruise report. This report focuses on any technical problems. An unusually large number of bad channels (16 out of 120) occurred in this experiment, especially in the last deployment. Still, four of the 9 dataloggers had no bad channels throughout. For the most part the bad channels were the result of three problems;

1. Datalogger resets prior to start of recording, 8 channels. These occur rarely enough, twice in 30 drops, that it is hard to pin down the cause. After the first occurrence in deployment 1, all dataloggers were programmed in the spheres to minimize any chance of disturbance. The next occurrence on C3 in deployment 4 did not involve anything unusual. Dataloggers also hung up during recovery and are a related problem, just occurring after the data has already been recorded. Including these cases raises some suspicion the problem may be a intermittent power connection on 2 or 3 dataloggers.

2. The vertical geophone wires breaking off the chassis connectors inside the geophone pack, 2 channels. The wires broke twice on A8 and 3 times on C9. The first case for both was between deployment 2 and deployment 3 while strapped to the deck in rough weather. After fixing, both worked for deployment 3. Prior to deployment 4 C9 was found again to have a broken wire while on deck. This was fixed in predeployment tests. Upon recovery both A8 and C9 were found to have had broken wires during recording. This must have occurred on deck before launch or during descent.

3. Problem with C9 hydrophone channel, 3 channels. An unresolved problem for which I thought I had found a simple fix the first time, (i.e., a pulled EO cable), and made some electronics changes in the second attempt that also didn't do it.

The other bad channels are a horizontal on A8 (2 channels) which I did not place much priority on fixing, a pulled EO cable (1 channel, A8 hydro) and two mysterious ones for which no cause was found and which did not reappear.

Table 1. Quality of each OBS channel in each deployment. Channels are listed in the order; 1=vertical, 2=horizontal_1, 3=horizontal_2, 4=hydrophone and the quality is indicated by; A=excellent, B=good, C=noisy, D=corrupted signal and F=failed to be recorded. # indicates the channel has not been reviewed for quality.

OBS Sphere	Deploy_1 Sigma 2	Deploy_2 Sigma 1	Deploy_3 Sigma 3	Deploy_4 Sigma 4
A1	BBCA	AAAA	BCCB	ABBA
A4	ACBB	ABBA	BBBB	ABBA
A3	BCBB	AAAA	BCBB	ABBA
A8	BBAA	ABBD	BADB	FCDF
C1	FFFF		ABBA	
C3	BBBB*	BBBB*	ABBF	FFFF
C4	AABA	BBBA	ABBB	ABBA
C9	ABBA	ABBD	BBBD	DBBD

Description of Bad Channels:

Deployment 1;

*C3 has parts of traces repeated. A section of about ten traces has portions of the same trace inserted early in the trace. This same section of ten traces repeats the behavior every track, or equivalently every 60 traces. The record section is still usable for some purposes as phases can still be seen clearly across bad portions. C1 failed to record any tracks. Suspect the datalogger was somehow reset during installation into sphere.

Deployment 2;

C3 has same problem as in deploy1, subsequent deployments used the spare datalogger (380) in this sphere.
A8 hydrophone shows peaks only. Loose connection?
C9 hydrophone shows peaks only, found loose EO cable. Thought that was it but turns out not so.

Deployment 3;

C9 hydrophone has same problem, looks ok in deck tests. Changed preamplifier.
C3 hydrophone did not record any signals. No reason found for this in pre or post deploy tests, that is analog signals ok.
A8 horizontal2 very weak. Known at deployment. Problem appeared when preamps removed to fix vertical geophone. Several quick attempts to find problem fruitless.

A1 has bands of traces where no signal is clear. This could be from the plotting program if there a portions of data containing spikes thereby throwing off the trace scaling. Not evident in later processing reviews.

Deployment 4;

C3 did not record any tracks. Suspect datalogger reset prior to start of recording. Datalogger was programmed in sphere on OBS power. Launch was smooth.
C9 hydrophone shows peaks only. Appears that only the low-gain signal is properly digitized?
C9 vertical has low signal levels, probably wire broken inside geophone pack again.
A8 has no signal on hydrophone. EO cable found partially unplugged when recovered but must have happened on deployment. Works when plugged in.
A8 vertical has no signal, probably wires broken inside geophone pack-second time.
A8 horizontal 2 still has no signal, since deploy2.
A4 time labels seem to be too early by 290 msecs at nearest offsets, add 290 msec to trace time to correct it. No reason is known for this timing discrepency.

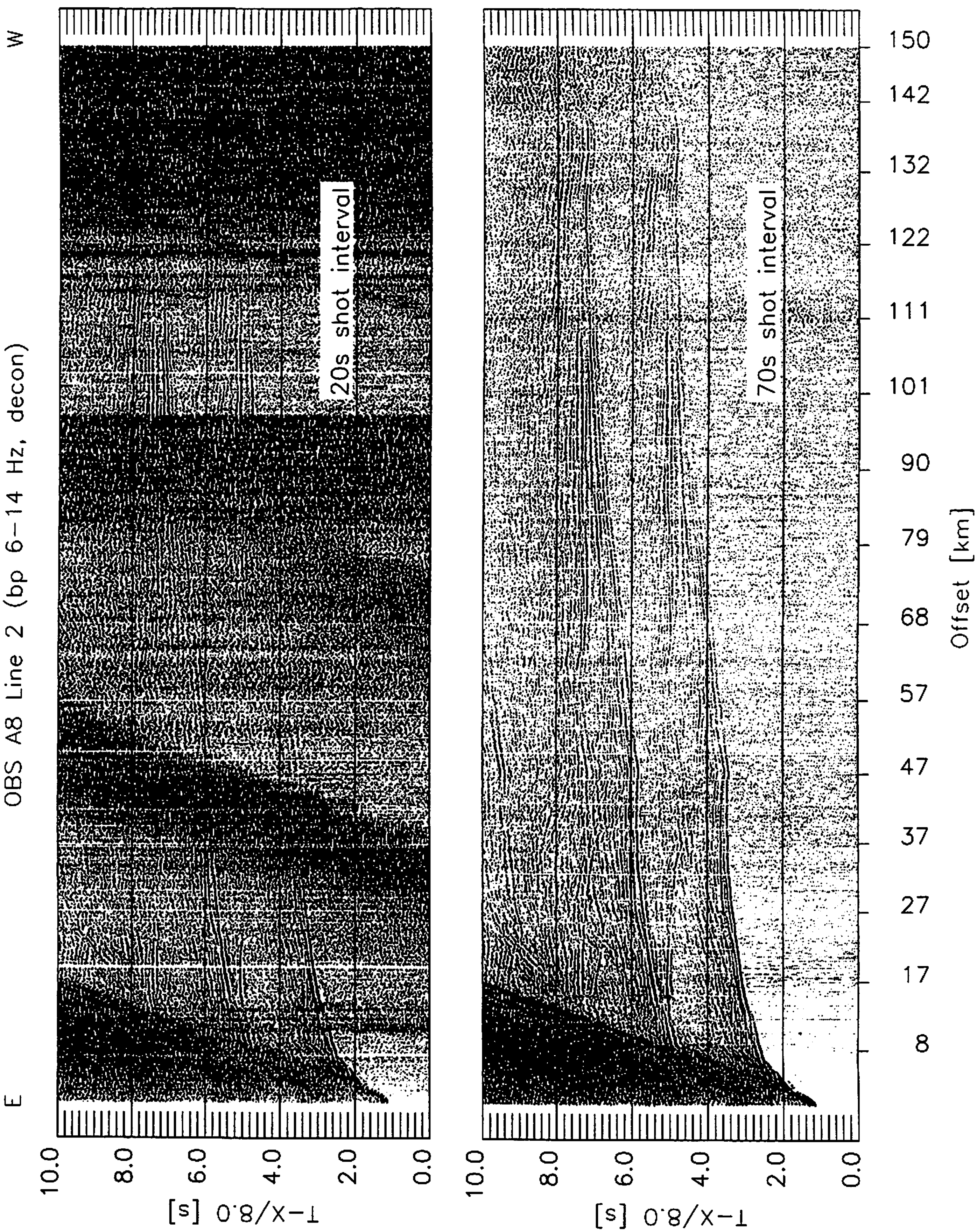
The time was lost on recovery or the datalogger was reset before start of recording on the following instruments:

Deployment	Reset	Lost time
D1	C1	A4, C3
D3		C9, C3*
D4	C3*	A4

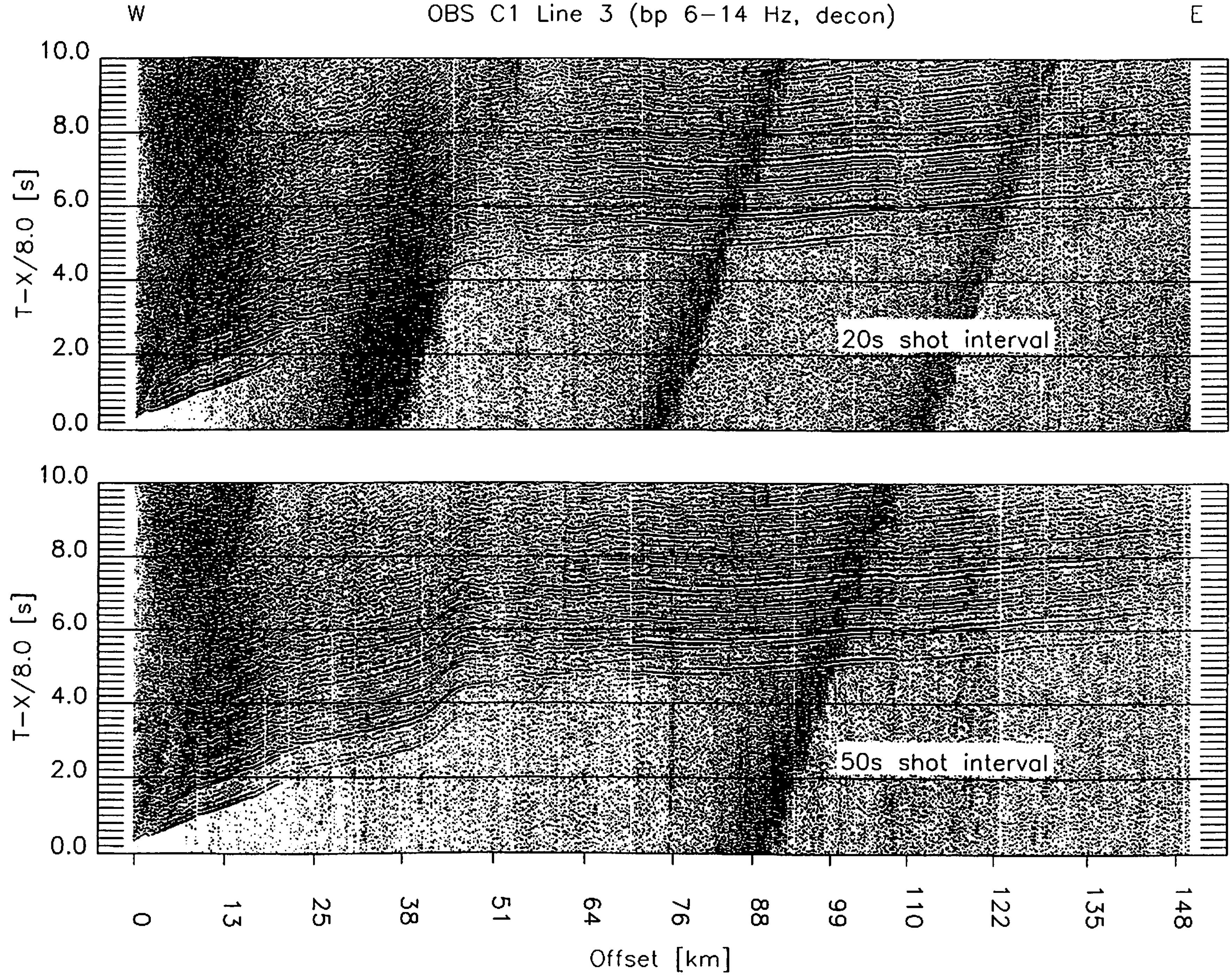
*indicates C3 was using spare datalogger 380.

Comparing the 30 drops in Greenland with previous experiments, we lost time on 2 of 19 drops in New Zealand and once in 36 drops in Oregon. C1 reset once in Oregon. There were no resets in New Zealand..

Lost time is often the result of a bang against the hull when recovering the OBS and there was more of this in Greenland than previous experiments. Jim Dolan remarked that the OBH also occasionally loses the time but had not on this cruise despite increased hull slams as well. This suggests it may not be the datalogger but a glitch in the power to the datalogger. I inspected closely the power wires leading from the datalogger power supply circuit (on top of battery) and there is potentially a problem with A4 and 380 (aka C3*) where these power wires connect to the PR-6 board with screw terminals. The dataloggers are now shipped with these wires connected so part of the startup procedure should be to recheck these connections.



OBS A8 Line 2 (bp 6–14 Hz, decon)
W
E
20s shot interval
70s shot interval
T−X/8.0 [s]
10.0
8.0
6.0
4.0
2.0
0.0
Offset [km]
150
142
132
122
111
101
90
79
68
57
47
37
27
17
8


W
OBS C1 Line 3 (bp 6-14 Hz, decon)
E
T-X/8.0 [s]
20s shot interval
50s shot interval
Offset [km]

Appendix 6
Sonobuoy Data

Seven radio sonobuoys were deployed from the R/V *Ewing* during the shooting of line 1c,to provide upper crustal seismic velocity control. Four sonobuoys had to be deployed at the second waypoint because of transmission failure of the first three (2,3,4). Two radio channels were available for the sonobuoys, enabling two sonobuoys to be recorded simultaneously. Data from each sonobuoy were recorded in SEGD format on two auxiliary channels of the MCS recording, one radio channel being recorded on MCS traces 157 and 158, and the second channel on traces 159 and 160.

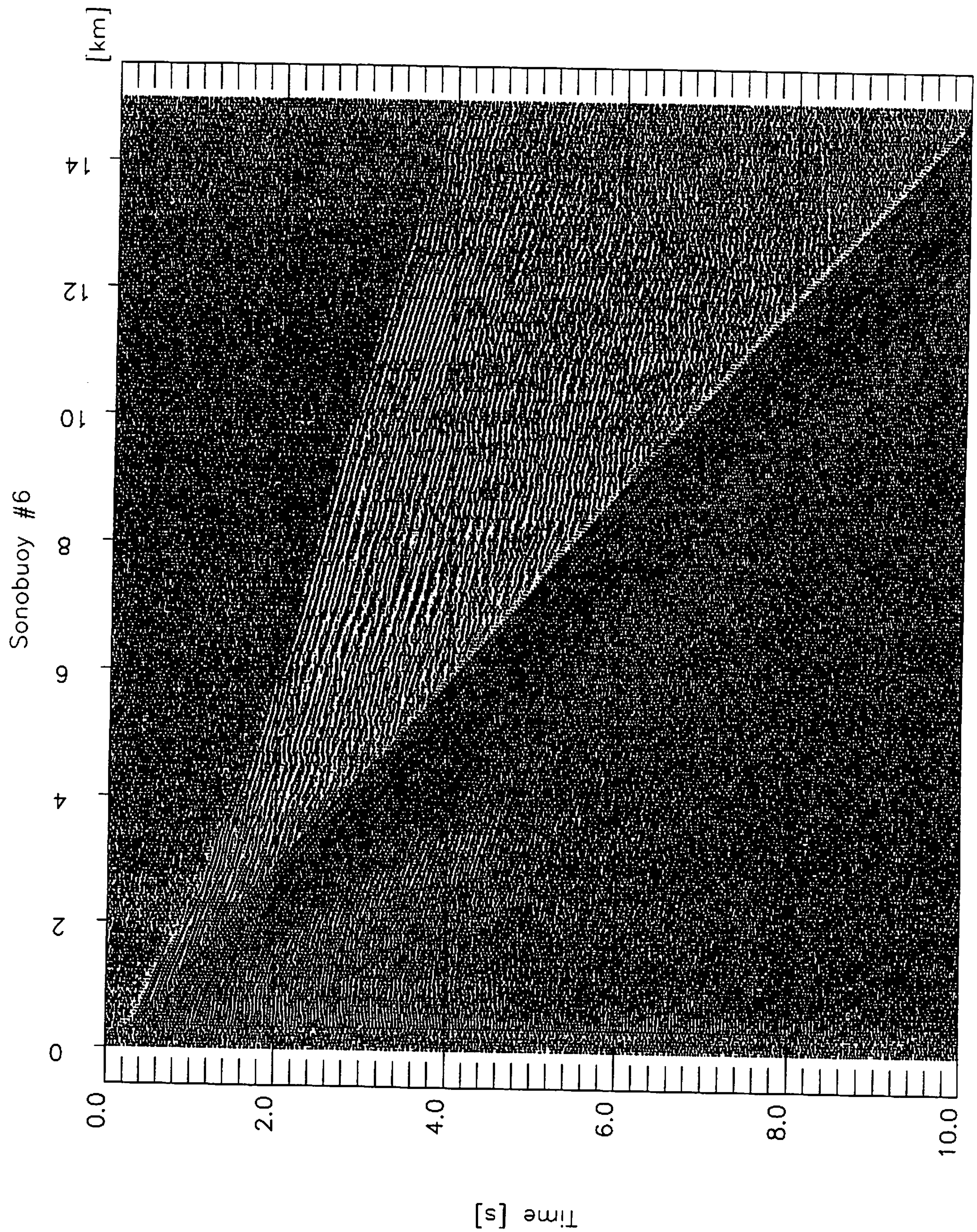
The record section "Sonobuoy #6" shows three distinct phases: the direct wave arrival, a strong basement refraction (about 6 km/s), and an intermediate velocity sediment refraction. A band pass filter (5-30 Hz) and automatic gain correction (0.2 s window) were applied for the data display. We noticed that the sonobuoy data collected in this cruise have significantly poorer quality than the data collected during cruise EW9601. Power spectra were calculated to inspect sonobuoy receiver response, and it turned out that the current receiver setting is quite inadequate for low-frequency (around 10 Hz) deep seismic reflections. According to the Science Officer, some modifications were made for the receivers sometime between these two cruises, and we suspect that the receiver response has somehow deteriorated unfortunately.

