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VENTFLUX2: Single Channel Seismics, Piston Coring, and CTD Casts Associated with Gas Hydrates Offshore Vancouver Island

Report of Cruise PGC01-003 C.C.G. Vessel John P. Tully 23 July-12 August 2001 Volume 1: Operations

GEORGE SPENCE
JOHANNA HOEHNE
School of Earth and Ocean Sciences
University of Victoria
Victoria, B.C.

RICHARD B. COFFIN
Chemical Dynamics and Diagnostics Branch
Chemistry Division

ROY HYNDMAN
ROBERT MACDONALD
Pacific Geoscience Centre
Geological Survey of Canada: Pacific Division

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George Spence,* Johanna Hoehne,* Richard B. Coffin Roy Hyndman,† and Robert MacDonald†

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*School of Earth and Ocean Sciences, University of Victoria, Victoria, B.C. V8W 2Y2
†Pacific Geosciences Centre, Geological Survey of Canada: Pacific Division, Sidney, B.C.

14. ABSTRACT

Cruise PGC00-003 was a collaborative experiment between the University of Victoria, the Geological Survey of Canada, and the Naval Research Laboratory. The program focussed on seafloor vents that may be sites of significant fluid and methane flux. There were six sites with different indicators of fluid flow selected for this cruise: (1) Bullseye vent: hydrate had been recovered in this region in four piston cores collected during the 2000 VentFlux cruise. (2) Cucumber Ridge: numerous tube worms and clams had been observed and collected during ROPOS dives in May 2001. (3) FishBoat site: in November 2000, a commercial trawler dragged up one to two tons of hydrate at this site in Barclay Canyon in water depth of 800 m. (4) ShallowPlume sites: apparent methane plumes were observed on the continental shelf edge in water depths of ~200 m. The plumes were identified on 28 MHz sounder records. (5) Nootka Fault Zone: swath bathymetry collected in July 2001 found two mud volcanoes in the open ocean basin in water depths of 2600 m. (6) NorthernFault Zone: Located ~5 km northwest of ODP Site 8889, this was detected as a northeast-southwest linear zone of seismic blanking on 1999 3D COAMS data. Sites 1 to 5 were targets for piston coring and water column sampling during daytime operations. Sites 2 to 6 were high resolution single channel seismic grids during nighttime operations.

15. SUBJECT TERMS

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Summary and Objectives

Background

Cruise PGC00-003 was a collaborative experiment between the University of Victoria, the Geological Survey of Canada, and the Naval Research Laboratory (Washington, DC and Stennis Space Center, Mississippi). The program mainly focussed on potential seafloor vents that may be sites of significant fluid and methane flux. There were six sites selected as targets for this cruise, each with different indicators of fluid flow:

1) Bullseye vent (formerly known as Vent Site 1 from Riedel 2001) : Hydrate had been recovered in this region in four piston cores collected during the VentFlux cruise in 2000. As well, numerous cores with gassy sediments and black carbonaceous sediments were collected (Novosel et al. 2000). Some clam fields and tube worms were also observed in ROPOS dives in September 2000 and May 2001. The vent was originally detected with prior high resolution seismic surveys – the DTAGS deeptow seismic survey in 1997 and the COAMS 3D seismic cruise in 1999.

2) Cucumber Ridge: Numerous tube worms and clams had been observed and collected during ROPOS dives in May 2001. Extensive carbonate crusts were also present.

3) FishBoat site: In November 2000, a commercial trawler dragged up one to two tonnes of hydrate at this site in Barclay Canyon in water depth of 800 m (Spence et al., 2001).

4) ShallowPlume sites: Apparent methane plumes had been observed on the edge of the continental shelf in water depths of ~200 m. The plumes were identified on 28 MHz sounder records collected from 1995, 1996 and 1997 (Ken Cooke, Pacific Biological Station, Nanaimo).

5) MudVolcano sites, Nootka Fault Zone: Swath bathymetry collected in July 2001 found two mud volcanoes in the open ocean basin in water depths of 2600 m (Riedel et al. 2001b). The main volcano, with a base width of ~ 1 km and a height of ~80 m, has a distinct moat filled with soft sediments. Within 50 m of the seafloor, CTD casts showed decreased salinity and oxygen, enhanced light reflectance, and a temperature increase of ~0.1 C.

6) NorthernFault zone: Located ~5 km northwest of ODP Site 8889, this fault zone was detected as a northeast-southwest linear zone of seismic blanking on 1999 3D COAMS data.

Sites 1 to 5 were intended as targets for piston coring and water column sampling during daytime operations. Sites 2 to 6 are regions where high resolution single channel seismic grids (25 m line separation) were collected during night-time operations.

Summary of Activities and Results

Sediment corers were deployed at a total of 21 sites – 19 deployments of the piston corer and 2 deployments of a small gravity corer. Eleven piston cores, with lengths up to 7.5 m, were sampled extensively for pore fluid extraction and geochemical analyses. These analyses will include light hydrocarbon concentration and isotopic analyses, sulfate and chloride concentrations, sulfate reduction rates, density/porosity, and methane productivity. Six piston cores were split and used for sedimentological analysis and for electrical resistivity measurements; 10% of the length of these cores were also sampled prior to splitting for geochemistry and pore fluid extraction. For two

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piston cores and the two gravity cores, no usable sediment was recovered, except for a few hand-size samples for sedimentology.

Gas hydrate was recovered at three locations within Bullseye vent. The top of hydrate ranged 0.5 m to 2 m beneath the seafloor, consistent with images of the top of the hydrate cap observed in high resolution seismic data collected in 1999 and 2000 (Riedel et al. 2001a; Riedel 2001). Penetration of these cores ranged from 1.2 m to 3.2 m – massive hydrate of thickness ~30 cm was typically found at the base of the cores, and this prevented further penetration of the core. Most hydrate samples were immediately immersed in liquid nitrogen. Some samples were placed in a sealed pressure chamber and allowed to dissociate. By examining the increase in pressure after complete dissociation, a gas/hydrate ratio of ~97 was calculated.

A total of 19 casts of the CTD were carried out. On all casts except the last, water samples were collected at a variety of depths for onboard determination of methane concentrations. On four casts, a full suite of water sampling was performed where later analyses will include methane concentration and isotopes, DOC and DIC concentrations, $\Delta^{14}C$ and $\delta^{13}C$ DOC, $\Delta^{14}C$ and $\delta^{13}C$ DIC, $\Delta^{14}C$ POC (surface), PC/PN, plus bacteria counts and species diversity. In addition to standard measurements of salinity and temperature, the CTD carried a near-real-time methane sensor (the METS methane sensor, manufactured by CAPSUM for the German research/technology ministry); unfortunately, only a low sensitivity instrument could be used and it appears that there were not sufficiently high methane levels to register on the instrument. On the last CTD cast, communication with the unit was lost just before it began its ascent from near the seafloor at 2425 m depth, and no water samples could be collected.

Methane levels in the water column were low at nearly all vent sites, including those where hydrate was collected. Maximum values were typically only 4-5 nmol/l, even just above the seafloor within a vent. Significant methane concentrations were detected at one of the shallow plume sites, where bubbling had been observed on echo sounders in 1995. At this site, water sampling was carried out on two vertical profiles and on two perpendicular lateral profiles just above the seafloor. Maximum methane levels of 137 nmol/l were detected, and the horizontal profiles were able to provide constraints on the lateral extent of the methane plume and thus on the total amount of methane in this region of the water column.

Approximately 700 km of single channel seismic lines were collected. The source was a 40 cu. in. sleeve gun. At Cucumber Ridge, a grid of 80 lines, each 3 km in length and separated by 25 m, provided excellent images of this carbonate/mud mound and of the BSR beneath it; such data should be very suitable for 3D migration techniques to image the complex structure. A similar grid of 60 lines was collected at the FishBoat site. No BSR was observed, and the bathymetry is even more complex than at Cucumber Ridge. These data will provide a challenge for 3D migration to see if any indication can be found of where massive seafloor hydrate had been recovered during the trawling operations. At the ShallowPlume sites, no obvious structures were found either at the seafloor or in the subsurface at the 1996 and 1995 sites. However, a prominent seafloor mound, approximately 800 m by 300 m in extent, was found at the most southerly (1997) site; a dramatic anticlinal structure was imaged down to ~300 m below the seafloor, with the seafloor mound located where the anticline breaches the seafloor. Unfortunately, methane levels were no higher than typical ocean background values on this margin, and so it is likely that the anticline is an old and inactive structure.

Approximately 150 km of seismic lines were recorded in the Nootka Fault zone in the region of several apparent mud volcanoes. In some cases sediment basement could be observed, at a depth of about 1.6 s twt. Clear indications of faulting could be seen, more obvious in lines that were parallel to the fault zone rather than in perpendicular lines. A 40 km seismic transect was recorded from near the deformation front through the most prominent mud volcano to a point about 20 km west of the volcano. Line direction was 285°, perpendicular to the local magnetic lineations. Two other lines with this heading were also recorded, one about 10 km south of the main line, and another about 15 km north. The northern line intersected the deformation front near another possible mud volcano, although details were difficult to determine due to diffractions and side echoes associated with the ridge at the deformation front. Six additional lines, 7 km long at 200 m spacing, crossed the main volcano. Two perpendicular lines crossed a second volcano about 6 km north of the main one. Beneath both volcanoes, a strong reflector was observed immediately beneath the surface structure, at ~500 m depth beneath the main (southern) volcano and ~800 m depth beneath the northern one. Possible indications of incipient volcanoes were also associated with similar reflection events.

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Narrative

Monday 23 July 2001 Day 204/205

1230 PDT Lab equipment loaded. All benches washed down with alcohol, in an effort to minimize possible 14C contamination from previous IOS chemistry cruises. Departure delayed until following day due to ship's mechanical problems (spare parts needed; dishwasher to be repaired).

Tuesday 24 July 2001 Day 205/206

1700 PDT Ship departs PGC.

Wednesday 25 July 2001 Day 206/207

1430 PDT Arrival at site. Deploy velocimeter at centre of transponder array in water depth 1257 m. Back at surface at 1519 PDT. Velocity profile is shown in Fig. 3.

1530 PDT With transponder over port side of aft deck, Rick Mang (NRL) woke up all 6 acoustic transponders that were deployed last year during VentFlux 2000. Unfortunately, a calibration of the system was not successful. Although all transponders would respond from a position in the centre of the array, not all would respond from other locations where it was desired to carry out calibration (i.e. at various points at distances from each transponder of approximately 1.5 times the water depth). Attempts were abandoned at about 0030 July 26.

Thursday 26 July 2001 Day 207/208

0800 PDT Preparations for first coring operation.
Core Site 1 just to east of blanking area at Vent 1. Piston corer began to descend at 1240 and entered the bottom at 1323. The pullout force on the tensiometer was 12000 lb. The core was back at the surface at 1350, and it was on deck by 1406.
7 m of core were filled with sediment. However, sediment was not visibly gassy or smelly.

1600 PDT Begin CTD1 operations at same location as Core 1. Sensitive methane sensor was attached. At ~450 m depth, the salinity pump turned off, and the CTD unit stopped transmitting or receiving data. CTD back on deck at 1700

1815 PDT Less sensitive methane sensor was attached to CTD. Unit ran successfully, and was lowered to ~60 m above the seafloor. On retrieval, 3 samples were taken at each of 7 depths. A full water column sampling program was carried out at this location. CTD out of water at 2020.

2100 PDT Begin preparation of compressor, airgun, firing unit, EPC's, MUSE recording. 3.5 kHz was not working. Two Teledyne streamers were recorded, one on either side of ship.

Friday 27 July 2001 Day 208/209

0100 PDT Start of seismic grid (Fig. 4) in area of Cucumber Ridge. MUSE system hung up twice (at 0500 and 0630 PDT), which required Ivan Frydecky to re-boot system.

0800 PDT End of seismic acqusition. Collected data on 12 lines (1, 6, 2, 17, 3, 12, 4, 11, 5, 13, 7, 14 , but only partially completed lines 4, 11, 7, and 13 (due to MUSE hang up).
During recovery, port streamer (older Teledyne) was caught in the ship's screws and lost; ship speed was too slow (estimated at < 1kt, even though GPS gave over 1 kt), and ship was simultaneously turned to starboard (little rudder control).

0845 PDT Test CTD with low sensitivivity methane sensor attached. Successful.

1000 PDT Core Site 2 in region of high reflectivity at the seafloor. Beginning of corer descent at 1037. The corer was at the bottom at 1105, and trigger core was at surface at 1127; core on rail at ~1145.
5 m of core was sediment filled. Entire core was sand. Core was cut into 75 cm sections, with 10 cm from each section given to geochemists.

1400 PDT Core Site 3 at westerly location where tube worms were found during ROPOS cruise in May 2001. Estimated water depth was 1315 m (with side echo at 1285 m); at bottom (1530), wire out was 1304 m. Pullout force was 13000 lb.
Only 30 cm of core was recovered, and none in gravity core. Sediment contained small pebbles, possibly carbonate. Small segment of core liner (?25 cm by 10 cm) had cracked and broken off.

1745 PDT CTD2 cast at core site 3. CTD brought to within 25 m of seafloor. Back on deck at 1915. Methane levels in water samples was very low, ~0.5-1 nml/l which is an expected background level.

2025 PDT Begin seismic acquisition. Only one Teledyne streamer, extended 4 m from starboard side on crane. 3.5 kHz sounder is working again

Saturday 28 July 2001 Day 209/210

0745 PDT End seismic acquisition. Collected 17 lines in 11.25 hours:
Lines 4, 19, 33, 8, 13/ 10, 20, 9, 21, 15/ 22, 16, 24, 18, 28/ 23, 31

Notes that lines 4 and 13 were repeats of lines on which MUSE recording problems had been encountered during the previous night.

0940 PDT Core site 4 (on flank of Cucumber Ridge, ~200 m northwest of site 3). Descent of corer began at 0940. It reached the bottom (1327 m) at 1009; pullout was 12000 lb.
Only 85 cm of penetration. Again, section 2 of liner had ~20cm by 10 cm hole in it. Also, piston had not separated Gravity core had 25 cm penetration. Sediments were similar to Site 3, with small carbonate pebbles.

1435 PDT Core site 5: descent began. It was in the seafloor at 1510 and back at the surface at 1555; the pullout force was 13000 lb. Water depth was probably 1328 m; a side echo on the 12 kHz sounder indicated a depth of 1304 m, but the wire out on the winch was 1336 m.
Piston core penetration was ~3.5 m, and gravity core penetrated ~0.5 m. Sediments were compacted clays; carbonate nodule was found in core cutter. Piston core divided into 75 cm sections, with bottom 7.5 cm given to geochemists.

1800 PDT CTD3 over side at core site 5. Back on deck at 1915.

1945 PDT Begin preparing for seismic acquisition. Begin acquisition at 2010.

Sunday July 29 Day 210/211

0745 PDT End seismic acquisition. 19 lines collected in 12 hours: 25, 34, 26, 39,. 27/ 41, 29, 37, 32, 44 / 30, 35, 36, 43, 38 / 47, 40, 46, 42. Only 1/3 of line 22 was collected due to shutdown of MUSE and so this line must be repeated.

0935 PDT Core 6 over side. Pinger attached 0938 (for attempt at tracking with acoustic transponder net). Core in bottom (1265 m) at 1006. Pullout 10000 lb.
Penetration was 7.17 m. Bottom 120 cm is sooty black, gas-charged; 3 gas samples were taken from expansion cracks.

1425 PDT Core 7 over side. In seafloor at 1459. On deck at 1550. Pullout tension was 12500 lb. Hydrate in core! Large and small chunks from ~1.5 m to bottom of core, which as about 315 cm long.

1745 PDT Begin CTD 4 (located at site of Core 7). End at 1900.

1930 PDT Begin seismic acquisition.

Monday July 30 Day 211/212

0750 PDT End seismic acquisition. Collected 18 full lines in 12 ¼ hours.
(Lines 11, 50, 15, 59, 45 / 63, 48, 51, 49, 53 /

52, 58, 51(part), 54, 57, 56 / 62, 55, 60)

0845 PDT CTD 5: repeat of CTD 4 at Core 7 location, since previous methane levels were extremely high and erratic, with some massive spikes in middle of water column. Concerned about (a) possible contamination in syringes or bottles from sediment methane analysis; (b) possible contamination from lubricant on winch wire, perhaps getting into Niskin bottles 3 months earlier. End of CTD cast at 1000.

1045 PDT Acoustic transducer over side on hydrocast winch with 100 lb weights attached. Lowered to 20 m depth. Still problems in getting calibration files to be properly created.

1105 PDT Prepare piston corer for Core 8. Core over side at 1240. At bottom at 1313. Hydrate! Pentration only about 115 cm. Massive 30 cm layer at bottom; chunks and flakes scattered in upper metre.

1515 PDT Start CTD 6, located 500 m northwest of Core 4 (from Year 2000). End cast at 1650.
Progress in setting up calibration of acoustic transponder. Continued with calibration until 1930.

2020 PDT Start airguns at 2020 PDT. Start recording at 2038.

Tuesday July 31 Day 212/213

0655 PDT End seismic. Recorded lines 29 (repeat), 61, 73, 64, 74 / 65, 72, 66, 76, 67 / 75, 69, 78, 68, 79 / 70, 77, 7, 22

0710 PDT Transit to FishBoat.

1232 PDT CTD 7 (file 01030013.dat). 923 m water depth.

~1500 PDT CTD 8 (file 01030014.dat). Drifted at ~1 kt from target.

~1700 PDT CTD 9 (file 01030015.dat). Repeat at location of target for CTD 8. Location at bottom was ~150 m from target.

1915 PDT Airguns started. MUSE started at 1930, recording at 1944.

Wednesday 1 August Day 213/214

0741 PDT End seismic. Recorded Test1, Test 2, Inl-1000, Inl-2000, xl-1500, xl-1000, xl-500, + lines 52, 46, 48, 45, 51, 44, 50, 43, 49, 42, 47.

0850 PDT Core 9 in water. At bottom at 0915. Pullout tension 10000 lb, compared to a normal tension of 5500 lb just before bottom. Core for geochemists.

1244 PDT Core 10 in water. Same location as Core 9, since entry in ship's ECPINS navigation system was same. Core on bottom at 1308, at surface at 1323. Core for geophysicists.

1629 PDT Core 11 at bottom. Water depth 871 m. Pullout tension 9000 lb. Core for geochemists.

1815 PDT Airguns + streamers deployed. Recording started at 1829.

Thursday 2 August Day 214/215

0700 PDT Seismic recording stopped. Recorded lines 53-72.

0845 PDT Core 12 in water. At bottom at 0910, in water depth of 884 m. On deck at 0942. The core position was noted on both lab and ship's GPS; the lab GPS was about 353 m forward of ship GPS, whereas its antenna is actually located just above lab about 20 m sternward of ship antenna.

1000 PDT Transit to Tofino for mini scientific crew change. Arrive at 1600, leave at 1730.

Friday 3 August Day 215/216

0100 PDT Arrival at Shallow Plume 1995. Start seismic at ~0130. End seismic at 0710. Recorded lines 1-20, 2 km in length separated by 100 m.

0815 PDT Start CTD 10 (file 01030016.dat), at target site as identified on 38 kHz sounder records from Fisheries at Pac Biol Station, Nanaimo. Water depth 183 m. On deck at 0853 PDT.

0950 PDT CTD 11 (file 01030017.dat), at mound site seen on seismic grid about 1.5 km NE of target site. Deepest point is 8 m above seafloor. Water depth 154 m. Highest methane levels was ~35 nmol/l

1257 PDT Core 13 in water. At bottom at 1303. Pullout tension 12500 lb. No core recovery – mud coated outside of barrel up to ~1 m above base, which is where the piston was located. Probably a cobble had blocked entrance of core. Gravity core penetration was ~20 cm, and contained rounded gravels right at seafloor.

1500 PDT Start preparations for Core 14, at mound site seen on seismic grid about 1.5 km NE of target site. Piston core was lost. Tension on pullout suddenly pegged against the stops at 25000 lb as ship rose on crest of swell. Wind conditions were light, with swell height about 2 m. Cable snapped probably just above trigger core. For such shallow water depth, there is too little give in the cable, particularly if there is too much angle in the cable if the ship is only moderately offset from the target. All cable that was out will be cut off before rigging new piston core.

1700 PDT Transit to ShallowPlume_1996 site, ~10 mi north of 1995 site.

1805 PDT CTD 12 (01030018.dat) over side. Back on deck at 1840. Water depth 162 m. No high levels of methane seen.

1910 PDT Seismic acquisition begins.

Saturday 4 August Day 216/217

0650 PDT End seismic acquisition. Acquired lines X1, X2, X3, 1-20 plus –1. Lines were 2 km long at 100 m spacing.

0800 PDT CTD 13 (file 01030019.dat) at central site at Shallow Plume 1995. Full suite of water samples taken. Maximum methane levels ~35 nmol/l (?).

1042 PDT Begin drift run for CTD 14 (file 01030020.dat), perpendicular to margin through central site. At 0900 measured drift of ship was on a course of 84° over a distance of 900 m in 35 minutes. However, drift during CTD run was only about 25 °, and so ship had to provide some minimal thrust from engines to achieve easterly course. Maximum methane levels were ~80 nmol/l at a station 4 in lateral profile, 822 m west of central site.

1429 PDT Core 15 at central site in Shallow Plume 1995. Small gravity corer only, with added weight. At bottom at 1433. Water depth 184 m.

1534 PDT CTD 15 (file 01030021.dat). Vertical profile 1 mi. SSE of station 4. Low methane levels (~7 nmol.m?). At deepest point, 4 m above bottom, at 1534. Back on deck at 1549.

1625 PDT CTD 16 (file 01030022.dat) at station 4 precisely. 5 m above bottom at 1625. Full vertical water sampling profile. Maximum methane levels 137 nmol/l)

1825 PDT CTD 17 (file 01030023.dat) begins. Lateral profile parallel to margin in NW direction, starting 772 m from Station 4 and ending 1507 m from Station 4.

2050 PDT Transit to Shallow Plume 1997, 3 hours south.

2350 PDT Start airguns for seismic. Lines are 2 km in length, separated by 100 m.

Sunday 5 August Day 217/218

0803 PDT End seismic acquistion. Seafloor mound found in west part of grid, with a size of 800 m by 300 m. Seismic data showed mound is at top of an anticline that breaches the seafloor.

0840 PDT CTD 18 (file 01030024.dat) in middle of seafloor mound. Water depth 240 m. No methane anomaly seen.

1038 PDT Core 16, small gravity corer, at same site as CTD 18. No recovery, except for small pebbles at end of core liner. No more coring or CTD is possible, due to winds which reach 40 kts.

1345 PDT Prepare seismic gear for Chapman lines. Proceed from NW to SE, into wind. End lines at 1810.

1810 PDT Transit to Mud Volcano.

2150 PDT Start airguns.

Monday 6 August Day 218/219

0645 PDT End seismic. Transit to Mud Volcano edifice.

0835 PDT CTD 19 (01030025.dat) going down at Mud Volcano edifice. At 0920, with CTD at 2425 m which is 15 m from bottom, communication with CTD failed.

0955 PDT CTD on deck. Methane sensor removed; it was fine, with no water leakage. No success in assessing problem. Could not set up just to fire bottles.

1525 PDT Core 17 going down at central edifice. In water depth of 2458 m, core at bottom at 1620. Pullout was 12,500 lb, compared to the weight of corer + cable just before penetration of 7500 lb. On deck at 1720. Penetration was 6.1 m. Bottom 1.5 m was very gassy sediments, with formation of expansion cracks. In a 15 cm section, there were very soupy sediments, similar to that seen at other sites where hydrate was present. Core given to geochemists.

1830 PDT Start seismic acquisition. Proceed from Mud Volcano 1 to Mud Volcano2, cross M2, then proceed back to MV1. Record along 6 lines parallel to original lines through MV1, at separation of 200 m.

Tuesday 7 August Day 219/220

0914 PDT Core 18P at site selected by Earl David for examining core penetrability (for later heat probe and pore pressure probes). In water depth of 2493 m, core at bottom at 1021 PDT. Pullout tension was 11,500 lb. Penetration was ~5.2 m. Many turbidite layers seen. Given to geophysicists.

1215 PDT Proceed to rendezvous with Coast Guard helicopter about 30 mi west of Estevan Point, where spare CTD will be delivered.

1920 PDT Start seismic acquisition.

Wednesday 8 August Day 220/221

0650 PDT End seismic acquisition. Lines MV15, MV16, MV17. End 3 miles east of Mud Volcano 3 at toe of accretionary prism. Transit to Mud Volcano 1

0830 PDT Arrive at site. Winds up to 30 kts. Delay core deployment.

1610 PDT Winds are not scheduled to weaken. Leave site for Bullseye vent area.

2205 PDT Start seismic at Northern Fault. Lines are 2 km long, and are separated by 25 m.

Thursday 9 August Day 221/222

0650 PDT End seismic acquisition.

0820 PDT Core 19 over side. It is located in Blank Zone 4, half way between Year 2000 sites C12 and C13. In water depth of 1257 m, core was on bottom at 0919 PDT, and on deck at 1005 PDT. Pullout tension was 10,000 lb.