Sonobuoy Log

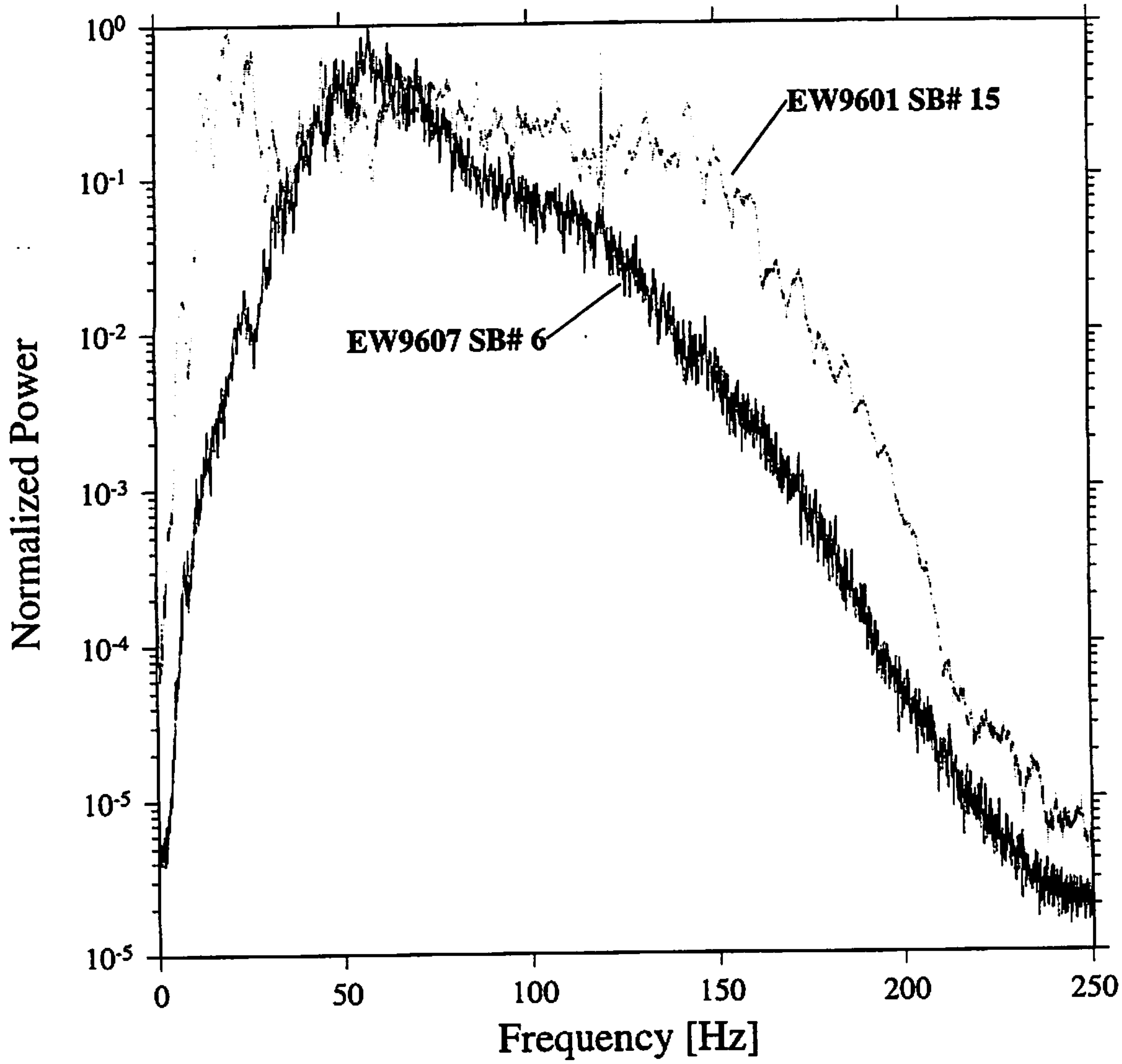
Sonobouy #	Latitude	Longitude	Start time	status	Shot Point #	channel	3480#	file
1	N 66° 06.370	W 26° 30.182	258/22:00	ok	7092-7391	2	252-253	sb1.segy
2	N 66° 03.221	W 26° 07.394	258/23:58	dud	7429	1	253	
3	N 66° 02.910	W 26° 05.365	259/00:08	dud	7457	1	253	
4	N 66° 02.609	W 26° 03.298	259/00:18	dud	7486	1	253	
5	N 66° 02.377	W 26° 01.347	259/00:28	ok	7514-7813	1	253	sb5.segy
6	N 65° 59.787	W 25° 43.061	259/02:44	ok	7778-8077	2	253-254	sb6.segy
7	N 65° 55.945	W 25° 18.620	259/04:06	ok	8138-8437	1	254	sb7.segy

NB: All sonobuoy data were first saved in 'ch1.segy' and 'ch2.segy'.
The first 300 traces beginning from the first shot point number were
then extracted and save in the above sb*.segy files.

Sampling interval in *.segy: 2ms
Number of samples per trace: 8000


Sonobuoy #6
[km]
0
2
4
6
8
10
12
14
Time [s]
0.0
2.0
4.0
6.0
8.0
10.0

Sonobuoy Receiver Response



Appendix 7: The Loss of OBH 21

On the afternoon of 23 Sept. 1996, OBH 21 was lost during recovery operations. The loss occurred during what had been shaping up to be a normal recovery. We released the instrument, it surfaced normally and we approached for recovery. As the instrument came alongside the bow, in full view from our position on the waistdeck, the ship pitched over a swell and was simultaneously pushed toward starboard by a gust of wind. The OBH disappeared from view. At first we thought the instrument must have been pushed around to the port side. After a few minutes, when the OBH did not reappear, the captain radioed that he believed the bow had struck the OBH and damaged it. The chief mate reported having caught a glimpse of the OBH listing and partially submerged. We deployed the transducer and were able to communicate with (only) one of the releases.

We then began a four-hour search process of steaming slowly in a grid pattern while ranging to the release. For some time we believed that the instrument was disabled but neutrally or slightly positively buoyant and near the surface (the ability to range to only one of the releases seemed to support this), but eventually it became clear that we were being fooled by the fact that the OBH was sinking very slowly. We ultimately were able to range to both releases and got a slant range that was constant at seafloor depth for 30 minutes. It took four hours for the OBH to sink 2429 m. Our estimate of the resting position of the remains of OBH 21 is 62° 25.782'N, 36° 49.401'W.

Sea state and wind were contributing factors in the loss of OBH 21; however, all other recoveries during SIGMA, including numerous recoveries in similar conditions, went smoothly, safely, and without incident. The captain believes that the ship's anchor struck the instrument, presumably breaking or separating one or more glass balls. After the loss of OBH 21 the captain modified the approach during recoveries to a more oblique line that keeps the OBH (or OBS) well away from the bow until past the bridge wing. This approach worked very well, and we recommend that it be adopted on all recoveries.

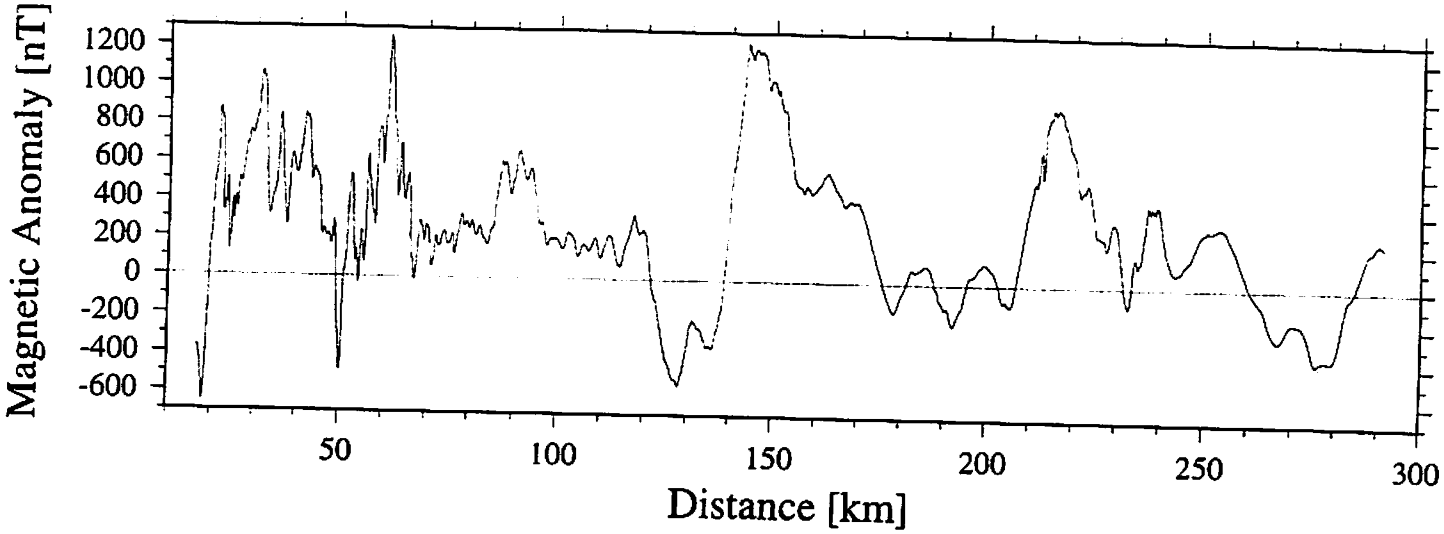
We considered options for dragging for the remains of OBH 21, and Bruce Francis provided us with a breakdown of the steps that would have been necessary, including fabrication of a grapple and rigging the core wire through the starboard A-frame, since the main block on the stern A-frame was inoperable. We estimated that an attempt to drag would have taken a minimum of 12 hours, and probably more like 24 hours to make a serious effort. We judged the chances of success of such an operation to be quite small due to the great water depth and the fact that the OBH frame was negatively buoyant. Given the difficult weather conditions of the Greenland margin, we were unwilling to spend so much of our remaining contingency time on a high-risk operation, especially since the lost time might have jeopardized our chances of completing Line 4, which we judged critical to the scientific objectives of our cruise. We therefore decided to abandon OBH 21.

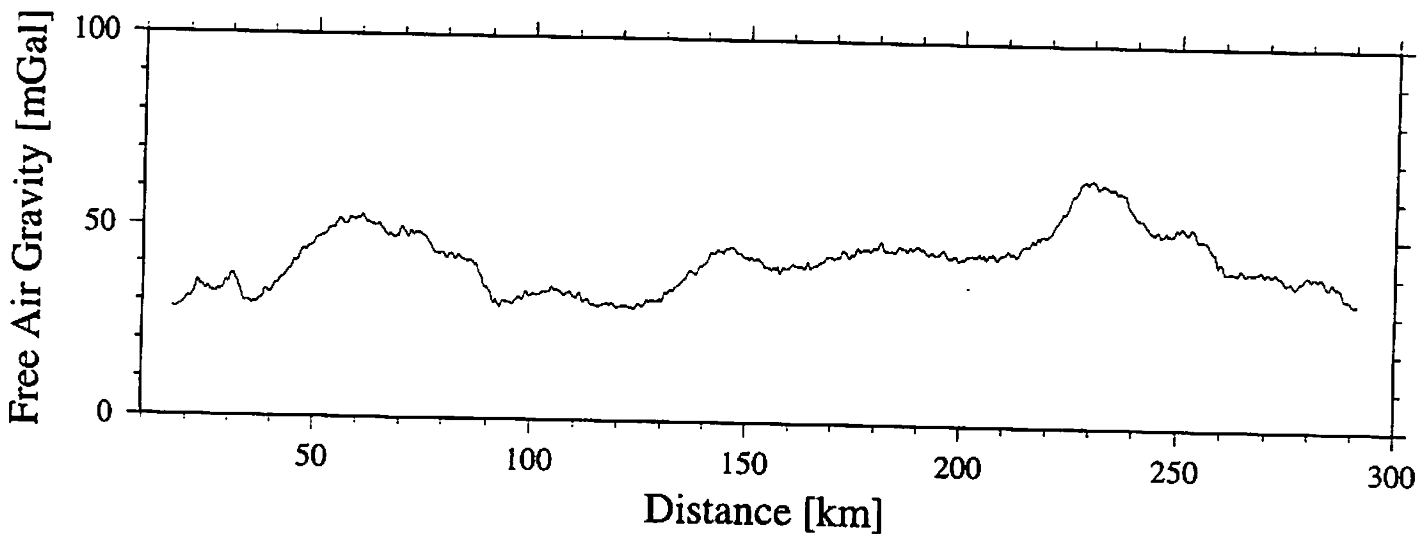
Appendix 8
Underway Geophysical Data

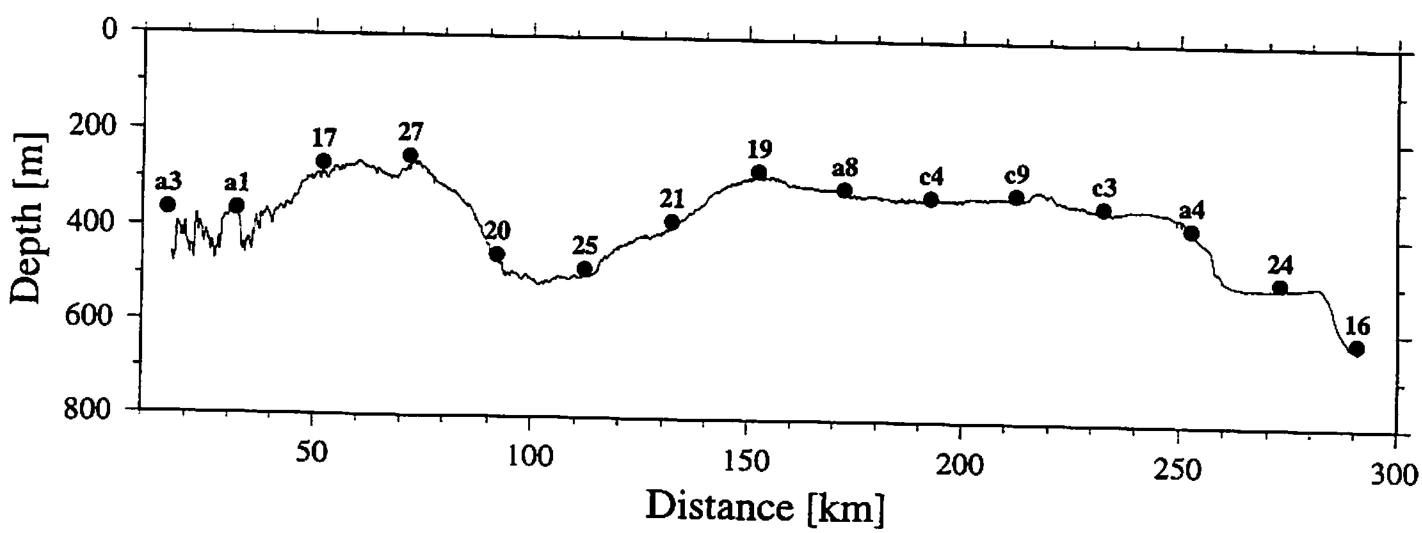
Magnetic, gravity, and Hydrosweep bathymetry data were collected along all four lines. The following figures show magnetic anomaly, free air gravity anomaly, and Hydroswee centerbeam bathymetry for each transect.

IGRF 1990 was used as a reference for magnetic anomaly calculation. Eotvos correction with GPS navigation correction was applied to measured gravity values prior to FAA calculation. Both anomaly profiles were filtered with 300 m-long cosine window for display.

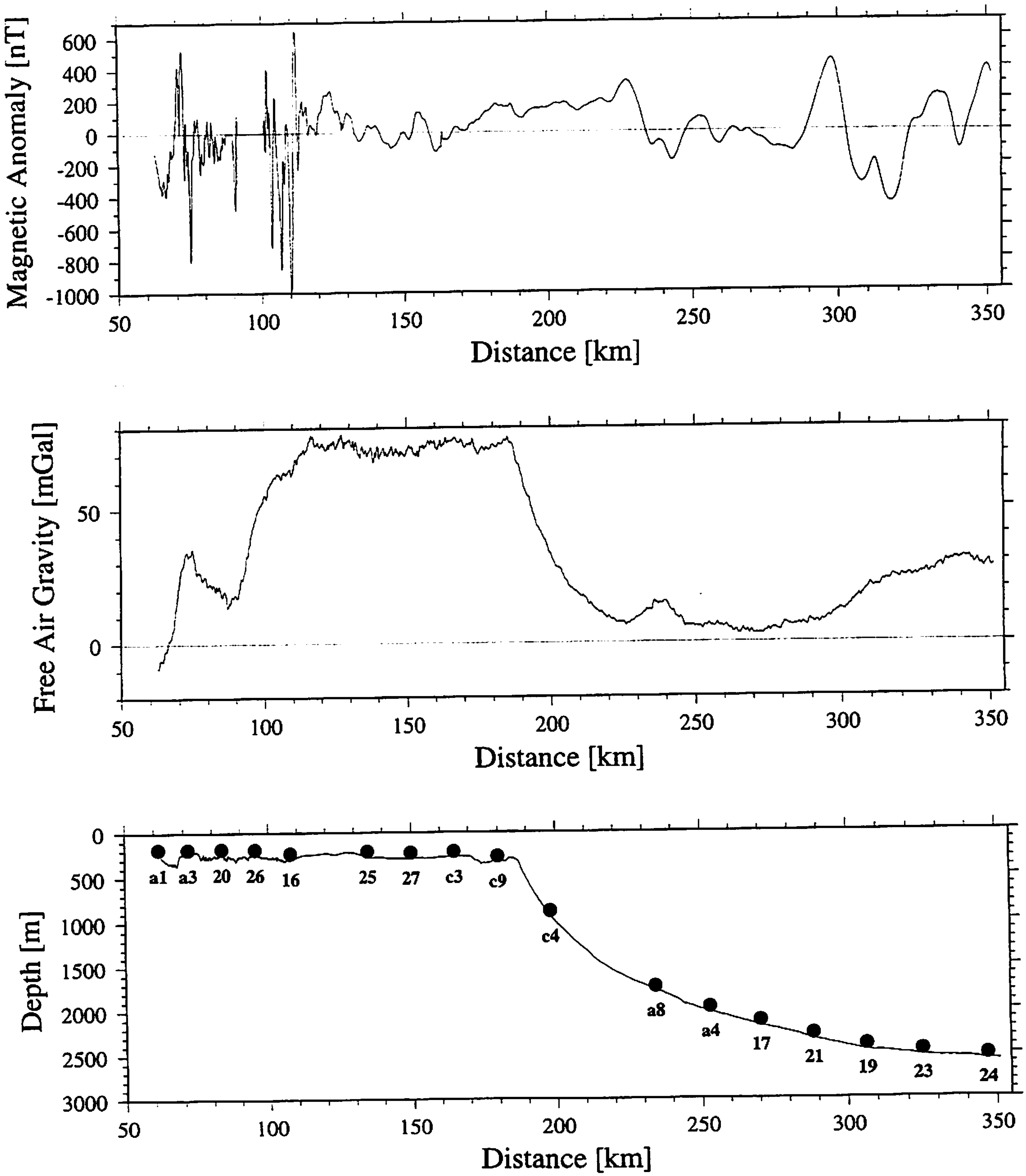
Line 1


Magnetic Anomaly [nT]
1200
1000
800
600
400
200
0
-200
-400
-600
50
100
150
200
250
300
Distance [km]


Free Air Gravity [mGal]
100
50
0
50
100
150
200
250
300
Distance [km]

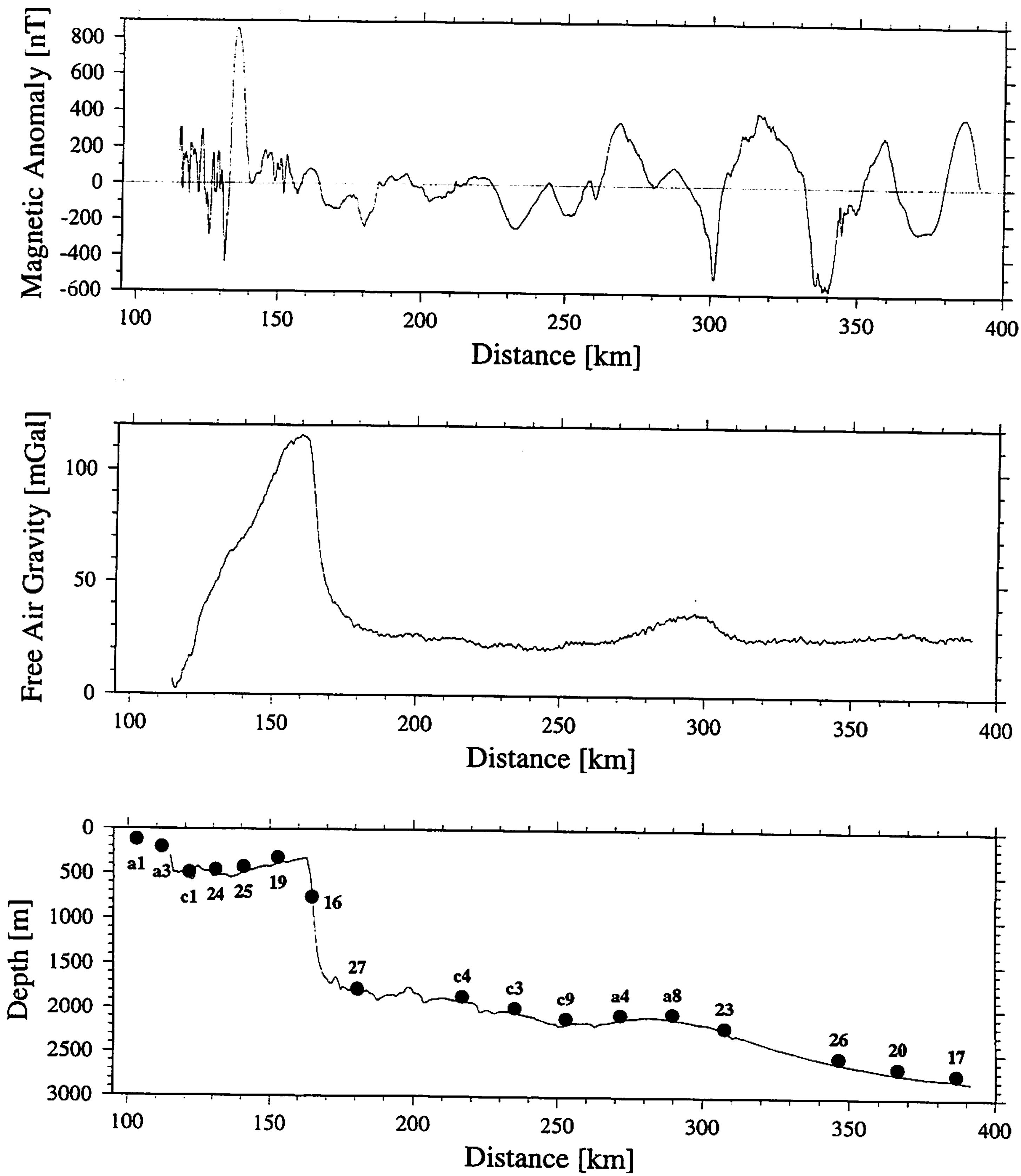

Depth [m]
0
200
400
600
800
a3
a1
17
27
20
25
21
19
a8
c4
c9
c3
a4
24
16
50
100
150
200
250
300
Distance [km]

Line 2



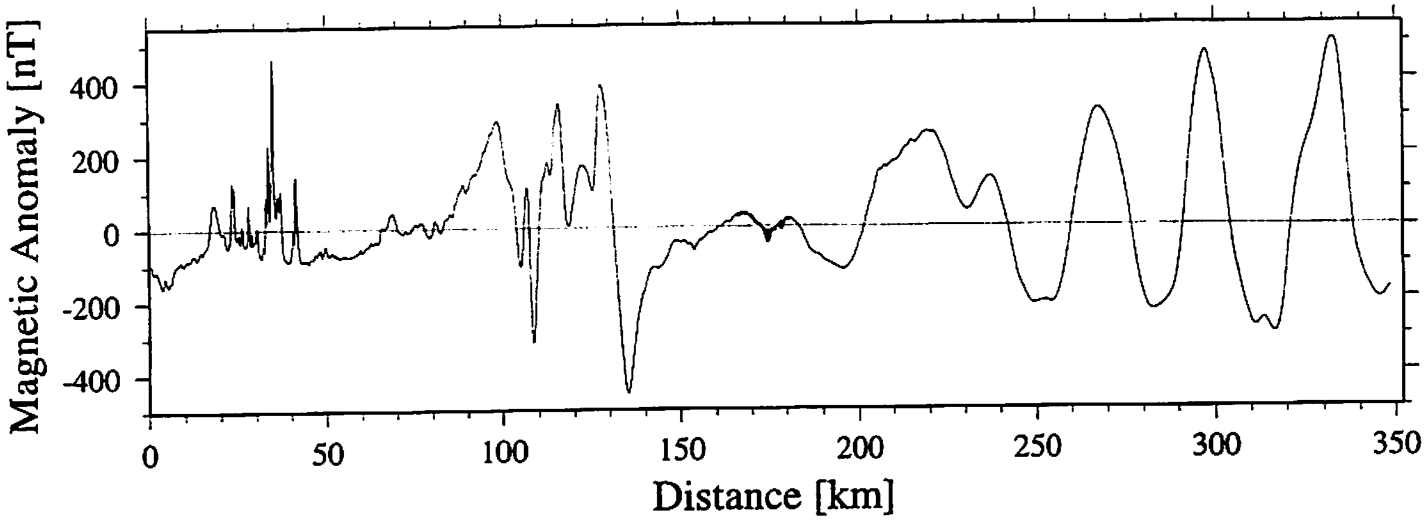
Magnetic Anomaly [nT]
600
400
200
0
-200
-400
-600
-800
-1000
50
100
150
200
250
300
350
Distance [km]
Free Air Gravity [mGal]
50
0
50
100
150
200
250
300
350
Distance [km]
Depth [m]
0
500
1000
1500
2000
2500
3000
a1
a3
20
26
16
25
27
c3
c9
c4
a8
a4
17
21
19
23
24
50
100
150
200
250
300
350
Distance [km]

Line 3

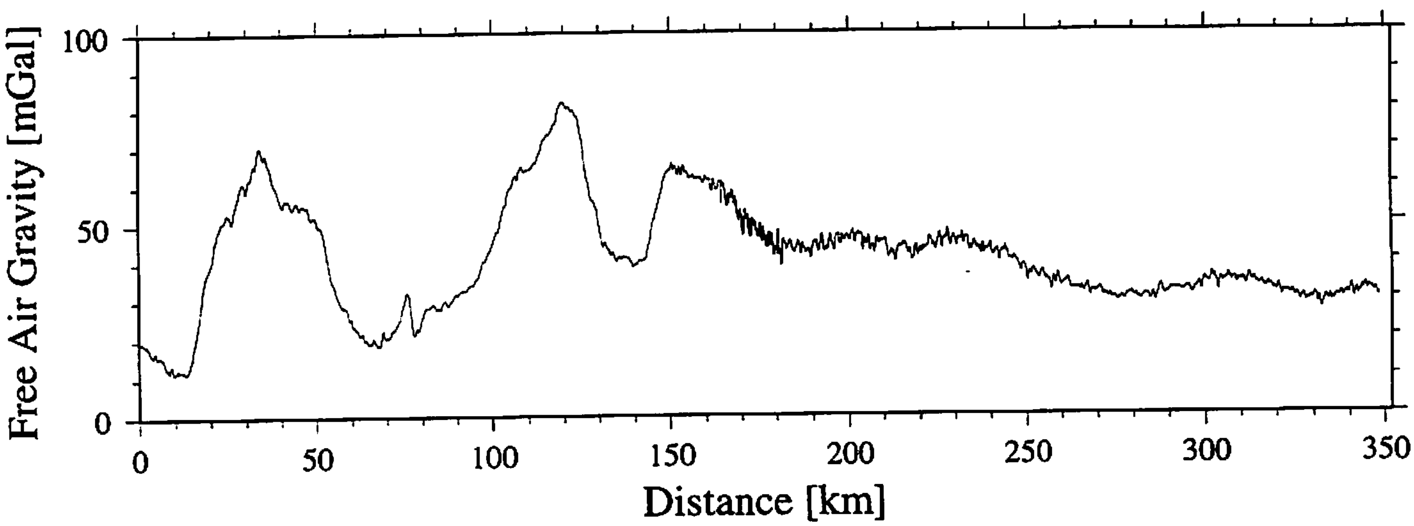


Magnetic Anomaly [nT]
800
600
400
200
0
-200
-400
-600
100
150
200
250
300
350
400
Distance [km]
Free Air Gravity [mGal]
100
50
0
Depth [m]
0
500
1000
1500
2000
2500
3000
a1
a3
c1
24
25
19
16
27
c4
c3
c9
a4
a8
23
26
20
17

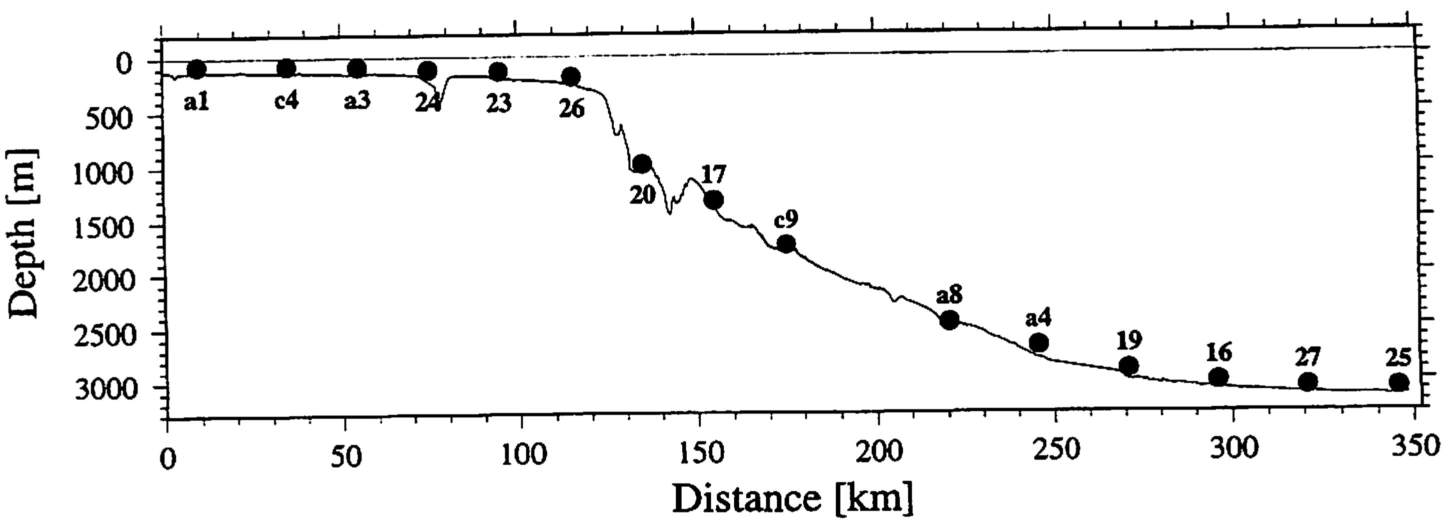
Line 4



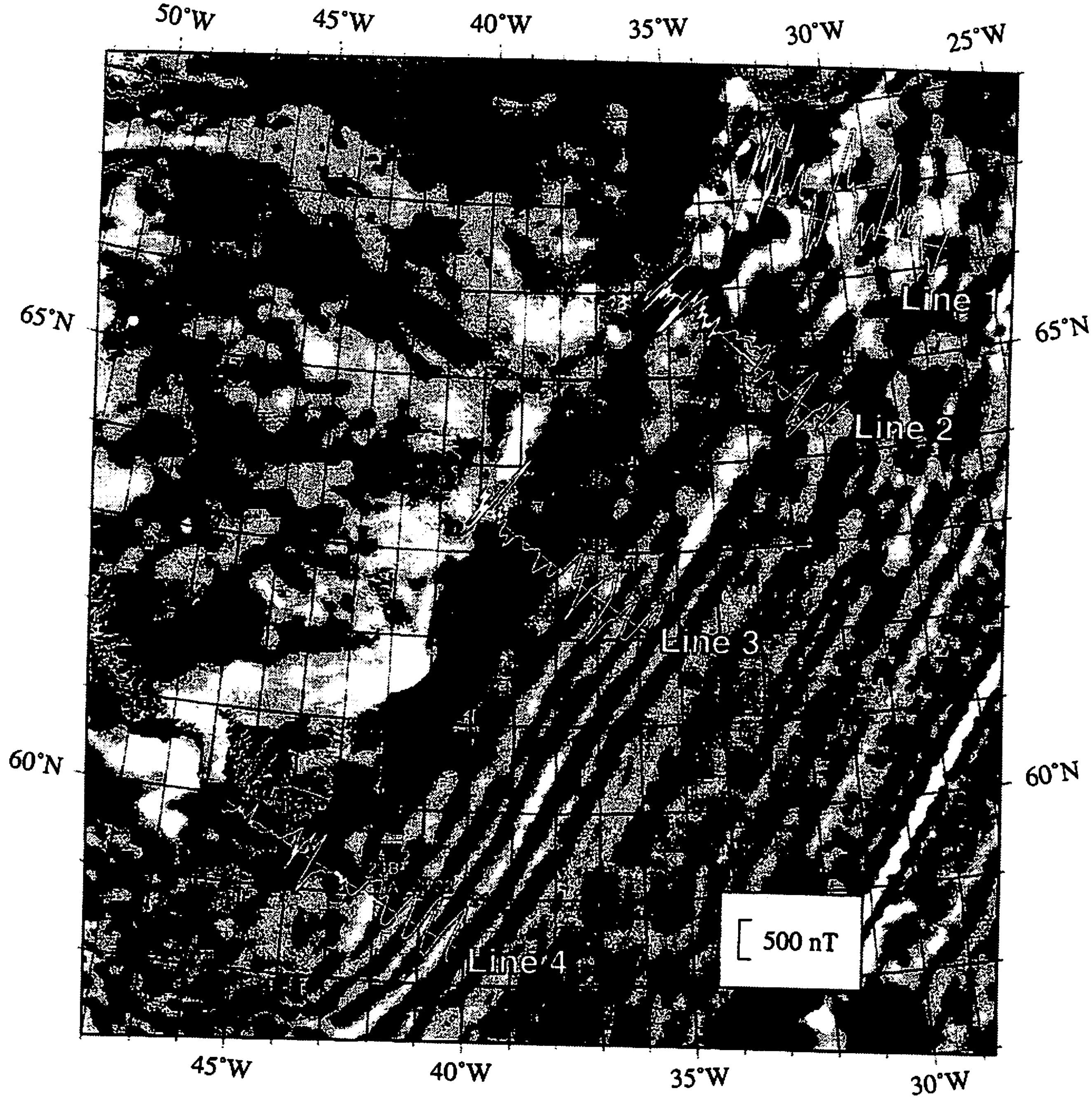
Magnetic Anomaly [nT]
400
200
0
-200
-400
0
50
100
150
200
250
300
350
Distance [km]

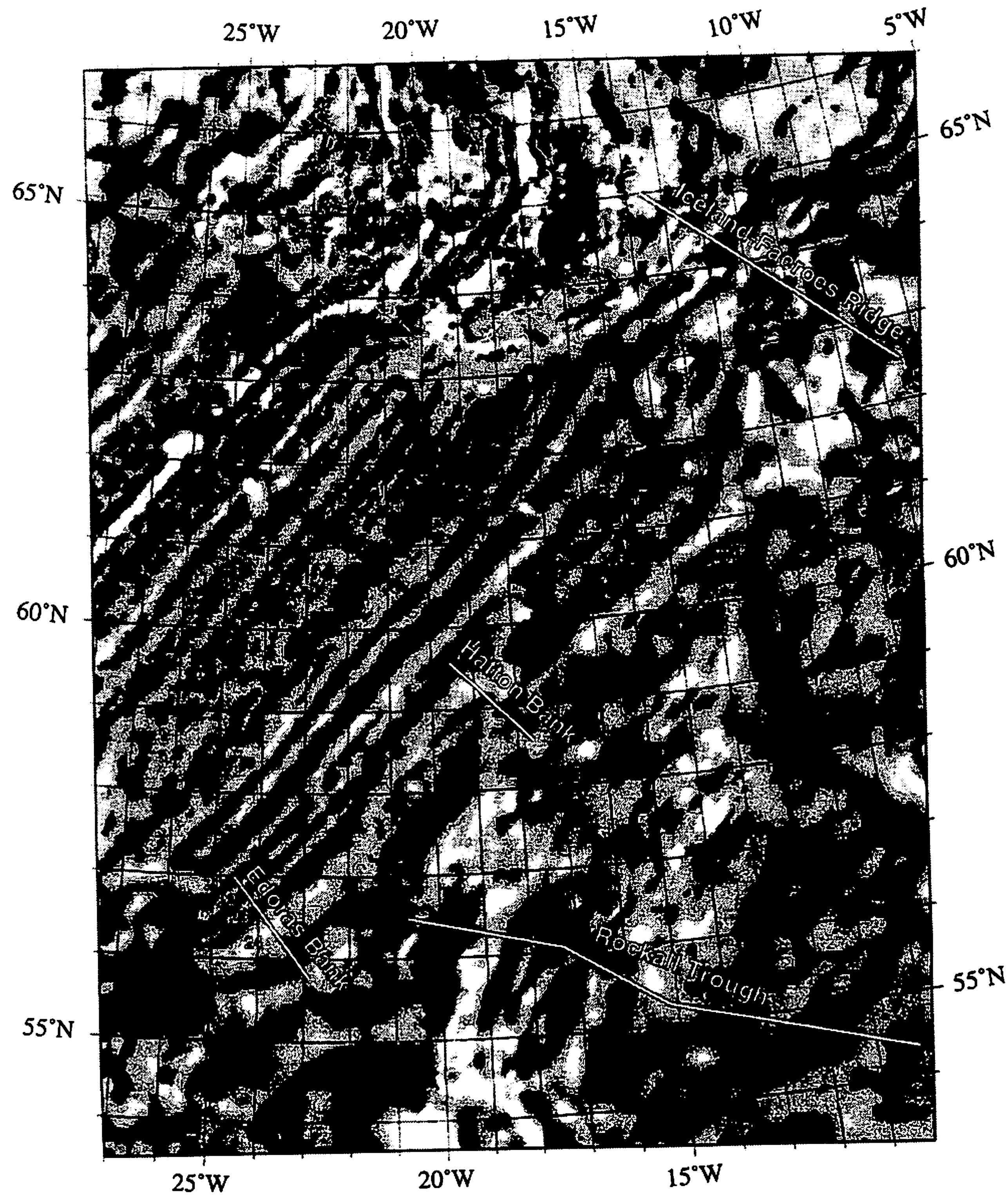


Free Air Gravity [mGal]
100
50
0
0
50
100
150
200
250
300
350
Distance [km]



Depth [m]
0
500
1000
1500
2000
2500
3000
a1
c4
a3
24
23
26
20
17
c9
a8
a4
19
16
27
25
0
50
100
150
200
250
300
350
Distance [km]

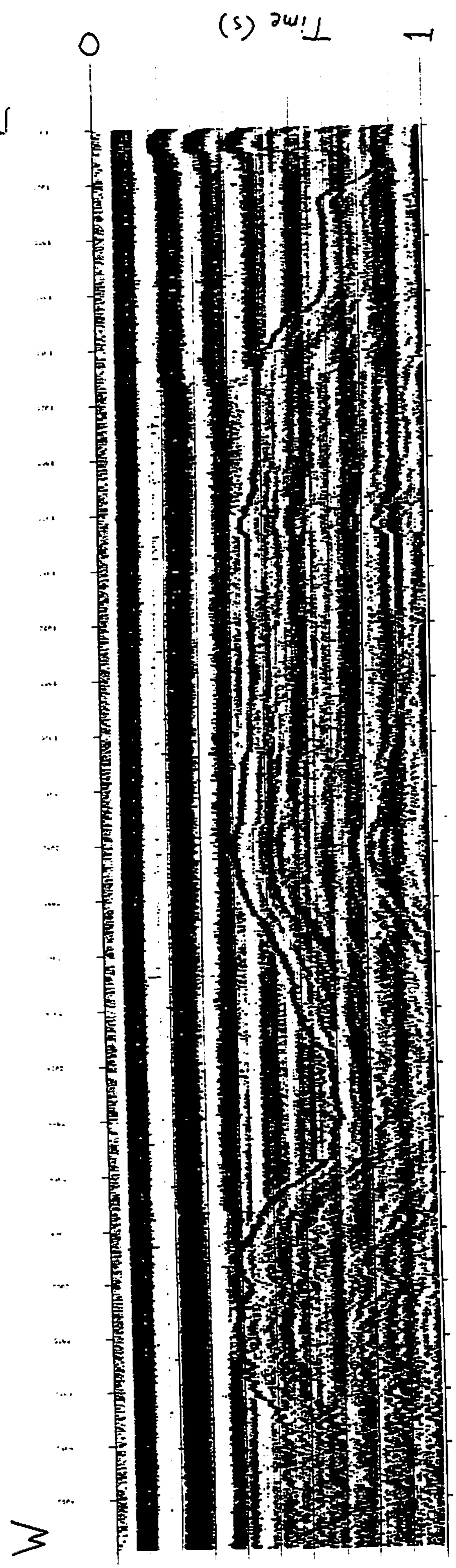

50°W
45°W
40°W
35°W
30°W
25°W
65°N
60°N
Line 1
Line 2
Line 3
Line 4
500 nT
45°W
40°W
35°W
30°W


25°W
20°W
15°W
10°W
5°W
65°N
60°N
55°N
Iceland Faeroes Ridge
Hatton Bank
Edoras Bank
Rockall Trough

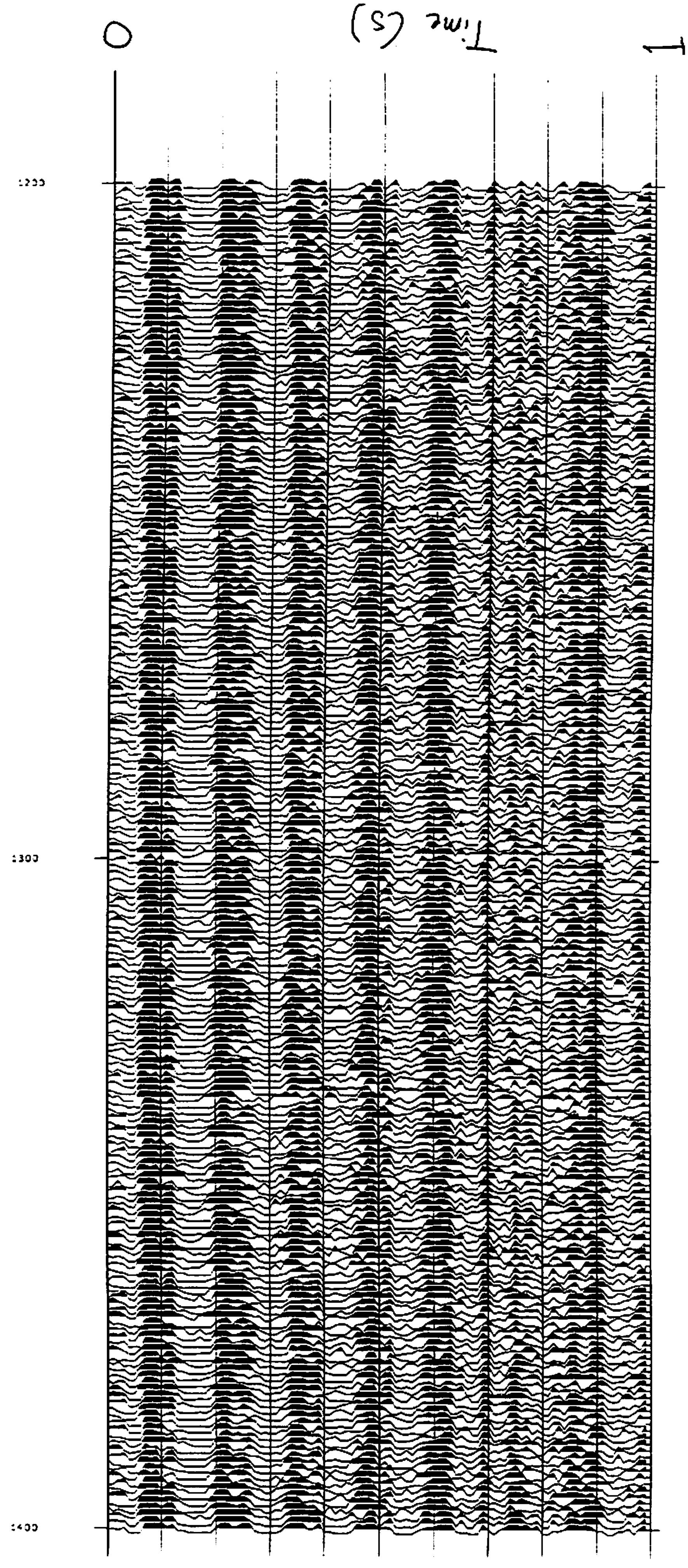
Appendix 9: On-board OBS Record, Line 1

OBS C1, which was not deployed on Line 1, was left on the deck in wet staging and recorded data during the shooting of Line 1. Although this was done merely as a test of an instrument that had failed on its first deployment, the resulting record section of the vertical-component geophone is of interest for several reasons. The first figure shows the record section for all of Line 1b. The direct arrival shows up as the horizontal bands of energy across the whole section. Changes in the character of the direct arrival correlate with changes in gun array configuration — e.g, at the beginning (E end) of the line, when the gun array was being brought on line, and again at ~SP 1700 when two guns were pulled, repaired, and put back in the water. In general, at the scale of this figure the *Ewing* airgun source appears quite repeatable. The seafloor reflection is visible as the ragged arrival crossing the section at 0.4–0.8 s. The shipboard OBS thus provides a novel way of measuring bathymetry.