1300 PDT Core 20 over side, at Bullseye vent near the location of hydrate Core 8. A pinger was attached at 50 m above the core, in an attempt to track core with acoustic transponder net. Core on bottom at 1342 PDT, in water depth of 1260 m. Pullout tension was 12,600 lb. At 1335 PDT, transit of core was stopped at 1000 m depth for check on acoustic transponder. Core was at 600 m depth at 1400 PDT, and on deck at 1440 PDT.
Unfortunately, the transponder was still not working, as position continued to drift even though the core was stopped.
There was no hydrate in core. The lower 1 ¾ sections were empty, and the core catcher was inverted. Dissociating hydrate likely blew out the core contents.

1633 PDT Core 21 over the side at same location as Core 20. Pinger was attached at 1638. Core was on bottom at 1712 PDT, in water of depth 1262 m. Pullout tension was 10,000 lb. It took ~20 min to go from 600 m depth until the core was on deck. It required an additional 5-10 min before the last massive hydrate sample was taken.

1913 PDT Go to Northern Fault to begin seismic. End at 2150. Transit to Fishboat.

Friday 10 August Day 222/223

0213 PDT Record seismic lines 25, 31, 26, 32, 27, 33, 28, 34, 29, 35, 30, 36, 20.

Operations and Equipment

I. Piston Coring Operations

The aft deck layout is shown in Fig. 17. Piston coring occurred between 6 a.m. and 6 p.m., the working hours of the main deck crew. The coring operations were the same as the 2000 VentFlux cruise. Coring was done over the starboard side using the starboard A-frame near the stern, the main crane, the 100 h.p. winch, and the large aft deck capstan. A block was rigged on a chain from the boat davit on the boat deck; a line extending from the yachting winch on the starboard rail went through the block to control the lower barrel. The 100 h.p. winch provided the main support for the corer. The crane lifted the lower portion of the corer weight enabling the corer barrel to come horizontal. The deck capstan lifted the trigger corer using a block on the starboard A-frame.

Normally, two cores were done each day. The first core was prepared starting at about 8 am, and typically started its descent at about 10 am. In 1300 m water, the descent took 30-40 min, and the ascent about 30 min. The first core was in the rack on deck at about 11 am. The second core was on deck about 4 pm.

A total of 21 cores was collected in this survey. For 11 cores, the entire length was cut into a series of whole rounds using a pipe cutter, with lengths typically 10 cm or 20 cm. These were sampled with a 10 mL syringe plus three 3 mL syringes for geochemical analyses (see Part III), and the remaining sediment wrapped in foil and frozen in plastic bags for later laboratory analysis. Six cores were cut into sections nominally 0.75 m in length, which were numbered with section 1 as the deepest section (first one recovered). Normally, 7.5 cm at the bottom of each section was removed and reserved for analysis by the geochemists. As well, the geochemists were typically given the gravity core. These six cores were split for physical property analysis. Half of each split core was left untouched for archive purposes. Table 4 provides the basic core and section information.

II. Physical property measurements and sedimentology

The resistivity probe was a small Wenner array (2 mm probe length, two outer current electrodes and two inner voltage electrodes, each separated by ~2 mm). On day 209, the initial resistivity probe failed, when one of the pins broke off; a new probe was constructed by Rick Mang using gold-plated pins. A digital voltmeter read the voltage of the inner electrodes, and another meter read the temperature of a probe inserted into the sediments. For each section, a calibration in standard seawater was carried out.

Most cores were photographed immediately after splitting using a digital camera. Normally, 2 pictures were required for each 0.75 m section.

After photography, the working section of the core was scraped (using a spatula in order to obtain a general mineralogy of that section). The sediment was sieved to remove the fine organic muds (smaller than 45μm.) and so to leave just the minerals. Resistivity measurements were then carried out (in 10cm intervals). Samples were taken of representative sediment types in each core. Table 6 shows a record of sediment samples taken.

III. Pore fluid sampling and geochemical measurements

Laura Lapham
llapham@unc.edu

(a) Porewater Analysis:

Sediment cores were collected by both gravity and piston coring aboard the C.C.G. J.P. Tully in areas of known and unknown hydrate occurrence. Five-centimeter sections were taken from each core at various depths, depending on length of core and visual observations of gas. Typically, sections were every 10cm for the first 50cm and then every 20cm for 1m and finally every 50cm for the end of the core. More detailed sections were taken if core showed gas expansion. Once core was sectioned, a 3-mL sediment plug was taken and immediately placed into a 20-mL glass serum vial for dissolved methane concentrations and carbon isotopic signatures; these samples will also be used for porosity measurements. Two 3-mL sediment plugs were then taken from the section and capped with a rubber stopper for sulfate reduction rate measurements. Finally, ~8-mL of sediment was placed into centrifuge tubes for measurements of dissolved sulfate and chloride. If enough porewater was extracted from sediment, 2-mL of water was placed into evacuated serum vials for dissolved inorganic carbon isotopic measurements and 1-mL for dissolved sulfide measurements.

(b) Dissolved methane:

Serum vials containing the 3-mL sediment plug were allowed to degas for some time. Three milliliters of dionized water were added to obtain a slurry in the bottle. The bottle was then shaken to release dissolved methane from the water, and 3-mL of headspace was injected into a gas chromatograph for light hydrocarbon concentrations. Once analyzed, the headspace was collected in a gas-tight syringe and transferred to a clean 20-mL serum vial for isotopic analysis back at the University of North Carolina at Chapel Hill on a Finigan-Mat 252 gas chromatograph/isotope ratio mass spectrometer. The vial containing original sediment plug was saved for porosity measurement.

(c) Sulfate Reduction Rates:

Once sediment plugs were in appropriate glass syringes, a 10μL aliquot of approximately 1μCi ^{35}S labeled H_2SO_4 in H_2O was line injected through a silicone filled septa. Samples were incubated at *in situ* (1°C) temperatures for 24 hours. After incubation, samples were dispensed into 100-mL glass serum vials containing 3-mL of 0.1M Na_2S, to swamp any and all nasty reactions that may oxidize some of the precious labeled sulfide that will be recovered. 3-mL of 0.5M ZnAc is then added to stabilize sulfide in the form of insoluble zinc sulfide and stop biological activity within minutes. Finally, 3-mL of 0.1M NaOH was added to cease any further biological activity. Bottles were then sealed with stoppers and aluminum caps and frozen until further analysis. Once back at the UNC-CH lab, sulfate reduction rates will be calculated as:

$$\text{Sulfate reduction rate (mM/day)} = \frac{H_2{}^{35}S * [SO_4{}^{2-}(mM)] * 1.04 * \phi}{{}^{35}SO_4{}^{2-}(\text{added}) * \text{incub. time}}$$

where $H_2{}^{35}S$ is determined by a acidic chromium reduction method, $SO_4{}^{2-}$(mM) is the concentration of sulfate in the porewater as determined by ion chromatography, 1.04 is an isotopic fractionation factor, ϕ is the porosity of the sediment, ${}^{35}SO_4{}^{2-}$(added) is the amount of labeled sulfate originally added to the incubation, and incub. time is the time the incubation lasted in days.

(d) Porewater Ion concentrations:

Once sediment plugs were in 15-mL falcon plastic centrifuge tubes, the tubes were spun on a Sorval GLC-2B with SPX rotor 28X105 round bottom centrifuge at about 4000 rpm for 30 minutes. Water was then decanted off and placed in 7-mL plastic scintillation vials for analysis back at UNC-CH labs on an ion chromatograph for both sulfate and chloride concentrations.

IV. Geochemistry: Naval Research Laboratory Cruise Overview

Rick Coffin
Naval Research Laboratory
Washington, D.C.

(a) Cruise Activities :

Sediment sampling Parameters/Approach

1. Couple U Victoria seismic profiles with NRL analysis of sediments.
2. NRL will sample 10cm band around Laura's syringe cores. To sample, cut cores and push fluid surface into jars. Harder cores in foil, softer in jars.
3. Laura will take 3-3cc sub cores, 1 for methane con and $\delta^{13}C$, 2 for sulfate reduction, 10cc core for centrifuge for pore waters. Parameters off the 10cc will be sulfide, $\delta^{13}C$ DIC.
4. Sediment parameters

a). PC/PN
b). phospholid $\delta^{13}C$, $\Delta^{14}C$
c). organic C $\delta^{13}C$, $\Delta^{14}C$
d). hopane $\delta^{13}C$, $\Delta^{14}C$
e). $HCO_3^{=}$ $\delta^{13}C$, $\Delta^{14}C$
f). pyrolysis
g). patties

Water Column Sampling

1. 7 water column depths (m) 5, 100, 500, 1000, bottom-100, bottom-50, bottom
2. Parameters

a). $\delta^{13}C$ DOC (two profiles)
b). $\Delta^{14}C$, $\delta^{13}C$, DIC, concentration also
c). methane concentration, 8 $\delta^{13}C$
d). species diversity
e). production
f). DOC concentration
g) PC $\delta^{13}C$
h) bacteria counts

3. Other sampling in water column

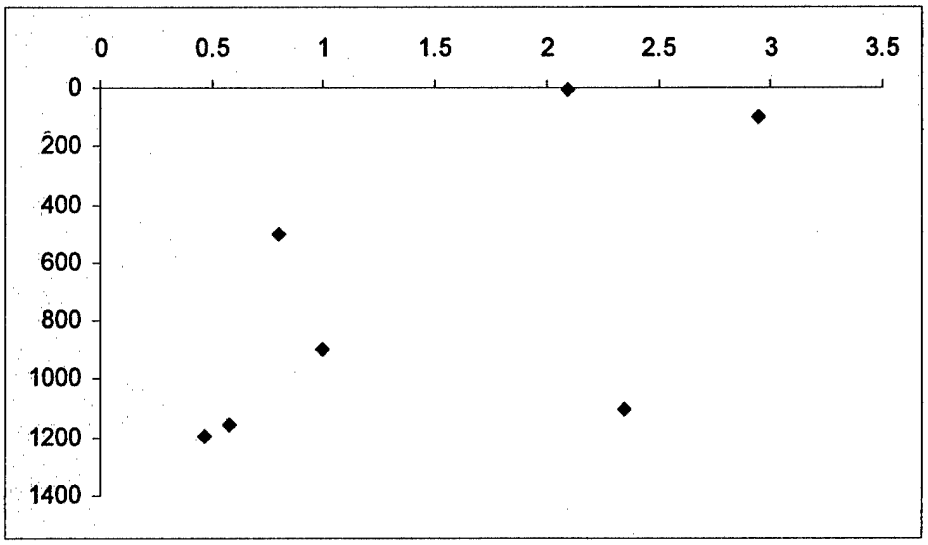
a). $\Delta^{14}C$ POC surface
b). $\Delta^{14}C$ DOC two surface, 6 bottom

(b) Field Work Narrative :

7/26/01

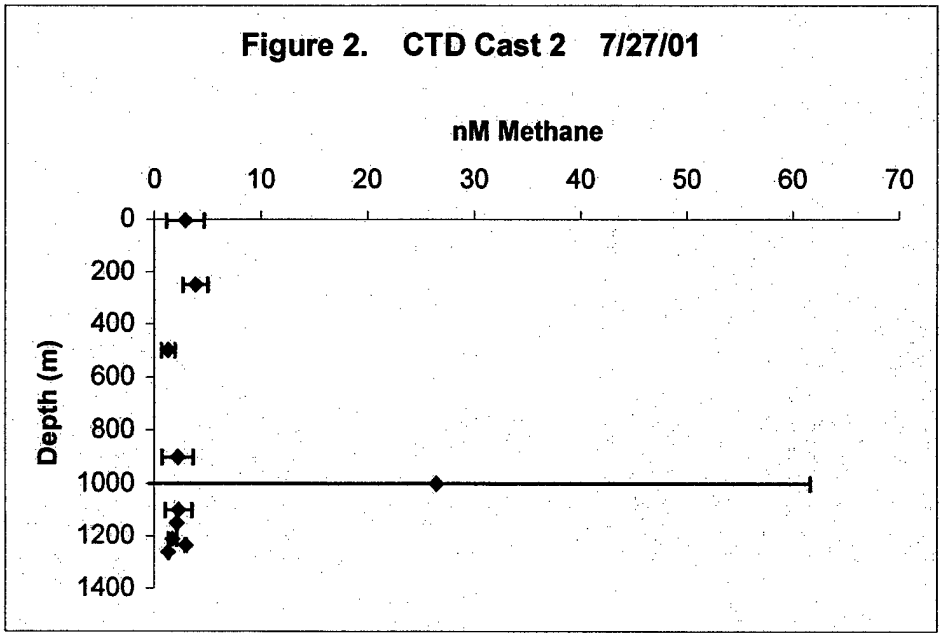
1. First core approximately 48 40.455 N, 126 50.697 W. Approach described above.
2. CTD 1 (6-parens = ship's number) cast on the same site. Parameters are listed above. Methane sensor was not working. We only took T and S. Bottom was approximately 1270 M. We took samples at 1190, 1155, 1100, 900, 500, 100, 5. Species diversity was not taken because fixing reagent was not dissolved. Methane concentrations through the water column were low (**Figure 1**).

Figure 1. Methane Cast 1: Depth (m) vs nM Methane



7/27/01

1. CTD 1a (7) cast to test the methane sensor.
2. Core for geophysics to test conductivity, NRL sub samples core. Core taken on site 2 above. This is noted in the record as core 2.
3. Core for NRL. Core taken on site 2 described above. This is recorded as core 3. This was a rocky grain core. The majority of the core was lost because of the rocky grain. Some sediment was taken for radio and stable carbon isotope analysis.
4. The day was concluded with a methane profile. 48 42'350 126 55.051. 10 samples were taken in duplicate. Depths include 5, 250, 500, 900, 1000, 1100, 1150, 1210, 1235, 1260. Concentrations of methane were run and low. This was taken over the site for the core above. See **Figure 2**, Cast 2(8)

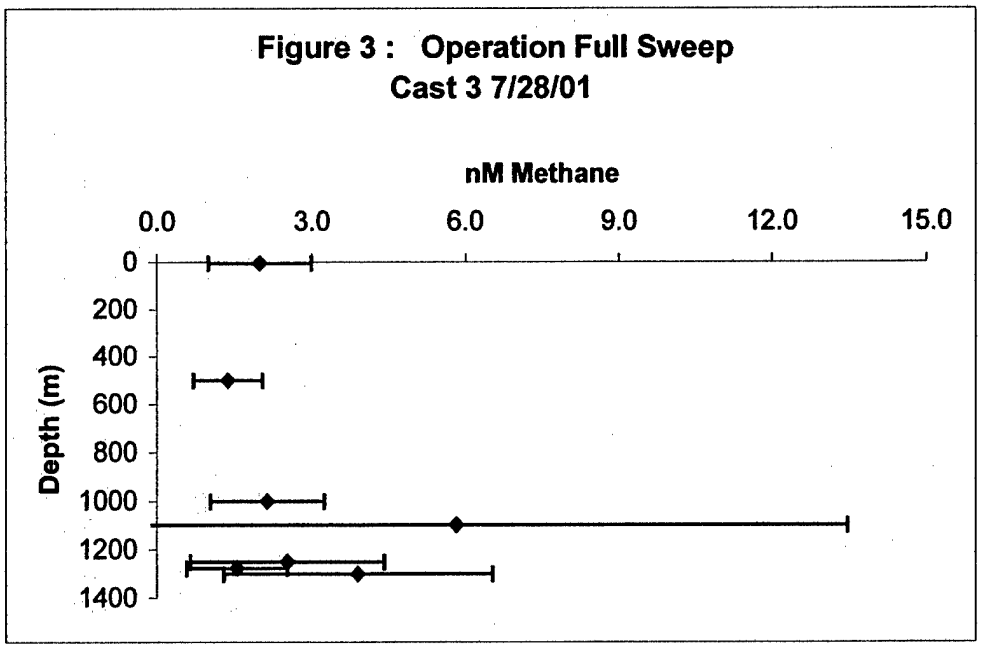


7/28/01

1. Core 4 taken outside the tube worm site. This was 200m NW of the core 3 site, looks like a slide line on the peak where core 3 was taken. The gravity shore was shallow about 20 cm. The piston core came out at 1 m. There was a strong sulfide odor. Looked heavy in carbonate.
2. Core 5 taken at the second location on the site description above. This is a primary work region for the tube worms. High sulfide was smelled, small particle, core imploded mid way, got a good gravity core and got the bottom section of the piston.
3. Water column CTD cast 3 (9). See **Figure 3.** This was taken over the core 5 region. Depth was 1320-10 m. samples were taken at 1300, 1275, 1250, 1100, 1000, 500, 5 m. Did one 14C DOC at the surface water. Species diversity was conducted at this site. In addition there was a full sampling.

7/29/01

1. Core 6 for NRL in the center hydrate vent sites. Site 1 above, off the main core hydrate center. Core was split in 22 sections for carbon isotope, sulfate cycling, and pore water analysis. The total core length was `7.2 m.
2. Core 7 top of hydrate mound site two. Obtained a large number of hydrate samples through approximately 2 m core. On the hydrate labeling there were sections A, B, C, D. The relation of these labels in the core are logged by George Spence. John Pohlman put some hydrates in a dissociation chamber. Found the chamber had a faulty valve. Sample was lost.



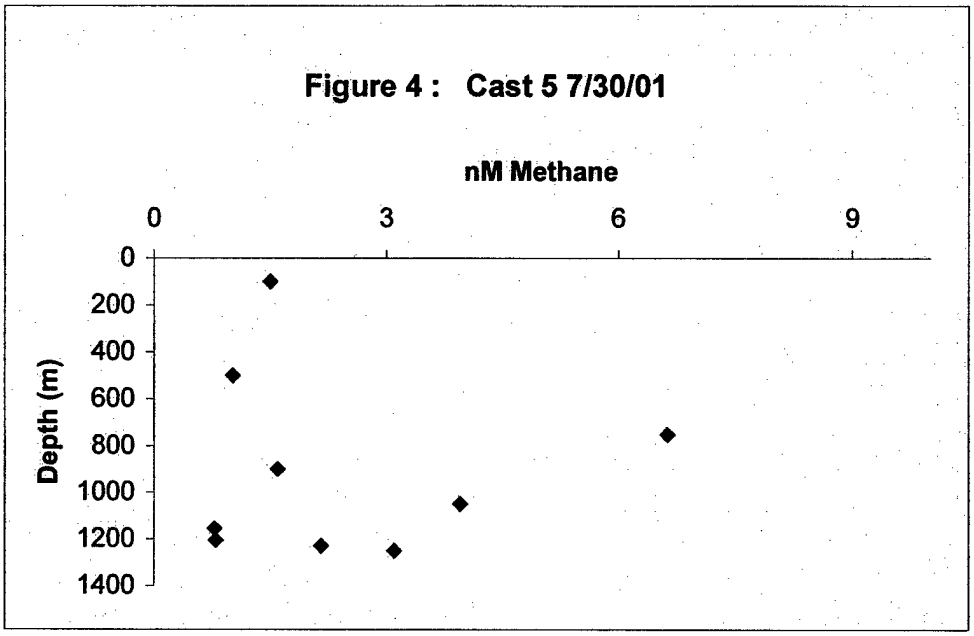
3. CTD Cast 4 (10) on the same region as core 7. Focus on the methane concentrations. Low values were found, does not warrant water column experiment (Figure 2). There were suspected high methane contaminant values. Sources for the contaminant were traced to the rinse water. The methane cast will be repeated on the following day. First effort for the day. These data are on the methane excel file.

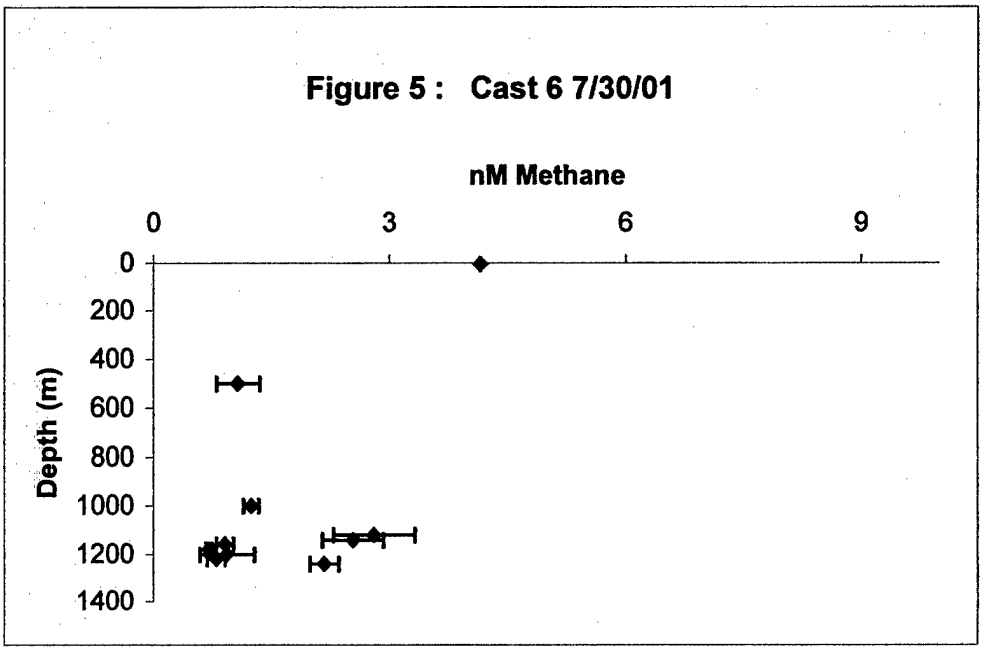
7/30/01

1. CTD cast 5 (11), methane cast repeated over core site 7 (**Figure 4**). Concentrations varying from 3-6 nM do not warrant a water column experiment.

2. Core 8 slightly off center point of Core 7. Found more hydrates through a 1.5 meter core. Hydrates were obtained at 89-94 cm and 20 cm from the bottom of the core. This core is logged in George Spence notes.

3. CTD cast 6 (12) , methane cast repeated going 500 m North West of the cast 4. Low methane concentrations were observed (**Figure 5**). Thought that the concentrations of low methane are associated with the deep hydrate presence and resulting stability.





7/31/01

1. Water column CTD cast 7 (13) over hydrate site 3 in the introduction notes above. This was a full suite of parameters completing the 3rd set. See **Figure 6.**

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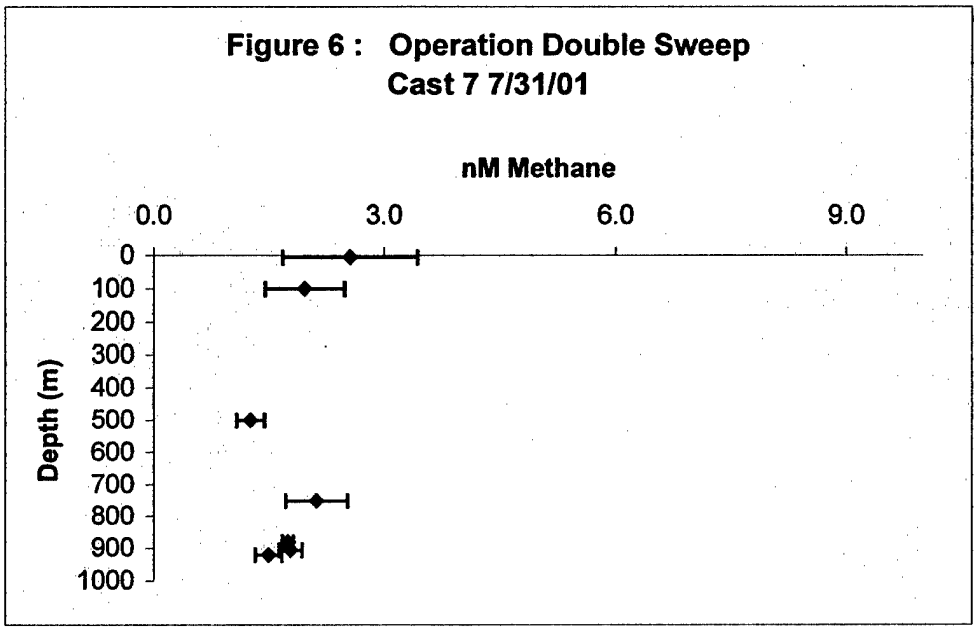
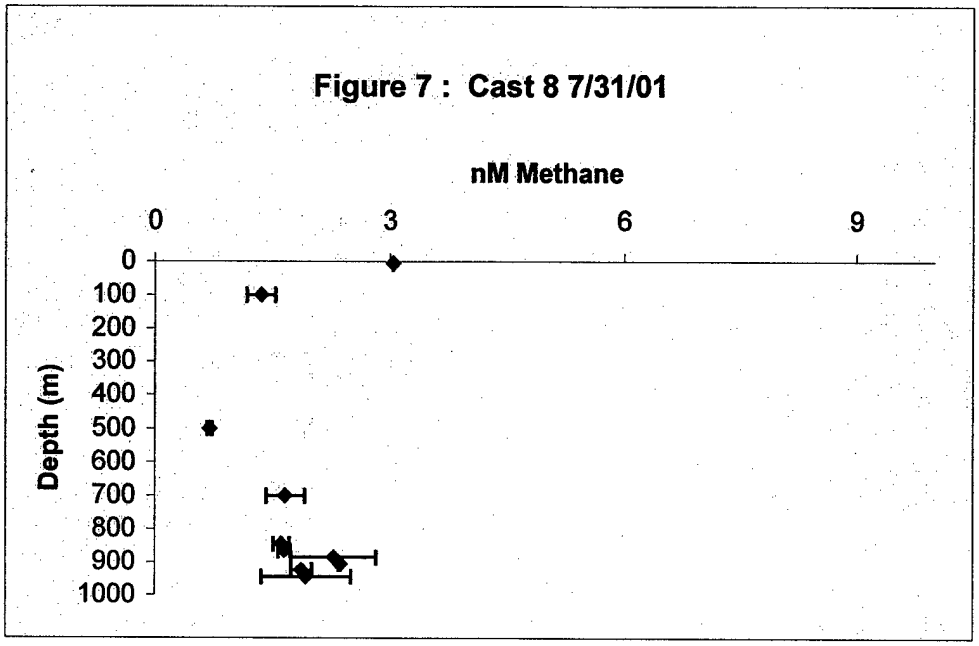
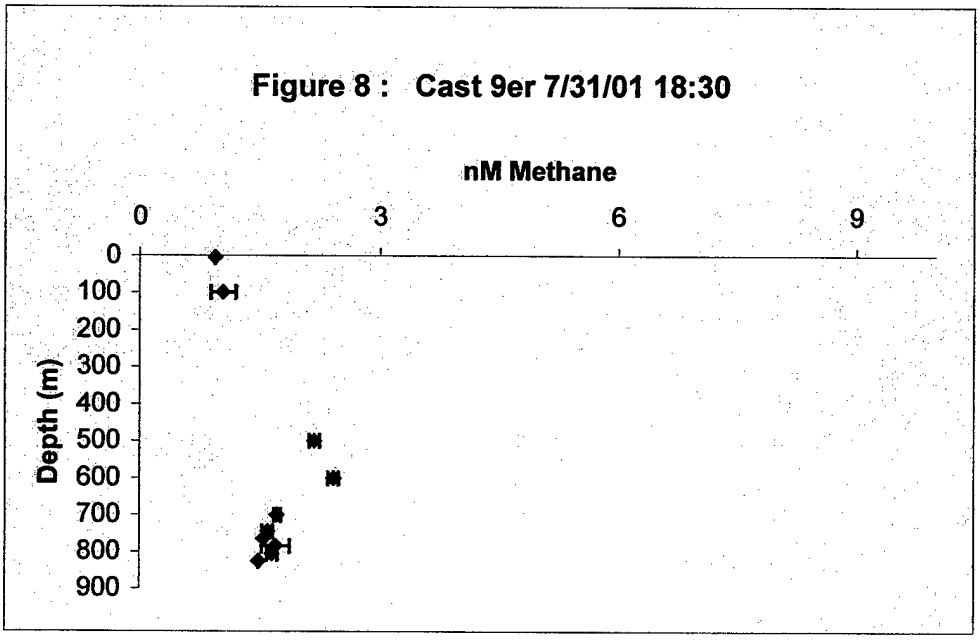


2. Water column CTD cast 8 (14) over hydrate site 3 in the introduction notes above. See **Figure 7.**



3. Water column CTD cast 9 (15) over hydrate site 3 in the introduction notes above. See **Figure 8.** Still low methane on all of the casts.