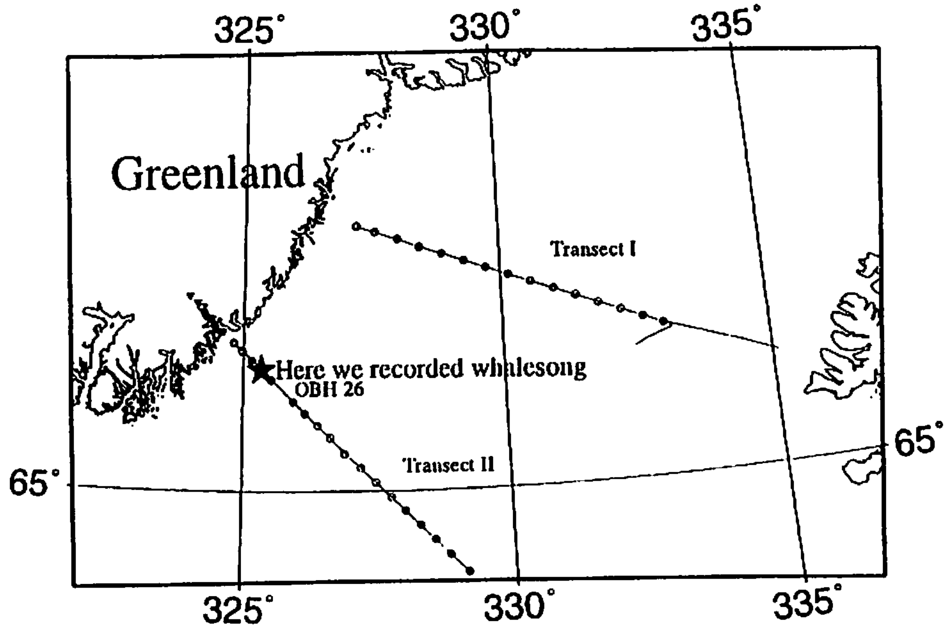
The second figure shows a blow-up of 200 traces from SP 1200–1400. The data are clipped, so detailed conclusions about the waveforms are impossible, though the data do suggest some trace-to-trace variability. The arrival time of the direct wave provides an estimate of the delay between the logged shot instant and the actual shot time: using a distance of 50 m from the center of the gun array to the wet staging area, we predict an arrival time of 0.033 s. The measured arrival time is approximately 0.040 s. Therefore the delay between the logged shot instant and the actual shot time (the gun firing delay) appears to be less than 10 ms.

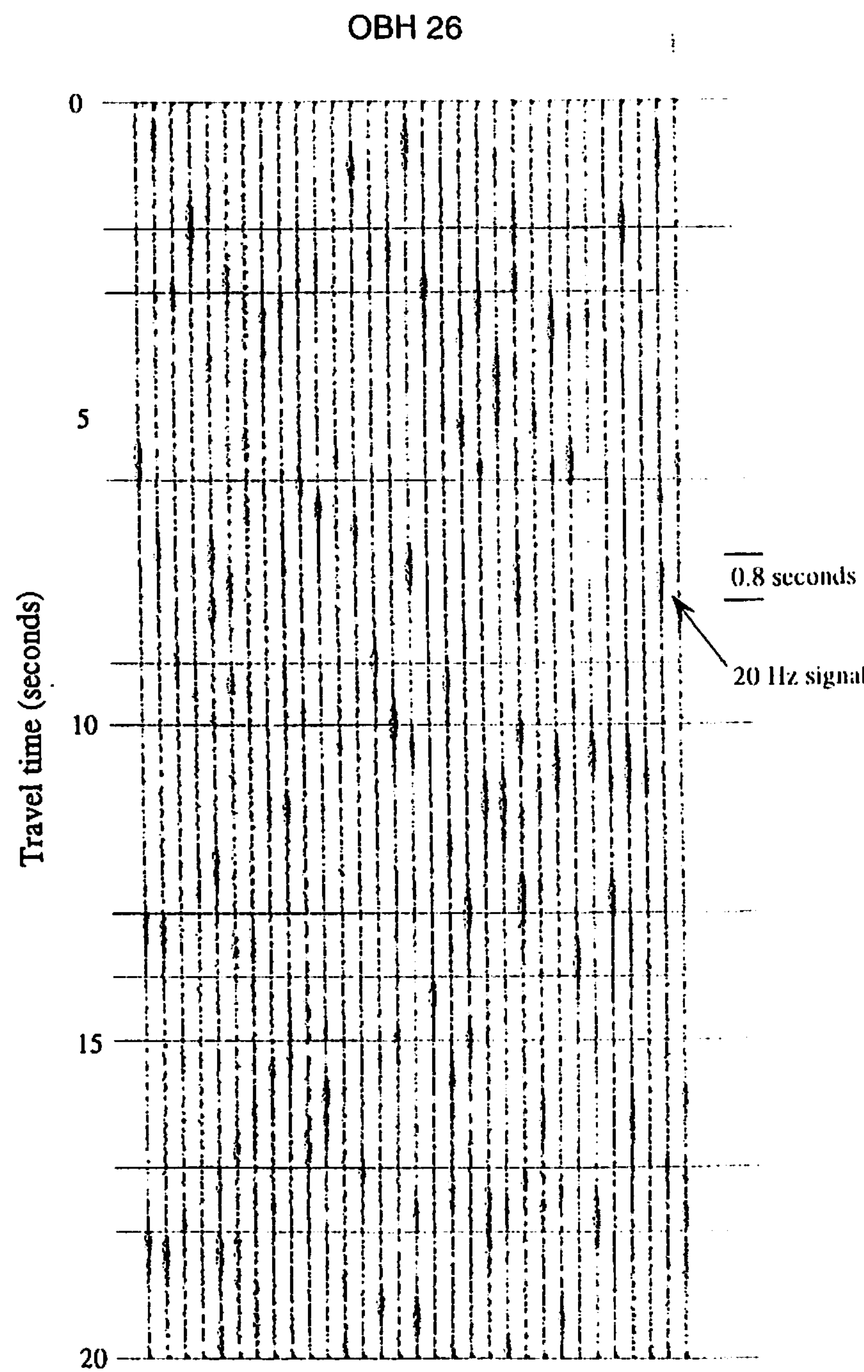


Time (s)
0
1
E
W


0
Time (s)
1
1200
1300
1400

Appendix 10 - Whalesong





With the 20 Hz signals, we can generally narrow it to one of two species -- the blue or the fin (also called finback). The typical Atlantic fin whale call is about 0.8 seconds duration, near 20 Hz, and is commonly repeated more or less every 10 seconds, sometimes in patterns. Most likely you would be hearing fin whales as they should be at least ten times more abundant than blues where you are. Call series for either species may continue for hours or even days.

Mark A. McDonald, University of Victoria

Appendix 11 MCS logs

Sigma 1996 Transect II

Seismic Recording LOG

Shot rate:21secs +/- 1 for 16sec
Sample rate:2ms

Channels:160 Aux. channels:4
Number of guns:20 Pressure 2000psi

Date	J.Day	Line	GMT	Latitude	Longitude	Tape #	Shot #	File #	Comments
		test				1	2	1	Bot
		test	19:14			1	47	53	Eot
		test	19:14			2	48	54	Bot
		test	19:34			2	100	106	Eot
		test	19:34			3	101	107	Bot
		test	19:51			3	153	159	Eot
		test	19:51			4			Bot
2-Sep	246	2	20:16	64°19.111	30°47.952	1	5	1	Bot start of line 2
2-Sep	246	2	20:34	64°20.1418N	30°50.5936	1	58	53	Eot
2-Sep	246	2				2	59	54	Bot
2-Sep	246	2	20:54	64°21.2780	30°53.0156	2	111	106	Eot
2-Sep	246	2				3	112	107	Bot
2-Sep	246	2	21:12	64°22.4330	30°55.4934	3	164	159	Eot
2-Sep	246	2				4	165	160	Bot
2-Sep	246	2	21:31	64°23.5513	30°58.0200	4	217	212	Eot
2-Sep	246	2				5	218	213	Bot
2-Sep	246	2	21:50	64°24.7299	31°00.4945	5	271	265	Eot
2-Sep	246	2				6	272	266	Bot
2-Sep	246	2	22:09	64°25.9088	31°03.1779	6	326	318	Eot
2-Sep	246	2				7	327	319	Bot
2-Sep	246	2	22:28	64°27.0074	31°05.6868	7	379	371	Eot
2-Sep	246	2				8	380	372	Bot
2-Sep	246	2	22:46	64°28.1843	31°08.0125	8	432	424	Eot
2-Sep	246	2				9	433	425	Bot
2-Sep	246	2	23:05	64°29.2829	31°10.4175	9	485	477	Eot
2-Sep	246	2				10	486	478	Bot
2-Sep	246	2	23:23	64°30.4286	31°12.9681	10	538	530	Eot
2-Sep	246	2				11	539	531	Bot
2-Sep	246	2	23:42	64°31.6027	31°15.5179	11	591	583	Eot
2-Sep	246	2				12	592	584	Bot
3-Sep	247	2	0:00	64°32.7320	31°18.1157	12	644	636	Eot

Sigma 1996 Transect II

Seismic Recording LOG

Shot rate:21secs +/- 1 for 16sec

Sample rate:2ms

Channels:160 Aux. channels:4

Number of guns:20 Pressure 2000psi

Date	J.Day	Line	GMT	Latitude	Longitude	Tape #	Shot #	File #	Comments
3-Sep	247	2	0:00	64°32.7320	31°18.1157	13	645	637	Bot
3-Sep	247	2	0:19	64°33.8818	31°20.6025	13	697	689	Eot
3-Sep	247	2				14	698	690	Bot
3-Sep	247	2	0:38	64°35.0131	31°23.1269	14	750	742	Eot
3-Sep	247	2				15	751	743	Bot
3-Sep	247	2	0:56	64°36.1519	31°25.6144	15	803	795	Eot
3-Sep	247	2				16	804	796	Bot
3-Sep	247	2	1:15	64°37.3142	31°28.1728	16	856	848	Eot
3-Sep	247	2				17	857	849	Bot
3-Sep	247	2	1:33	64°38.4372	31°30.7523	17	909	901	Eot
3-Sep	247	2				18	910	902	Bot
3-Sep	247	2	1:52	64°39.680	31°33.620	18	962	954	Eot
3-Sep	247	2				19	963	955	Bot
3-Sep	247	2	2:10	64°40.805	31°36.054	19	1015	1007	Eot
3-Sep	247	2				20	1016	1008	Bot
3-Sep	247	2	2:30	64°42.063	31°38.927	20	1068	1060	Eot
3-Sep	247	2				21	1069	1061	Bot
3-Sep	247	2	2:46	64°43.232	31°41.610	21	1121	1113	Eot
3-Sep	247	2				22	1122	1114	Bot
3-Sep	247	2	3:06	64°44.397	31°44.264	22	1174	1166	Eot
3-Sep	247	2				23	1175	1167	Bot
3-Sep	247	2	3:24	64°45.658	31°47.077	23	1227	1219	Eot
3-Sep	247	2				24	1228	1220	Bot
3-Sep	247	2	3:44	64°46.939	31°49.935	24	1282	1272	Eot
3-Sep	247	2				25	1283	1273	Bot
3-Sep	247	2	4:02	64°48.093	31°52.665	25	1336	1325	Eot
3-Sep	247	2				26	1337	1326	Bot
3-Sep	247	2	4:23	64°49.436	31° 55.677	26	1396	1378	Eot
3-Sep	247	2				27	1397	1379	Bot
3-Sep	247	2	4:43	64°50.745	31°58.699	27	1453	1431	Eot
3-Sep	247	2				28	1454	1432	Bot
3-Sep	247	2	5:03	64° 52.094	32°01.786	28	1510	1484	Eot

Sigma 1996 Transect II

Seismic Recording LOG

Shot rate:21secs +/- 1 for 16sec

Sample rate:2ms

Channels:160 Aux. channels:4

Number of guns:20 Pressure 2000psi

Date	J.Day	Line	GMT	Latitude	Longitude	Tape #	Shot #	File #	Comments
3-Sep	247	2	5:03	64° 52.094	32°01.786	29	1511	1485	Bot
3-Sep	247	2	5:24	64°53.444	32°04.838	29	1570	1537	Eot
3-Sep	247	2				30	1571	1538	Bot
3-Sep	247	2	5:47	64°54.780	32°08.028	30	1631	1590	Eot
3-Sep	247	2				31	1632	1591	Bot
3-Sep	247	2	6:05	64°56.033	32°10.830	31	1686	1643	Eot
3-Sep	247	2				32	1687	1644	Bot
3-Sep	247	2	6:25	64 57.217	32°13.448	32	1742	1696	Eot
3-Sep	247	2				33	1743	1697	Bot
3-Sep	247	2	6:46	64°58.800	32°17.128	33	1802	1749	Eot
3-Sep	247	2				34	1803	1750	Bot
3-Sep	247	2	7:05	64°59.822	32°19.530	34	1856	1802	Eot
3-Sep	247	2					1857	1803	Bot
3-Sep	247	2	7:23	65°00.800	32°22.042	35	1909	1855	Eot
3-Sep	247	2				36	1910	1856	Bot
3-Sep	247	2	7:43	65°02.076	32°25.019	36	1965	1908	Eot
3-Sep	247	2				37	1966	1906	Bot
3-Sep	247	2	8:02	65°03.272	32°27.566	37	2020	1961	Eot
3-Sep	247	2				38	2021	1962	Bot
3-Sep	247	2	8:21	65°04.314	32°30.000	38	2074	2014	Eot
3-Sep	247	2				39	2075	2015	Bot
3-Sep	247	2	8:41	65°05.446	32°32.753	39	2131	2067	Eot
3-Sep	247	2				40	2132	2068	Bot
3-Sep	247	2	9:00	65°05.571	32°35.388	40	2185	2120	Eot
3-Sep	247	2				41	2186	2121	Bot
3-Sep	247	2	9:20	65°07.808	32°38.308	41	2242	2173	Eot
3-Sep	247	2				42	2243	2174	Bot
3-Sep	247	2	9:38	65°08.805	32°40.669	42	2295	2226	Eot
3-Sep	247	2				43	2296	2227	Bot
3-Sep	247	2	9:58	65°09.893	32°43.256	43	2350	2279	Eot
3-Sep	247	2				44	2351	2280	Bot
3-Sep	247	2	10:16	65°11.20	32°46.31	44	2404	2332	Eot

Sigma 1996 Transect II

Seismic Recording LOG

Shot rate:21secs +/- 1 for 16sec

Sample rate:2ms

Channels:160 Aux. channels:4

Number of guns:20 Pressure 2000psi

Date	J.Day	Line	GMT	Latitude	Longitude	Tape #	Shot #	File #	Comments
3-Sep	247	2	10:16	65°11.20	32°46.31	45	2405	2333	Bot
3-Sep	247	2	10:38	65°12.28	32°48.90	45	2461	2385	Eot
3-Sep	247	2				46	2462	2386	Bot
3-Sep	247	2	10:57	65°13.37	32°51.57	46	2514	2438	Eot
3-Sep	247	2				47	2515	2439	Bot
3-Sep	247	2	11:16	65°14.48	32°54.25	47	2570	2491	Eot
3-Sep	247	2				48	2571	2492	Bot
3-Sep	247	2	11:35	65°15.55	32°56.83	48	2624	2544	Eot
3-Sep	247	2				49	2625	2545	Bot
3-Sep	247	2	11:55	65°16.71	32°59.59	49	2680	2597	Eot
3-Sep	247	2				50	2681	2598	Bot
3-Sep	247	2	12:14	65°17.87	33°02.30	50	2735	2650	Eot
3-Sep	247	2				51	2736	2651	Bot
3-Sep	247	2	12:38	65°19.23	33°05.52	51	2802	2703	Eot
3-Sep	247	2				52	2803	2704	Bot
3-Sep	247	2	12:59	65°20.48	33°08.43	52	2862	2756	Eot
3-Sep	247	2				53	2863	2757	Bot
3-Sep	247	2	13:17	65°21.54	33°11.18	53	2915	2809	Eot
3-Sep	247	2				54	2916	2810	Bot
3-Sep	247	2	13:37	65°22.73	33°14.04	54	2971	2862	Eot
3-Sep	247	2				55	2973	2863	Bot
3-Sep	247	2	13:58	65°24.03	33°17.07	55	3032	2915	Eot
3-Sep	247	2				56	3033	2916	Bot
3-Sep	247	2	14:18	65°25.32	33°20.17	56	3085	2968	Eot
3-Sep	247	2				57	3086	2969	Bot
3-Sep	247	2	14:36	65°26.25	33°22.71	57	3140	3021	Eot
3-Sep	247	2				58	3141	3022	Bot
3-Sep	247	2	14:54	65°27.34	33°25.02	58	3193	3074	Eot
3-Sep	247	2				59	3194	3075	Bot
3-Sep	247	2	15:13	65°28.50	33°27.93	59	3246	3127	Eot
3-Sep	247	2				60	3247	3128	Bot
3-Sep	247	2	15:31	65°29.45	33°30.35	60	3299	3180	Eot