NOTE: With the low methane concentrations over the active hydrate regions, primary focus will be the to look at the change in methane concentrations in the water column

moving to shore. This will assist in understanding the hydrate stability and regions that are potential for destabilization and flux into the ocean and atmosphere.

8/1/01

1. Sediment core 9 over the active fishing methane hydrate regions. Site 3 above. NRL/UNC took the lead on this core. The core was approximately 7m. Laura Lapham and NRL split the core for sulfate cycling and carbon isotope ratio analysis. The dryness of the core required three twenty ml centrifuge tubes for pore waters.
2. Sediment core 10 over the active fishing boat methane hydrate region. U. Victoria took on the responsibility for this core. Core was broken up.
3. Sediment core 11. Over the fishing region, site 3 above. NRL/UNC took the lead on this core. John Pohlman ran an experiment on the 3 depths of this core for a balance of methane production and oxidation. Used the fluoride inhibitor to for elimination of the autotrophic cycles. Ran the experiment for 24 hrs with three sample periods.

8/2/01

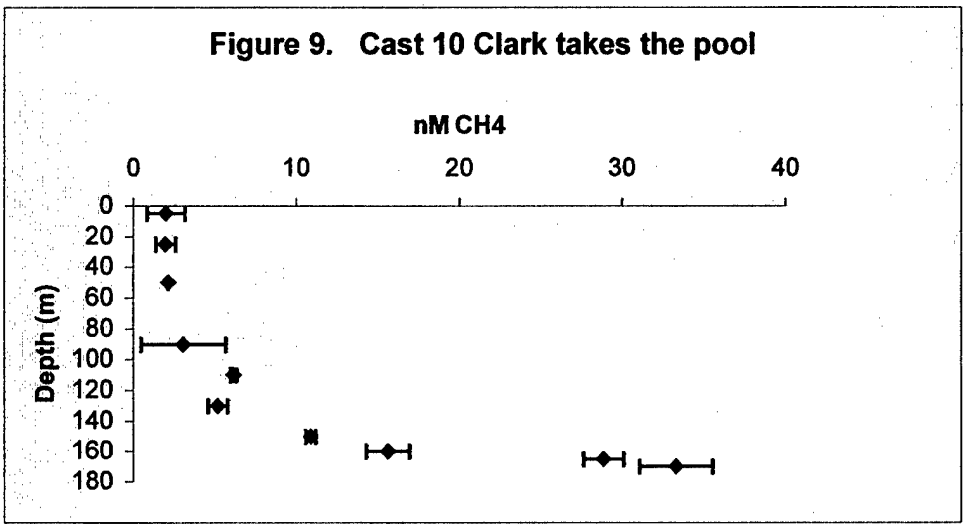
1. Sediment core 12. Laura Lapham took sub sections. Over site 4, 200 m more large active methane seep region. Full suite was conducted.
2. Scientific party was unloaded.

8/3/01

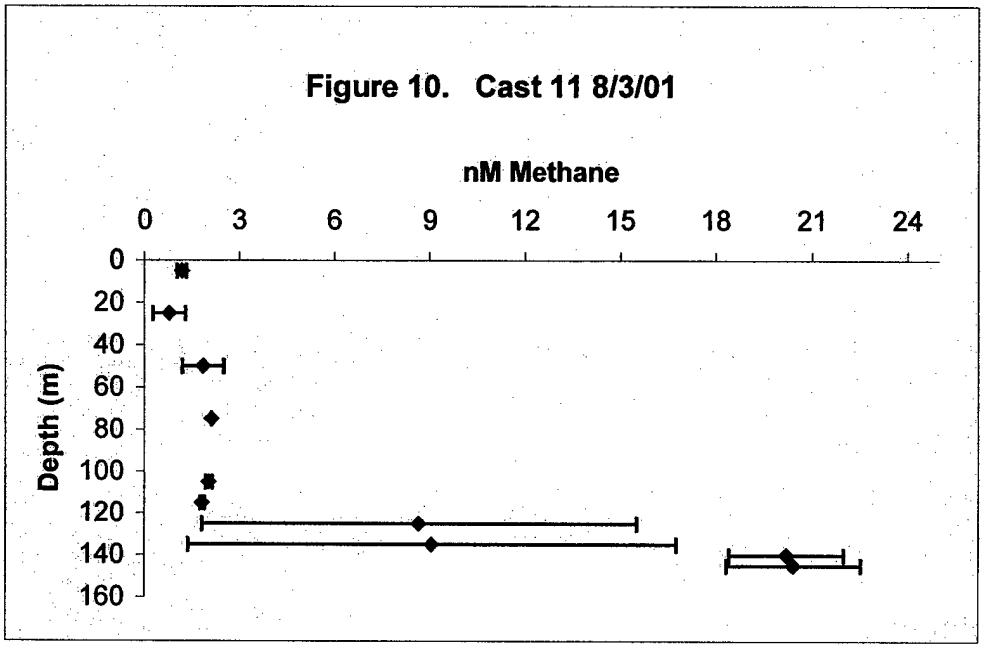
1. Water column CTD cast 10 (16). See **Figure 9.**

2. Lost piston core.

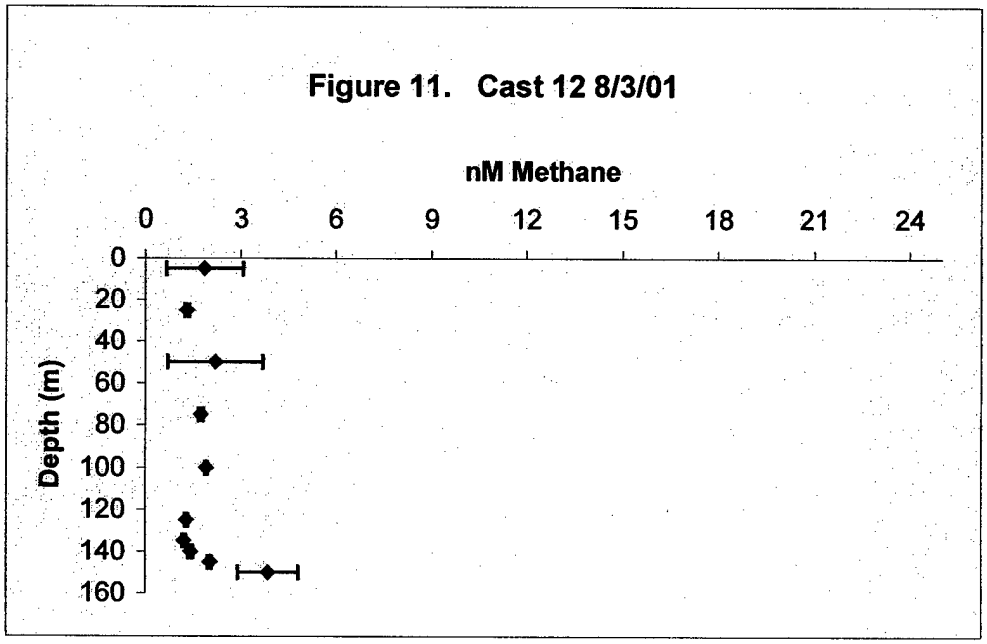
Figure 9. Cast 10 Clark takes the pool



3. CTD 11(17) 49 20.825, 127 8.232, 154m deep. See **Figure 10.**

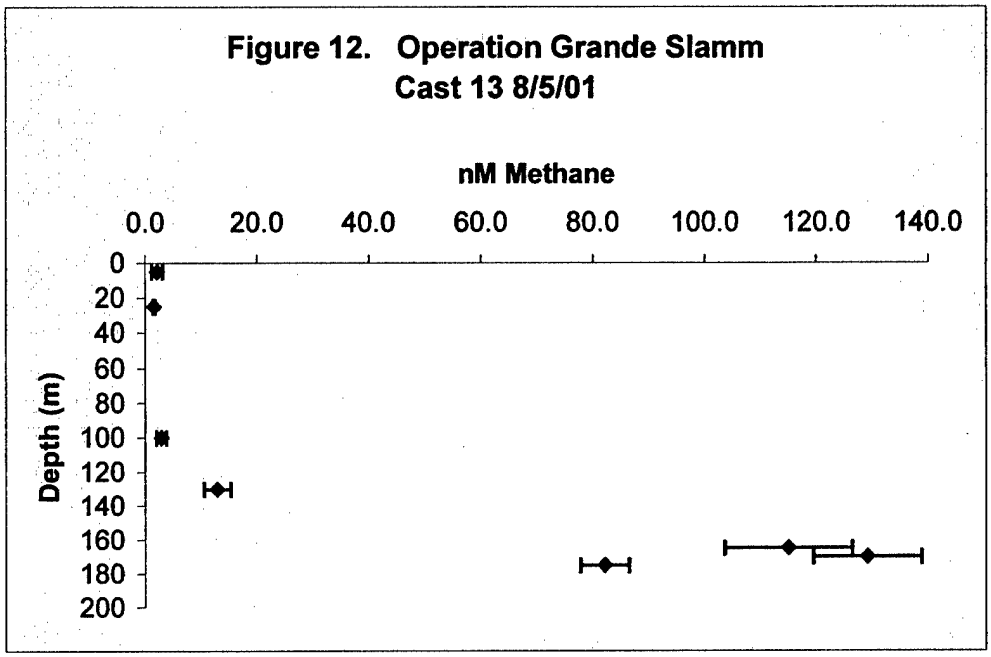


4. CTD cast 12(18). 162 m deep. See **Figure 11.**

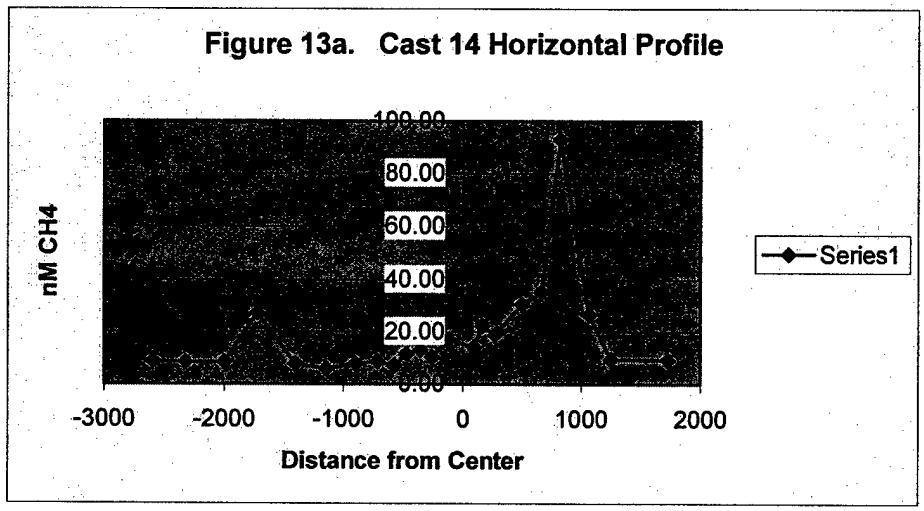


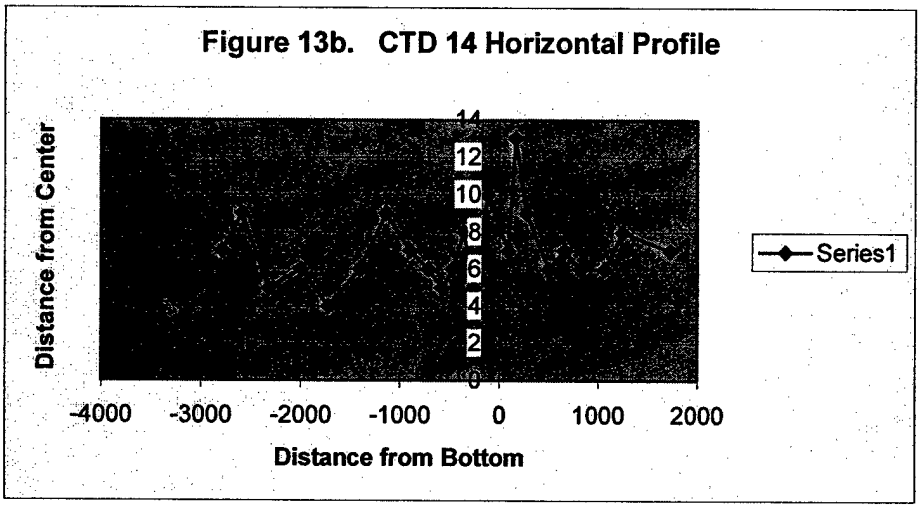
8/4/01

1. Start full suite on top of the preliminary 200 m site. This was cast 13(19). See **Figure 12.**



2. Start bottom drift sampling. Cast 14(20). See **Figure 13.** We started to drift 1 mi upstream from the item #1 location. We fired the bottles 23 times at individual stations. There were 9 samples above the center point and 13 below for 1.5 miles. Combined with the previous vertical profile this give 2-D resolution, next sample was across the high concentration found in a perpendicular track. Lat Lon, depth, and distance traveled for the sampling is in the log book. This analysis give 3-d survey of the methane flux from the sediment. Parameters for the profiles were methane concentration and bacterial production.

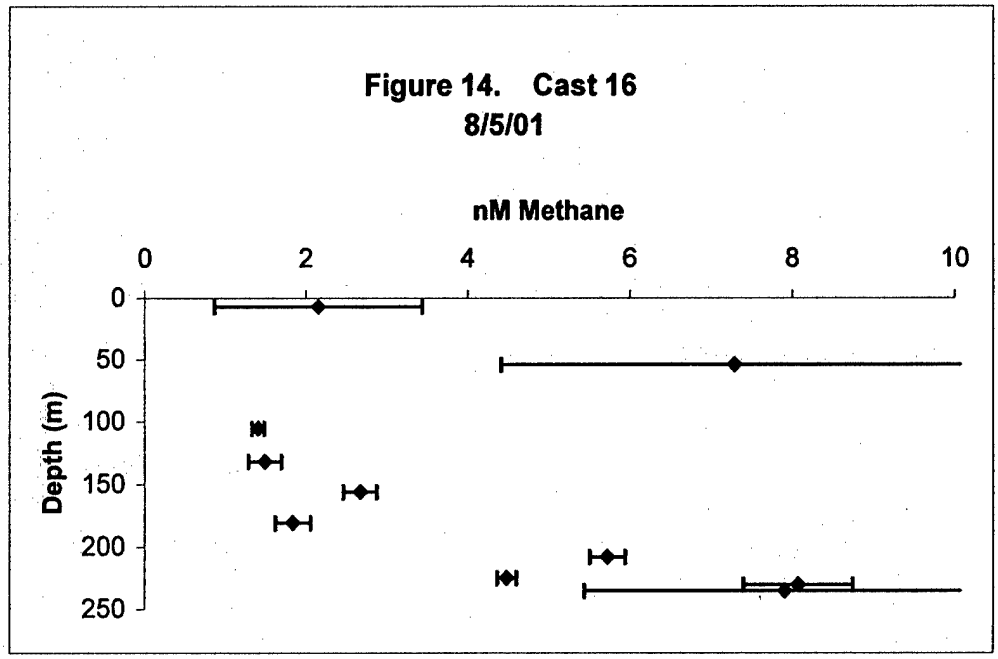




3. Cast 15(21) bottom sample on the southern point of the second transect. This was done because fishing nets were in the way of the planned line.

1	9.12	
2	9.40	
3	26.56	

4. Cast 16(22) full cast over the site 4 on the first transect. Depths include 183,175, 165, 150,100, 50, 5 m. See **Figure 14**.



5. Fishing boat was gone and the second bottom methane sampling profile was conducted CTD17(23). See **Figure 15**.

Figure 15a. CTD 17 Horizontal Profile

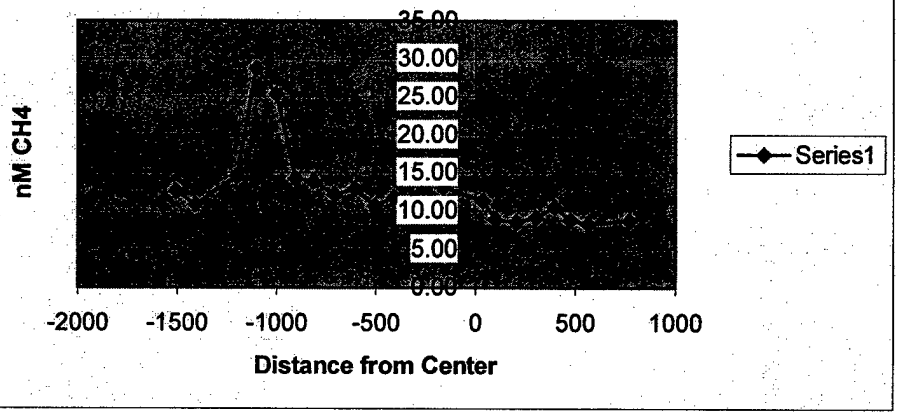
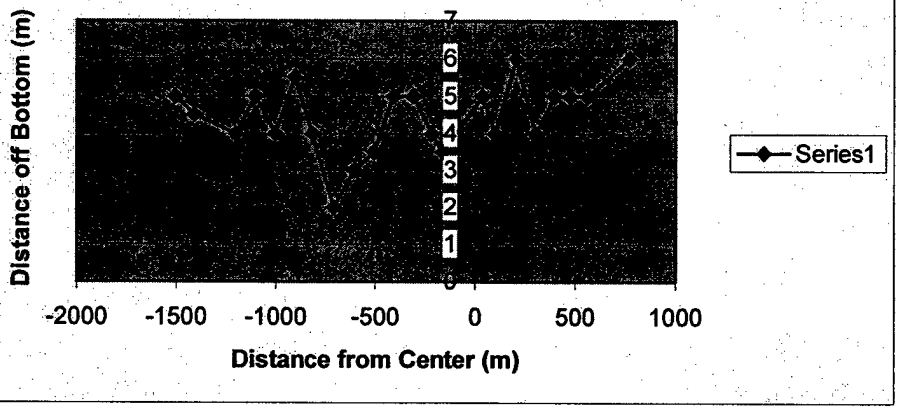


Figure 15b. CTD 17, Distance of Sediment



8/5/01

1. Southern most station at 200m 49 00 068, 126 43 630. Depths were 224, 220, 215, 200, 175, 150, 125, 100, 50 ,and 5 meters. CTD 18(24). 49 00.063 126 43.636. See **Figure 16.**
2. Bad seas lost the remainder of the day.
3. Core 16- gravel no data.

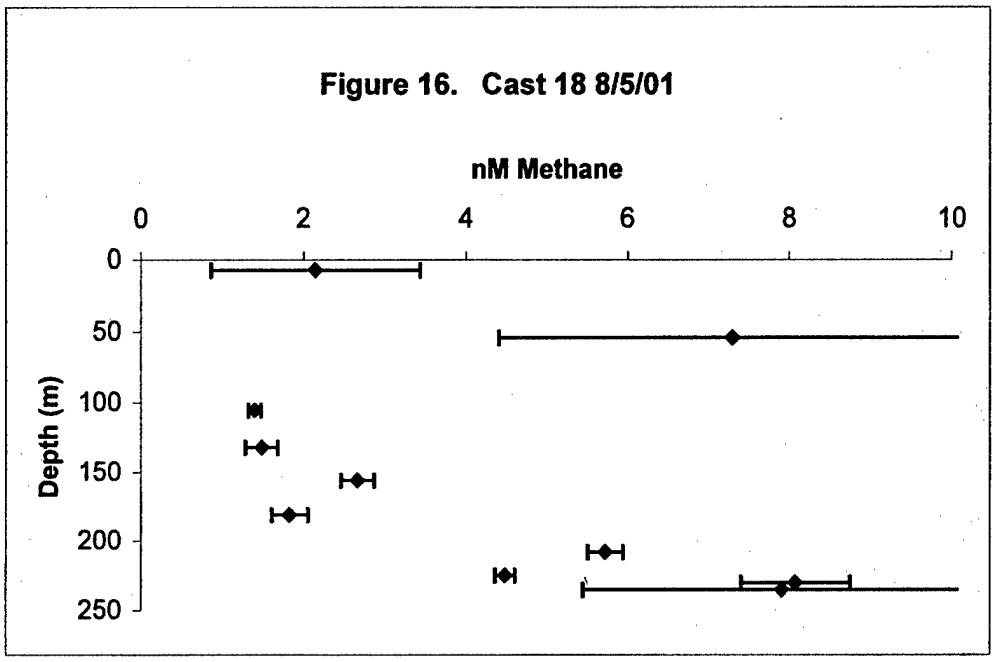


Figure 16. Cast 18 8/5/01

8/6/01

1. Site 5 deep CTD taken. CTD went off line at 2450 meter. System was taken apart and found that rosette control was not functioning.
2. Core was taken for full geochemistry profile on top of the hydrate mound. Core 18.

8/7/01

1. One core taken on the top of the deep sea hydrate mound. Geophysics analysis was conducted. A couple of samples preserved Core 18-P

8/801

Weather prohibited coring on the second hydrate mound.

CTD could not be repaired water column sampling is lost. Future work for hydrate dissociation and flux into the water column and atmosphere needs to focus on the intermediate depths in the range of 400-700 m. This will work assist in the interpretation of 4-140 nM methane seen near shore (200m) and 1-6 nM seen at 1200-1400 m depths. This work in the future should be coupled with bubble traps to assist in calculations on the flux to the atmosphere.

8/90/01

1. Geochemical coring on site 1. This is core 19. Obtained a core that was ~7.6 m long. Had methane pocket toward the deep end of the core. The remaining core was uniform in color.
2. Geophysical core on site 1 more toward the center of the mound with the goal to obtain hydrates. This core seems to have had methane that exploded out the piston. A small amount of core was obtained toward the surface. This core 20.
3. Core 21. Same site as the previous lost core. Hydrates were obtained from the mouth of the piston core, ie the trap. 21 cm up the core from the bottom, and at a marked location that George Spence has marked. One hydrate sample was put into the pressure chamber. Johanna has this core sketch and John will get a copy.

NOTES no core 17.