Sigma 1996 Transect II

Seismic Recording LOG

Shot rate:21secs +/- 1 for 16sec

Sample rate:2ms

Channels:160 Aux. channels:4

Number of guns:20 Pressure 2000psi

Date	J.Day	Line	GMT	Latitude	Longitude	Tape #	Shot #	File #	Comments
3-Sep	247	2	15:31	65°29.45	33°30.35	61	3300	3181	Bot
3-Sep	247	2	15:50	65°30.45	33°32.69	61	3353	3233	Eot
3-Sep	247	2				62	3354	3234	Bot
3-Sep	247	2	16:09	65°31.51	33°35.74	62	3406	3286	Eot
3-Sep	247	2				63	3407	3287	Bot
3-Sep	247	2	16:27	65°32.65	33°38.35	63	3459	3339	Eot
3-Sep	247	2				64	3460	3340	Bot
3-Sep	247	2	16:46	65°33.63	33°40.97	64	3512	3392	Eot
3-Sep	247	2				65	3513	3393	Bot
3-Sep	247	2	17:04	65°34.70	33°43.49	65	3565	3445	Eot
3-Sep	247	2				66	3566	3446	Bot
3-Sep	247	2	17:23	65°35.81	33°46.17	66	3618	3498	Eot
3-Sep	247	2				67	3619	3499	Bot
3-Sep	247	2	17:41	65°36.81	33°48.67	67	3671	3551	Eot
3-Sep	247	2				68	3672	3552	Bot
3-Sep	247	2	18:00	65°37.90	33°51.26	68	3724	3604	Eot
3-Sep	247	2				69	3725	3605	Bot
3-Sep	247	2	18:18	65°39.08	33°54.40	69	3777	3657	Eot
3-Sep	247	2				70	3778	3658	Bot
3-Sep	247	2	18:37	65°40.10	33°57.07	70	3830	3710	Eot
3-Sep	247	2				71	3831	3711	Bot
3-Sep	247	2	18:59	65°41.27	33°59.87	71	3893	3763	Eot
3-Sep	247	2				72	3904	3771	Bot
3-Sep	247	2	19:19	65°42.62	34°02.82	72	3949	3816	Eot
3-Sep	247	2				73	3950	3817	Bot
3-Sep	247	2	19:38	65°43.60	34°05.40	73	4002	3869	Eot
3-Sep	247	2				74	4003	3870	Bot
3-Sep	247	2	19:51	65°44.51	34°07.89	74	4042	3909	Eot , forced end of line 2 due to weather
4-Sep	248	2c	6:48	65°31.45	33°34.26	75	10007	3912	Bot, Sol 2c
4-Sep	248	2c	7:05	65°32.33	33°37.47	75	10057	3962	Eot
4-Sep	248	2c				76	10058	3963	Bot
4-Sep	248	2c	7:25	65°33.17	33°39.41	76	10110	4015	Eot

Sigma 1996 Transect II

Seismic Recording LOG

Shot rate:21secs +/- 1 for 16sec
Sample rate:2ms

Channels:160 Aux. channels:4
Number of guns:20 Pressure 2000psi

Date	J.Day	Line	GMT	Latitude	Longitude	Tape #	Shot #	File #	Comments
4-Sep	248	2c	7:25	65°33.17	33°39.41	77	10111	4016	Bot
4-Sep	248	2c	7:45	65°34.07	33°41.76	77	10163	4068	Eot
4-Sep	248	2c				78	10164	4069	Bot
4-Sep	248	2c	8:02	65°34.99	33°44.15	78	10216	4121	Eot
4-Sep	248	2c				79	10217	4122	Bot
4-Sep	248	2c	8:20	65°35.99	33°46.42	79	10269	4174	Eot
4-Sep	248	2c				80	10270	4175	Bot
4-Sep	248	2c	8:40	65°36.87	33°48.62	80	10326	4227	Eot
4-Sep	248	2c				81	10327	4228	Bot
4-Sep	248	2c	9:00	65°37.74	33°50.97	81	10381	4280	Eot
4-Sep	248	2c				82	10382	4281	Bot
4-Sep	248	2c	9:34	65°39.284	33°54.974	82	10477	4333	Eot
4-Sep	248	2c				83	10478	4334	Bot
4-Sep	248	2c	9:52	65°40.13	33°58.18	83	10530	4386	Eot
4-Sep	248	2c				84	10531	4387	Bot
4-Sep	248	2c	10:10	65°41.51	33°59.56	84	10584	4439	Eot
4-Sep	248	2c				85	10585	4440	Bot
4-Sep	248	2c	10:29	65°42.05	34°01.96	85	10637	4492	Eot
4-Sep	248	2c				86	10638	4493	Bot
4-Sep	248	2c	10:49	65°43.05	34°04.16	86	10694	4545	Eot
4-Sep	248	2c				87	10695	4546	Bot
4-Sep	248	2c	11:12	65°44.17	34°07.08	87	10759	4598	Eot
4-Sep	248	2c				88	10760	4599	Bot
4-Sep	248	2c	11:39	65°45.59	34°10.82	88	10837	4651	Eot
4-Sep	248	2c				89	10838	4652	Bot
4-Sep	248	2c	11:59	65°46.66	34°13.30	89	10894	4704	Eot
4-Sep	248	2c				90	10895	4705	Bot
4-Sep	248	2c	12:17	65°47.69	34°15.67	90	10947	4757	Eot
4-Sep	248	2c				91	10948	4758	Bot
4-Sep	248	2c	12:37	65°48.78	34°18.64	91	11004	4810	Eot
4-Sep	248	2c				92	11008	4811	Bot

Sigma 1996 Transect II

Seismic Recording LOG

					Shot rate:21secs +/- 1 for 16sec				Channels:160 Aux. channels:4
					Sample rate:2ms				Number of guns:20 Pressure 2000psi
Date	J.Day	Line	GMT	Latitude	Longitude	Tape #	Shot #	File #	Comments
4-Sep	248	2c				92			Eot Tape #92 was partically
4-Sep	248	2c				93			Bot recorded in conjunction with
4-Sep	248	2c	13:43	65°52.55	34°29.12	93	11191	3947	Eot #93, end and beginning shot
4-Sep	248	2c				94/76b	11193	3948	Bot numbers were not given.
4-Sep	248	2c	14:03	65°53.48	34°30.43	94/76b	11250	3999	Eot Rebooting created new tape
4-Sep	248	2c				95/77b	11251	4000	Bot numbers so that #93 is75b,
4-Sep	248	2c	14:23	65°54.79	34°33.80	95/77b	11305	4052	Eot #94/76b, 95/77b, ...
4-Sep	248	2c				96/78b	11306	4053	Bot
4-Sep	248	2c	14:41	65°55.84	34°36.78	96/78b	11359	4105	Eot
4-Sep	248	2c				97/79b	11360	4106	Bot
4-Sep	248	2c	15:05	65°57.01	34°40.08	97/79b	11426	4158	Eot
4-Sep	248	2c				98/80b	11427	4159	Bot
4-Sep	248	2c		65°58.10	34°42.90	98/80b	11488	4207	Eot
4-Sep	248	2c				97b			Bot At this point the computer
4-Sep	248	2c	15:54	65°59.46	34°46.30	97b	11566	3962	Eot gave a new tape number-97b
4-Sep	248	2c				98b	11567	3963	Bot the tape numbers continue on
4-Sep	248	2c	16:15	65°00.37	34°48.81	98b	11625	4015	Eot consecutively, 98, 99, 100, . . .
4-Sep	248	2c				99	11626	4016	Bot
4-Sep	248	2c	16:36	65°01.37	34°51.43	99	11686	4068	Eot
4-Sep	248	2c				100	11687	4069	Bot
4-Sep	248	2c	16:56	65°02.18	34°53.98	100	11745	4121	Eot
4-Sep	248	2c				101	11746	4122	Bot
4-Sep	248	2c	17:26	66°03.56	34°57.34	101	11829	4174	Eot
4-Sep	248	2c				102	11830	4175	Bot
4-Sep	248	2c	17:45	66°04.40	34°59.53	102	11882	4227	Eot
4-Sep	248	2c				103	11883	4228	Bot
4-Sep	248	2c	18:03	66°05.244	35°01.673	103	11935	4280	Eot
4-Sep	248	2c				104	11936	4281	Bot
4-Sep	248	2c	18:22	66°06.182	35°03.918	104	11988	4333	Eot
4-Sep	248	2c				105	11989	4334	Bot
4-Sep	248	2c	18:40	66°07.136	35°06.687	105	12041	4386	Eot
4-Sep	248	2c				106	12042	4387	Bot

Sigma 1996 Transect II

Seismic Recording LOG

Shot rate:21secs +/- 1 for 16sec

Sample rate:2ms

Channels:160 Aux. channels:4

Number of guns:20 Pressure 2000psi

Date	J.Day	Line	GMT	Latitude	Longitude	Tape #	Shot #	File #	Comments
4-Sep	248	2c	18:59	66°08.123	35°08.973	106	12094	4439	Eot
4-Sep	248	2c				107	12095	4440	Bot
4-Sep	248	2c	19:10	66°08.943	35°10.365	107	12127	4472	Eot, eol line 2c
4-Sep	248	2e	21:42	66°07.574	35°08.735	108	20000	4500	Bot, bol line 2e
4-Sep	248	2e	22:01	66°07.0040	35°06.4430	108	20052	4552	Eot
4-Sep	248	2e				109	20053	4553	Bot
4-Sep	248	2e	22:20	66°06.0907	35°04.2296	109	20105	4605	Eot
4-Sep	248	2e				110	20106	4606	Bot
4-Sep	248	2e	22:39	66°05.2982	35°01.6608	110	20158	4658	Eot
4-Sep	248	2e				111	20159	4659	Bot
4-Sep	248	2e	22:57	66°04.4511	34°59.1906	111	20211	4711	Eot
4-Sep	248	2e				112	20212	4712	Bot
4-Sep	248	2e	23:17	66°03.4651	34°56.5284	112	20268	4764	Eot
4-Sep	248	2e				113	20269	4765	Bot
4-Sep	248	2e	23:36	66°02.5002	34°53.8597	113	20324	4817	Eot
4-Sep	248	2e				114	20325	4818	Bot
4-Sep	248	2e	23:57	66°01.4043	34°50.9851	114	20384	4870	Eot
4-Sep	248	2e				115	20385	4871	Bot
5-Sep	249	2e	0:17	66°00.4715	34°48.2177	115	20440	4923	Eot
5-Sep	249	2e				116	20441	4924	Bot
5-Sep	249	2e	0:36	65°59.6587	34°45.5669	116	20493	4976	Eot
5-Sep	249	2e				117	20494	4977	Bot
5-Sep	249	2e	0:54	65°58.8552	34°43.0289	117	20546	5029	Eot
5-Sep	249	2e				118	20547	5030	Bot
5-Sep	249	2e	1:13	65°57.7593	34°41.1420	118	20599	5082	Eot
5-Sep	249	2e				119	20600	5083	Bot
5-Sep	249	2e	1:31	65°56.7708	34°39.0161	119	20652	5135	Eot
5-Sep	249	2e				120	20653	5136	Bot
5-Sep	249	2e	1:52	65°55.7255	34°38.5912	120	20711	5188	Eot
5-Sep	249	2e				121	20712	5189	Bot
5-Sep	249	2e	2:21	65°54.328	34°32.792	121	20797	5239	Eot (eot errors, not recorded)
5-Sep	249	2e				122	20807	4500	Bot

Sigma 1996 Transect II

Seismic Recording LOG

					Shot rate:21secs +/- 1 for 16sec				Channels:160 Aux. channels:4
					Sample rate:2ms				Number of guns:20 Pressure 2000psi
Date	J.Day	Line	GMT	Latitude	Longitude	Tape #	Shot #	File #	Comments
5-Sep	249	2e	2:58	65°52.527	34°27.911	122	20900	4530	Eot
5-Sep	249	2e				123	20901	4531	Bot
5-Sep	249	2e	3:13	65°51.895	34°26.268	123	20927	4551	Eot (eot errors, not recorded)
5-Sep	249	2e	3:20	65°51.572	34°25.421	124	20961	4500	Bot
5-Sep	249	2e	3:48	65°49.996	34°21.713	124	21042	4531	Eot
5-Sep	249	2e				125	21044	4532	Bot
5-Sep	249	2e	4:14	65°48.858	34°18.797	125	21117	4552	Eot
5-Sep	249	2e				126	21118	4553	Bot
5-Sep	249	2e	4:26	65°48.421	34°17.764	126	21129	4561	Eot
5-Sep	249	2e	4:31	65°48.071	34°16.914	127	21166	4500	Bot
5-Sep	249	2e	4:56	65°46.863	34°13.801	127	21237	4552	Eot
5-Sep	249	2e				128	21238	4553	Bot
5-Sep	249	2e	5:14	65°46.041	34°11.724	128	21290	4605	Eot
5-Sep	249	2e				129	21291	4606	Bot
5-Sep	249	2e	5:33	65°45.114	34°09.446	129	21343	4658	Eot
5-Sep	249	2e				130	21344	4659	Bot
5-Sep	249	2e	5:52	65°44.275	34°07.126	130	21396	4711	Eot
5-Sep	249	2e				131	21397	4712	Bot
5-Sep	249	2e	6:15	65°43.100	34°04.213	131	21455	4764	Eot
5-Sep	249	2e				132	21456	4765	Bot
5-Sep	249	2e	6:38	65°41.975	34°01.429	132	21526	4817	Eot
5-Sep	249	2e				133	21527	4818	Bot
5-Sep	249	2e	6:57	65°40.906	33°58.958	133	21583	4870	Eot
5-Sep	249	2e				134	21584	4871	Bot
5-Sep	249	2e	7:17	65°39.886	33°56.412	134	21638	4923	Eot
5-Sep	249	2e				135	21639	4924	Bot
5-Sep	249	2e	7:37	65°38.933	33°53.680	135	21691	4976	Eot
5-Sep	249	2e				136	21692	4977	Bot
5-Sep	249	2e	7:53	65°37.991	33°51.319	136	21744	5029	Eot
5-Sep	249	2e				137	21745	5030	Bot
5-Sep	249	2e	8:12	65°36.944	33°48.972	137	21797	5082	Eot
5-Sep	249	2e				138	21798	5083	Bot

Sigma 1996 Transect II

Seismic Recording LOG

Shot rate:21secs +/- 1 for 16sec
Sample rate:2ms

Channels:160 Aux. channels:4
Number of guns:20 Pressure 2000psi

Date	J.Day	Line	GMT	Latitude	Longitude	Tape #	Shot #	File #	Comments
5-Sep	249	2e	8:28	65°36.010	33°46.766	138	21842	5127	Eot, eol line 2e

Sigma 1996 Transect II

Seismic Recording LOG

					Shot rate:73 +/-1 sec				Channels:--- Aux. channels:--
					Sample rate:--				Number of guns:20 Pressure 2000psi
Date	**J.Day**	**Line**	**GMT**	**Latitude**	**Longitude**	**Tape #**	**Shot #**	**File #**	**Comments**
5-Sep	249	2f	21:23	66°08.65	35°09.43		30001		SOL Line 2f Airguns only
5-Sep	249	2f	23:37	66°00.55	34°46.57		30104		Eol line 2f
6-Sep	250	2g	4:38	66°02.48	34°34.8		30241		SOL LINE 2G Airguns only
7-Sep	251	2g	9:22	64°19.83	30°49.77		31658		EOL LINE 2G

Sigma 1996 Transect I

Seismic Recording Log

Shot rate:21secs +/- 1 for 16sec
Sample rate:2ms

Channels:160 Aux. channels:4
Number of guns:20 Pressure 2000psi

Date	J.Day	Line	GMT	Latitude	Longitude	Tape #	Shot #	File #	Comments
11-Sep	255	1b	11:18	66°00.92	27°33.73	140	1	1	Bot, Sol 1b
11-Sep	255	1b	11:23	66°01.04	27°32.37	140	17	17	Eot
11-Sep	255	1b				141	18	18	Bot
11-Sep	255	1b	11:43	66°01.37	27°29.80	141	72	72	Eot
11-Sep	255	1b				142	73	73	Bot
11-Sep	255	1b	12:02	66°01.98	27°26.74	142	128	128	Eot
11-Sep	255	1b				143	129	129	Bot
11-Sep	255	1b	12:22	66°02.53	27°24.02	143	184	184	Eot
11-Sep	255	1b				144	185	185	Bot
11-Sep	255	1b	12:41	66°03.14	27°21.24	144	240	240	Eot
11-Sep	255	1b				145	241	241	Bot
11-Sep	255	1b	13:01	66°03.81	27°18.50	145	296	296	Eot
11-Sep	255	1b				146	297	297	Bot
11-Sep	255	1b	13:21	66°04.27	27°15.39	146	352	352	Eot
11-Sep	255	1b				147	353	353	Bot
11-Sep	255	1b	13:40	66°04.67	27°12.27	147	408	408	Eot
11-Sep	255	1b				148	409	409	Bot
11-Sep	255	1b	14:00	66°05.14	27°08.95	148	464	464	Eot
11-Sep	255	1b				149	465	465	Bot
11-Sep	255	1b	14:15	66°05.59	27°05.48	149	520	520	Eot
11-Sep	255	1b				150	521	521	Bot
11-Sep	255	1b	14:39	66°06.06	27°02.22	150	576	576	Eot
11-Sep	255	1b				151	577	577	Bot
11-Sep	255	1b	14:59	66°06.48	26°58.98	151	632	632	Eot
11-Sep	255	1b				152	633	633	Bot
11-Sep	255	1b	15:09	66°06.76	26°56.98	152	688	688	Eot
11-Sep	255	1b				153	689	689	Bot
11-Sep	255	1b	15:37	66°07.38	26°52.29	153	744	744	Eot
11-Sep	255	1b				154	745	745	Bot
11-Sep	255	1b	15:58	66°08.65	26°51.46	154	800	800	Eot
11-Sep	255	1b				155	801	801	Bot
11-Sep	255	1b	16:17	66°09.44	26°54.69	155	856	856	Eot

Sigma 1996 Transect I

Seismic Recording Log

					Shot rate:21secs +/- 1 for 16sec				Channels:160 Aux. channels:4
					Sample rate:2ms				Number of guns:20 Pressure 2000psi
Date	J.Day	Line	GMT	Latitude	Longitude	Tape #	Shot #	File #	Comments
11-Sep	255	1b				156	857	857	Bot
11-Sep	255	1b	16:37	66°10.15	26°58.18	156	912	912	Eot
11-Sep	255	1b				157	913	913	Bot
11-Sep	255	1b	16:56	66°10.84	27°02.64	157	968	968	Eot
11-Sep	255	1b				158	969	969	Bot
11-Sep	255	1b	17:16	66°11.59	27°07.18	158	1024	1024	Eot
11-Sep	255	1b				159	1025	1025	Bot
11-Sep	255	1b	17:36	66°12.38	27°11.43	159	1080	1080	Eot
11-Sep	255	1b				160	1081	1081	Bot
11-Sep	255	1b	17:55	66°13.20	27°19.96	160	1136	1136	Eot
11-Sep	255	1b				161	1137	1137	Bot
11-Sep	255	1b	18:15	66°13.88	27°20.07	161	1192	1192	Eot
11-Sep	255	1b				162	1193	1193	Bot
11-Sep	255	1b	18:34	66°14.61	27°24.27	162	1248	1248	Eot
11-Sep	255	1b				163	1249	1249	Bot
11-Sep	255	1b	18:53	66°15.29	27°28.43	163	1304	1304	Eot
11-Sep	255	1b				164	1305	1305	Bot
11-Sep	255	1b	19:13	66°15.8890	27°31.9378	164	1360	1360	Eot
11-Sep	255	1b				165	1361	1361	Bot
11-Sep	255	1b	19:33	66°16.59	27°35.98	165	1416	1416	Eot
11-Sep	255	1b				166	1417	1417	Bot
11-Sep	255	1b	19:53	66°17.18	27°39.60	166	1472	1472	Eot
11-Sep	255	1b				167	1473	1473	Bot
11-Sep	255	1b	20:12	66°17.81	27°43.24	167	1528	1528	Eot
11-Sep	255	1b				168	1529	1529	Bot
11-Sep	255	1b	20:31	66°18.40	27°46.72	168	1584	1584	Eot
11-Sep	255	1b				169	1585	1585	Bot
11-Sep	255	1b	20:51	66°18.96	27°50.14	169	1640	1640	Eot
11-Sep	255	1b				170	1641	1641	Bot
11-Sep	255	1b	21:11	66°19.55	27°53.55	170	1696	1696	Eot
11-Sep	255	1b				171	1697	1697	Bot
11-Sep	255	1b	21:30	66°20.12	27°57.18	171	1752	1752	Eot

Sigma 1996 Transect I

Seismic Recording Log

					Shot rate:21secs +/- 1 for 16sec				Channels:160 Aux. channels:4
					Sample rate:2ms				Number of guns:20 Pressure 2000psi
Date	J.Day	Line	GMT	Latitude	Longitude	Tape #	Shot #	File #	Comments
11-Sep	255	1b				172	1753	1753	Bot
11-Sep	255	1b	21:50	66°20.6803	28°00.4510	172	1808	1808	Eot
11-Sep	255	1b				173	1809	1809	Bot
11-Sep	255	1b	22:10	66°21.3054	28°04.1154	173	1864	1864	Eot
11-Sep	255	1b				174	1865	1865	Bot
11-Sep	255	1b	22:30	66°21.9168	28°07.7852	174	1920	1920	Eot
11-Sep	255	1b				175	1921	1921	Bot
11-Sep	255	1b	22:49	66°22.5365	28°11.5624	175	1976	1976	Eot
11-Sep	255	1b				176	1977	1977	Bot
11-Sep	255	1b	23:09	66°23.1529	28°15.3257	176	2032	2032	Eot
11-Sep	255	1b				177	2033	2033	Bot
11-Sep	255	1b	23:28	66°23.7764	28°19.1428	177	2088	2088	Eot
11-Sep	255	1b				178	2089	2089	Bot
11-Sep	255	1b	23:48	66°24.3912	28°22.9386	178	2144	2144	Eot
11-Sep	255	1b				179	2145	2145	Bot
12-Sep	256	1b	0:08	66°25.0020	28°26.6061	179	2200	2200	Eot
12-Sep	256	1b				180	2201	2201	Bot
12-Sep	256	1b	0:27	66°25.5539	28°30.1776	180	2256	2256	Eot
12-Sep	256	1b				181	2257	2257	Bot
12-Sep	256	1b	0:47	66°26.1512	28°33.8195	181	2312	2312	Eot
12-Sep	256	1b				182	2313	2313	Bot
12-Sep	256	1b	1:06	66°26.6790	28°37.2497	182	2368	2368	Eot
12-Sep	256	1b				183	2369	2369	Bot
12-Sep	256	1b	1:26	66°27.2837	28°40.895	183	2424	2424	Eot
12-Sep	256	1b				184	2425	2425	Bot
12-Sep	256	1b	1:46	66°27.7697	28°44.6137	184	2480	2480	Eot
12-Sep	256	1b				185	2481	2481	Bot
12-Sep	256	1b	2:05	66°28.371	28°48.415	185	2536	2536	Eot
12-Sep	256	1b				186	2537	2537	Bot
12-Sep	256	1b	2:25	66°29.039	28°52.157	186	2592	2592	Eot
12-Sep	256	1b				187	2593	2593	Bot
12-Sep	256	1b	2:44	66°29.719	28°56.132	187	2648	2648	Eot

Sigma 1996 Transect I

Seismic Recording Log

Shot rate:21secs +/- 1 for 16sec

Sample rate:2ms

Channels:160 Aux. channels:4

Number of guns:20 Pressure 2000psi

Date	J.Day	Line	GMT	Latitude	Longitude	Tape #	Shot #	File #	Comments
12-Sep	256	1b				188	2649	2649	Bot
12-Sep	256	1b	3:04	66°30.362	29°00.248	188	2704	2704	Eot
12-Sep	256	1b				189	2705	2705	Bot
12-Sep	256	1b	3:24	66°30.983	29°04.374	189	2760	2760	Eot
12-Sep	256	1b				190	2761	2761	Bot
12-Sep	256	1b	3:43	66°31.574	29°08.267	190	2816	2816	Eot
12-Sep	256	1b				191	2817	2817	Bot
12-Sep	256	1b	4:03	66°32.209	29°12.512	191	2872	2872	Eot
12-Sep	256	1b				192	2873	2873	Bot
12-Sep	256	1b	4:22	66°33.000	29°17.421	192	2928	2928	Eot
12-Sep	256	1b				193	XX	XX	Bot No data on tape
12-Sep	256	1b				193	XX	XX	Eot No data on tape
12-Sep	256	1b				194	XX	XX	Bot No data on tape
12-Sep	256	1b				194	XX	XX	Eot No data on tape
12-Sep	256	1b				195	XX	XX	Bot No data on tape
12-Sep	256	1b				195	XX	XX	Eot No data on tape
12-Sep	256	1b				196	XX	XX	Bot No data on tape
12-Sep	256	1b				196	XX	XX	Eot No data on tape
12-Sep	256	1b	4:23	66°33.000	29°17.421	197	2933	2932	Bot
12-Sep	256	1b	4:43	66°33.458	29°20.300	197	2987	2987	Eot
12-Sep	256	1b				198	2988	2988	Bot
12-Sep	256	1b	5:03	66°34.032	29°24.075	198	3043	3043	Eot
12-Sep	256	1b				199	3044	3044	Bot
12-Sep	256	1b	5:22	66°34.588	29°28.034	199	3099	3099	Eot
12-Sep	256	1b				200	3100	3100	Bot
12-Sep	256	1b	5:42	66°35.260	29°32.441	200	3156	3155	Eot
12-Sep	256	1b				201	3157	3156	Bot
12-Sep	256	1b	6:02	66°35.707	29°35.388	201	3212	3211	Eot
12-Sep	256	1b				202	3213	3212	Bot
12-Sep	256	1b	6:22	66°36.202	29°39.381	202	3268	3267	Eot
12-Sep	256	1b				203	3269	3268	Bot
12-Sep	256	1b	6:41	66°36.912	29°43.025	203	3324	3323	Eot

Sigma 1996 Transect I

Seismic Recording Log

					Shot rate:21secs +/- 1 for 16sec				Channels:160 Aux. channels:4
					Sample rate:2ms				Number of guns:20 Pressure 2000psi
Date	**J.Day**	**Line**	**GMT**	**Latitude**	**Longitude**	**Tape #**	**Shot #**	**File #**	**Comments**
12-Sep	256	1b				204	3325	3324	Bot
12-Sep	256	1b	7:01	66°37.447	29°46.611	204	3380	3379	Eot
12-Sep	256	1b				205	3381	3380	Bot
12-Sep	256	1b	7:20	66°38.018	29°50.398	205	3436	3435	Eot
12-Sep	256	1b				206	3437	3436	Bot
12-Sep	256	1b	7:40	66°38.593	29°54.379	206	3492	3441	Eot
12-Sep	256	1b				207	3493	3442	Bot
12-Sep	256	1b	8:00	66°39.198	29°58.328	207	3548	3547	Eot
12-Sep	256	1b				208	3549	3548	Bot
12-Sep	256	1b	8:20	66°39.787	30°02.203	208	3604	3603	Eot
12-Sep	256	1b				209	3605	3604	Bot
12-Sep	256	1b	8:39	66°40.341	30°05.960	209	3660	3659	Eot
12-Sep	256	1b				210	3661	3660	Bot
12-Sep	256	1b	8:58	66°40.913	30°09.870	210	3715	3714	Eot
12-Sep	256	1b				211	3716	3715	Bot
12-Sep	256	1b	9:18	66°41.473	30°13.573	211	3772	3771	Eot
12-Sep	256	1b				212	3773	3772	Bot
12-Sep	256	1b	9:37	66°42.102	30°17.840	212	3828	3827	Eot
12-Sep	256	1b				213	3829	3828	Bot
12-Sep	256	1b	9:57	66°42.550	30°21.160	213	3884	3883	Eot
12-Sep	256	1b				214	3885	3884	Bot
12-Sep	256	1b	10:15	66°43.120	30°24.740	214	3940	3939	Eot
12-Sep	256	1b				215	3941	3940	Bot
12-Sep	256	1b	10:36	66°43.64	30°28.41	215	3996	3995	Eot
12-Sep	256	1b				216	3997	3996	Bot
12-Sep	256	1b	10:56	66°44.19	30°32.36	216	4052	4051	Eot
12-Sep	256	1b				217	4053	4052	Bot
12-Sep	256	1b	11:15	66°44.75	30°36.11	217	4108	4107	Eot
12-Sep	256	1b				218	4109	4108	Bot
12-Sep	256	1b	11:35	66°45.29	30°39.86	218	4164	4163	Eot
12-Sep	256	1b				219	4165	4164	Bot
12-Sep	256	1b	11:54	66°45.87	30°43.81	219	4220	4219	Eot

Sigma 1996 Transect I

Seismic Recording Log

					Shot rate:21secs +/- 1 for 16sec				Channels:160 Aux. channels:4
					Sample rate:2ms				Number of guns:20 Pressure 2000psi
Date	J.Day	Line	GMT	Latitude	Longitude	Tape #	Shot #	File #	Comments
12-Sep	256	1b				220	4221	4220	Bot
12-Sep	256	1b	12:14	66°46.41	30°47.78	220	4276	4275	Eot
12-Sep	256	1b				221	4277	4276	Bot
12-Sep	256	1b	12:34	66°46.94	30°51.69	221	4332	4331	Eot
12-Sep	256	1b				222	4333	4332	Bot
12-Sep	256	1b	12:53	66°47.51	30°55.59	222	4388	4387	Eot
12-Sep	256	1b				223	4389	4388	Bot
12-Sep	256	1b	13:13	66°48.07	30°59.49	223	4444	4443	Eot
12-Sep	256	1b				224	4445	4444	Bot
12-Sep	256	1b	13:32	66°48.58	31°03.33	224	4500	4499	Eot
12-Sep	256	1b				225	4501	4500	Bot
12-Sep	256	1b	13:52	66°49.15	31°07.11	225	4556	4555	Eot
12-Sep	256	1b				226	4557	4556	Bot
12-Sep	256	1b	14:11	66°49.74	31°11.27	226	4612	4611	Eot
12-Sep	256	1b				227	4613	4612	Bot
12-Sep	256	1b	14:31	66°50.22	31°15.07	227	4669	4667	Eot
12-Sep	256	1b				228	4670	4668	Bot
12-Sep	256	1b	14:51	66°50.78	31°19.00	228	4725	4723	Eot
12-Sep	256	1b				229	4726	4724	Bot
12-Sep	256	1b	15:11	66°51.32	31°22.88	229	4781	4779	Eot
12-Sep	256	1b				230	4782	4780	Bot
12-Sep	256	1b	15:30	66°51.85	31°26.89	230	4837	4835	Eot
12-Sep	256	1b				231	4838	4836	Bot
12-Sep	256	1b	15:50	66°52.43	31°30.88	231	4893	4891	Eot
12-Sep	256	1b				232	4894	4892	Bot
12-Sep	256	1b	16:09	66°52.90	31°34.63	232	4949	4947	Eot
12-Sep	256	1b				233	4950	4948	Bot
12-Sep	256	1b	16:29	66°53.47	31°38.33	233	5005	5003	Eot
12-Sep	256	1b				234	5006	5004	Bot
12-Sep	256	1b	16:49	66°53.90	31°42.26	234	5061	5059	Eot
12-Sep	256	1b				235	5062	5060	Bot
12-Sep	256	1b	17:08	66°54.43	31°45.91	235	5117	5115	Eot

Sigma 1996 Transect I

Seismic Recording Log

					Shot rate:21secs +/- 1 for 16sec Sample rate:2ms				Channels:160 Aux. channels:4 Number of guns:20 Pressure 2000psi
Date	J.Day	Line	GMT	Latitude	Longitude	Tape #	Shot #	File #	Comments
12-Sep	256	1b				236	5118	5116	Bot
12-Sep	256	1b	17:28	66°54.99	31°49.80	236	5173	5171	Eot
12-Sep	256	1b				237	5174	5172	Bot
12-Sep	256	1b	17:47	66°55.47	31°53.54	237	5229	5227	Eot
12-Sep	256	1b				238	5230	5228	Bot
12-Sep	256	1b	18:07	66°55.98	31°57.34	238	5285	5283	Eot
12-Sep	256	1b				239	5286	5284	Bot
12-Sep	256	1b	18:27	66°56.45	32°01.11	239	5341	5339	Eot
12-Sep	256	1b				240	5342	5340	Bot
12-Sep	256	1b	18:46	66°56.99	32°04.87	240	5397	5395	Eot
12-Sep	256	1b				241	5398	5396	Bot
12-Sep	256	1b	19:06	66°57.48	32°08.83	241	5453	5451	Eot
12-Sep	256	1b				242	5454	5452	Bot
12-Sep	256	1b	19:26	66°57.96	32°12.37	242	5510	5507	Eot
12-Sep	256	1b				243	5511	5508	Bot
12-Sep	256	1b	19:45	66°58.54	32°16.64	243	5566	5563	Eot
12-Sep	256	1b				244	5567	5564	Bot
12-Sep	256	1b	20:05	66°59.04	32°20.62	244	5622	5619	Eot
12-Sep	256	1b				245	5623	5620	Bot
12-Sep	256	1b	20:25	66°59.56	32°24.62	245	5678	5675	Eot
12-Sep	256	1b				246	5679	5676	Bot
12-Sep	256	1b	20:44	67°00.12	32°28.71	246	5734	5731	Eot
12-Sep	256	1b				247	5735	5732	Bot
12-Sep	256	1b	21:05	67°00.62	32°32.88	247	5792	5787	Eot
12-Sep	256	1b				248	5793	5788	Bot
12-Sep	256	1b	21:24	67°01.63	32°36.80	248	5848	5843	Eot
12-Sep	256	1b				249	5849	5844	Bot
12-Sep	256	1b	21:44	67°01.63	32°40.51	249	5904	5899	Eot
12-Sep	256	1b				250	5905	5900	Bot
12-Sep	256	1b	22:04	67°02.0755	32°44.0238	250	5960	5955	Eot
12-Sep	256	1b				251	5961	5956	Bot
12-Sep	256	1b	22:13	67°02.4433	32°45.6297	251	5987	5982	Eot, Eol line 1b

Sigma 1996 Transect I

Seismic Recording Log

					Shot rate:21 +/- 1 sec				Channels:160 Aux. channels:8
					Sample rate:2ms				Number of guns:20 Pressure 2000psi
Date	J.Day	Line	GMT	Latitude	Longitude	Tape #	Shot #	File #	Comments
14-Sep	258	1c	15:38	66°16.456	27°37.315		6000		SOL LINE 1c Airgun only
14-Sep	258	1c	21:45	66°06.843	26°33.382	252	7050	7050	Sonoboy Recording Enabled
14-Sep	258	1c	22:27	66°05.646	26°24.938	252	7168	7168	Eot
14-Sep	258	1c				253	7169	7169	Bot
15-Sep	259	1c	2:50	65°58.274	25°32.587	253	7918	7918	Eot
15-Sep	259	1c				254	7919	7919	Bot
15-Sep	259	1c	6:27	65°51.657	~~65°51.588~~ 24°53.1708	254	8538	8538	Eol Line 1c

Sigma 1996 Transect III

Seismic Recording LOG

					Shot rate:21secs +/- 1 for 16sec				Channels:160 Aux. channels:4
					Sample rate:2ms				Number of guns:20 Pressure 2000psi
Date	J.Day	Line	GMT	Latitude	Longitude	Tape #	Shot #	File #	Comments
20-Sep	264	3	18:08	62° 04.49	35° 48.16	260	100	1	start of line 3
20-Sep	264	3	18:28	62° 05.54	35° 51.07	260	155	56	EOT
20-Sep	264	3				261	156	57	BOT
20-Sep	264	3	18:47	62° 06.63	35° 53.56	261	211	112	EOT
20-Sep	264	3				262	212	113	BOT
20-Sep	264	3	19:07	62° 07.63	35° 56.34	262	267	168	EOT
20-Sep	264	3				263	268	169	BOT
20-Sep	264	3	19:27	62° 08.63	35° 58.34	263	323	224	EOT
20-Sep	264	3				264	324	225	BOT
20-Sep	264	3	19:48	62° 09.70	36° 01.91	264	379	280	EOT
20-Sep	264	3				265	380	281	BOT
20-Sep	264	3	20:06	62° 10.67	36° 04.40	265	435	336	EOT
20-Sep	264	3				266	436	337	BOT
20-Sep	264	3	20:25	62° 11.68	36° 07.06	266	491	392	EOT
20-Sep	264	3				267	492	393	BOT
20-Sep	264	3	20:45	62° 12.59	36° 09.51	267	547	448	EOT
20-Sep	264	3				268	548	449	BOT
20-Sep	264	3	21:04	62°13.58	36° 12.38	268	603	504	EOT
20-Sep	264	3				269	604	505	BOT
20-Sep	264	3	21:24	62° 14.62	36° 15.14	269	659	560	EOT
20-Sep	264	3				270	660	561	BOT
20-Sep	264	3	21:44	62° 15.70	36° 17.93	270	715	616	EOT
20-Sep	264	3				271	716	617	BOT
20-Sep	264	3	22:04	62° 16.65	36° 20.55	271	771	672	EOT
20-Sep	264	3				272	772	673	BOT
20-Sep	264	3	22:23	62° 17.64	36° 23.08	272	827	728	EOT
20-Sep	264	3				273	828	729	BOT
20-Sep	264	3	22:43	62° 18.64	36° 25.82	273	883	784	EOT
20-Sep	264	3				274	884	785	BOT
20-Sep	264	3	23:02	62°19.6389	36° 28.5581	274	939	840	EOT
20-Sep	264	3				275	940	841	BOT
20-Sep	264	3	23:22	62°20.676	36°31.310	275	995	896	EOT

Sigma 1996 Transect III

Seismic Recording LOG

					Shot rate:21secs +/- 1 for 16sec				Channels:160 Aux. channels:4
					Sample rate:2ms				Number of guns:20 Pressure 2000psi
Date	J.Day	Line	GMT	Latitude	Longitude	Tape #	Shot #	File #	Comments
20-Sep	264	3	23:22			276	996	897	BOT
20-Sep	264	3	23:42	62°21.6436	36°33.8885	276	1051	952	EOT
20-Sep	264	3				277	1052	953	BOT
21-Sep	265	3	0:01	62°22.6416	36°36.6289	277	1107	1008	EOT
21-Sep	265	3				278	1108	1009	BOT
21-Sep	265	3	0:21	62°23.5901	36°39.2933	278	1163	1064	EOT
21-Sep	265	3				279	1164	1065	BOT
21-Sep	265	3	0:40	62°24.5520	36°41.8081	279	1219	1120	EOT
21-Sep	265	3				280	1220	1121	BOT
21-Sep	265	3	1:00	62°25.4994	36°44.4748	280	1275	1176	EOT
21-Sep	265	3				281	1276	1177	BOT
21-Sep	265	3	1:20	62°26.5223	36°47.2120	281	1331	1232	EOT
21-Sep	265	3				282	1332	1233	BOT
21-Sep	265	3	1:39	62°27.5174	36°49.9687	282	1387	1288	EOT
21-Sep	265	3				283	1388	1289	BOT
21-Sep	265	3	1:59	62°28.5643	36°52.7213	283	1443	1344	EOT
21-Sep	265	3				284	1444	1345	BOT
21-Sep	265	3	2:18	62°29.592	36°55.575	284	1499	1400	EOT
21-Sep	265	3				285	1500	1401	BOT
21-Sep	265	3	2:38	62°30.607	36°58.313	285	1555	1456	EOT
21-Sep	265	3				286	1556	1457	BOT
21-Sep	265	3	2:57	62°31.557	37°00.973	286	1611	1512	EOT
21-Sep	265	3				287	1612	1513	BOT
21-Sep	265	3	3:17	62°32.546	37°03.495	287	1667	1568	EOT
21-Sep	265	3				288	1668	1569	BOT
21-Sep	265	3	3:37	62°33.469	37°06.070	288	1723	1624	EOT
21-Sep	265	3				289	1724	1625	BOT
21-Sep	265	3	3:56	62°34.405	37°08.678	289	1779	1680	EOT
21-Sep	265	3				290	1781	1682	BOT
21-Sep	265	3	4:16	62°35.324	37°11.279	290	1835	1736	EOT
21-Sep	265	3				291	1836	1737	BOT
21-Sep	265	3	4:35	62°36.235	37°13.860	291	1891	1792	EOT