(c) Parameter/Method Listing

-Cascadia Margin Cruise Sampling Plan

ITALICISED SECTIONS WERE NOT TAKEN. LOW METHANE AND INOPERABLE ROSETTE/CTD

Hydrates:

1. LN2 – taken care of
2. Cloth Bags – about the size of a sheet of paper. Get Brand from small box obtained in 1998. Forest Supply of something. They are in Kansas **We Have bags that will be good according to Rick**
3. Al Foil (baked) (100 sheets) **Found in SAM'S CLUB Sara will buy them**
4. Digital Camera
5. Ruler
6. Black background
7. LN2 transport dewars (2) -- order from Taylor Wharton now

Water Column:

Profiles:

3 stations, 2 profiles/station → 6 total profiles
1200-1400m water column → 0,50,200,500,1000, 1200, bottom (7 depths)
DOC&DIC concentration: 3/depth → 21/cast → 126 total for profiles
Bacterial Counts: 2/depth → 84 total for profiles
Production → 4/depth → 196 total for profile
DIC (c13&14) isotopes → 13C: 3/depth → 21/cast, 1cast/station → 63 total (collect from 13CH4 bottle)
14C: 3/depth → 63 total
DOC (c13&14) isotopes → top and bottom, 1 cast/station → 6 total of each
POM → 126 total for profiles
PC/PN → 126 total for profiles.
Methane concentration and isotopes. Concentrations will be analyzed on board. Number unlimited.
16SRNA for microbial diversity → One profile at each station. Collect one sample at 3 depths – surface, mid and bottom → 9 total in triplicate → 27 samples

Biomarkers: (profile)
Transfer volume to carboy and pump on deck. Up to 200L needed. Freeze cartridge filter.

10 um cartridge pre-filter (2) (3) on hand
1 um cartridge prefilter (2) –(2) on hand one on order
Blue filter cartridge housing (1)
0.2 um cartridge filter (bunch in drawer) - 15—At least 15 on hand
Pneumatic pumps – recommendation from Tom on what is best pump (2)
New Si tubing tubing -- 50' ---50 Ft. of new Si tube ordered
Plastic tubing clamps to fit cartridge filters holders
4 50L carboys – Acid Rinse

Cartridge filter frozen after filtration. Endpoint of filtration determined by reduced flow

??? air supply on ship.

3 Stations, 3 depths. Collect in Duplicate. 18 samples total

Sediments:

Deep piston cores were analyzed for:
%OC and bulk d13C, carbonates, pyrolysis, biomarker extractions (13C and 14C) and bulk 14C.

Some representative cores (5cm sections) will be collected if the number of cores pressed is less. These cores will be cut and stored in baked glass jars with teflon lined caps. No cores will be shipped!

Hydrates will be pulled or cut out, photographed and frozen. Are there any polyethylene core liners that we can use? Use a utility knife to cut them.

The other option for hydrate recovery is to precut the core liners so they can be folded open and sampled without taking time to cut the core after sampling.

Equipment:
50 sleeves. (polycarbonate tubes). Still waiting on Rick to tell me what dimensions of the core. Otherwise get Laura to ask Jeff what size he provided last year.

Pore Water Press – 1-2/day (Laura). Rick wants 5/day for spatial resolution. Is this feasible?
200 caps
5 core catchers
electrical tape (10 rolls)
3000 baked sheets of Al foil **Found in SAM'S CLUB Sara Will buy them**
3000 small ziploc bags--- **NRL Store has these in 100 bag packs**
500 larger ziploc bags--- **NRL Store has these in 100 bag packs**
120 500ml Ichem jars—**ordered 10 cases of 12**

Parameters:
Biomarkers
DIC and DOC 13C Isotopes (stable and radio, inorganic &organic)
Dissolved gases (pore water press product, UNC materials)
SRR (pore water press product, UNC materials)
Chlorinity (pore water press product, UNC materials)
Production → surface only
DIC and DOC conc.

Pore Water Dating….

1. Methane:

Methane will be analyzed for concentration in the field. Water samples will be the first collected and into a 100ml syringes and after shaking injected into the GC.

Number of Samples for concentration: Unlimited

Equipment:
Shimazu FID GC
H2, N2 and Air requested from George Spence.
Chad packs rest of equipment.
Extras? Drierite, syringes, stopcocks…..What else?
Fittings, tubing, valves….
Standards, including CO2
Methanizer
Catalyst for methanizer
Bag of Q-tips

2. DIC:

DIC will be analyzed for concentration, stable and radioisotopes.

Method:
Water samples will be collected whole and fixed with a saturated solution of HgCl2.
Concentration samples will be collected in 50ml amber serum vials
Radiocarbon samples will be collected in 125ml clear serum vials
2000um = 24mgC/L, so should collect 2mg/sample. 100ml=2.4mg
Stable Isotope samples will be collected in 15ml serum vials. 15ml=360ug

For every 2 mls sample add 1 ul HgCl2. Seal Serum vials first and then use a syringe to relieve the pressure. Then add the HgCl2. Store these samples at room temp in the dark.

Numbers:
Profiles: 2 profiles/station, 3 stations → 6 casts

Materials:
Ashed 50 ml serum vials
Ashed 125ml serum vials
Ashed 15 ml serum vials
HgCl2
icated HgCl2 Hamilton syringe
Grey butyl septa
Al caps
crimper

3. POM:

POC or "Seston" will be collected and measured for concentration only.

Materials:
1. 4 filtration towers
2. Filtration rack
3. Appropriate tubing
4. Drierite
5. Drierite trap
6. Water trap
7. GAST pump
8. Forceps
9. 1L bottles (Rick – volume okay?)
10. 150 prebaked and preweighed 48 mm filters

Save for stable isotope analysis?

4. DOC:

Radioisotopes: Collect in 4L Glass Amber bottles. Add 2mls sat. HgCl2 to fix and refrigerate.
Stable Isotopes: Collect in 1L Nalgene bottles. Add 0.5 mls sat. HgCl2 to fix and refrigerate.
Concentration: Collect in amber ampoule through a conditioned teflon tube. Run numerous liters through the tube to condition it. Keep the tube in a ziploc bag when not in use. Fill the amber ampoules directly to about ¾ volume and flame seal. Freeze.

50uMC= 0.6mg/liter.

Materials:
1. 50 ml sat HgCl2.
2. Dispensing syringe – one dedicated to HgCl2
3. Bag for storing syringe in
4. 4L plastic coated amber jugs
5. 1L Nalgene bottles
6. Electrical tape.
7. ashed amber ampoules
8. torch (buy in Victoria)
9. teflon tube (2) – bubble tubing type
10. tube storage bag

5. PC/PN:

PC/PN samples will be collected for PC/PN only. PC/PN samples will be collected by filtering seawater samples through a 13mm ashed GFF filter. Samples will pumped from Niskin bottle and filtered through the 13 GFF filter apparatus. Filter until the filter is clogged, collect volume in a graduated cylinder (record volume filtered). Place filters in petri dishes and freeze. **3- 13 mm filter towers with manifold and gast pump plus two pneumatic pump and associated hose and Si Tubing**

Volume for PC/PN: 10L

6. Bacterial Counts:

Collect water samples in 20 ml scintillation vials with the plastic v-caps. Samples are filled all the way to the top and then add about 500ul of formalin (2 drops). Samples are stored in the refrigerator.

Water Column: 84
Experiment: 192
Total: 276

7. Bacterial Production:

Water Column: 196
Experiments: 384
Surface Sediments: 40
TOTAL: 620

8. Pore Water:

Laura Lapham UNC has all data listed for pore water. Pore water will be measured from dissolved CH4, H2S, SO4 and chlorinity. What else do we need done? DIC? DOC? Isotopes?

We will collect one core/site dedicated to measuring the concentration and isotopic values of the DIC and DOC. First, we can measure the CO2 in the headspace using the methanizer. Or, we can measure the DIC from the DOC ampoules. DIC = TC-DOC.

So for a 10 ml sample → Collect 5 mls pore water in the syringe. Introduce 10ul 85% H3PO4. Add 10 ml headspace N2. Shake for 10 minutes. Inject headspace gas into GC and measure CH4, other hydrocarbons and CO2. Transfer sample into the ampoule. Use a GasTite Syring for this. SGE, an Australian outfit, sells the best such syringes. We have one 50 ml syringe and should get an or 2 extra. Do they have 25 ml syringes? Do not use plastic if we are going to save sample for DOC. Also, we will need to fill the syringe with an open split. GasTite syringes are not as easy to withdraw. Using pressure to push the plunger back will generate too much internal pressure.

129Iodine dating – collect 15 mls in a serum vial, seal and refrigerate.

9. Microbial Diversity:

Water Column: Collect water sample from desired depth and collect no less than, but up to 10L of water on a 47mm 0.2 um millipore filter. Confirm w/ Will before ordering.

10. General:

1. cable ties
2. latex gloves (3 boxes)
3. tools (screwdrivers, pliers, wrench, etc.)
4. duct tape (3 rolls)
5. permanent marker (sharpie) – box (fat and thin tip)
6. rinse water (do they have this on board?)
7. rinse 10% HCl (4L)
8. flat forceps (4)
9. pens
10. electrical tape (10)

Sediment Experiment:

Methane experiments were not conducted in the water column because methane concentrations were not great enough to support a significant amount of the water column microbial production. In shore there were concentrations up to 140 nm that were worth experimentation but timing and planning horizontal methane surveys did not allow this analysis. Instead experiments were designed for the sediments. A comparison was made of the methane oxidation relative to methane production in sediment samples. These experiments were conducted with the assumption that methyl fluoride inhibits the autotrophs. This may not be the case for the deep sediment methane oxidation cells. The methyl fluoride inhibition needs lab testing. 3 stations, 3 experiments were taken for methane cycling through different core depths that were viewed as active gas sections. Autotrophic (nitrification and methanotrophy) -vs- Heterotrophic Production:As measured with the inhibitor methyl flouride.

Method:

1. Add inhibitor to treatment group.
   3% (v/v) so... 125 mls=3.75mls gas; 100 mls=3mls gas; 50mls;1.5mls gas
   Someone needs to determine actual volume of bottles....

2. Inhibitor will be added by direct syringe injection through the septum.

3. Measure t0 (methane), store other t0 samples.
   Production: remove 1 ml aliqout and put it in the production tube

4. Collect at 0, 4, 12 and 24hrs

Materials for Experiment:
MeF cylinder – ground ship
Ringstand (1)
1 Regulator w/ syringe tip (2)
10 ml transfer syringe (5)
needles (5)

Parameters for Experiment:
DIC
Bacterial Production
Biomass
Methane consumption

V. Seismic Activities

The seismic source was a 40 cu. in sleeve gun, fired by distance at an interval of 12.48 m. At a nominal ship speed of 4 kts, this corresponded to a shot time interval of ~ 6 s. The Rix compressor could supply air at a rate of ? cu. ft. per minute, so it had sufficient air capacity. For most of the survey, the reflections were detected using the 25 m Teledyne single channel array, towed from a block on the crane which extended about 3 m from the starboard side of the ship. The preamplifier filter in the Teledyne array was set to ?40 Hz. A Kronhite filter acted on the data coming from the preamp. Filter limits were 60 Hz and 2100 Hz; after Day 217, the low frequency limit was set to 30 Hz. The gun and array geometry were made almost the same as that in 1999 – a gun depth of ~2 m at a distance of 25 m behind the stern of the ship, and an array depth of ~4 m with the head of the array 57 m behind the stern. The seismic data were recorded on channel 1 of the MUSE system (sample rate of 500 μs, record length of 5 s or 6 s). Simultaneously, the 3.5 kHz data were recorded on channel 2 of the MUSE (sample rate 40 μs, record length typically 900 ms, delay 1310 ms; for deep water, the sample rate was increased to 80 μs so that a record length of 2600 ms could be used).

For the first night of seismic recording, a second Teledyne streamer was towed off the port side of the ship. The separation of the two streamers was 3 m (offset of port streamer) + 14 m (beam of ship) + 3 m (offset of starboard streamer), for a total of 20 m. With the airgun towed behind the centre of the ship, two seismic lines were collected simultaneously for which the reflection points were separated by 10 m. For grids in which the ship's track was separated by 25 m, the resultant pattern of lines alternated between 15 m and 10 m separation. This averaged 12.5 m, the same value as the shots, and would lead to uniform spatial sampling in both horizontal directions – suitable for 3D migration. Unfortunately, the second streamer was lost (caught in ship's screw) during the first recovery. Subsequent operations used just one streamer (the newer one).

VI. Acoustic Transponders and Navigation

Navigation used Differential GPS. The Science Lab antenna was located 12 m from the stern on the aft mast, and the ship's antenna was 20.4 m forward of the Science Lab antenna. Navigation software provided by Ivan Frydecky fired the airguns by distance. Every 5 s, it recorded latitude/longitude along with the water depth picked from the 12 kHz transceiver; a constant water velocity of 1492.6 m/s was assumed for calculation of water depth.

Richard (Rick) Mang
Electronic Technician
Naval Research Lab.
Stennis Space Center, MS
rmang@nrlssc.navy.mil
228 688-5508

Ivan Frydecky
Consulting Engineer
FCI
North Saanich, B.C. Canada
frydecky@home.com
250 656-0436

Table 1. Scientific Personnel

George Spence	Co-Chief Scientist	(250)721-6187	gspence@uvic.ca
Bob Macdonald	Co-Chief Scientist; mechanical	(250)363-6420	macdonald@pgc.nrcan.gc.ca
Ivan Frydecky	electronics/navigation	(250)656-0436	frydecky@home.com
Johanna Hoehne	phys props, sed, seismic	(250)721-9400	jhoehne@uvic.ca
Rick Coffin	ocean chem, pore fluids	(202)767-0065	rcoffin@ccsalpha3.nrl.navy.mil
John Pohlman	ocean chem, pore fluids	(804)684-7153	johnp@ccf.nrl.navy.mil
Scott Tumey	ocean chem, pore fluids		
Clark Mitchell	ocean chem		
Chad Miller	ocean chem, pore fluids		
Ryan Briscoe	ocean chem, pore fluids		
Laura Lapham	pore fluids	(919)962-1254	llapham@unc.edu
Rick Mang	Acoustic Transponders	(228)688-5508	rmang@nrlssc.navy.mil
	First Leg Only		
Ivana Novosel	physical props, seds	(250)381-7443	novosel@uvic.ca
Mladen Nedemovic	seismics		
Robert Lamontagne	ocean chem		
G. Richard Coffin	hoser		
	Second Leg Only		
Michael Riedel	seismics	(250)721-6188	mriedel@uvic.ca
Mikhail Zykov	seismics	(250)995-3172	zmm@uvic.ca
Yan Hu	seismics		yanhu@uvic.ca
Steven Bloomer	bottom characterization		

Table 2. Ship's crew

C.O.	John Anderson
Ch Officer	Richard Slusacek
2nd Officer	Ian Poyntz
3rd Officer	Matt Jantzen
Boatswain	John Greene
Leading Seaman	Bill Blacklock
Leading Seaman	Tom Jamieson
Deckhand	Maddy Haider
Deckhand	Kirk Smith
Deckhand	Rene Dickenson
Deckhand	Matt Heinl
Ch Engineer	Randy Morford
Senior Engineer	Rick Bailey
2nd Engineer	Colin Schofield
Oiler	Ian Hatt
Oiler	Dave Walsh
Chief Cook	Brent Parsons
2nd Cook	Phil May
Steward	Bob Rayner
Steward	Kalyn Culligan
Steward	Vince Gabas

Table-3a

NT 18 TRANSPONDERS
ALL RECEIVE ON 9 kHz
TURNAROUND TIME 15 ms.

NT18-10

STA	XMIT(kHz)	DISABLE	ENABLE	REL	SN
A	11.0	79	73	81	8705197
B	11.5	80	78	82	8705198
C	12.0	88	86	90	8705199
D	do not attempt to control at this time				8705200

NT18-11

STA	XMIT	DISABLE	ENABLE	REL	SN
E	13.0	107	105	109	910202
F	14.5	59	57	61	910203

OCEANO RT 1X1
RELAY TRANSPONDER

TRANSMIT	RECEIVE	TURNAROUND TIME
9.O	14	15 ms

Table-3b

TRANSPONDER LOCATIONS

XPONDER	LAT	LON	DEPTH (m)
A	N48 39.5719	W126 51.4566	1314
B	N48 40.2299	W126 52.1645	1269
C	N48 40.8953	W126 52.8761	1277
D	N48 41.4439	W126 51.7326	1235
E	N48 40.7673	W124 51.0091	1231
F	N48 40.1027	W126 50.2962	1283

Table 4. DECK CORE LOG – Location and description of cores

CORE #	LATITUDE	LONGITUDE	TIME (day/hour)	WATER DEPTH (m)	CORE LENGTH (m)	SECTION #	DEPTH OF SECTION TOP (cm)	SECTION LENGTH (cm)	COMMENTS
1	48°40.044	126°50.75	207/1350 PDT	1267					Chemists' core
2	48°42.4451	126°52.7257	208/1127 PDT	1321	4.78+0.4 missing	6	40	90	
						5	137	75	Sample 1406
						4	212	57	
						3	276	68	
						2	351	75	
						1	433	68	
3	48°42.333	126°55.045	1530 PDT	1315	0.30	1	0	30	Carbonate pebbles
						gravity	0	-	
4	48°42.431	126°55.178	1007 PDT	1327	0.86	1	0	85	Chemists' core
						gravity	0	25	
5	48°42.314	126°54.766	1510 PDT	1325	3.84	5	0	96	
						4	96	61	
						3	164	62	
						2	234	67	
						1	309	68	
6	48°39.966	126°51.067	1006 PDT	1265	7.17	3	0	110	Chemists' core

DECK CORE LOG (cont'd)

CORE #	LATITUDE	LONGITUDE	TIME (day/hour)	WATER DEPTH (m)	CORE LENGTH (m)	SECTION #	DEPTH OF SECTION TOP (cm)	SECTION LENGTH (cm)	COMMENTS
6						2	110	310	Sample 1434
						1	420	297	Sample 1438
7	48°40.047	126°51.110	1459 PDT	1264	4.15	2	0	115	HYDRATE!
						1	115	300	
8	48°40.099	126°51.017	1313 PDT	1259	1.53	1	0	153	HYDRATE!
9	48°18.188	126°4.567	0915 PDT	840	7.71	1			Chemists' core
						Gravity			
10	48°18.201	126°4.565	1323	840	6.07	1	422	150	Same area as above (accident). Lost 119cm of top seds
						2	269	153	
						3	119	150	
						4	0	119	
11	48° 18.077	126°4.799	1629	871	6.39	1	0		Chemists' core
12	48°18.055	126°04.681	09:10	884	7.58	1	683.5	67.5	
						2	608.5	67.5	
						3	533.5	67.5	
						4	465.5	60.5	
						5	392.5	67.5	
						6	315.5	67.5	
						7	240.5	67.5	
						8	152	67.5	
						9	90	67.5	

DECK CORE LOG (cont'd)

CORE #	LATITUDE	LONGITUDE	TIME (day/hour)	WATER DEPTH (m)	CORE LENGTH (m)	SECTION #	DEPTH OF SECTION TOP (cm)	SECTION LENGTH (cm)	COMMENTS
13	49°20.002	127°09.014	13:03	184					Chemists; core ~20 cm in Gravity core / 3 pebbles in Piston
14	49 20.802	127 08.205							LOST gravity and piston cores
15	49 19.999	127 08.997	14:33	184				~5cm of sediment recovered	
16	49 00.035	126 43.597	10:38	240					Nothing recovered
17	49 10.697	127 51.802	16:20	2458	6.3	1	321	310	Chemists' core
						2	25	296	Took 15 samples
						3	0	25	B74-B88
18p	49 10.001	127 46.991	10:21	2493	5.81	1	517	67.5	
						2	456	60	
						3	318	67.5	
						4	306	67.5	
						5	158	123	
						6	0	108	

DECK CORE LOG (cont'd)

CORE #	LATITUDE	LONGITUDE	TIME (day/hour)	WATER DEPTH (m)	CORE LENGTH (m)	SECTION #	DEPTH OF SECTION TOP (cm)	SECTION LENGTH (cm)	COMMENTS
19	48 41.203	126 52.244	09:19	1257	8.68				Chemists' core Took samples B105-B115
20	48 40.122	126 50.977	13:42	1260	3.41	1	286	55	
						2	136	150	
						3	0	136	
21	48 40.091	126 50.988	17:12	1262	5.68	2	0	264	HYDRATE
						1	264	304	

TABLE 5. Hydrate samples

CORE #	SAMPLE #	SECTION #	COLLECTED BY	CANNISTER	DEPTH BELOW SEAFLOOR (cm)
7	A	1	John	NRL	405-415
7	B	2	John	NRL	395-405
7	C	2	John	NRL	305-310
7	D	2	John	NRL	310-315
8	A	1	John	NRL	0-153
21	A	1	Michael	UVic: White	548-568
21	B	1	John	NRL: 1	481-526
21	C	1	Michael	UVic: Red	460-481
21	D	1	John	NRL: 2	384-460
21	E	1	Rick	hydrate	374-384
21	F	1	John	NRL: 4	374-384
21	G	1	John	NRL: 3	294-305
21	H	1	Michael	UVic: Yellow	284-294
21	I	1	Michael	UVic: Black	264-284

Table 6. SEDIMENT SAMPLES

VIAL/ BAG #	CORE #	SECTION #	DEPTH (cm)	COMMENTS
1399	2	6	60	Clay matrix with fine sand patches
1400	2	6	80	Clay matrix
1401	2	6	100	Medium to coarse sand
1402	2	6	120	Similar to 1399 and 1400
1403	3	-	-	The only salvaged part of the core – Cucumber Ridge
1404	2	6	WSS	Whole Section Scrape: sieved @ 45μm
1405	3	-	-	Cucumber ridge sample sieved @ 45μm
1406	4	-	WSS	
1407	2	5		Clay matrix with fine sand patches
1408	2	5		Medium to coarse sand
1409	2	5		Coarse seds with shell fragments
1410	2	5		Fine to medium sands
1411	2	4	WSS	Disturbed section; no other analysis done
1412	2	3	290	Disturbed section
1413	2	3	310	Disturbed section
1414	2	3	WSS	
1415	2	2	385	Med. to fine grained sand and some silt with dark coarse minerals
1416	2	2		Scrape of the dewatering structure
1417	2	2	WSS	
1418	2	1	440	Fine sand and silt
1419	2	1	470	Medium sand
1420	2	1	WSS	
1421	5	4	100	Cemented sediments
1422	5	4	155	Cemented seds

VIAL/ BAG #	CORE #	SECTION #	DEPTH (cm)	COMMENTS
1423	5	4	WSS	
1424	5	3	170	Silty clay
1425	5	3	190	Silty clay with small pebble size carbonates
1426	5	3	210	Parts and surroundings of a large carbonate rock
1427	5	3	WSS	
1428	5	2	237	Silty clay with some fine to med size seds
1429	5	2	261	Rock fragments in silty matrix
1430	5	2		Stiff silty clay
1431	5	2		More greenish silty matrix
1432	5	2	WSS	Some samples were bagged
1433	5	1	WSS	Other samples were bagged
B1	9	-	0-5	Chemists' core – Fish Boat site
B2	9	-	40-45	
B3	9	-	100-105	
B4	9	-	140-145	
B5	9	-	180-185	
B6	9	-	210-215	
B7	9	-	290-295	
B8	9	-	400-405	
B9	5	5	0-10	
B10	5	2	254	
B11	5	1	315	
B12	5	1	320	
B13	5	1	340	
B14	5	1	360	

VIAL/ BAG #	CORE #	SECTION #	DEPTH (cm)	COMMENTS
B15	7	4	50	HYDRATE
B16	7	2	335	
B17	7	1	390	
B18	7	3	75	
B19	8	1	-	
B20				
1434	6	-	-	Sieved sample – v. oily looking
1435	6	-	-	Same sample as above, left unsieved
1436	10	3	WSS	
1437	10	2	WSS	
B21	10	3	129	Silty to fine grained matrix with some darker patches
B22	10	3	145	Silty matrix
B23	10	3	160	Silty to fine grained matrix
B24	10	3	175	Fine sandy layer
B25	10	3	202	Silty to fine grained matrix
B26	10	3	247	Sand layer
B27	10	2	290	Clay to fine sand layer
B28	10	2	299	Pink spot
B29	10	2	312	Silty layer
B30	10	2	337	Sandy layer
B31	10	2	378	More brownish sandy layer
B32	10	2	395	More brownish silty layer
B33	10	1	430	Clay mineral rich layer, bit coarser, not too much
B34	10	1	440	Silty clay w/ some small (<1mm) black dots
B35	10	1	461	Pink layer
B36	10	1	481	Gray silty clay

VIAL/ BAG #	CORE #	SECTION #	DEPTH (cm)	COMMENTS
B37	10	1	527	Deformation structure
438	10	1	WSS	
B38	12	9	105	Grey silty clay with small rocks
B39	12	9	125	Grey silty clay
B40	12	9	130	Dark silty clay horizon
B41	12	9	145	Greenish-grey silty clay
B42	12	8	155	Dark greyish silt with a few small rocks
B43	12	8	175	Brownish silty clay
B44	12	8	190	Greenish-grey silty caly
B45	12	8	210	Dark sand
B46	12	8	228	Grey silty clay
1439	12	8/9	WSS	
1440	12	7/6	WSS	
B47	12	7	242	Dark grey silty clay
B48	12	7	250	Slightly lighter grey silty clay
B49	12	7	260	Lighter grey silty clay
B50	12	7	280	Grey silty clay with darker bands
B51	12	7	300	Sand layer
B52	12	6	330	Grey silty clay
B53	12	6	335	Very wet sand, large pore space
B54	12	6	365	Wet sand
B55	12	6	370	Grey silty clay
B57	12	5	320	Grey silty clay
B58	12	5	350	Very wet sand
B59	12	5	370	Thin dark grey silty clay layers
B60	12	4	415	Sand layer

VIAL/ BAG #	CORE #	SECTION #	DEPTH (cm)	COMMENTS
B61	12	4	440	Thin dark grey silty clay
1441	12	5/4	WSS	
B62	12	3	465	Dark grey silty clay
B63	12	3	475	Very wet sand layer
B64	12	2	535	Green-grey silty clay
B65	12	2	560	Grey silty clay with elongated cabonate? pieces
B66	12	2	580	Sand layer
1442	12	3	WSS	
1443	12	2	WSS	
B67	12	1	610	Grey silty clay
B68	12	1	630	Dark sand inclusion, not a straight horizon
B69	12	1	665	Grey silty clay
1444	12	1	WSS	
B70	13	piston		Core did not penetrate, 3 pebbles recovered
B71	13	Gravity		Small amount; ~20cm of sediment recovered
B72	13	gravity		
B73	15			~5cm of sediment recovered
B74	16		30-35	Chemist's core
B75	16		75-80	
B76	16		90-95	
B77	16		115-120	
B78	16		130-135	
B79	16		190-195	
B81	16		265-270	
B82	16		375-380	

VIAL/ BAG #	CORE #	SECTION #	DEPTH (cm)	COMMENTS
B83	16		395-400	
B80	16		205-210	Chemist's core continued
B84	16		485-490	
B85	16		520-525	
B86	16		580-585	
B87	16		605-610	
B88	16		665-675	
B89	18p	1	525	Very wet sand
B90	18p	1	550	Grey silty clay
B91	18p	1	570	Very wet sand
B92	18p	1	575	Grey-green silty clay
1445	18p		WSS	
1446	18p		WSS	
B93	18p	2	470	Very green silty clay
B94	18p	2	500	Grey-green silty clay
B95	18p	2	510	Very wet sand
B96	18p	3	385	Very watery sand
B97	18p	3	410	Greenish grey silty clay, with a few oxidizing black spots
B98	18p	4	335	Greenish grey silty clay
1447	18p	3	WSS	
1448	18p	4	WSS	
B99	18p	5	180	Greenish grey silty clay
1449	18p	5	WSS	
1450	18p	6	WSS	
B100	18p	5	235	Dark sandy layer
B101	18p	5	260	Greenish-grey silty clay

VIAL/ BAG #	CORE #	SECTION #	DEPTH (cm)	COMMENTS
B102	18p	6	5	Very mushy silty clay
B103	18p	6	20	Wet greenish grey silty clay
B104	18p	6	75	Drier greenish grey silty clay
B105	19		45-50	Chemists' core
B106	19		105-110	
B107	19		145-150	
B108	19		195-200	
B109	19		265-270	
B110	19		315-320	
B111	19		415-420	
B112	19		515-520	
B113	19		615-620	
B114	19		720-725	
B115	19		805-810	
B116	20	1	Bottom	
B117	20	1	top	
B118	20	2	150	Grey silty clay
B119	20	2	200	Grey silty clay with black layers
B120	20	2	225	Grey silty clay with black layers
B121	20	2	265	Grey silty clay with black layers
1451	20	2	WSS	
1452	20	3	WSS	
B122	20	3	40	Very mushy wet grey silt clay
B123	20	3	90	Grey silty clay (dry) expansion cracks
B124	20	3	120	Grey silty clay. Very smelly

TABLE 7. Photo log of split cores

CORE #	SECTION #	TRIPOD POSITION	FILE NAME (i.e. c1s1p1.jpg)	COMMENTS
2	1	1	C2s1a.jpg	
2	1	2	C2s1b.jpg	
2	1	3	C2s1c.jpg	
2	2	1	C2s2a.jpg	
2	2	2	C2s2b.jpg	
2	2	3	C2s2c.jpg	
2	3	1	C2s3a.jpg	
2	3	2	C2s3b.jpg	
2	5	1	C2s5a.jpg	
2	5	2	C2s5b.jpg	
2	5	3	C2s5c.jpg	
2	6	1	C2s6a1.jpg	
2	6	2	C2s6b1.jpg	
2	6	1	C2s6a2.jpg	Same section as above- different lighting
2	6	2	C2s6b2.jpg	
5	1	1	C5s1a.jpg	
5	1	2	C5s1b.jpg	
5	1	3	C5s1c.jpg	
5	2	1	C5s2a.jpg	
5	2	2	C5s2b.jpg	
5	2	3	C5s2c.jpg	
5	3	1	C5s3a.jpg	
5	3	2	C5s3b.jpg	
5	4	1	C5s4a.jpg	
5	4	2	C5s4b.jpg	
10	1	1	C10s1a.jpg	
10	1	2	C10s1b.jpg	
10	1	3	C10s1c.jpg	
10	1	4	C10s1d.jpg	
10	1	5	C10s1e.jpg	
10	2	1	C10s2a.jpg	
10	2	2	C10s2b.jpg	
10	2	3	C10s2c.jpg	
10	2	4	C10s2d.jpg	
10	3	1	C10s3a.jpg	

PHOTO LOG (cont'd)

CORE #	SECTION #	TRIPOD POSITION	FILE NAME (i.e. c1s1p1.jpg)	COMMENTS
10	3	2	C10s3b.jpg	
10	3	3	C10s3c.jpg	
10	3	4	C10s3d.jpg	
10	3	5	C10s3e.jpg	
12	9	1	C12s9a.jpg	
12	9	2	C12s9b.jpg	
12	8	1	C12s8a.jpg	
12	8	2	C12s8b.jpg	
12	8	3	C12s8c.jpg	
12	7	1	C12s7a.jpg	
12	7	2	C12s7b.jpg	
12	7	3	C12s7c.jpg	
12	6	1	C12s6a.jpg	
12	6	2	C12s6b.jpg	
12	6	3	C12s6c.jpg	
12	5	1	C12s5a.jpg	
12	5	2	C12s5b.jpg	
12	5	3	C12s5c.jpg	
12	4	1	C12s4a.jpg	
12	4	2	C12s4b.jpg	
12	3	1	C12s3a.jpg	
12	3	2	C12s3b.jpg	
12	3	3	C12s3c.jpg	
12	2	1	C12s2a.jpg	
12	2	2	C12s2b.jpg	
12	2	3	C12s2c.jpg	
12	1	1	C12s1a.jpg	
12	1	2	C12s1b.jpg	
12	1	3	C12s1c.jpg	
18p	1	1	C18pS1a.jpg	
18p	1	2	C18pS1b.jpg	
18p	1	3	C18pS1c.jpg	
18p	2	1	C18pS2a.jpg	
18p	2	2	C18pS2b.jpg	
18p	3	1	C18pS3a.jpg	

PHOTO LOG (cont'd)

CORE #	SECTION #	TRIPOD POSITION	FILE NAME (i.e. c1s1p1.jpg)	COMMENTS
18p	3	2	C18pS3b.jpg	
18p	3	3	C18pS3c.jpg	
18p	4	1	C18pS4a.jpg	
18p	4	2	C18pS4b.jpg	
18p	5	1	C18pS5a.jpg	
18p	5	2	C18pS5b.jpg	
18p	5	3	C18pS5c.jpg	
18p	5	4	C18pS5d.jpg	
18p	6	1	C18pS6a.jpg	
18p	6	2	C18pS6b.jpg	
18p	6	3	C18pS6c.jpg	
18p	6	4	C18pS6d.jpg	
20	2	1	C20s2a.jpg	
20	2	2	C20s2b.jpg	
20	2	3	C20s2c.jpg	
20	2	4	C20s2d.jpg	
20	2	5	C20s2e.jpg	
20	3	1	C20s3a.jpg	
20	3	2	C20s3b.jpg	
20	3	3	C20s3c.jpg	
20	3	4	C20s3d.jpg	
20	3	5	C20s3e.jpg	

TABLE 8. CTD CAST INFORMATION

Cast	Date	Time	Lat	Lon	Raw Data	Converted Data	Binned Data	Depths	Type	Notes
	7/26/01	23:16:35	48 40.04 N	126 50.72 W	01030006.dat	01030006.cnv	0006.cnv			Methane Sensor Malfunctioned
1	7/26/01	1:27:07	49 40.04 N	127 50.72 W	01030007.dat	01030007.cnv	0007.cnv	1195,1155,1100,900,500,100,surface	Methane	No Methane Sensor
	7/27/01	15:40:11	48 42.50 N	126 52.66 W	0103007a.dat	0103007a.cnv	007a.cnv			Testing new methane sensor
2	7/27/01	0:47:15	48 42.34 N	126 55.07 W	01030008.dat	01030008.cnv	0008.cnv	1260,1235,1210,1150,1100,1000,900,500,250,surface	Methane	
3	7/28/01	1:01:29	48 42.28 N	126 54.76 W	01030009.dat	01030009.cnv	0009.cnv	1300,1275,1250,1100,1000,500,surface	Full	
4	7/29/01	0:49:21	48 40.06 N	126 51.07 W	01030010.dat	01030010.cnv	0010.cnv	1245,1225,1285,1155,1045,900,750,500,100,Surface	Methane	
5	7/30/01	15:51:03	48 40.05 N	126 51.12 W	01030011.dat	01030011.cnv	0011.cnv	1250,1230,1205,1155,1050,900,750,500,100,surface	Methane	
6	7/30/01	22:36:33	48 40.27 N	126 51.12 W	01030012.dat	01030012.cnv	0012.cnv	1240,1220,1200,1180,1160,1140,1120,1000,500,surface	Methane	
7	7/31/01	19:13:43	48 18.06 N	126 04.13 W	01030013.dat	01030013.cnv	0013.cnv	920,905,880,750,500,100,surface	Full	
8	7/31/01	21:52:33	48 18.16 N	126 05.57 W	01030014.dat	01030014.cnv	0014.cnv	945,925,905,885,865,845,700,500,100,surface	Methane	
9	Jul-01	1:10:45	48 18.20 N	126 04.47 W	01030015.dat	01030015.cnv	0015.cnv	825,805,785,765,745,700,600,500,100,surface	Methane	
10	8/3/01	14:41:42	49 19.73 N	127 08.80 W	01030016.dat	01030016.cnv	0016.cnv	170,165,160,150,130,110,90,50,25,surface	Methane	No Methane Sensor
11	8/3/01	16:34:06	49 20.71 N	127 08.61 W	01030017.dat	01030017.cnv	0017.cnv	145,140,135,125,115,105,75,50,25,surface	Methane	
12	8/3/01	1:03:04	49 30.04 N	127 12.97 W	01030018.dat	01030018.cnv	0018.cnv	150,145,140,135,125,100,75,50,25,surface	Methane	

13	8/4/01	15:12:04	49 19.98 N	127 09.06 W	01030019.dat	01030019.cnv	0019.cnv	175,780,165,130,100,25,surface	Full		
14	8/4/01	17:23:18	49 19.87 N	127 11.43 W	01030020.dat	01030020.cnv	0020.cnv		Methane	Lateral Profile	
15	8/4/01	22:32:22	49 19.30 N	127 08.81 W	01030021.dat	01030021.cnv	0021.cnv	187	Methane		
16	8/4/01	23:14:36	49 20.10 N	127 09.65 W	01030022.dat	01030022.cnv	0022.cnv	183,175,165,150,100,50,surface			
17	8/4/01	1:12:04	49 19.70 N	127 09.19 W	01030023.dat	01030023.cnv	0023.cnv		Methane	Lateral Profile	
18	8/5/01	15:35:36	49 00.05 N	126 43.67 W	01030024.dat	01030024.cnv	0024.cnv	224,220,215,200,175,150,125,100,50,surface	Methane		
19	8/6/01	15:03:08	49 10.70 N	127 51.80 W	01030025.dat	01030025.cnv	0025.cnv			Lost communications with CTD	

TABLE 9: SEISMIC DATA LOG – Cucumber Ridge

LINE #		DAY (UT) M/D	TIME (UT)	Latitude [° NORTH]	LONGITUDE [° WEST]	TELEDYNE		3.5 KHZ		TAPE# / FILE#	COMMENTS
						SHOT # CRUISE	SHOT # LINE	SHOT # CRUISE	SHOT# LINE		
1	SOL	07/27	07:24:40			876				1/1	Wind NW 25 knts (broadside to lines)
1	EOL	208	07:55:24			1136				1/1	
6	SOL	07/27	07:55:24	48 41.3138	126 55.6502	1197				1/ 2	
6	EOL	208	08:23:07	48 42.5002	126 53.4070	1581				1/ 2	
2	SOL	07/27	08:35:08	48 42.5478	126 53.0353	1582				1/3	
2	EOL	208	09:11:50	48 41.4224	126 55. 7464	1936				1/3	
17	SOL	07/27	09:12:19	48 41.4692	126 55.7234	1937				1/ 4	
17	EOL	208	09:41:42	48 42.6990	126 53.3703	2277				1/ 4	
3	SOL	07/27	09:47:39	48 42.6240	126 52.9661	2278				1/5	
3	EOL	208	10:22:47	48 41.3042	126 55.6518	2649				1/5	
12	SOL	07/27	10:26:30	48 41.2553	126 55.8193	2650				1/6	
12	EOL	208	11:02:01	48 42.7829	126 53.0622	3002				1/6	
4	SOL	07/27	11:03:20	48 42.7373	126 53.0229	3003				1/7	MUSE system stopped recording Did not get all of line 4
4	EOL	208	11:41:16	48 41.2946	126 55.9045	??					

SEISMIC DATA LOG – Cucumber Ridge (cont'd)

LINE #		DAY (UT) M/D	TIME (UT)	Latitude [° NORTH]	LONGITUDE [° WEST]	TELEDYNE		3.5 KHZ		TAPE# / FILE#	COMMENTS
						SHOT # CRUISE	SHOT # LINE	SHOT # CRUISE	SHOT# LINE		
11	SOL	07/27	12:02:01	48 42.1389	126 54.2696	20				1/9	Only half of the line b/c MUSE system stopped again
11	EOL	208	12:16:15	48 42.7320	126 52.8710	201				1/9	
5	SOL	07/27	12:17:03	48 42.6929	126 52.8333	202				1/10	
5	EOL	208	12:55:31	48 41.3049	126 55.8947	593				1/10	
13	SOL	07/27	12:55:54	48 41. 3277	126 55.9061	594				1/11	
13	EOL	208	13:28:40	48 42.9101	126 53.1212	803				1/11	
7	SOL	07/27	13:48:07	48 42.0312	126 54.3835	5				2/1	MUSE system started recording half way through line 7
7	EOL	208	14:07:30	48 41.3285	126 55.8869	193				2/1	
14	SOL	07/27	14:08:26	48 41.3860	126 55.8600	202				2/2	
14	EOL	208	14:36:42	48 42.6312	126 53.4311	464				2/2	

SEISMIC DATA LOG - Cucumber Ridge (cont'd)

LINE #		DAY (UT) M/D	TIME (UT)	Latitude [° NORTH]	LONGITUDE [° WEST]	TELEDYNE		3.5 KHZ		TAPE# / FILE#	COMMENTS
						SHOT # CRUISE	SHOT # LINE	SHOT # CRUISE	SHOT# LINE		
Repeat of line4	SOL	07/28	03:26	48 41.4293	126 55.4558	323		990		2/3	True start shot 345 & 1042 1500 psi gun pressure
4	EOL	209	03:54	48 42.	126 53.	618				2/3	
19	SOL	07/28	03:54	48 42.	126 53.	619				2/4	
19	EOL	209	04:26	48 41.48	126 55.9	950				2/4	
33	SOL	07/28	04:26	48 41.48	126 55.9	951				2/5	
33	EOL	209	05:02	48 42.94	126 53.21	1305				2/5	
8	SOL	07/28	5:02	48 42.94	126 53.21	1306				2/6	
8	EOL	209	5:38	48 41.36	126 55.80	1657				2/6	
13	SOL	07/28	5:38	48 41.36	126 55.80	1658				2/7	
13	EOL	209	6:13	48 42.90	126 52.87	2034				2/7	
10	SOL	07/28	6:13	48 42.90	126 52.87	2035				2/8	
10	EOL	209	6:55	48 41.36	126 56.06	2435				2/8	
20	SOL	07/28	6:55	48 41.36	126 56.06	2436				2/9	
20	EOL	209	7:33:11	48 42.9218	126 53.0909	2819				2/9	

SEISMIC DATA LOG - Cucumber Ridge (cont'd)

LINE #		DAY (UT) M/D	TIME (UT)	Latitude [° NORTH]	LONGITUDE [° WEST]	TELEDYNE		3.5 KHZ		TAPE# / FILE#	COMMENTS
						SHOT # CRUISE	SHOT # LINE	SHOT # CRUISE	SHOT# LINE		
9	SOL	07/28	07:33:48	48 42.8878	126 53.0456	2820				2/10	
9	EOL	209	08:11:33	48 41.3202	126 55.9196	3207				2/10	
21	SOL	07/28	08:11:37	48 41.3383	126 55.9196	3208				2/11	
21	EOL	209	08:47:27	48 42.9478	126 53.1484	3581				2/11	
15(part)	SOL	07/28	08:47:34	48 42.9095	126 53.1196	3582				2/12	Problems with MUSE only half of the line 15
15	EOL	209	9:26??			3721				2/12	Started recording half way through line 22
22(part)	SOL	07/28	09:40:30			50		125		3/1	
22	EOL	209	10:21:11	48 43.4748	126 51.3953	448		1106		3/1	Did a very wide circle off of the grid b/c of traffic
16	SOL	07/28	10:21:12	48 43.4646	126 51.3871	449		1108		3/2	
16	EOL	209	11:17:25	48 41.3223	126 56.1505	1035		2463		3/2	
24	SOL	07/28	11:17:26	48 41.3280	126 56.1463	1036		2466		3/3	
24	EOL	209	11:54:28	48 42.8664	126 53.0229	1419		3342		3/3	
18	SOL	07/28	11:54:38	48 42.8611	126 53.0189	1420		3347		3/ 4	Bad Start circled around to start over
restarted	EOL	209		48 42.9084	126 53.1617	1695		4110		3/ 4	

SEISMIC DATA LOG - Cucumber Ridge (cont'd)

LINE #		DAY (UT) M/D	TIME (UT)	Latitude [° NORTH]	LONGITUDE [° WEST]	TELEDYNE		3.5 KHZ		TAPE# / FILE#	COMMENTS
						SHOT # CRUISE	SHOT # LINE	SHOT # CRUISE	SHOT# LINE		
18(again)	SOL	07/28	12:26:42	48 42.8883	126 53.1739	1696		4112		3/5	
18	EOL	209	13:01:12	48 41.4049	126 56.0398	2041		4941		3/5	
28	SOL	07/28	13:01:27	48 41.4112	126 56.0516	2043		4947		3/6	
28	EOL	209	13:36:18	48 42.9415	126 53.1456	2404		5782		3/6	
23	SOL	07/28	13:36:25	48 42.9207	126 53.1357	2405		5788		3/7	
23	EOL	209	14:12:48	48 41.4739	126 56.1948	2794		6661		3/7	
31	SOL	07/28	14:12:55	48 41.4826	126 56.1793	2795		6664		3/8	
31	EOL	209	14:43	48 42.835	126 53.601	3113		7387		3/8	End of Day 2

SEISMIC DATA LOG - Cucumber Ridge (cont'd)

LINE #		DAY (UT) M/D	TIME (UT)	Latitude [° NORTH]	LONGITUDE [° WEST]	TELEDYNE		3.5 KHZ		TAPE# / FILE#	COMMENTS
						SHOT # CRUISE	SHOT # LINE	SHOT # CRUISE	SHOT# LINE		
11	SOL	07/30	03:00	48 42.521	126 53.5390	6249		11368		4/15	
11	EOL	211	03:29	48 41.44	126 55.88	6548		2068		4/15	
50	SOL	07/30	03:29	48 41.44	126 55.88	6549		12069		4/16	
50	EOL	211	04:05	48 43.10	126 53.63	5930		12935		4/16	
15	SOL	07/30	04:05	48 43.10	126 53.63	6931		12936		4/17	
15	EOL	211	04:44	48 41.39	126 55.98	7330		13867		4/17	
59	SOL	07/30	04:44	48 41.39	126 55.98	7331		13868		4/18	
59	EOL	211	05:28	48 43.22	126 53.48	7795		14940		4/18	
45	SOL	07/30	05:28	48 43.22	126 53.48	7796		14941		4/19	
45	EOL	211	06:01	48 41.74	126 56.27	8150		15724		4/19	
63	SOL	07/30	06:01	48 41.74	126 56.27	8151		15725		4/20	
63	EOL	211	06:39	48 43.14	126 53.67	8523		16608		4/20	End of TAPE #4
48	SOL	07/30	06:40	48 43.10	126 53.69	8553		16685		5/1	Start of TAPE #5
48	EOL	211	07:12:50	48 41.7301	126 56.4611	8868		17423		5/1	

SEISMIC DATA LOG - Cucumber Ridge (cont'd)

LINE #		DAY (UT) M/D	TIME (UT)	Latitude [° NORTH]	LONGITUDE [° WEST]	TELEDYNE		3.5 KHZ		TAPE# / FILE#	COMMENTS
						SHOT # CRUISE	SHOT # LINE	SHOT # CRUISE	SHOT# LINE		
51	SOL	07/30	07:12:51	48 41.7365	126 56.4607	8869		17424		5/2	
51	EOL	211	07:50:11	48 43.2725	126 53.3745	9249		18319		5/2	
49	SOL	07/30	07:50:12	48 43.2622	126 53.3700	9250		18320		5/3	
49	EOL	211	08:30:48	48 41.7553	126 56.4640	9632		19295		5/3	
53	SOL	07/30	08:30:49	48 41.7595	126 56.4718	9633		19296		5/4	
53	EOL	211	09:05:54	48 43.2434	126 53.4999	10004		20136		5/4	
52	SOL	07/30	09:05:55	48 43.2319	126 53.4849	10005		20137		5/5	
52	EOL	211	09:43:29	48 41.7465	126 56.5622	10371		21040		5/5	
58	SOL	07/30	09:43:30	48 41.7444	126 56.5787	10372		21041		5/6	
58	EOL	211	10:20:29	48 43.3290	126 53.5099	10761		21927		5/6	
51	SOL	07/30	10:29:30	48 43.3214	126 53.4928	10762		21928		5/7	Circled to start a new line (line 51 already done)
	EOL	211	10:41:36	48 43.1680	126 53.5429	10933		22439		5/7	
54	SOL	07/30	10:41:37	48 43.1585	126 53.5653	10934		22440		5/8	Wind increased to 35 knots Broadside to lines
54	EOL	211	11:15:23	48 41.7652	126 56.5623	11247		23245		5/8	Winds gusting up to 40 knots

SEISMIC DATA LOG - Cucumber Ridge (cont'd)

LINE #		DAY (UT) M/D	TIME (UT)	Latitude [° NORTH]	LONGITUDE [° WEST]	TELEDYNE		3.5 KHZ		TAPE# / FILE#	COMMENTS
						SHOT # CRUISE	SHOT # LINE	SHOT # CRUISE	SHOT# LINE		
57	SOL	07/30	11:15:24	48 41.7730	126 56.5521	11248		23246		5/9	Increased ship speed to 5 knots to maintain straight survey lines
57	EOL	211	11:48:09	48 43.3748	126 53.2932	11510		24031		5/9	
56	SOL	07/30	11:48:10	48 43.3631	126 53.2824	11511		24032		5/10	
56	EOL	211	12:23:34	48 41.7605	126 56.6580	11778		24881		5/10	
62	SOL	07/30	12:23:35	48 41.7669	126 56.6518	11779		24882		5/11	
62	EOL	211	12:55:39	48 43.4082	126 53.3498	12009		25651		5/11	
55	SOL	07/30	12:55:40	48 43.3970	126 53.3404	12010		25652		5/12	
55	EOL	211	13:32:35	48 41.6078	126 56.5296	12289		26536		5/12	
60	SOL	07/30	13:32:36	48 41.6130	126 56.5329	12290		26537		5/13	
60	EOL	211	14:09:00	48 43.4935	126 53.6633	12598		27410		5/13	
71	SOL	07/30	14:09:01	48 43.4898	126 53.6796	12600		27411		5/14	
71	EOL	211	14:37:10	48 42.0461	126 56.3546	12799		28089		5/14	End of Day 4

SEISMIC DATA LOG - Cucumber Ridge (cont'd)

LINE #		DAY (UT) M/D	TIME (UT)	Latitude [° NORTH]	LONGITUDE [° WEST]	TELEDYNE		3.5 KHZ		TAPE# / FILE#	COMMENTS
						SHOT # CRUISE	SHOT # LINE	SHOT # CRUISE	SHOT# LINE		
29	SOL	07/31	03:38	48 41.899	126 55.331	35		120		5/15	SOL ~250m after targeted start
29	EOL	212	04:00	48 42.959	126 53.419	192		629		5/15	
61	SOL	07/31	04:00	48 42.96	126 53.419	194		630		5/16	
61	EOL	212	04:32	48 41.92	126 46.47	610		1675		5/16	
73	SOL	07/31	04:32	48 41.92	126 46.47	611		1676		5/17	
73	EOL	212	05:14	48 43.45	126 53.83	857		2422		5/17	
64	SOL	07/31	05:14	48 43.45	126 53.83	858		2423		5/18	
64	EOL	212	05:48	48 41.98	126 56.48	1218		3264		5/18	
74	SOL	07/31	05:48	48 41.98	126 56.48	1219		3265		5/19	
74	EOL	212	06:18	48 43.39	126 53.71	1430		3976		5/19	
65	SOL	07/31	06:18	48 43.39	126 53.71	1431		3977		5/20	
65	EOL	212	06:55	48 42.04	126 56.30	1752		4740		5/20	
72	SOL	07/31	06:55	48 42.04	126 56.30	2		4		6/1	
72	EOL	212	07:25:36	48 43.3829	126 53.7163	215		738		6/1	