Sigma 1996 Transect III

Seismic Recording LOG

					Shot rate:21secs +/- 1 for 16sec				Channels:160 Aux. channels:4
					Sample rate:2ms				Number of guns:20 Pressure 2000psi
Date	J.Day	Line	GMT	Latitude	Longitude	Tape #	Shot #	File #	Comments
21-Sep	265	3	4:35	62°36.235	37°13.860	292	1892	1793	BOT
21-Sep	265	3	4:56	62°37.266	37°16.699	292	1950	1848	EOT
21-Sep	265	3				293	1951	1849	BOT
21-Sep	265	3	5:16	62°38.038	37°19.042	293	2006	1904	EOT
21-Sep	265	3				294	2007	1905	BOT
21-Sep	265	3	5:35	62°38.962	37°21.455	294	2062	1960	EOT
21-Sep	265	3				295	2063	1961	BOT
21-Sep	265	3	5:55	62°39.902	37°24.030	295	2118	2016	EOT
21-Sep	265	3				296	2119	2017	BOT
21-Sep	265	3	6:15	62°40.907	37°26.867	296	2174	2072	EOT
21-Sep	265	3				297	2175	2073	BOT
21-Sep	265	3	6:35	62°41.823	37°29.425	297	2228	2128	EOT
21-Sep	265	3				298	2229	2129	BOT
21-Sep	265	3	6:53	62°42.745	37°32.040	298	2286	2184	EOT
21-Sep	265	3				299	2287	2285	BOT
21-Sep	265	3	7:13	62°43.640	37°34.631	299	2342	2240	EOT
21-Sep	265	3				300	2343	2241	BOT
21-Sep	265	3	7:33	62°44.516	37°37.063	300	2398	2296	EOT
21-Sep	265	3				301	2399	2297	BOT
21-Sep	265	3	7:52	62°45.355	37°39.468	301	2454	2352	EOT
21-Sep	265	3				302	2455	2353	BOT
21-Sep	265	3	8:12	62°46.401	37°41.401	302	2510	2408	EOT
21-Sep	265	3				303	2511	2409	BOT
21-Sep	265	3	8:32	62°47.184	37°[illegible].538	303	2566	2464	EOT
21-Sep	265	3				304	2567	2465	BOT
21-Sep	265	3	8:52	62°48.081	37°47.211	304	2622	2520	EOT
21-Sep	265	3				305	2623	2521	BOT
21-Sep	265	3	9:11	62°48.974	37°49.840	305	2678	2576	EOT
21-Sep	265	3				306	2679	2577	BOT
21-Sep	265	3	9:31	62°49.917	37°52.471	306	2734	2632	EOT
21-Sep	265	3				307	2765	2633	BOT
21-Sep	265	3	9:50	62°50.815	37°55.099	307	2790	2688	EOT

Sigma 1996 Transect III

Seismic Recording LOG

					Shot rate:21secs +/- 1 for 16sec				Channels:160 Aux. channels:4
					Sample rate:2ms				Number of guns:20 Pressure 2000psi
Date	J.Day	Line	GMT	Latitude	Longitude	Tape #	Shot #	File #	Comments
21-Sep	265	3	9:50	62°50.815	37°55.099	308	2791	2689	BOT
21-Sep	265	3	10:10	62°51.72	37°57.76	308	2846	2744	EOT
21-Sep	265	3				309	2847	2745	BOT
21-Sep	265	3	10:29	62°52.65	38°00.47	309	2902	2800	EOT
21-Sep	265	3				310	2903	2801	BOT
21-Sep	265	3	10:49	62°53.64	38°03.24	310	2958	2856	EOT
21-Sep	265	3				311	2959	2857	BOT
21-Sep	265	3	11:09	62°54.62	38°06.19	311	3014	2912	EOT
21-Sep	265	3				312	3015	2913	BOT
21-Sep	265	3	11:29	62°55.61	38°09.17	312	3070	2968	EOT
21-Sep	265	3				313	3071	2969	BOT
21-Sep	265	3	11:48	62°56.65	38°12.08	313	3126	3024	EOT
21-Sep	265	3				314	3127	3025	BOT
21-Sep	265	3	12:08	62°57.68	38°15.06	314	3182	3080	EOT
21-Sep	265	3				315	3183	3081	BOT
21-Sep	265	3	12:27	62°58.71	38°18.04	315	3238	3136	EOT
21-Sep	265	3				316	3239	3137	BOT
21-Sep	265	3	12:47	62°59.73	38°21.11	316	3294	3192	EOT
21-Sep	265	3				317	3295	3193	BOT
21-Sep	265	3	13:06	63°00.80	38°24.20	317	3350	3248	EOT
21-Sep	265	3				318	3351	3249	BOT
21-Sep	265	3	13:26	63°02.12	38°28.02	318	3406	3304	EOT
21-Sep	265	3				319	3407	3305	BOT
21-Sep	265	3	13:46	63°02.84	38°30.25	319	3462	3360	EOT
21-Sep	265	3				320	3463	3361	BOT
21-Sep	265	3	14:05	63°03.84	38°33.08	320	3518	3416	EOT
21-Sep	265	3				321	3519	3427	BOT
21-Sep	265	3	14:25	63°04.85	38°33.08	321	3574	3472	EOT
21-Sep	265	3				322	3575	3473	BOT
21-Sep	265	3	14:44	63°05.81	38°38.93	322	3630	3528	EOT
21-Sep	265	3				323	3631	3529	BOT
21-Sep	265	3	15:04	63°06.87	38°42.07	323	3686	3584	EOT

Sigma 1996 Transect III

Seismic Recording LOG

					Shot rate:21secs +/- 1 for 16sec				Channels:160 Aux. channels:4
					Sample rate:2ms				Number of guns:20 Pressure 2000psi
Date	J.Day	Line	GMT	Latitude	Longitude	Tape #	Shot #	File #	Comments
21-Sep	265	3	15:04	63°06.87	38°42.07	324	3687	3585	BOT
21-Sep	265	3	15:23	63°07.79	38°44.71	324	3742	3640	EOT
21-Sep	265	3				325	3743	3641	BOT
21-Sep	265	3	15:43	63°08.77	38°47.66	325	3798	3696	EOT
21-Sep	265	3				326	3799	3697	BOT
21-Sep	265	3	16:02	63°09.73	38°49.08	326	3854	3752	EOT
21-Sep	265	3				327	3855	3753	BOT
21-Sep	265	3	16:22	63°10.69	38°53.50	327	3910	3808	EOT
21-Sep	265	3				328	3911	3809	BOT
21-Sep	265	3	16:42	63°11.63	38°56.31	328	3966	3864	EOT
21-Sep	265	3				329	3967	3865	BOT
21-Sep	265	3	17:01	63°12.56	38°59.28	329	4022	3920	EOT
21-Sep	265	3				330	4023	3921	BOT
21-Sep	265	3	17:21	63°13.56	39°02.14	330	4078	3976	EOT
21-Sep	265	3				331	4079	3977	BOT
21-Sep	265	3	17:40	63°14.55	39°04.99	331	4134	4032	EOT
21-Sep	265	3				332	4135	4033	BOT
21-Sep	265	3	18:00	63°15.48	39°07.90	332	4190	4088	EOT
21-Sep	265	3				333	4191	4089	BOT
21-Sep	265	3	18:19	63°16.52	39°11.27	333	4246	4144	EOT
21-Sep	265	3				334	4247	4145	BOT
21-Sep	265	3	18:39	63°17.59	39°14.35	334	4302	4200	EOT
21-Sep	265	3				335	4303	4201	BOT
21-Sep	265	3	18:59	63°18.59	39°17.42	335	4358	4256	EOT
21-Sep	265	3				336	4359	4257	BOT
21-Sep	265	3	19:07	63°18.96	39°18.52	336	4414	4312	EOT
21-Sep	265	3				337	4415	4313	BOT
21-Sep	265	3	19:38	63°20.54	39°23.39	337	4470	4368	EOT
21-Sep	265	3				338	4471	4369	BOT
21-Sep	265	3	19:57	63°21.56	39°26.46	338	4526	4424	EOT
21-Sep	265	3				339	4527	4425	BOT
21-Sep	265	3	20:17	63°22.57	39°29.39	339	4583	4480	EOT

Sigma 1996 Transect III

Seismic Recording LOG

Shot rate:21secs +/- 1 for 16sec | Sample rate:2ms | Channels:160 | Aux. channels:4 | Number of guns:20 | Pressure 2000psi

Date	J.Day	Line	GMT	Latitude	Longitude	Tape #	Shot #	File #	Comments
21-Sep	265	3	20:17	63°22.57	39°29.39	340	4584	4481	BOT
21-Sep	265	3	20:37	63°23.50	39°32.39	340	4639	4536	EOT
21-Sep	265	3				341	4640	4537	BOT
21-Sep	265	3	20:57	63°24.39	39°35.15	341	4695	4592	EOT
21-Sep	265	3				342	4696	4593	BOT
21-Sep	265	3	21:16	63°25.30	39°37.85	342	4751	4648	EOT
21-Sep	265	3				343	4752	4649	BOT
21-Sep	265	3	21:36	63°26.20	39°40.66	343	4807	4704	EOT
21-Sep	265	3				344	4808	4705	BOT
21-Sep	265	3	21:56	63°26.9839	39°43.2048	344	4863	4760	EOT
21-Sep	265	3				345	4864	4761	BOT
21-Sep	265	3	22:15	63°27.8560	39°45.7714	345	4919	4816	EOT
21-Sep	265	3				346	4920	4817	BOT
21-Sep	265	3	22:35	63°28.6804	39°48.3051	346	4975	4872	EOT
21-Sep	265	3				347	4976	4873	BOT
21-Sep	265	3	22:55	63°29.5020	39°50.9048	347	5031	4928	EOT
21-Sep	265	3				348	5032	4929	BOT
21-Sep	265	3	23:14	63°30.2691	39°53.5047	348	5087	4984	EOT
21-Sep	265	3				349	5088	4985	BOT
21-Sep	265	3	23:34	63°31.0205	39°56.1878	349	5143	5040	EOT
21-Sep	265	3				350	5144	5041	BOT
21-Sep	265	3	23:53	63°31.7038	39°58.5852	350	5199	5096	EOT
21-Sep	265	3				351	5200	5097	BOT
22-Sep	266	3	0:13	63°32.3890	40°01.1570	351	5255	5152	EOT
22-Sep	266	3				352	5256	5153	BOT
22-Sep	266	3	0:33	63°33.0919	40°03.0733	352	5311	5208	EOT
22-Sep	266	3				353	5312	5209	BOT
22-Sep	266	3	0:52	63°33.7834	40°04.7510	353	5367	5264	EOT
22-Sep	266	3				354	5368	5265	BOT
22-Sep	266	3	1:12	63°34.4284	40°06.6082	354	5423	5320	EOT
22-Sep	266	3				355	5424	5321	BOT
22-Sep	266	3	1:22	63°34.7519	40°07.3697	355	5452	5349	EOT Forced end of Line 3

Sigma 1996 Transect III

Seismic Recording LOG

					Shot rate:50secs +/- 1				Channels:--- Aux. channels:-
					Sample rate:				Number of guns:20 Pressure 2000psi
Date	J.Day	Line	GMT	Latitude	Longitude	Tape #	Shot #	File #	Comments
22-Sep	266	3b	1:41	63°39.107	40°19.658		6001		Start of line 3b , airgun only
23-Sep	267	3b	9:56	62°30.726	36°58.664		7676		EOL 3b

Sigma 1996 Transect IV

Seismic Recording LOG

					Shot rate:21secs +/- 1 for 16 sec					Channels:160 AUX. channels:4
					Sample rate:2ms					Number of guns:20 Pressure 2000psi
Date	J.Day	Line	GMT	Latitude	Longitude	Tape #	Shot #	File #	Comments
29-Sep	273	4	7:43	59°55.939	45°32.628	356	100	1	Bot
29-Sep	273	4	8:17	59°54.548	45°28.498	356	155	57	Eot
29-Sep	273	4				357	156	58	Bot
29-Sep	273	4	8:36	59°53.934	45°26.042	357	211	112	Eot
29-Sep	273	4				358	212	113	Bot
29-Sep	273	4	8:55	59°53.370	45°26.743	358	267	158	Eot
29-Sep	273	4				359	268	159	Bot
29-Sep	273	4	9:15	59°52.742	45°21.316	359	323	224	Eot
29-Sep	273	4				360	324	225	Bot
29-Sep	273	4	9:35	59°52.103	45°18.549	360	379	280	Eot
29-Sep	273	4				361	380	281	Bot
29-Sep	273	4	9:55	59°51.489	45°16.342	361	435	336	Eot
29-Sep	273	4				362	436	337	Bot
29-Sep	273	4	10:15	59°50.836	45°13.658	362	491	392	Eot
29-Sep	273	4				363	492	393	Bot
29-Sep	273	4	10:34	59°50.099	45°10.824	363	547	448	Eot
29-Sep	273	4				364	548	449	Bot
29-Sep	273	4	10:54	59°49.343	45°07.943	364	603	504	Eot
29-Sep	273	4				365	604	505	Bot
29-Sep	273	4	11:13	59°48.642	45°05.133	365	659	560	Eot
29-Sep	273	4				366	660	561	Bot
29-Sep	273	4	11:33	59°47.915	45°02.170	366	715	616	Eot
29-Sep	273	4				367	716	617	Bot
29-Sep	273	4	11:53	59°47.149	44°59.178	367	771	672	Eot
29-Sep	273	4				368	772	673	Bot
29-Sep	273	4	12:12	59°46.376	44°56.210	368	827	728	Eot
29-Sep	273	4				369	828	729	Bot
29-Sep	273	4	12:32	59°45.488	44°53.282	369	883	784	Eot
29-Sep	273	4				370	884	785	Bot
29-Sep	273	4	12:52	59°44.739	44°50.153	370	939	840	Eot
29-Sep	273	4				371	940	841	Bot
29-Sep	273	4	13:12	59°44.174	44°47.079	371	995	896	Eot

Sigma 1996 Transect IV

Seismic Recording LOG

					Shot rate:21secs +/- 1 for 16 sec				Channels:160 AUX. channels:4
				Sample rate:2ms					Number of guns:20 Pressure 2000psi
Date	J.Day	Line	GMT	Latitude	Longitude	Tape #	Shot #	File #	Comments
29-Sep	273	4	13:12	59°44.174	44°47.079	372	996	897	Bot
29-Sep	273	4	13:31	59°43.416	44°44.370	372	1051	952	Eot
29-Sep	273	4				373	1052	953	Bot
29-Sep	273	4	13:50	59°42.807	44°41.722	373	1096	?	Eot
29-Sep	273	4				374	1111	1009	Bot
29-Sep	273	4	14:00	59°42.483	44°40.528	374	1136	1034	Begin turn to avoid iceberg.
29-Sep	273	4				374	1166	1064	Eot
29-Sep	273	4	14:11	59°42.249	44°39.073	375	1167	1065	BOT
29-Sep	273	4	14:30	59°41.760	44°36.435	375	1222	1120	EOT
29-Sep	273	4				376	1223	1121	BOT
29-Sep	273	4	14:50	59°41.129	44°33.986	376	1278	1176	EOT
29-Sep	273	4				377	1279	1177	BOT
29-Sep	273	4	15:09	59°40.313	44°31.736	377	1334	1232	EOT
29-Sep	273	4				378	1335	1233	BOT
29-Sep	273	4	15:19	59°39.913	44°30.555	378	1361	1259	Back on line after iceberg turn.
29-Sep	273	4	15:29	59°39.578	44°29.356	378	1390	1288	EOT
29-Sep	273	4				379	1391	1289	BOT
29-Sep	273	4	15:48	59°38.973	44°27.018	379	1446	1344	EOT
29-Sep	273	4				380	1447	1345	BOT
29-Sep	273	4	16:08	59°38.324	44°24.502	380	1502	1400	EOT
29-Sep	273	4				381	1503	1401	BOT
29-Sep	273	4	16:28	59°37.611	44°21.732	381	1558	1456	EOT
29-Sep	273	4				382	1559	1457	BOT
29-Sep	273	4	16:47	59°36.889	44°18.944	382	1614	1512	EOT
29-Sep	273	4				383	1615	1513	BOT
29-Sep	273	4	17:07	59°36.206	44°16.311	383	1670	1568	EOT
29-Sep	273	4				384	1671	1569	BOT
29-Sep	273	4	17:26	59°35.476	44°13.518	384	1726	1624	EOT
29-Sep	273	4				385	1727	1625	BOT
29-Sep	273	4	17:46	59°34.700	44°10.630	385	1782	1680	EOT
29-Sep	273	4				386	1783	1681	BOT
29-Sep	273	4	18:06	59°33.95	44°07.70	386	1838	1736	EOT

Sigma 1996 Transect IV

Seismic Recording LOG

					Shot rate:21secs +/- 1 for 16 sec				Channels:160 AUX. channels:4
				Sample rate:2ms					Number of guns:20 Pressure 2000psi
Date	J.Day	Line	GMT	Latitude	Longitude	Tape #	Shot #	File #	Comments
29-Sep	273	4	18:06	59°33.95	44°07.70	387	1839	1737	BOT
29-Sep	273	4	18:25	59°26.50	44°05.00	387	1894	1792	EOT
29-Sep	273	4				388	1895	1793	BOT
29-Sep	273	4	18:45	59°32.65	44°02.63	388	1950	1848	EOT
29-Sep	273	4				389	1951	1849	BOT
29-Sep	273	4	19:04	59°31.98	44°00.04	389	2006	1904	EOT
29-Sep	273	4				390	2007	1905	BOT
29-Sep	273	4	19:24	59°31.258	43°57.437	390	2062	1960	EOT
29-Sep	273	4				391	2063	1961	BOT
29-Sep	273	4	19:44	59°30.50	43°54.57	391	2118	2016	EOT
29-Sep	273	4				392	2119	2017	BOT
29-Sep	273	4	20:03	59°29.79	43°51.85	392	2174	2072	EOT
29-Sep	273	4				393	2175	2073	BOT
29-Sep	273	4	20:22	59°29.08	43°49.32	393	2230	2128	EOT
29-Sep	273	4				394	2231	2129	BOT
29-Sep	273	4	20:42	59°28.53	43°47.07	394	2286	2184	EOT
29-Sep	273	4				395	2287	2185	BOT
29-Sep	273	4	21:03	59°27.80	43°44.94	395	2342	2240	EOT
29-Sep	273	4				396	2343	2241	BOT
29-Sep	273	4	21:22	59°27.20	43°42.55	396	2398	2296	EOT
29-Sep	273	4				397	2399	2297	BOT
29-Sep	273	4	21:41	59°26.61	43°39.93	397	2454	2352	EOT
29-Sep	273	4				398	2455	2353	BOT
29-Sep	273	4	22:01	59°26.0339	43°37.5533	398	2510	2408	EOT
29-Sep	273	4				399	2511	2409	BOT
29-Sep	273	4	22:21	59°25.5039	43°34.9066	399	2566	2464	EOT
29-Sep	273	4				400	2567	2465	BOT
29-Sep	273	4	22:40	59°24.7829	43°32.3104	400	2622	2520	EOT
29-Sep	273	4				401	2623	2521	BOT
29-Sep	273	4	23:00	59°23.9561	43°29.8112	401	2678	2576	EOT
29-Sep	273	4				402	2679	2577	BOT
29-Sep	273	4	23:19	59°23.1728	43°27.1959	402	2734	2632	EOT

Sigma 1996 Transect IV — Seismic Recording LOG

					Shot rate:21secs +/- 1 for 16 sec				Channels:160 AUX. channels:4
				Sample rate:2ms					Number of guns:20 Pressure 2000psi
Date	J.Day	Line	GMT	Latitude	Longitude	Tape #	Shot #	File #	Comments
29-Sep	273	4	23:19	59°23.1728	43°27.1959	403	2735	2633	BOT
29-Sep	273	4	23:39	59°22.4943	43°24.7777	403	2790	2688	EOT
29-Sep	273	4				404	2791	2689	BOT
29-Sep	273	4	23:59	59°21.8654	43°22.4211	404	2846	2744	EOT
29-Sep	273	4				405	2847	2745	BOT
30-Sep	274	4	0:18	59°21.1794	43°20.0824	405	2902	2800	EOT
30-Sep	274	4				406	2903	2801	BOT
30-Sep	274	4	0:38	59°20.55178	43°17.7796	406	2958	2856	EOT
30-Sep	274	4				407	2959	2857	BOT
30-Sep	274	4	0:57	59°19.9063	43°15.5698	407	3014	2912	EOT
30-Sep	274	4				408	3015	2913	BOT
30-Sep	274	4	1:17	59°19.2747	43°13.2365	408	3070	2968	EOT
30-Sep	274	4				409	3071	2969	BOT
30-Sep	274	4	1:37	59°18.6844	43°11.0567	409	3126	3024	EOT
30-Sep	274	4				410	3127	3025	BOT
30-Sep	274	4	1:56	59°18.040	43°08.648	410	3182	3080	EOT
30-Sep	274	4				411	3183	3081	BOT
30-Sep	274	4	2:16	59°17.462	43°06.566	411	3238	3136	EOT
30-Sep	274	4				412	3239	3137	BOT
30-Sep	274	4	2:35	59°16.811	43°04.350	412	3294	3192	EOT
30-Sep	274	4				413	3295	3193	BOT
30-Sep	274	4	2:55	59°16.164	43°01.961	413	3550	3248	EOT
30-Sep	274	4				414	3351	3249	BOT
30-Sep	274	4	3:14	59°15.505	42°59.490	414	3406	3304	EOT
30-Sep	274	4				415	3407	3305	BOT
30-Sep	274	4	3:35	59°14.775	42°57.020	415	3462	3360	EOT
30-Sep	274	4				416	3463	3361	BOT
30-Sep	274	4	3:54	59°14.002	42°54.065	416	3518	3416	EOT
30-Sep	274	4				417	3519	3417	BOT
30-Sep	274	4	4:13	59°13.417	42°51.813	417	3574	3472	EOT
30-Sep	274	4				418	3575	3473	BOT
30-Sep	274	4	4:33	59°13.643	42°49.202	418	3630	3528	EOT