SEISMIC DATA LOG - Cucumber Ridge (cont'd)

LINE #		DAY (UT) M/D	TIME (UT)	Latitude [° NORTH]	LONGITUDE [° WEST]	TELEDYNE		3.5 KHZ		TAPE# / FILE#	COMMENTS
						SHOT # CRUISE	SHOT # LINE	SHOT # CRUISE	SHOT# LINE		
66	SOL	07/31	07:25:37	48 43.3759	126 53.7163	216		739		6/2	
66	EOL	212	07:59:56	48 41.9434	126 56.7054	532		1162		6/2	
76	SOL	07/31	07:59:57	48 41.9507	126 56.6487	533		1163		6/3	
76	EOL	212	08:28:30	48 43.4519	126 53.7981	739		2247		6/3	
67	SOL	07/31	08:28:31	48 43.4452	126 53.7847	740		2248		6/4	
67	EOL	212	08:59:14	48 41.9215	126 56.6607	995		2986		6/4	
75	SOL	07/31	08:59:15	48 41.9273	126 56.6654	996		2987		6/5	
75	EOL	212	09:28:10	48 43.4305	126 53.7379	1191		3681		6/5	
69	SOL	07/31	09:28:11	48 43.4236	126 53.7665	1192		3682		6/6	
69	EOL	212	09:58:45	48 41.9354	126 56.7238	1445		4414		6/6	
78	SOL	07/31	09:58:46	48 41.9391	126 56.7290	1446		4415		6/7	
78	EOL	212	10:27:33	48 43.4922	126 53.8087	1661		5104		6/7	
68	SOL	07/31	10:27:34	48 43.4902	126 53.7952	1662		5105		6/8	
68	EOL	212	11:00:40	48 41.9677	126 56.6814	19122		5898		6/8	

SEISMIC DATA LOG - Cucumber Ridge (cont'd)

LINE #		DAY (UT) M/D	TIME (UT)	Latitude [° NORTH]	LONGITUDE [° WEST]	TELEDYNE		3.5 KHZ		TAPE# / FILE#	COMMENTS
						SHOT # CRUISE	SHOT # LINE	SHOT # CRUISE	SHOT# LINE		
79	SOL	07/31	11:00:41	48 41.9863	126 56.6812	1913		5899		6/9	
79	EOL	212	11:29:22	48 43.4477	126 53.7943	2115		6589		6/9	
70	SOL	07/31	11:20:23	48 43.4370	126 53.7864	2116		6590		6/10	
70	EOL	212	12:03:00	48 41.0009	126 56.7068	2461		7394		6/10	
77	SOL	07/31	12:03:01	48 41.0067	126 56.7143	2462		7395		6/11	
77	EOL	212	12:45:39	48 43.2810	126 53.8813	2699		8420		6/11	
7	SOL	07/31	12:45:40	48 43.3712	126 53.6424	2670		8421		6/12	
7	EOL	212	13:31:26	48 41.4369	126 55.7841	3134		9516		6/12	
22	SOL	07/31	13:31:27	48 41.4471	126 55.7720	3135		9517		6/13	
22	EOL	212	13:55:28	48 42.6890	126 53.5646	3322		10093		6/13	End of VENTFLUX 2 site
22e	SOL	212				3323				6/14	
22e	EOL	212				3339				6/14	END

SEISMIC DATA LOG - FishBoat

LINE #		DAY (UT) M/D	TIME (UT)	Latitude [° NORTH]	LONGITUDE [° WEST]	TELEDYNE		3.5 KHZ		TAPE# / FILE#	COMMENTS
						SHOT # CRUISE	SHOT # LINE	SHOT # CRUISE	SHOT# LINE		
1	SOL	08/01	02:49	48 19.212	126 02.468	12		33		7/1	SOL and SOL values in this column represent start positions on the grid (after turns)
1	EOL	213	04:13			909		2400		7/1	
2	SOL	08/01	04:13	48 17.157	126 10.202	910		2401		7/2	SOL is 3-400m past true start line
2	EOL	213	04:49	48 17.959	126 06.042	1144		3355		7/2	
In line 1000	SOL	08/01	05:01	48 18.286	126 05.706	13		41		7/3	MUSE crashed. Tape rewound started at file 3 at 05:01:16
	EOL	213	05:28	48 17.91	126 03.311	300		747		7/3	EOL on grid at 235 / 383 Gun pressure 2150 psi
In line 2000	SOL	08/01	05:28	48 17.91	126 03.311	301		748		7/4	SOL 358 / 923
	EOL	213	06:03	48 17.574	126 06.268	636		1707		7/4	EOL 594 / 1591
X-line 2500	SOL	08/01	06:03	48 17.574	126 06.268	637		1708		7/5	SOL 718 / 1938
	EOL	213	06:33	48 19.026	126 05.317	932		2500		7/5	EOL 878 / 2357 Gun pressure 1850 psi
X-line 1500	SOL	08/01	06:33	48 19.026	126 05.317	933		2501		7/6	SOL 1004 / 2688
	EOL	213	07:00	48 17.513	126 04.544	1207		3206		7/6	EOL 1163 / 3091
X-line 500	SOL	08/01	07:00	48 17.514	126 04.469	1208		3207			
	EOL	213	07:38:26	4819.6908	126 03.8405	1585		4332			Turning to commence new grid

SEISMIC DATA LOG - FishBoat (cont'd)

LINE #		DAY (UT) M/D	TIME (UT)	Latitude [° NORTH]	LONGITUDE [° WEST]	TELEDYNE		3.5 KHZ		TAPE# / FILE#	COMMENTS
						SHOT # CRUISE	SHOT # LINE	SHOT # CRUISE	SHOT# LINE		
Turn to new grid	SOL	08/01	07:38:27	48 19.69	126 03.84	1586		4333		7/8	
	EOL	213	08:03:03	48 18.9757	126 03.6302	1789		4889		7/8	
00A	SOL	08/01	08:03:04	48 18. 9747	126 03.6430	1790		4890		7/9	Parallel to grid lines
	EOL	213	08:23:56	48 19.0455	126 04.9115	1941		5445		7/9	
00B	SOL	08/01	08:23:57	48 19.0536	126 04.8943	1942		5446		7/10	Perpendicular to grid line, plus turn
	EOL	213	08:50:28	48 18.1580	126 03.1759	2235		6153		7/10	
52	SOL	08/01	08:50:29	48 18.1572	126 03.2112	2236		6154		7/11	
52	EOL	213	09:20:55	48 18.1840	126 06.6700	2581		6965		7/11	EOL 2528 / 6852
46	SOL	08/01	09:20:56	48 18.1946	126 06.6708	2582		6966		7/12	SOL 2663 / 7182
46	EOL	213	09:50:43	48 18.1869	126 03.0940	2945		7761		7/12	EOL 2899 / 7670
48	SOL	08/01	09:50:44	48 18.1752	126 03.0848	2946		7762		7/13	SOL 3021 / 7979
48	EOL	213	10:24:15	48 18.2316	126 06.6591	3323		8656		7/13	EOL 3273 / 8544
45	SOL	08/01	10:24:16	48 18.2418	126 06.6625	3324		8657		7/14	
45	EOL	213	10:55:40	48 18.1763	126 03.0257	3698		9490		7/14	EOL 3646 / 9381

SEISMIC DATA LOG - FishBoat (cont'd)

LINE #		DAY (UT) M/D	TIME (UT)	Latitude [° NORTH]	LONGITUDE [° WEST]	TELEDYNE		3.5 KHZ		TAPE# / FILE#	COMMENTS
						SHOT # CRUISE	SHOT # LINE	SHOT # CRUISE	SHOT# LINE		
51	SOL	08/01	10:55:41	48 18.1689	126 03.0244	3699		9491		7/15	SOL 3768 / 9713
51	EOL	213	11:30:42	48 18.1757	126 06.7528	4081		10426		7/15	EOL 4019 / 10286
44	SOL	08/01	11:30:43	48 18.1865	126 06.7552	4082		10427		7/16	SOL 4157 / 10619
44	EOL	213	12:03:08	48 18.1775	126 02.9883	4465		11290		7/16	EOL 4405 / 11156
50	SOL	08/01	12:03:09	48 18.1708	126 02.5872	4466		11291		7/17	SOL 4539 / 11524
50	EOL	213	12:39:08	48 18.2108	126 06.6708	4843		12252		7/17	EOL 4780 / 12108
43	SOL	08/01	12:39:09	48 18.2242	126 06.6679	4844		12253		7/18	SOL 4914 / 12430
43	EOL	213	13:08:13	48 18.2073	126 03.0705	5204		13026		7/18	EOL 5150 / 12925
49	SOL	08/01	13:08:14	48 18.1994	126 03.0658	5205		13027		7/19	SOL 5277 / 13220
49	EOL	213	13:39:58	48 18.2060	126 06.6141	5570		13874		7/19	EOL 5518 / 13759
42	SOL	08/01	13:39:59	48 18.2153	126 06.6166	5571		13875		7/20	SOL 5636 / 14031
42	EOL	213	14:08:46	48 18.2382	126 03.0556	5930		14638		7/20	EOL 5873 / 14520
47	SOL	08/01	14:08:07	48 18.2241	126 03.0446	5931		14639		7/21	SOL 6004 / 14869
47	EOL	213	14:41	48 18.210	126 06.273	6262		15503		7/21	

SEISMIC DATA LOG - FishBoat (cont'd)

LINE #		DAY (UT) M/D	TIME (UT)	Latitude [° NORTH]	LONGITUDE [° WEST]	TELEDYNE		3.5 KHZ		TAPE# / FILE#	COMMENTS
						SHOT # CRUISE	SHOT # LINE	SHOT # CRUISE	SHOT# LINE		
53	SOF	08/02	01:29	48 18.128	126 03.877	150		519		8/1	SOL several hundred meters past start of grid
53	EOF	214	01:55	48 17.994	126 06.577	440		1305		8/1	
54	SOF	08/02	01:55	48 17.994	126 06.577	441		1306		8/2	SOL 550 / 1623
54	EOF	214	02:30	48 17.999	126 02.889	869		2336		8/2	EOL 793 / 2166
63	SOF	08/02	02:30	48 17.999	126 02.889	870		1337		8/3	SOL 958 / 2626
63	EOF	214				1285		3541		8/3	EOL 1201 / 3289
55	SOF	08/02		48 18.098	126 05.934	1286		3542		8/3	SOL 1286 / 3542
55	EOF	214	03:31	48 18.035	126 03.224	1569		4184		8/3	EOL 1530 / 4088
64	SOF	08/02	03:31	48 18.010	126 03.232	1570		4185		8/4	MUSE crashed
64	EOF	214	04:07	48 18.05	126 06.41	1302		5247		8/4	File #5 is empty
56p	SOF	08/02	04:15	48 18.08	126 05.41	25		54		8/6	Part of line
56p	EOF	214	04:31	48 18.04	126 03.20	257		555		8/6	
65p1	SOF	08/02	04:31	48 18.04	126 03.20	258		556		8/7	Part of line
65p1	EOF	214	04:46	48 17.96	126 04.69	402		904		8/7	

SEISMIC DATA LOG - FishBoat (cont'd)

LINE #		DAY (UT) M/D	TIME (UT)	Latitude [° NORTH]	LONGITUDE [° WEST]	TELEDYNE		3.5 KHZ		TAPE# / FILE#	COMMENTS
						SHOT # CRUISE	SHOT # LINE	SHOT # CRUISE	SHOT# LINE		
65p2	SOF	08/02	04:51	48 17.96	126 05.08	17		43		9/1	Part of line
65p2	EOF	214	05:05	48 18.02	126 06.45	167		492		9/1	
56	SOF	08/02	05:05	48 18.02	126 06.45	168		493		9/2	Repeated line- full
56	EOF	214	05:31	48 18.02	126 03.12	511		1270		9/2	
65	SOF	08/02	05:31	48 18.02	126 03.12	512		1271		9/3	Repeated line- full
65	EOF	214	06:06	48 17.99	126 06.43	860		2319		9/3	
57	SOF	08/02	06:06	48 17.99	126 06.43	861		2320		9/4	
57	EOF	214	06:30	48 18.06	126 03.22	1182		3043		9/4	
66	SOF	08/02	06:30	48 18.06	126 03.22	1183		3044		9/5	
66	EOF	214	07:07:30	48 18.0196	126 06.6853	1555		4154		9/5	EOL 1495 / 3980
58	SOF	08/02	07:07:31	48 18.0255	126 06.6810	1556		4155		9/6	SOL 1619 / 4314
58	EOF	214	07:35:39	48 17.9746	126 03.0658	1923		4977		9/6	EOL 1860 / 4834
67	SOF	08/02	07:35:40	48 17.9659	126 03.0678	1924		4978		9/7	SOL 1985 / 5188
67	EOF	214	08:11:47	48 17.9923	126 06.7113	2299		6062		9/7	EOL 2228 / 5856

SEISMIC DATA LOG - FishBoat (cont'd)

LINE #		DAY (UT) M/D	TIME (UT)	Latitude [° NORTH]	LONGITUDE [° WEST]	TELEDYNE		3.5 KHZ		TAPE# / FILE#	COMMENTS
						SHOT # CRUISE	SHOT # LINE	SHOT # CRUISE	SHOT# LINE		
59	SOF	08/02	08:11:48	48 17.9962	126 06.7050	2300		6063		9/8	SOL 2360 / 6245
59	EOF	214	08:40:25	48 18.0300	126 03.0789	2662		6920		9/8	EOL 2604 / 6791
68	SOF	08/02	08:40:26	48 18.0278	126 03.0814	2663		6921		9/9	SOL 2730 / 7190
68	EOF	214	09:15:26	48 17.9485	126 06.6567	3033		7971		9/9	EOL 2971 / 7810
60	SOF	08/02	09:15:27	48 17.9590	126 06.6570	3034		7972		9/10	SOL 3102 / 8168
60	EOF	214	09:45:36	48 18.0062	126 03.0856	3391		8874		9/10	EOL 3332 / 8738
69	SOF	08/02	09:45:37	48 18.0017	126 03.0642	3392		8875		9/11	SOL 3470 / 9126
69	EOF	214	10:19:55	48 17.9739	126 06.7020	3771		9904		9/11	EOL 3708 / 9742
61	SOF	08/02	10:19:56	48 17.9778	126 06.7010	3772		9905		9/12	SOL 3843 / 10112
61	EOF	214	10:50:14	48 17.9784	126 03.0227	4143		10815		9/12	
70	SOF	08/02	10:50:15	48 17.9704	126 03.0148	4144		10816		9/13	SOL 4227 / 11080
70	EOF	214	11:24:04	48 17.9171	126 06.6436	4522		11829		9/13	EOL 4469 / 11700
62	SOF	08/02	11:24:05	48 17.9314	126 06.6442	4523		11830		9/14	SOL 4588 / 12036
62	EOF	214	11:54:32	48 17.9684	126 03.1409	4880		12742		9/14	EOL 4829 / 12617

SEISMIC DATA LOG - FishBoat (cont'd)

LINE #		DAY (UT) M/D	TIME (UT)	Latitude [° NORTH]	LONGITUDE [° WEST]	TELEDYNE		3.5 KHZ		TAPE# / FILE#	COMMENTS
						SHOT # CRUISE	SHOT # LINE	SHOT # CRUISE	SHOT# LINE		
76	SOF	08/02	11:54:33	48 17.9613	126 03.1370	4881		12743		9/15	SOL 4955 / 12970
76	EOF	214	12:27:09	48 17.8436	126 06.6939	5250		13721		9/15	EOL 5190 / 13565
71	SOF	08/02	12:27:10	48 17.8507	126 06.6957	5251		13722		9/16	SOL 5322 / 13935
71	EOF	214	12:57:00	48 17.9551	126 03.3327	5594		14616		9/16	EOL 5564 / 14540
72	SOF	08/02	12:57:01	48 17.9568	126 03.3098	5595		14617		9/17	SOL 5685 / 14860
72	EOF	214	13:31:05	48 17.8993	126 06.7214	5988		15638		9/17	EOL 5930 / 15500
73	SOF	08/02	13:31:06	48 17.9164	126 06.7251	5989		15639		9/18	SOL 6063 / 15835
73	EOF	214	14:02:25	48 17.9482	126 02.9929	6366		16579		9/18	EOL 6309 / 16428
74	SOF	08/02	14:02:26	48 17.9931	126 02.9921	6367		16580		9/19	SOL 6443 / 16810
74	EOF	214	14:33	48 17.844	126 06.330	6701		17501		9/19	EOL 6689 / 17470

SEISMIC DATA LOG - FishBoat (cont'd)

LINE #		DAY (UT) M/D	TIME (UT)	Latitude [° NORTH]	LONGITUDE [° WEST]	TELEDYNE		3.5 KHZ		TAPE# / FILE#	COMMENTS
						SHOT # CRUISE	SHOT # LINE	SHOT # CRUISE	SHOT# LINE		
FB 25	SOF	222	09:10	48 18.568	126 06.383	22		86		19/1	SOL 61 / 182
	EOF	222	09:39	48 18.488	126 03.460	316		841			EOL 304 / 812
FB 31	SOF	222	09:39	48 18.488	126 03.460	317		842		19/2	SOL 352 / 941
	EOF	222	10:03	48 18.438	126 06.269	606		1564			EOL 594 / 1537
FB 26	SOF	222	10:03	48 18.438	126 06.269	606		1565		19/3	SOL 633 / 1644
	EOF	222	10:26	48 18.475	126 03.508	884		2256			EOL 875 / 2233
FB 32	SOF	222	10:26	48 18.475	126 03.508	885		2257		19/4	SOL 916 / 2343
	EOF	222	10:50	48 18.420	126 06.276	1168		2956			EOL 1155 / 2925
FB 27	SOF	222	10:50	48 18.420	126 06.276	1169		2957		19/5	SOL 1199 / 3042
	EOF	222	11:14	48 18.4733	126 03.4586	1457		3686			EOL 1442 / 3652
FB 33	SOF	222	11:14	48 18.4733	126 03.4586	1458		3687		19/6	SOL 1498 / 3795
	EOF	222	11:40	48 18.4116	126 06.3169	1758		4459			EOL 1741 / 4415
FB 28	SOF	222	11:40	48 18.4116	126 06.3169	1759		4460		19/7	SOL 1791 / 4542
	EOF	222	12:03	48 18.4563	126 03.3912	2054		5197			EOL 2031 / 5141

SEISMIC DATA LOG - FishBoat (cont'd)

LINE #		DAY (UT) M/D	TIME (UT)	Latitude [° NORTH]	LONGITUDE [° WEST]	TELEDYNE		3.5 KHZ		TAPE# / FILE#	COMMENTS
						SHOT # CRUISE	SHOT # LINE	SHOT # CRUISE	SHOT# LINE		
FB 34	SOF	222	12:03	48 18.4563	126 03.3912	2055		5198		19/8	SOL 2092 / 5300
	EOF	222	12:29	48 18.3924	126 06.2871	2351		5925			EOL 2335 / 5885
FB 39	SOF	222	12:29	48 18.3924	126 06.2871	2352		5926		19/9	SOL 2390 / 6035
	EOF	222	12:53	48 18.4238	126 03.4129	2651		6658			EOL 2630 / 6609
FB 35	SOF	222	12:53	48 18.4238	126 03.4129	2652		6659		19/10	SOL 2688 / 6752
	EOF	222	13:18	48 18.3790	126 06.2855	2949		7393			EOL 2933 / 7352
FB 30	SOF	222	13:18	48 18.3790	126 06.2855	2950		7394		19/11	SOL 2981 / 7482
	EOF	222	13:42	48 18.4026	126 03.3952	3247		8140			EOL 3223 / 8082
FB 36	SOF	222	13:42	48 18.4026	126 03.3952	3248		8141		19/12	SOL 3282 / 8245
	EOF	222	14:11	48 18.3847	126 06.5162	3560		8994			EOL 3521 / 8882
FB 20	SOF	222	14:11	48 18.3847	126 06.5162	3561		8995		19/13	SOL 3644 / 9251
	EOF	222	14:41	48 18.455	126 03.361	3926		9881			EOL 3881 / 9795
FB 37	SOF	222	14:41	48 18.455	126 03.361	3927		9882		19/14	SOL 3973 / 10039
	EOF	222	15:09	48 18.3647	126 06.2795	4229		10719			EOL 4208 / 10674

SEISMIC DATA LOG - FishBoat (cont'd)

LINE #		DAY (UT) M/D	TIME (UT)	Latitude [° NORTH]	LONGITUDE [° WEST]	TELEDYNE		3.5 KHZ		TAPE# / FILE#	COMMENTS
						SHOT # CRUISE	SHOT # LINE	SHOT # CRUISE	SHOT# LINE		
FB 21	SOF	222	15:09	48 18.3647	126 06.2795	4230		10719		19/15	SOL 4274 / 10840
	EOF	222	15:33	48 18.5340	126 03.4330	4530		11468			EOL 4511 / 11422
FB 38	SOF	222	15:33	48 18.5340	126 03.4330	4531		11469		19/16	SOL 4589 / 11663
	EOF	222	16:00	48 18.3478	126 06.2960	4849		12260			EOL 4830 / 12217
FB 22	SOF	222	16:00	48 18.3478	126 06.2960	4850		12261		19/17	SOL 4895 / 12376
	EOF	222	16:26	48 18.5134	126 03.4031	5140		13045			EOL 5115 / 12978
FB 39	SOF	222	16:26	48 18.5134	126 03.4031	5141		13046		19/18	SOL 5199 / 13298
	EOF	222	17:00	48 18.3428	126 06.4697	5474		14062			EOL 5436 / 13955
FB 23	SOF	222	17:00	48 18.3428	126 06.4697	5475		14063		19/19	SOL 5535 / 14222
	EOF	222	17:30	48 18.3641	126 03.3351	5815		14958			EOL 5767 / 14820
FB 40	SOF	222	17:30	48 18.3641	126 03.3351	5816		14959		19/20	SOL 5860 / 15095
	EOF	222	17:56	48 18.3816	126 06.2248	6121		15733			EOL 6096 / 15680
FB 24	SOF	222	17:56	48 18.3816	126 06.2248	6122		15734		19/21	SOL 6152 / 15810
	EOF	222	18:16	48 18.4800	126 03.5512	6381		16330			EOL 6377 / 16320

SEISMIC DATA LOG - FishBoat (cont'd)

LINE #		DAY (UT) M/D	TIME (UT)	Latitude [° NORTH]	LONGITUDE [° WEST]	TELEDYNE		3.5 KHZ		TAPE# / FILE#	COMMENTS
						SHOT # CRUISE	SHOT # LINE	SHOT # CRUISE	SHOT# LINE		
FB 41	SOF	222	18:16	48 18.4800	126 03.5512	6382		16331		19/22	SOL 6424 / 16449
	EOF	222	18:38	48 18.2905	126 06.1521	6666		17007			EOL 6659 / 16995

SEISMIC DATA LOG - ShallowPlume 95

LINE #		DAY (UT) M/D	TIME (UT)	Latitude [° NORTH]	LONGITUDE [° WEST]	TELEDYNE		3.5 KHZ		TAPE# / FILE#	COMMENTS
						SHOT # CRUISE	SHOT # LINE	SHOT # CRUISE	SHOT# LINE		
01	SOF	08/03	06:08:00	48 20.431	127 08.229	42		176		10/1	Start of shallow plume #1 (1995) e of MUSE settings: Teledyne 0sec delay, 2sec listening time; 500us sampling rate. 3.5kHz 0sec delay; 1sec listening time; 40us sampling rate SOL 64 / 275
01	EOF	215	06:28:00	49 13.6	127 09.56	248		1092		10/1	EOL 224 / 981
02	SOF	08/03	06:28:00	49 13.6	127 09.56	249		1093		10/2	SOL 361 / 1593
02	EOF	215	06:55	49 20.57	127 07.76	586		2434		10/2	EOL 522 / 2195
03	SOF	08/03	06:55	49 20.57	127 07.76	587		2435		10/3	SOL 683 / 2950
03	EOF	215	07:21	49 19.481	127 09.816	871		3786		10/3	EOL 840 / 3658
04	SOF	08/03	07:21	49 19.481	127 09.816	872		3787		10/4	Transit line
04	EOF	215	07:43	49 20.453	127 09.520	1074		4720		10/4	EOL 1074
05	SOF	08/03	07:45	49 20.453	127 09.520	1075		4721		10/5	SOL 1096 / 4850
05	EOF	215	08:05	49 19.21	127 08.17	1315		5728		10/5	EOL 1256 / 5485

SEISMIC DATA LOG - ShallowPlume 95 (cont'd)