Sigma 1996 Transect IV

Seismic Recording LOG

					Shot rate:21secs +/- 1 for 16 sec				Channels:160 AUX. channels:4
				Sample rate:2ms					Number of guns:20 Pressure 2000psi
Date	J.Day	Line	GMT	Latitude	Longitude	Tape #	Shot #	File #	Comments
30-Sep	274	4	4:33	59°13.643	42°49.202	419	3631	3529	BOT
30-Sep	274	4	4:53	59°11.891	42°46.497	419	3687	3584	EOT
30-Sep	274	4				420	3688	3585	BOT
30-Sep	274	4	5:12	59°11.270	42°44.281	420	3743	3640	EOT
30-Sep	274	4				421	3744	3641	BOT
30-Sep	274	4	5:32	59°10.558	42°41.907	421	3799	3696	EOT
30-Sep	274	4				422	3800	3697	BOT
30-Sep	274	4	5:40	59°10.368	42°40.926	422	3821	3718	EOT Forced EOL
30-Sep	274	4d	10:13	59°14.513	42°56.164	423	5000	5000	BOT Start of Line 4D
30-Sep	274	4d	10:33	59°13.985	42°54.074	423	5055	5055	EOT
30-Sep	274	4d				424	5056	5056	BOT
30-Sep	274	4d	10:53	59°13.421	42°51.809	424	5111	5111	EOT
30-Sep	274	4d				425	5112	5112	BOT
30-Sep	274	4d	11:12	59°12.745	42°49.484	425	5167	5167	EOT
30-Sep	274	4d				426	5168	5168	BOT
30-Sep	274	4d	11:32	59°12.110	42°47.224	426	5223	5223	EOT
30-Sep	274	4d				427	5224	5224	BOT
30-Sep	274	4d	11:51	59°11.413	42°44.803	427	5279	5279	EOT
30-Sep	274	4d				428	5280	5280	BOT
30-Sep	274	4d	12:11	59°10.840	42°42.567	428	5335	5335	EOT
30-Sep	274	4d				429	5336	5336	BOT SQTP-error 84
30-Sep	274	4d	12:30	59°10.168	42°40.299	429	5391	5391	EOT
30-Sep	274	4d				430	5392	5392	BOT
30-Sep	274	4d	12:50	59°09.612	42°38.267	430	5447	5447	EOT
30-Sep	274	4d				431	5448	5448	BOT
30-Sep	274	4d	13:10	59°09.014	42°36.012	431	5503	5503	EOT
30-Sep	274	4d				432	5504	5504	BOT
30-Sep	274	4d	13:29	59°08.411	42°33.908	432	5559	5559	EOT
30-Sep	274	4d				433	5560	5560	BOT
30-Sep	274	4d	13:48	59° 07.79	42° 31.65	433	5615	5615	EOT
30-Sep	274	4d				434	5616	5616	BOT
30-Sep	274	4d	14:08	59° 07.14	42° 29.46	434	5671	5671	EOT

Sigma 1996 Transect IV

Seismic Recording LOG

					Shot rate:21secs +/- 1 for 16 sec				Channels:160 AUX. channels:4
				Sample rate:2ms					Number of guns:20 Pressure 2000psi
Date	J.Day	Line	GMT	Latitude	Longitude	Tape #	Shot #	File #	Comments
30-Sep	274	4d	14:08	59° 07.14	42° 29.46	435	5672	5672	BOT
30-Sep	274	4d	14:27	59° 06.48	42° 27.02	435	5727	5727	EOT
30-Sep	274	4d				436	5728	5728	BOT
30-Sep	274	4d	14:47	59° 05.83	42° 24.85	436	5783	5783	EOT
30-Sep	274	4d				437	5784	5784	BOT
30-Sep	274	4d	15:07	59° 05.23	42° 22.88	437	5839	5839	EOT
30-Sep	274	4d				438	5840	5840	BOT
30-Sep	274	4d	15:27	59° 04.68	42° 20.69	438	5896	5895	EOT
30-Sep	274	4d				439	5897	5896	BOT
30-Sep	274	4d	15:46	59° 03.97	42° 18.68	439	5952	5951	EOT
30-Sep	274	4d				440	5953	5952	BOT
30-Sep	274	4d	16:06	59° 03.25	42° 16.29	440	6008	6007	EOT
30-Sep	274	4d				441	6009	6008	BOT
30-Sep	274	4d	16:25	59° 02.54	42° 13.53	441	6064	6063	EOT
30-Sep	274	4d				442	6065	6064	BOT
30-Sep	274	4d	16:45	59° 01.84	42° 10.67	442	6120	6119	EOT
30-Sep	274	4d				443	6121	6120	BOT
30-Sep	274	4d	17:04	59° 01.23	42° 08.03	443	6176	6175	EOT
30-Sep	274	4d				444	6177	6176	BOT
30-Sep	274	4d	17:24	59° 00.46	42° 05.33	444	6232	6231	EOT
30-Sep	274	4d				445	6233	6232	BOT
30-Sep	274	4d	17:44	58° 59.78	42° 03.01	445	6289	6288	EOT
30-Sep	274	4d				446	6290	6289	BOT
30-Sep	274	4d	18:04	58° 59.03	42° 00.66	446	6344	6343	EOT
30-Sep	274	4d				447	6345	6344	BOT
30-Sep	274	4d	18:23	58° 58.31	41° 58.56	447	6400	6399	EOT
30-Sep	274	4d				448	6401	6400	BOT
30-Sep	274	4d	18:43	58° 57.62	41° 56.31	448	6456	6455	EOT
30-Sep	274	4d				449	6457	6456	BOT
30-Sep	274	4d	19:02	58° 56.94	41° 54.01	449	6512	6511	EOT
30-Sep	274	4d				450	6513	6512	BOT
30-Sep	274	4d	19:22	58° 56.30	41° 51.81	450	6568	6567	EOT

Sigma 1996 Transect IV

Seismic Recording LOG

				Shot rate:21secs +/- 1 for 16 sec					Channels:160 AUX. channels:4
				Sample rate:2ms					Number of guns:20 Pressure 2000psi
Date	J.Day	Line	GMT	Latitude	Longitude	Tape #	Shot #	File #	Comments
30-Sep	274	4d	19:22	58° 56.30	41° 51.81	451	6569	6568	BOT
30-Sep	274	4d	19:42	58° 55.61	41° 49.57	451	6624	6623	EOT
30-Sep	274	4d				452	6625	6624	BOT
30-Sep	274	4d	20:01	58° 54.99	41° 47.41	452	6680	6679	EOT
30-Sep	274	4d				453	6681	6680	BOT
30-Sep	274	4d	20:20	58° 54.35	41° 45.28	453	6736	6735	EOT
30-Sep	274	4d				454	6737	6736	BOT
30-Sep	274	4d	20:40	58° 53.74	41° 42.84	454	6792	6791	EOT
30-Sep	274	4d				455	6793	6792	BOT
30-Sep	274	4d	21:00	58° 52.97	41° 40.30	455	6848	6847	EOT
30-Sep	274	4d				456	6849	6848	BOT
30-Sep	274	4d	21:20	58° 52.25	41° 37.87	456	6904	6903	EOT
30-Sep	274	4d				457	6905	6904	BOT
30-Sep	274	4d	21:39	58° 51.50	41° 35.57	457	6960	6959	EOT
30-Sep	274	4d				458	6961	6960	BOT
30-Sep	274	4d	21:59	58° 50.79	41° 33.06	458	7016	7015	EOT
30-Sep	274	4d				459	7017	7016	BOT
30-Sep	274	4d	22:19	58°50.0719	41°30.6066	459	7072	7071	EOT
30-Sep	274	4d				460	7073	7072	BOT
30-Sep	274	4d	22:38	58°49.3165	41°28.0884	460	7128	7127	EOT
30-Sep	274	4d				461	7129	7128	BOT
30-Sep	274	4d	22:58	58°48.6127	41°25.5870	461	7184	7183	EOT
30-Sep	274	4d				462	7185	7184	BOT
30-Sep	274	4d	23:17	58°47.9526	41°22.9999	462	7240	7239	EOT
30-Sep	274	4d				463	7241	7240	BOT
30-Sep	274	4d	23:37	58°47.2144	41°20.3742	463	7296	7295	EOT
30-Sep	274	4d				464	7297	7296	BOT
30-Sep	274	4d	23:57	58°46.4403	41°17.7638	464	7352	7351	EOT
30-Sep	274	4d				465	7353	7352	BOT
1-Oct	275	4d	0:16	58°45.6216	41°15.1308	465	7408	7407	EOT
1-Oct	275	4d				466	7409	7408	BOT
1-Oct	275	4d	0:36	58°44.7612	41°12.5587	466	7464	7463	EOT

Sigma 1996 Transect IV Seismic Recording LOG

					Shot rate:21secs +/- 1 for 16 sec				Channels:160 AUX. channels:4
				Sample rate:2ms					Number of guns:20 Pressure 2000psi
Date	J.Day	Line	GMT	Latitude	Longitude	Tape #	Shot #	File #	Comments
1-Oct	275	4d	0:36	58°44.7612	41°12.5587	467	7465	7464	BOT
1-Oct	275	4d	0:55	58°43.9185	41°09.9996	467	7520	7519	EOT
1-Oct	275	4d				468	7521	7520	BOT
1-Oct	275	4d	1:15	58°43.0994	41°07.4098	468	7576	7575	EOT
1-Oct	275	4d				469	7577	7576	BOT
1-Oct	275	4d	1:35	58°42.3339	41°04.8126	469	7632	7631	EOT
1-Oct	275	4d				470	7633	7632	BOT
1-Oct	275	4d	1:54	58°41.5938	41°02.2230	470	7688	7687	EOT
1-Oct	275	4d				471	7689	7688	BOT
1-Oct	275	4d	2:14	58°40.755	40°59.477	471	7744	7743	EOT
1-Oct	275	4d				472	7745	7744	BOT
1-Oct	275	4d	2:33	58°39.9498	40°57.1833	472	7800	7799	EOT
1-Oct	275	4d				473	7801	7800	BOT
1-Oct	275	4d	2:53	58°39.0487	40°54.7674	473	7856	7855	EOT
1-Oct	275	4d				474	7857	7856	BOT
1-Oct	275	4d	3:13	58°38.2820	40°52.5367	474	7912	7911	EOT
1-Oct	275	4d				475	7913	7912	BOT
1-Oct	275	4d	3:32	58°37.6670	40°50.2702	475	7968	7967	EOT
1-Oct	275	4d				476	7969	7968	BOT
1-Oct	275	4d	3:52	58°37.1520	40°48.0728	476	8024	8023	EOT
1-Oct	275	4d				477	8025	8024	BOT
1-Oct	275	4d	4:12	58°36.6926	40°45.8621	477	8080	8079	EOT
1-Oct	275	4d				478	8081	8080	BOT
1-Oct	275	4d	4:31	58°36.2273	40°43.8343	478	8136	8135	EOT
1-Oct	275	4d				479	8137	8136	BOT
1-Oct	275	4d	4:50	58°35.6898	40°41.8274	479	8192	8191	EOT
1-Oct	275	4d				480	8193	8192	BOT
1-Oct	275	4d	5:10	58°35.0458	40°39.9538	480	8248	8247	EOT
1-Oct	275	4d				481	8249	8248	BOT
1-Oct	275	4d	5:30	58°34.4446	40°38.0914	481	8304	8303	EOT
1-Oct	275	4d				484	8307	8305	BOT
1-Oct	275	4d	5:50	58°38.855	40°36.077	484	8361	8360	EOT

Sigma 1996 Transect IV

Seismic Recording LOG

					Shot rate:21secs +/- 1 for 16 sec				Channels:160 AUX. channels:4
				Sample rate:2ms					Number of guns:20 Pressure 2000psi
Date	J.Day	Line	GMT	Latitude	Longitude	Tape #	Shot #	File #	Comments
1-Oct	275	4d	5:50	58°38.855	40°36.077	485	8362	8361	BOT
1-Oct	275	4d	6:09	58°33.535	40°34.222	485	8417	8416	EOT
1-Oct	275	4d				486	8418	8417	BOT
1-Oct	275	4d	6:29	58°32.810	40°32.624	486	8473	8472	EOT
1-Oct	275	4d				487	8474	8473	BOT
1-Oct	275	4d	6:48	58°32.229	40°30.867	487	8529	8528	EOT
1-Oct	275	4d				488	8530	8529	BOT
1-Oct	275	4d	7:08	58°31.688	40°29.019	488	8585	8584	EOT
1-Oct	275	4d				489	8586	8585	BOT
1-Oct	275	4d	7:27	58°31.107	40°26.955	489	8641	8640	EOT
1-Oct	275	4d				490	8642	8641	BOT
1-Oct	275	4d	7:47	58°30.570	40°25.117	490	8697	8696	EOT
1-Oct	275	4d				491	8698	8697	BOT
1-Oct	275	4d	8:06	58°29.951	40°23.184	491	8753	8752	EOT
1-Oct	275	4d				492	8754	8753	BOT
1-Oct	275	4d	8:26	58°29.295	40°21.328	492	8809	8808	EOT
1-Oct	275	4d				493	8810	8809	BOT
1-Oct	275	4d	8:46	58°28.749	40°19.305	493	8865	8864	EOT
1-Oct	275	4d				494	8866	8865	BOT
1-Oct	275	4d	9:06	58°28.243	40°17.102	494	8921	8920	EOT
1-Oct	275	4d				495	8922	8921	BOT
1-Oct	275	4d	9:25	58°27.591	40°15.226	495	8977	8976	EOT
1-Oct	275	4d				496	8978	8977	BOT
1-Oct	275	4d	9:45	58°26.816	40°13.296	496	9033	9032	EOT
1-Oct	275	4d				497	9034	9033	BOT
1-Oct	275	4d	10:04	58°26.093	40°11.199	497	9089	9088	EOT
1-Oct	275	4d				498	9090	9089	BOT
1-Oct	275	4d	10:17	58°25.553	40°09.501	498	9127	9126	Forced EOL 4D

Appendix 11: Cruise Plan

As a summary of cruise operations, we present two cruise timetables. The first one is a cruise plan as of 28 August, created while we were underway to Ammassalik. The second one is the actual time taken during the cruise, created after the end of the cruise. The Date and Time columns represent the date and time at the **end** of the activity in that row (e.g., we finished deploying OBH/S on Line 3 at 0800 on 20 September).

A cursory comparison of the two tables shows that the cruise proceeded remarkably close to plan. Each transect took 7–10 days to complete. We used all the contingency time allotted on Lines 2 and 3, the highest-priority lines; we saved some time on Line 1 by shortening the main shooting; and we had 40 hours of unused contingency time at the end of the cruise.

Task	Duration	Elapsed Hours	Elapsed Days	Date		Time
Steam St. John's - Angmagssalik	130	130	5.42	30	Steam:	4.00
Wireline release tests	2	132	5.50	30		6.00
Transfer oil, Angmagssalik	6	138	5.75	30		12.00
Steam to Line II	8	146	6.09	30	6.09	20.00
Deploy 19 OBH/S, Line II	34	180	7.50	1		6.00
Deploy MCS streamer and guns	30	210	8.75	2		12.00
Shoot Line II	35	245	10.19	3		23.00
Recover guns + streamer	10	255	10.61	4		9.00
Recover 19 OBH/S, Line II	44	298	12.44	6	Profile II:	4.00
Contingency	48	346	14.44	8	8.34	4.00
Steam to Line I	17	363	15.14	8		21.00
Deploy 19 OBH/S, Line I	40	403	16.79	10		13.00
Deploy streamer + guns	24	427	17.79	11		13.00
Shoot Line I	48	475	19.80	13		13.00
Recover guns + streamer	8	483	20.13	13		21.00
Recover 19 OBH/S, Line I	45	528	21.99	15	Profile I:	18.00
Contingency	24	552	22.99	16	8.55	18.00
Steam to Line III	41	593	24.70	18		11.00
Deploy 19 OBH/S, Line III	33	626	26.06	19		20.00
Deploy streamer + guns	24	650	27.06	20		20.00
Shoot Line III	32	681	28.39	22		3.00
Recover guns + streamer	10	691	28.81	22		13.00
Recover 19 OBH/S, Line III	49	741	30.86	24	Profile III:	15.00
Contingency	28	769	32.03	25	9.04	19.00
Steam to Line IV	24	793	33.04	26		19.00
Deploy 19 OBH/S, Line IV	40	832	34.69	28		10.00
Deploy streamer + guns	18	850	35.44	29		4.00
Shoot Line IV	48	899	37.44	1		5.00
Recover guns + streamer	8	907	37.77	1		13.00
Recover 19 OBH/S, Line IV	50	956	39.84	3	Profile IV:	14.00
Contingency	24	980	40.84	4	8.81	14.00
Steam to St. John's	89	1069	44.54	8		7.00
			knots	kph		
	Cruising speed:		10.50	19.43		
	Deploy time:		1.00			
	Recovery Deep:		2.00			
	Recovery Shallow:		1.00			
	Shooting speed:		4.50	8.33		

Task	Duration	Elapsed Hours	Elapsed Days	Date		Time
Steam St. John's - Angmagssalik	126	126	5.25	30	Steam:	0.00
Wireline release tests	6	132	5.50	30		6.00
Transfer oil, Angmagssalik	6	138	5.75	30		12.00
Steam to Line II	8	146	6.08	30	6.08	20.00
Deploy 19 OBH/S, Line II	30	176	7.33	1		2.00
Deploy MCS streamer and guns	39	215	8.96	2		17.00
Shoot Line II	48	263	10.96	4		17.00
Re-shoot MCS, shelf	14	277	11.52	5		7.00
Recover streamer & steam to EOL	12	289	12.02	5		19.00
Re-shoot for OBH/S	37	326	13.56	7		8.00
Recover 19 OBH/S, Line II	41	367	15.27	9	Profile II:	1.00
Contingency	0	367	15.27	9	9.19	1.00
Steam to Line I	13	380	15.81	9		14.00
Deploy 15 OBH/S, Line I	30	410	17.06	10		20.00
Deploy streamer + guns	12	422	17.56	11		8.00
Shoot Line I (incl. short cross line)	37	459	19.10	12		21.00
Recover guns + streamer	8	467	19.44	13		5.00
Recover 13 OBH/S, Line I	33	499	20.79	14		13.00
Steam to last OBH + deploy guns	1	500	20.83	14		14.00
Shoot to Iceland, recover guns	15	515	21.46	15		5.00
Steam back to OBH & recover 2 OBH	12	527	21.96	15	Profile I:	17.00
Contingency	0	527	21.96	15	6.69	17.00
Steam to Line III	36	563	23.46	17		5.00
Weather (+ deploy 2 OBS)	50	613	25.54	19		7.00
Deploy 17 OBH/S, Line III	25	638	26.58	20		8.00
Deploy streamer + guns	10	648	27.00	20		18.00
Shoot Line III	30	678	28.25	22		0.00
Recover streamer; wait for daylight	9	687	28.60	22		9.00
Re-shoot Line III; recover guns	27	714	29.73	23		12.00
Recover 18 OBH/S, Line III	49	762	31.75	25	Profile III:	12.00
Contingency	0	762	31.75	25	9.79	12.00
Steam to Line IV	27	789	32.88	26		15.00
Wait for weather	25	814	33.92	27		16.00
Deploy 16 OBH/S, Line IV	28	842	35.06	28		20.00
Deploy streamer + guns	7	849	35.35	29		2.00
Shoot Line IV	53	902	37.56	1		8.00
Recover guns + streamer	4	906	37.73	1		11.00
Recover 3 OBH, wait for weather	51	956	39.83	3		14.00
Recover remaining13 OBH/S	24	980	40.83	4	Profile IV:	14.00
Contingency - Unused	40				9.08	
Steam to St. John's	73	1053	43.88	7		15.00