LINE #		DAY (UT) M/D	TIME (UT)	Latitude [° NORTH]	LONGITUDE [° WEST]	TELEDYNE		3.5 KHZ		TAPE# / FILE#	COMMENTS
						SHOT # CRUISE	SHOT # LINE	SHOT # CRUISE	SHOT# LINE		
06	SOF	08/03	08:05	49 19.21	127 08.17	1316		5729		10/6	SOL 1362 / 6150
06	EOF	215	08:35	49 20.707	127 09.849	1605		7150		10/6	EOL 1554 / 6907
07	SOF	08/03	08:35	49 20.707	127 09.849	1606		7151		10/7	SOL 1675 / 6475
07	EOF	215	08:57	49 19.373	127 08.293	1865		8251		10/7	EOL 1836 / 8123
08	SOF	08/03	08:57	49 19.373	127 08.293	1866		8252		10/8	
08	EOF	215	09:12	49 19.439	127 09.707	2020		8957		10/8	
09	SOF	08/03	09:12	49 19.439	127 09.707	2021		8958		10/9	
09	EOF	215	09:35	49 20.624	127 07.908	2272		10084		10/9	EOL 2224 / 9876
10	SOF	08/03	09:35	49 20.624	127 07.908	2273		10085		10/10	SOL 2384 / 10614
10	EOF	215	10:17	49 19.218	127 10.903	2762		12077		10/10	EOL 2548 / 11239
11	SOF	08/03	10:17	49 19.218	127 10.903	2763		12078		10/11	
11	EOF	215	10:29	49 19.750	127 09.818	1872		12639		10/11	
12	SOF	08/03	10:29	49 19.750	127 09.818	1873		12640		10/12	SOL 2908 / 12101
12	EOF	215	10:50	49 20.567	127 07.931	3168		13643		10/12	EOL 3067 / 13403

SEISMIC DATA LOG - ShallowPlume 95 (cont'd)

LINE #		DAY (UT) M/D	TIME (UT)	Latitude [° NORTH]	LONGITUDE [° WEST]	TELEDYNE		3.5 KHZ		TAPE# / FILE#	COMMENTS
						SHOT # CRUISE	SHOT # LINE	SHOT # CRUISE	SHOT# LINE		
13	SOF	08/03	10:50	49 20.567	127 07.931	3169		13644		10/13	SOL 3193 / 13945
13	EOF	215	11:12	49 19.4231	127 10.0458	3495		14793		10/13	EOL 3349 / 14527
14	SOF	08/03	11:12	49 19.4231	127 10.0458	3496		14794		10/14	SOL 3481 / 15116
14	EOF	215	11:39	49 20.7348	127 08.3572	3683		16025		10/14	EOL 3647 / 15865
15	SOF	08/03	11:39	49 20.7348	127 08.3572	3684		16026		10/15	SOL 3775 / 16437
15	EOF	215	12:02	49 19.5919	127 10.2007	3976		17139		10/15	EOL 3936 / 16997
16	SOF	08/03	12:02	49 19.5919	127 10.2007	3977		17140		10/16	SOL 4071 / 17600
16	EOF	215	12:27	49 20.5500	127 08.4500	4242		18358		10/16	EOL 4231 / 18320
17	SOF	08/03	12:27	49 20.5500	127 08.4500	4243		18359		10/17	
17	EOF	215	12:45	49 20.3150	127 08.0983	4426		19184		10/17	EOL 4400 / 19070
18	SOF	08/03	12:45	49 20.3150	127 08.0983	4427		19185		10/18	SOL 4458 / 19308
18	EOF	215	13:05	49 20.3580	127 08.1212	4675		20132		10/18	EOL 4619 / 19923
19	SOF	08/03	13:05	49 20.3580	127 08.1212	4676		20135		10/19	SOL 4763 / 20545
19	EOF	215	13:38	49 20.1579	127 07.990	4987		21592		10/19	EOL 4924 / 21293

SEISMIC DATA LOG - ShallowPlume 95 (cont'd)

LINE #		DAY (UT) M/D	TIME (UT)	Latitude [° NORTH]	LONGITUDE [° WEST]	TELEDYNE		3.5 KHZ		TAPE# / FILE#	COMMENTS
						SHOT # CRUISE	SHOT # LINE	SHOT # CRUISE	SHOT# LINE		
20	SOF	08/03	13:44	49 19.8674	127 08.613	11		41		11/1	MUSE crashed after line 19
20	EOF	215	13:54	49 19.3228	127 09.7911	123		412		11/1	EOL 123 / 415
	SOF		14:04	49 19.685	127 09.745	252		1002			END of survey Shallow Plume 1995
	EOF										

SEISMIC DATA LOG - ShallowPlume 96

LINE #		DAY (UT) M/D	TIME (UT)	Latitude [° NORTH]	LONGITUDE [° WEST]	TELEDYNE		3.5 KHZ		TAPE# / FILE#	COMMENTS
						SHOT # CRUISE	SHOT # LINE	SHOT # CRUISE	SHOT# LINE		
X 1	SOF	08/04	02:30	49 29.481	127 13.044	188		908		11/2	Start of Shallow Plume #2 1996 SOL 204 / 935
	EOF	216	02:48	49 30.8586	127 13.0693	392		1806		11/2	EOL 364 / 1687
X 2	SOF	08/04	02:48	49 30.8586	127 13.0693	393		1809		11/3	SOL 451 / 2163
	EOF	216	03:14:30	49 29.44	127 13.09	632		3053		11/3	EOL 613 / 2955
X 3	SOF	08/04	03:14:30	49 29.44	127 13.09	633		3054		11/4	SOL 774 / 3710
	EOF	216	03:44	49 30.957	127 12.957	948		4480		11/4	EOL 925 / 4391
transit	SOF	08/04	03:44	49 30.957	127 12.957	949		4481		11/5	transit
	EOF	216	04:02	49 30.13	127 11.75	1131		5353		11/5	
11	SOF	08/04	04:02	49 30.13	127 11.75	1132		5354		11/6	SOL 1176 / 5550
11	EOF	216	04:22	49 30.14	127 14.13	1367		6309		11/6	EOL 1339 / 6191
20	SOF	08/04	04:22	49 30.14	127 14.13	1368		6310		11/7	SOL 1470 / 6793
20	EOF	216	04:50	49 30.56	127 12.01	1647				11/7	EOL 1630 / 7593
12	SOF	08/04	04:50	49 30.16	127 12.01	1648				11/8	SOL 1731 / 8044
12	EOF	216	05:14	49 30.16	127 14.10	1911		8814		11/8	EOL 1892 / 8736

SEISMIC DATA LOG - ShallowPlume 96 (cont'd)

LINE #		DAY (UT) M/D	TIME (UT)	Latitude [° NORTH]	LONGITUDE [° WEST]	TELEDYNE		3.5 KHZ		TAPE# / FILE#	COMMENTS
						SHOT # CRUISE	SHOT # LINE	SHOT # CRUISE	SHOT# LINE		
19	SOF	08/04	05:14	49 30.16	127 14.10	1912		8815		11/9	SOL 2000 / 9245
19	EOF	216	05:41	49 30 52	127 11.50	2190		10078			EOL 2163 / 9957
13	SOF	08/04	05:41	49 30.52	127 11.50	2191		10079		11/10	SOL 2281 / 10554
13	EOF	216	06:08	49 30.22	127 14.24	2480		11378			EOL 2441 / 11220
18	SOF	08/04	06:06	49 30.22	127 14.24	2481		11379		11/11	SOL 2555 / 11762
18	EOF	216	06:33	49 30.46	127 11.57	2736		12555			EOL 2716 / 12470
14	SOF	08/04	06:33	49 30.46	127 11.57	2737		12556		11/12	SOL 2792 / 12852
14	EOF	216	06:58	49 30.498	127 14.485	3016		13772			EOL 2951 / 13518
17	SOF	08/04	06:58	49 30.498	127 14.485	3017		13773		11/13	SOL 3091 / 14128
17	EOF	216	07:24	49 30.386	127 11.668	3302		15045			EOL 3255 / 14835
15	SOF	08/04	07:24	49 30.386	127 11.668	3303		15046		11/14	SOL 3365 / 15335
15	EOF	216	07:54	49 30.39	127 11.81	3638		16493			EOL 3473 / 15802 Traffic started again
15	SOF	08/04	07:54	49 30.39	127 11.81	3639		16494		11/15	SOL 3719 / 16917
15	EOF	216	08:25	49 30.378	127 14.578	3943		17940			EOL 3880 / 17680

SEISMIC DATA LOG - ShallowPlume 96 (cont'd)

LINE #		DAY (UT) M/D	TIME (UT)	Latitude [° NORTH]	LONGITUDE [° WEST]	TELEDYNE		3.5 KHZ		TAPE# / FILE#	COMMENTS
						SHOT # CRUISE	SHOT # LINE	SHOT # CRUISE	SHOT# LINE		
16	SOF	08/04	08:25	49 30.378	127 14.578	3944		17941		11/16	SOL 4032 / 18466
16	EOF	216	08:55	49 30.36	127 11.68	4242		19439			EOL 4194 / 19215
6	SOF	08/04	08:55	49 30.36	127 11.68	4243		19440		11/17	SOL 4374 / 20170
6	EOF	216	09:28	49 29.907	127 14.251	4574		20985			EOL 4537 / 20832
10	SOF	08/04	09:28	49 29.907	127 14.251	4575		20986		11/18	SOL 4628 / 21217
10	EOF	216	09:47	49 30.005	127 11.903	4814		21908			EOL 4788 / 21817
7	SOF	08/04	09:47	49 30.005	127 11.903	4815		21909		11/19	SOL 4855 / 22108
7	EOF	216	10:05	49 29.928	127 14.128	5038		22743			EOL 5017 / 22699
9	SOF	08/04	10:05	49 29.928	127 14.128	5039		22744		11/20	SOL 5076 / 22946
9	EOF	216	10:23	49 29.958	127 11.946	5258		23627			EOL 5237 / 23535
5	SOF	08/04	10:23	49 29.958	127 11.946	5259		23628		11/21	SOL 5308 / 23911
5	EOF	216	10:47	49 29.798	127 14.072	5484		24774			EOL 5468 / 24700
8	SOF	08/04	10:47	49 29.798	127 14.072	5485		24775		11/22	SOL 5521 / 24958
8	EOF	216	11:06	49 29.8920	127 11.8815	5711		25682			EOL 5683 / 25573

SEISMIC DATA LOG - ShallowPlume 96 (cont'd)

LINE #		DAY (UT) M/D	TIME (UT)	Latitude [° NORTH]	LONGITUDE [° WEST]	TELEDYNE		3.5 KHZ		TAPE# / FILE#	COMMENTS
						SHOT # CRUISE	SHOT # LINE	SHOT # CRUISE	SHOT# LINE		
4	SOF	08/04	11:06	49 29.8320	127 11.8815	5711		25687		11/23	SOL 5762 / 25956
4	EOF	216	11:36	49 29.8339	127 14.8522	6022		27123			EOL 5922 / 26677
3	SOF	08/04	11:36	49 29.8339	127 14.8522	6023		27127		11/24	SOL 6152 / 27738
3	EOF	216	12:09	49 29.6171	127 11.3110	6402		28699			EOL 6310 / 28352
1	SOF	08/04	12:09	49 29.6171	127 11.3110	6403		28703		11/25	SOL 6492 / 29207
1	EOF	216	12:45	49 29.6409	127 14.2127	6760		30460			EOL 6654 / 29953
2	SOF	08/04	12:45	49 29.6409	127 14.2127	6761		30463		11/26	SOL 6798 / 30612
2	EOF	216	13:06	49 29.5520	127 11.4760	7031		31453			EOL 6991 / 31200
-1	SOF	08/04	13:06	49 29.5520	127 11.4760	7032		31454		11/27	SOL 7111 / 31878
-1	EOF	216	13:40	49 29.5460	127 14.2001	7372		33084			EOL 7272 / 32631

SEISMIC DATA LOG - ShallowPlume 97

LINE #		DAY (UT) M/D	TIME (UT)	Latitude [° NORTH]	LONGITUDE [° WEST]	TELEDYNE		3.5 KHZ		TAPE# / FILE#	COMMENTS
						SHOT # CRUISE	SHOT # LINE	SHOT # CRUISE	SHOT# LINE		
11	SOF	08/05	07:10	48 59.049	126 43.524	145		710		11/29	Frequency of the airgun: 30 Hz SOL 213 / 976
11	EOF	217	07:31	49 00.464	126 42.454	393		1724			EOL 373 / 1643
10	SOF	08/05	07:31	49 00.464	126 42.454	394		1725		11/30	SOL 421 / 1883
10	EOF	217	07:51	48 59.293	126 43.453	599		2659			EOL 583 / 2581
12	SOF	08/05	07:51	48 59.293	126 43.453	600		2660		11/31	SOL 627 / 2798
12	EOF	217	08:10	49 00.552	126 42.428	825		3578			EOL 787 / 3410
9	SOF	08/05	08:10	49 00.552	126 42.428	826		3579		11/32	SOL 861 / 3772
9	EOF	217	08:31	48 59.127	126 43.487	1060		4574			EOL 1022 / 4416
D	SOF	08/05	08:31	48 59.127	126 43.487	1061		4575		11/33	SOL 1218 / 5354
D	EOF	217	09:04	48 59.199	126 41.394	1402		6153			EOL 1381 / 6059
A	SOF	08/05	09:04	48 59.199	126 41.394	1403		6154		11/34	SOL 1439 / 6357
A	EOF	217	09:24	48 59.760	126 44.297	1618		7161			EOL 1600 / 7080
K	SOF	08/05	09:24	48 59.760	126 44.297	1619		7162		11/35	SOL 1717 / 7659
K	EOF	217	09:53	48 59.525	126 42.223	1893		8414			EOL 1879 / 8411

SEISMIC DATA LOG - ShallowPlume 97 (cont'd)

LINE #		DAY (UT) M/D	TIME (UT)	Latitude [° NORTH]	LONGITUDE [° WEST]	TELEDYNE		3.5 KHZ		TAPE# / FILE#	COMMENTS
						SHOT # CRUISE	SHOT # LINE	SHOT # CRUISE	SHOT# LINE		
H	SOF	08/05	09:53	48 59.525	126 42.223	1894		8415		11/36	SOL 1927 / 8659
H	EOF	217	10:10	48 00.013	126 43.979	2099		9350			EOL 2088 / 9306
J	SOF	08/05	10:10	48 00.013	126 43.979	2100		9351		11/37	SOL 2125 / 9480
J	EOF	217	10:30	48 59.497	126 42.206	2303		10303			EOL 2288 / 10232
G	SOF	08/05	10:30	48 59.497	126 42.206	2304		10304		11/38	SOL 2338 / 10508
G	EOF	217	10:50	49 00.088	126 44.314	2531		11275			EOL 2500 / 11154
I	SOF	08/05	10:50	49 00.088	126 44.314	2532		11276		11/39	SOL 2583 / 11531 SOL 2613 / 11671
I	EOF	217	11:10	48 59.700	126 42.8813	2723		12215			EOL 2706 / 12144
GH	SOF	08/05	11:10	48 59.700	126 42.8813	2724		12216		11/40	SOL 2751 / 12350
GH	EOF	217	11:21	49 00.09	126 44.26	2872		12762			EOL 2835 / 12635
L	SOF	08/05	11:21	49 00.09	126 44.26	2873		12763		11/41	SOL 2933 / 13012
L	EOF	217	11:38	48 59.8657	126 42.8494	3070		13565			EOL 3047 / 13470
I	SOF	08/05	11:38	48 59.8657	126 42.8494	3071		13566		11/42	SOL 3102 / 13716
I	EOF	217	11:53	49 00.3075	126 44.2768	3248		14281			EOL 3209 / 14130

SEISMIC DATA LOG - ShallowPlume 97 (cont'd)

LINE #		DAY (UT) M/D	TIME (UT)	Latitude [° NORTH]	LONGITUDE [° WEST]	TELEDYNE		3.5 KHZ		TAPE# / FILE#	COMMENTS
						SHOT # CRUISE	SHOT # LINE	SHOT # CRUISE	SHOT# LINE		
N	SOF	08/05	11:53	49 00.3075	126 44.2768	3249		14282		11/43	SOL 3282 / 14458
N	EOF	217	12:09	49 00.3075	126 44.2768	3410		15046			EOL 3393 / 14970
M	SOF	08/05	12:09	48 59.9808	126 42.8241	3411		15048		11/44	SOL 3430 / 15145
M	EOF	217	12:27	49 00.6955	126 44.1731	3640		15924			EOL 3546 / 15570
21	SOF	08/05	12:27	49 00.6955	126 44.1731	3641		15925		11/45	SOL 3732 / 16297
21	EOF	217	12:50	48 59.5100	126 44.2921	3916		17020			EOL 3893 / 16927
20	SOF	08/05	12:50	48 59.5100	126 44.2921	3917		17021		11/46	SOL 3979 / 17310
20	EOF	217	13:08	49 00.6677	126 43.1769	4161		17986			EOL 4141 / 17820
19	SOF	08/05	13:08	49 00.6677	126 43.1769	4162		17987		11/47	SOL 4179 / 17998
19	EOF	217	13:28	48 59.5001	126 44.1092	4358		18835			EOL 4340 / 18758
22	SOF	08/05	13:28	48 59.5001	126 44.1092	4359		18836		11/48	SOL 4408 / 19048
22	EOF	217	13:49	49 00.7504	126 43.2724	4604		19877			EOL 4567 / 19677
17	SOF	08/05	13:49	49 00.7504	126 43.2724	4605		19878		11/49	SOL 4654 / 20115
17	EOF	217	14:10	48 59.4264	126 43.9324	4831		20865			EOL 4815 / 20800

SEISMIC DATA LOG - ShallowPlume 97 (cont'd)

LINE #		DAY (UT) M/D	TIME (UT)	Latitude [° NORTH]	LONGITUDE [° WEST]	TELEDYNE		3.5 KHZ		TAPE# / FILE#	COMMENTS
						SHOT # CRUISE	SHOT # LINE	SHOT # CRUISE	SHOT# LINE		
18	SOF	08/05	14:10	48 59.4264	126 43.9324	4832		20865		11/50	SOL 4893 / 21145
18	EOF	217	14:28	49 00.67	126 43.06	5092		21860			EOL 5064 / 21745
16	SOF	08/05	14:28	49 00.67	126 43.06	5093		21861		11/51	SOL 2143 / 22116
16	EOF	217	14:51	48 59.461	126 43.853	5317		22835			

SEISMIC DATA LOG - Lines for Ross Chapman in upper slope

LINE #		DAY (UT) M/D	TIME (UT)	Latitude [° NORTH]	LONGITUDE [° WEST]	TELEDYNE		3.5 KHZ		TAPE# / FILE#	COMMENTS
						SHOT # CRUISE	SHOT # LINE	SHOT # CRUISE	SHOT# LINE		
CH 1	SOF	217	21:05	49 04.523	126 54.965	19		70		12/1	SOL 132 / 416
		217	21:24	49 03.394	126 53.974	222		717			mid point
		217	21:42	49 02.305	126 52.983	410		1318			mid point
	EOF	217	22:21	48 59.091	126 50.901	868		2664			EOL 815 / 2496
CH 1-2	SOF	217	22:21	48 59.091	126 50.901	869		2665		12/2	SOL 1009 / 3119; transition line
	EOF	217	23:35	48 59.994	126 51.884	1009		3119			Point on CH 1-2
CH 2	SOF	217	23:39	49 02.5449	126 57.0831	1728		5348			SOL 1728 / 53435
		217	23:55	49 03.9971	126 55.1552	1943		5926			mid point
		218	00:10	49 03.4432	126 53.2828	2133		6445			00:15 ships nav system lost satellites for a minute
		218	00:30	49 03.9890	126 50.0027	2381		7119			6793 delay for 3.5 kHz changed to 300msec
		218	00:50	49 04.6007	126 48.4701	2642		7929			mid point
CH 2	EOF	218	01:15	49 05.0849	126 46.4405	2369		8679			EOL

SEISMIC DATA LOG - MudVolcano

LINE #		DAY (UT) M/D	TIME (UT)	Latitude [° NORTH]	LONGITUDE [° WEST]	TELEDYNE		3.5 KHZ		TAPE# / FILE#	COMMENTS
						SHOT # CRUISE	SHOT # LINE	SHOT # CRUISE	SHOT# LINE		
MV 1	SOF	218	5:19:10	49 07.37	127 32.20	13		25		13/1	Airgun: 6 sec recording time, 0.5ms dt delay 1300ms
		218	6:20					1350			3.5 kHz recording time 1310ms; delay 1300ms
		218	07:00	49 09.27	127 43.38	724		1915			
		218	07:30	49 09.847	127 46.685	936		2363			
		218	07:33	49 09.918	127 47.096	962		2418			Core position 16
		218	08:00	49 10.411	127 49.981	1147		2813			
		218	08:12	49 10.628	127 51.338	1235		3001			Approaching MV
		218	08:16:50	49 10.713	127 51.812	1264		3067			Center of MV
		218	08:23	49 10.84	127 52.57	1310		3170			End of MV
		218	08:30	49 10.948	127 53.148	1352		3263			
		218	09:00	49 11.456	127 56.223	1547		3728			
		218	09:30	49 11.928	127 58.974	1725		4161			
		218	10:00	49 12.374	128 01.586	1895		4612			
		218	10:30	49 12.796	128 04.118	2056		5063			

SEISMIC DATA LOG - MudVolcano (cont'd)

LINE #		DAY (UT) M/D	TIME (UT)	Latitude [° NORTH]	LONGITUDE [° WEST]	TELEDYNE		3.5 KHZ		TAPE# / FILE#	COMMENTS
						SHOT # CRUISE	SHOT # LINE	SHOT # CRUISE	SHOT# LINE		
MV1		218	11:00	49 13.238	128 06.074	2218		5502			
		218	11:32	49 13.797	128 09.984	2430		5987			EOL
	EOF	218	11:33	49 13.81	128 10.10	2435		6001		13/2	EOF
MV2	SOF	218	11:38	49 13.81	128 10.10	2436		6002			SOL SOF
		218	11:38	49 13.821	128 09.986	2470		6085			
	EOF	218	12:55	49 08.18	128 07.93	3010		7234			
MV3	SOF	218	12:55	49 08.18	128 07.93	3011		7235		13/3	SOL
	EOF	218	13:45:40	49 06.996	128 01.156	3317		7995			
MV4	SOF	219	01:47	49 08.5809	127 50.6961	24		57		13/4	SOL 48 / 118
	EOF	219	03:22	49 15.998	128 54.527	743		1487			EOL
MV5	SOF	219	03:23	49 16.063	127 54.5523	750		1497		13/5	SOL 772 / 1546
	EOF	219	04:02			995		1993			EOL 994 / 1993
MV6	SOF	219	04:13	49 14.153	127 51.3012	6		13		14/1	MUSE back online
	EOF	219	05:11	49 13.319	12756.538	344		880			EOL 333 / 858

SEISMIC DATA LOG - MudVolcano (cont'd)

LINE #		DAY (UT) M/D	TIME (UT)	Latitude [° NORTH]	LONGITUDE [° WEST]	TELEDYNE		3.5 KHZ		TAPE# / FILE#	COMMENTS
						SHOT # CRUISE	SHOT # LINE	SHOT # CRUISE	SHOT# LINE		
MV7	SOF	219	05:11	49 13.319	12756.538	345		881		14/2	SOL 360 / 916
	EOF	219	05:43	49 15.868	127 54.817	500		1360			EOL 498 / 1348
MV8	SOF	219	05:43	49 15.868	127 54.817	501		3161		14/3	SOL 501 / 1361
	EOF	219	07:26	49 08.600	127 50.973	1221		2905			EOL 1204 / 2870
MV8B	SOF	219	07:26	49 08.600	127 50.973	1222		2906		14/4	SOL 1261 / 3000
	EOF	219	07:53	49 09.888	127 49.056	1412		3294			EOL 1402 / 3274
MV9	SOF	219	07:53	49 09.888	127 49.056	1413		3295		14/5	SOL 1451 / 3380
	EOF	219	08:51	49 10.979	127 55.147	1834		4170			EOL 1812 / 4145
MV11	SOF	219	08:51	49 10.979	127 55.147	1835		4171		14/6	SOL 1858 / 4223
	EOF	219	09:47	49 10.066	127 48.804	2218		5010			EOL 2209 / 4990
MV10	SOF	219	09:47	49 10.066	127 48.804	2219		5011		14/7	SOL 2248 / 5097
	EOF	219	10:57	49 11.395	127 54.827	8		20			EOL 2384 / 5430 Crash half way on line
MV13	SOF	219	10:57	49 11.395	127 54.827	9		21		15/1	SOL 13 / 36
	EOF	219	11:55	49 10.3874	127 48.7475	392		890			EOL 383 / 870

SEISMIC DATA LOG - MudVolcano (cont'd)

LINE #		DAY (UT) M/D	TIME (UT)	Latitude [° NORTH]	LONGITUDE [° WEST]	TELEDYNE		3.5 KHZ		TAPE# / FILE#	COMMENTS
						SHOT # CRUISE	SHOT # LINE	SHOT # CRUISE	SHOT# LINE		
MV12	SOF	219	11:55	49 10.3874	127 48.7475	393		891		15/2	SOL 415 / 955
	EOF	219	12:47	49 11.4348	127 55.1282	717		1682			EOL 694 / 1636
MV14	SOF	219	12:47	49 11.4348	127 55.1282	718		1683		15/3	SOL 747 / 1750
	EOF	219	13:48	49 10.3739	127 48.7221	1139		2584			EOL 1121 / 2537
MV10 R	SOF	219	13:48	49 10.3739	127 48.7221	1140		2585		15/4	SOL 1190 / 270
	EOF	219	14:51	49 11.0375	127 55.0054	1573		3549			EOL 1563 / 3520
MV15	SOF	220	02:34	49 01.731	127 31.695	38		85		16/1	SOL 38 / 85
	EOF	220	07:15	49 07.044	128 01.118	1916		4284			EOL 1909 / 4266
MV16	SOF	220	07:15	49 07.044	128 01.118	1917		4285		16/2	SOL 1917 / 4285
	EOF	220	10:28	49 20.915	127 55.305	3253		7190			EOL 3245 / 7173
MV17	SOF	220	10:28	49 20.915	127 55.305	3254		7191		16/3	SOL 3475 / 7665
		220	13:26	49 15.945	127 37.431	4363		9865			Change of airgun delay to 1000 ms
	EOF	220	13:47	49 15.509	127 34.943	4515		10172			EOL 4515 / 10172

SEISMIC DATA LOG - NorthernFault

LINE #		DAY (UT) M/D	TIME (UT)	Latitude [° NORTH]	LONGITUDE [° WEST]	TELEDYNE		3.5 KHZ		TAPE# / FILE#	COMMENTS
						SHOT # CRUISE	SHOT # LINE	SHOT # CRUISE	SHOT# LINE		
NF 3	SOF	221	05:09	48 43.102	126 55.123	70		74		17/1	Start of North Fault Survey
	EOF	08/08	05:25	48 42.594	126 53.440	251		280			EOL 239 / 267
NF 1	SOF	221	05:25	48 42.594	126 53.440	252		281		17/2	SOL 330 / 388
		08/08	05:53			514		625			EOL 511 / 620
	EOF	221									Shut down MUSE
NF 9	SOF	08/08	05:56	48 43.123	126 54.947	31		32		17/3	SOL a bit late 05:58
	EOF	221	06:14	48 42.626	126 53.3227	210		238			EOL 185 / 208
NF 2	SOF	08/08	06:14	48 42.626	126 53.3227	211		239		17/4	SOL 272 / 348
	EOF	221	06:41	48 43.145	126 53.3555	467		598			EOL 453 / 578
NF 6	SOF	08/08	06:41	48 43.145	126 53.3555	468		599		17/5	SOL 491 / 637
		221	07:02	48 42.532	126 53.325	680		873			EOL 654 / 841
	EOF	08/08									
NF 4	SOF	221				681		874		17/6	SOL 716 / 941
	EOF	08/08	07:25	48 43.20	126 55.331	903		1183			EOL 888 / 1163

SEISMIC DATA LOG - NorthernFault (cont'd)

LINE #		DAY (UT) M/D	TIME (UT)	Latitude [° NORTH]	LONGITUDE [° WEST]	TELEDYNE		3.5 KHZ		TAPE# / FILE#	COMMENTS
						SHOT # CRUISE	SHOT # LINE	SHOT # CRUISE	SHOT# LINE		
NF 11	SOF	221	07:25	48 43.201	126 55.331	904		1184		17/7	SOL 922 / 1208
	EOF	08/08	07:41	48 42.685	126 53.434	1100		1400			EOL 1093 / 1391
NF 5	SOF	221	07:41	48 42.685	126 53.434	1101		1401		17/8	SOL 1133 / 1449
	EOF	08/08	08:12	48 43.205	126 55.385	1302		1807			EOL 1310 / 1793
NF 10	SOF	221	08:12	48 43.205	126 55.385	1303		1808		17/9	SOL 1351 / 1841
	EOF	08/08	08:29	48 42.665	126 53.397	1538		2036			EOL 1526 / 2024
NF 7	SOF	221	08:29	48 42.665	126 53.397	1539		2037		17/10	SOL 1615 / 2130
	EOF	08/08	08:52	48 43.211	126 55.345	1803		2347			EOL 1788 / 2329
NF 12	SOF	221	08:52	48 43.211	126 55.345	1804		2348		17/11	SOL 1832 / 2385
	EOF	08/08	09:10	48 42.668	126 53.301	2026		2585			EOL 2008 / 2564
NF 8	SOF	221	09:10	48 42.668	126 53.301	2027		2586		17/12	SOL 2081 / 2656
	EOF	08/08	09:35	48 43.299	126 55.249	2280		2917			EOL 2257 / 2885
NF 18	SOF	221	09:35	48 43.299	126 55.249	2281		2918		17/13	SOL 2299 / 2940
	EOF	08/08	09:51	48 42.770	126 53.329	2475		3137			EOL 2464 / 3125

SEISMIC DATA LOG - NorthernFault (cont'd)

LINE #		DAY (UT) M/D	TIME (UT)	Latitude [° NORTH]	LONGITUDE [° WEST]	TELEDYNE		3.5 KHZ		TAPE# / FILE#	COMMENTS
						SHOT # CRUISE	SHOT # LINE	SHOT # CRUISE	SHOT# LINE		
NF 13	SOF	221	09:51	48 42.770	126 53.329	2476		3138		17/14	SOL 2512 / 3186
	EOF	08/08	10:10	48 42.296	126 55.318	2904		3391			EOL 2687 / 3374
NF 19	SOF	221	10:10	48 42.296	126 55.318	2705		3392		17/15	SOL 2733 / 3424
	EOF	08/08	10:29	48 42.766	126 53.265	2923		3633			EOL 2907 / 3614
NF 14	SOF	221	10:29	48 42.766	126 53.265	2924		3634		17/16	SOL 2966 / 3687
	EOF	08/08	10:48	48 43.298	126 55.298	3155		3891			EOL 3140 / 3876
NF 20	SOF	221	10:48	48 43.298	126 55.298	3156		3892		17/17	SOL 3187 / 3927
	EOF	08/08	11:07	48 42.7782	126 53.2638	3378		4141			EOL 3365 / 4126
NF 15	SOF	221	11:07	48 42.7782	126 53.2638	3379		4142		17/18	SOL 3419 / 4195
	EOF	08/08	11:27	48 43.3113	126 55.2691	3612		4409			EOL 3596 / 4394
NF 21	SOF	221	11:27	48 43.3113	126 55.2691	3613		4410		17/19	SOL 3653 / 4460
	EOF	08/08	11:47	48 42.7782	126 53.2263	3841		4675			EOL 3820 / 4652
NF 16	SOF	221	11:47	48 42.7782	126 53.2263	3842		4676		17/20	SOL 3889 / 4737
	EOF	08/08	12:09	48 43.3322	126 55.3006	4084		4971			EOL 4069 / 4948

SEISMIC DATA LOG - NorthernFault (cont'd)

LINE #		DAY (UT) M/D	TIME (UT)	Latitude [° NORTH]	LONGITUDE [° WEST]	TELEDYNE		3.5 KHZ		TAPE# / FILE#	COMMENTS
						SHOT # CRUISE	SHOT # LINE	SHOT # CRUISE	SHOT# LINE		
NF 22	SOF	221	12:09	48 43.3322	126 55.3006	4084		4971		17/21	SOL 4120 / 5017
	EOF	08/08	12:29	48 42.7983	126 53.2251	4317		5238			EOL 4296 / 5215
NF 17	SOF	221	12:29	48 42.7983	126 53.2251	4318		5239		17/22	SOL 4358 / 5295
	EOF	08/08	12:48	48 43.3476	126 55.3141	4557		5498			EOL 4535 / 5476
NF 23	SOF	221	12:48	48 43.3476	126 55.3141	4558		5499		17/23	SOL 4643 / 5607
	EOF	08/08	13:10	48 42.8245	126 53.3123	4825		5785			EOL 4815 / 5776
NF 3 redone	SOF	221	13:10	48 42.8245	126 53.3123	4826		5786		17/24	SOL 4878 / 5858 Bad start, circled around to start again
	EOF	08/08									
NF 3 redone	SOF	221	13:21	48 42.5890	126 53.2809	4935		5930		17/25	SOL 4978 / 5983
	EOF	08/08	13:39	48 43.1479	126 55.3001	5166		6177			EOL 5156 / 6167

SEISMIC DATA LOG - NorthernFault (cont'd)

LINE #		DAY (UT) M/D	TIME (UT)	Latitude [° NORTH]	LONGITUDE [° WEST]	TELEDYNE		3.5 KHZ		TAPE# / FILE#	COMMENTS
						SHOT # CRUISE	SHOT # LINE	SHOT # CRUISE	SHOT# LINE		
NF 9R	SOF	222		48 42.712	126 54.618	186		184		18/2	SOL 167 / 361
	EOF	222	02:43	48 43.244	126 55.237	353		713			EOL 345 / 695
NF 24	SOF	222	02:43	48 43.244	126 55.237	354		714		18/3	SOL 409 / 827
	EOF	222	03:04	48 42.8317	126 53.2465	599		1193		18/3	EOL 584 / 1164
NF 0	SOF	222	03:04	48 42.8317	126 53.2465	600		1194		18/4	SOL 686 / 1396
	EOF	222	03:30	48 43.152	126 55.398	879		1759		18/4	EOL 864 / 1728
NF 25	SOF	222	03:30	48 43.152	126 55.398	880		1760		18/5	SOL 941 / 1869
	EOF	222	03:50	48 42.831	126 53.260	1132		2218		18/5	EOL 1118 / 2191
NF –1	SOF	222	03:50	48 42.831	126 53.260	1133		2219		18/6	SOL 1220 / 2457
	EOF	222	04:17:30	48 43.1248	126 53.367	1405		2811		18/6	EOL 1393 / 2788
NF 26	SOF	222	04:17:31	48 43.1248	126 53.367	1406		2812		18/7	SOL 1481 / 2970
	EOF	222		48 42.871	126 53.304	1662		3321		18/7	EOL 1654 / 3308

TABLE 10 : **Description of selected cores**

CORE 2

General Description

- Core appears to be mostly consisted of one large sand layer
- Separated into six ~70cm sections
- Six ~7cm sections were cut off for chemical analysis
- Top ~30cm of sediment were lost upon core recovery

Detailed Description

C2S6 (40-130cm BSF)

Whole Section Scrape at 45μm: #1404
40-90 cm below sea floor (BSF)
- clay to fine sand with patches of medium to coarse sand scattered throughout
- grayish-green colour
- some bioturbation observed
- samples: 1399 (60cm BSF), and 1400 (80cm BSF)

90-110 cm BSF
- medium to coarse sand
- medium to dark gray
- sharp contact on top
- samples: 1401 (100cm BSF)

110-130 cm BSF
- clay to fine sand with patches of medium to coarse sand scattered throughout
- grayish-green colour
- samples: 1402 (120 cm BSF)

C2S5 (137-212cm BSF)

Whole Section Scrape at 45μm: #1406
137-167 cm BSF
- silt to fine sand with some patches of medium sand
- greenish-gray colour
- sample: 1407 (140cm BSF, silt), 1408 (157cm BSF, sandy patch)

167-212 cm BSF
- medium sand in silty matrix (20% matrix)
- coarser sand with shell fragments at 183cm BSF depth, sample: 1409
- sample: 1410 (200cm BSF)

C2S4 (212-269cm BSF)

Whole Section Scrape at 45μm: #1411
- The section was not completely filled with sediments and thus got mixed upon recovery
- For this reason no further analysis was conducted

C2S3 (279-344cm BSF)

Whole Section Scrape at 45μm: #1414
- The sediment in this section was also mixed during the recovery
- Various vertical features artificially made during the recovery were observed
- Resistivity measurements were conducted in order to get the general values for the entire section
- Samples: 1412 (290cm BSF), 1413 (310cm BSF)

C2S2 (315-426cm BSF)

Whole Section Scrape at 45μm: #1417

315-395cm BSF
- fine to medium sand in silty matrix (20%)
- some layering and/or sorting might have been present before it was mixed and disturbed by the coring
- layer of coarse dark brown and black minerals at 385cm depth (sample 1415)

395-426cm BSF
- dewatering structure most likely made during piston coring – fine sand and silt coming from below (the middle of the structure) and coarser sediments on the outer walls
- sample: 1416 (scrape of the inner part of the structure)

C2S1 (433-501cm BSF)

Whole Section Scrape at 45μm: #1420

433-450cm BSF
- fine sand and silt
- sample: 1418 (440cm BSF)

450-501cm BSF
- fine to medium sand
- sample: 1419 (470cm BSF)
- dewatering structure from 490-501cm consisting of fine sand and silt

CORE 5

General Description

- Gas core – suspected to be situated immediately above the shallow hydrate layer; however, the core did not penetrate deep enough (only ~4m long)
- Split into five ~70cm sections; five ~7cm samples taken for chemical analysis
- Top 96cm sediments were mixed during the recovery and thus no further measurements were conducted

Detailed Description

C5S4 (96-156.5cm BSF)

Whole Section Scrape at 45μm: #1423

96-146cm BSF
- Greenish-gray silty mud
- Some presence of gas expansion (small holes and cracks ~2mm thick)
- Several small (<1mm in diameter) black (carbon?) dots

- Some light green patches scattered throughout
- On top of the section a 'vain' of cemented sediments (sample 1421)

146-156.5cm BSF
- grayish silty mud
- Bottom 2cm partly cemented (sample 1422)

C5S3 (164-226.5cm BSF)

Whole Section Scrape at 45μm: #1427

164-184cm BSF
- silty clay
- gray (some green tint) with lighter gray patches with no textural change (sample 1424)
- gradational contact with the section below

184-226.5cm BSF
- silty clay matrix (80%) with pebble size carbonate chunks (sample 1425)
- at 203cm BSF, 5cm in diameter carbonate rock (fizzed with HCl) (sample 1426)
- bottom 2cm missing
- The entire section appeared to be very stiff, but with application of pressure pore water would come to the surface

C5S2 (234-301cm BSF)

Whole Section Scrape at 45μm: #1432

234-244cm BSF
- silty clay matrix (90%) with some fine to medium sand sediments scattered throughout
- some cemented patches (sample 1428)

244-254cm BSF
- coarser sediments in silty matrix with shell fragments (sample bagged)

254-260cm BSF
- rock fragments in matrix similar to above; rocks fell apart upon biting (!) (sample 1429)

260-301cm BSF
- silty clay greenish-gray matrix
- very stiff
- some coarser grained sediments (carbonates?) scattered throughout
- more pore water observed on the surface of the cut core near the bottom of the section
- the seds are becoming more greenish and more stiff as well towards the bottom of the section (sample 1430)
- some light gray bands present from 285-300cm BSF (sample 1431)
- a layer of much coarser (pebble) sediments found from 300-301cm BSF

C5S1 (309-376 cm BSF)

Whole Section Scrape at 45μm: #1433

308-318cm BSF
- greenish, very stiff clay silt, with some very small darker dots (carbon balls) (**samples ???**)

318-338cm BSF

- brown colour somewhat coarser matrix (still in the clay silt range) with some fine to medium sands scattered around

338-340cm BSF
- appears to be a transition between the seds above and below
- partially cemented (carbonate?)
- small pebble to cobble size semi-rounded rock

340-353cm BSF
- leopard looking section (i.e. various lighter brown matrix with darker brown dots)
- coarser sediments in a silty matrix (10%)

CORE 7

General Description

- Gas hydrate core
- Total length 413cm BSF
- The core contained solid gas hydrate in two main forms: scattered throughout as pebble size chunks, and as larger ~10cm diameter pieces
- Most of the solid gas hydrate was found approximately below 3m BSF
- The core was cut into several pieces and samples were taken for various chemical and sedimentological analysis (see core sketch)
- Two temperature measurements were taken at 385cm (9 °C) and 305cm (-1.1 °C) depth BSF

CORE 8

General Description

- Gas hydrate core
- Total length 153cm BSF
- The solid gas hydrate was found scattered throughout the core
- Several samples were taken for various chemical, isotope, and sedimentological analysis
- Two temperature measurements were taken at 111cm (2.8 °C) and 53cm (6.1 °C) BSF
- A 6cm gas pocket was observed immediately upon the recovery at 99cm depth BSF

CORE 10

General Description

- Total length 607 cm BSF
- The second core liner failed thus ~120 cm of sediment was lost from the top
- Core was divided into 3 sections

Detailed Description

C10S3 (119-269 cm BSF)

Whole Section Scrape at 45μm: #1436

119-135cm BSF
- silty to fine grained gray matrix

- darker gray patches
- some coarse grained sediments scattered throughout
- sample: B21

135-145cm BSF
- silty gray clay matrix
- uniform
- sample: B22

145-170cm BSF
- silty gray matrix
- darker patches of silty clay
- some coarse grained sediments
- sample: B23

170-269cm BSF
- fine sand layers interbedded with gray silty clay matrix
- samples: B24, B25, B26

C10S2 (269-419 cm BSF)

Whole Section Scrape at 45μm: #1437

269-289 cm BSF
- silty matrix mostly uniform, some darker coarser sediment layers

289-295 cm BSF
- clay to fine sand layer
- sample:B27

295-385 cm BSF
- silty matrix with coarser darker layers (~1cm thick)
- pink spot ~300cm BSF
- sample: B28
- shell and fine sandy clay layer ~308cm BSF

385-400 cm BSF
- browner silty clay
- coarser layers, different shear strength and porosity
- samples: B31, B32

400-419cm BSF
- silty matrix with some darker layering

C10S1 (422-572 cm BSF)

Whole Section Scrape at 45μm: #1438

422-432 cm BSF
- gray clay
- light greenish gray layering
- last 1cm more clay minerals, coarser
- sample: B33

432-460cm BSF
- gray silty clay

- some oxidizing black spots
- sample: B34

460-462cm BSF
- pink horizontal layer
- sample: B35

462-572cm BSF
- gray silty clay
- some very thin coarser layers (<0.5cm thick)
- deformation structure ~480cm –572cm BSF
- samples: B36, B37

CORE 12

General Description

- Total length 758 cm
- Top 90 cm lost during recovery
- Split into 9 sections
- Length of sections ~67.5 cm each
- Chemists took top 7.5cm of each section

Detailed Description

C12S9 (90-152cm BSF)

Whole Section Scrape at 45μm (combined sections 9 and 8): #1439

90-138cm BSF
- gray silty clay
- some slightly coarser/darker bands
- banding is rhythmic like event horizons
- some small rocks at ~100-110cm BSF
- samples B38, B39, B40

138-152cm BSF
- greenish gray silty clay
- sample: B41

C12S8 (152-240.5 cm BSF)

152-170cm BSF
- dark grayish silty clay
- few small rocks
- darker horizon layering
- sample B42

170-185cm BSF
- brownish silty clay matrix
- few coarser-grained layers
- sample: B43

185-205cm BSF
- greenish gray silty clay

- darker band horizons
- sample: B44

205-210cm BSF
- sandy layer
- sample: B45

210-240.5cm BSF
- darker coarse grained horizon layering
- gray silty clay
- few sandy layers
- sample: B46

C12S7 (240-307cm BSF)

Whole Section Scrape at 45μm (combined sections 7 and 6): #1440

240-307cm BSF
- color grades gradually and gradationally with depth
- dark gray silty clay to light gray silty clay
- few dark bands present throughout section
- sandy layers present at ~300cm BSF
- samples: B47, B48, B49, B50, B51

C12S6 (315-382cm BSF)

315-332cm BSF
- grey silty clay, uniform in color
- dark sand layers at ~320cm BSF

332-335cm BSF
- very wet sand layer
- large pore space, lots of fluid
- bottom boundary with clay is gradational
- upper boundary is abrupt
- sample: B53

335-382cm BSF
- gray silty clay
- few darker sandy layers
- samples: B54, B55

C12S5 (315-390cm BSF)

Whole Section Scrape at 45μm (combination of sections 5 and 4): #1441

315-390cm BSF
- gray silty mud
- sample: B57
- thin sand layer at 305cm BSF and 385cm BSF
- very wet sand inclusion ~3cm at 345cm BSF
- sample: B58
- thin dark gray bands of clay at 360-370cm BSF
- sample B59

C12S4 (400-465cm BSF)

400-465cm BSF
- gray silty clay with darker layers interbedded
- thin fine grained sand layer at 405cm BSF
- coarser grained sand layers at 410cm and 455cm BSF
- samples: B60, B61

C12S3 (458-525 cm BSF)

Whole Section Scrape at 45μm: #1442

458-472cm BSF
- dark gray silty clay
- sample: B62

472-478cm BSF
- very wet sand layer
- sample: B 63

478-525cm BSF
- green-gray silty clay-mud
- few oxidizing black spots
- thin sand layers at 510cm and 515cn BSF

C12S2 (533-600 cm BSF)

Whole Section Scrape at 45μm: #1443

533-536cm BSF
- green-gray silty clay
- sample: B64

536-578 cm BSF
- gray silty clay
- elongated carbonate pieces, shaped like work tubes at ~560cm BSF
- sample: B65

578-581cm BSF
- sand layer
- sample: B66

581-600cm BSF
- gray silty clay
- few thin sand layers

C12S1 (608-680 cm BSF)

Whole Section Scrape at 45μm: #1444

608-630cm BSF
- gray silty clay
- sample: B67

630-634cm BSF
- dark sand layer, with branches, not smooth horizons

- sample: B68

634-680cm BSF
- gray silty clay
- random sandy patches
- sample: B69

CORE 13

General Description

- Shallow Plume site
- Water depth ~200 meters
- Piston did not penetrate

Detailed Description

- 3 small, black, well rounded pebbles recovered in piston core
- possibly glacial
- sample: B70
- ~20cm of sediment and rocks recovered in gravity core
- samples: B71, B72

CORE 15

General Description

- another unsuccessful recovery
- ~5cm of sediment recovered
- sample: B73

CORE 16

General Description

- Chemists' core
- Total length ~630 cm, with expansion cracks ~675 cm
- Samples collected for physical properties in Ziploc Bags

Detailed Description

Samples collected at the following depths BSF:

B74- 30-35cm
B75- 75-80cm
B76- 90-95cm
B77-115-120cm
B78-130-135cm
B79- 190-195cm
B80- 205-210cm
B81- 265-270cm
B82- 375-380cm

B83- 395-400cm
B84- 485-490cm
B85- 520-525cm
B86- 580-585cm
B87- 605-610cm
B88- 665-675cm

CORE 18p

General Description

- Total length recovered 5.81 meters
- Split into 6 sections
- Section lengths 75cm; 67.5cm for physical properties analysis, 7.5cm for chemists
- Labeled 18p to distinguish phys. prop core from chemists #18 core

Detailed Description

C18pS6 (0-108 cm BSF)

Whole Section Scrape at 45μm: #1450

0-10cm BSF
- very wet mushy gray silty clay
- sample: B102

10-50cm BSF
- wet greenish-gray silty clay
- sample: B103

50-108cm BSF
- drier greenish-gray silty clay
- small white shell pieces at ~70 cm BSF
- sample: B104

C18pS5 (158-280 cm BSF)

Whole Section Scrape at 45μm: #1449

158-165cm BSF
- small section missing

158-235cm BSF
- grayish green silty clay
- few black oxidizing spots
- sample: B99

235-237cm BSF
- dark sandy layer
- sample: B100

237-270cm BSF
- grayish green silty clay

- sample: B101

270-280cm BSF
- grayish green silty clay
- 1cm missing at ~271cm BSF
- 2cm missing at ~275cm BSF

C18pS4 (306-374 cm BSF)

Whole Section Scrape at 45μm: #1448

306-315cm BSF
- missing sediment (empty space)

315-374 cm BSF
- uniform greenish gray silty clay
- sample B98

C18pS3 (381-448 cm BSF)

Whole Section Scrape at 45μm: #1447

381-384cm BSF
- greenish gray silty clay

384-386cm BSF
- very watery sand layer
- sample: B96

386-448 cm BSF
- uniform greenish gray silty clay
- few oxidizing black spots
- sample: B97
- thin sand layer at 430 cm BSF

C18pS2 (455-516 cm BSF)

Whole Section Scrape at 45μm: #1446

455-465cm BSF
- 1cm sand layer at the top
- green silty clay
- 1cm sand layer at the bottom (drier than previous layer)

465-470cm BSF
- very bright green silty clay layer
- sample: B93

470-505cm BSF
- gray to gray-green silty clay
- green inclusion ~4cm long (perpendicular to core liner)at 485cm BSF
- sand inclusion ~ 7cm long (parallel to core liner) at 490-497cm BSF

- sample: B94

505-510cm BSF
- very wet sand
- sample: B95

510-516cm BSF
- green silty clay

C18pS1 (520-580cm BSF)

Whole Section Scrape at 45μm: #1445

520-528cm BSF
- gray silty clay

528-530cm BSF
- very wet sand
- sample: B89

530cm BSF
- thin gray clay layer

531-540cm BSF
- sand and silt mixture

540-580cm BSF
- alternating wet sand layers and gray silty clay layers
- samples: B90, B91, B92

CORE 19

General Description

- Chemists' core
- Total length 8.68 meters
- Took samples for physical analysis in sample bags

Detailed Description

- Samples collected at the following depths BSF:

B105- 45-50cm
B106- 105-110cm
B107-145-150cm
B108-195-200cm
B109- 265-270cm
B110- 315-320cm
B111- 415-420cm
B112- 515-520cm
B113- 615- 620cm
B114- 720- 725cm
B115- 805-810cm

CORE 20

General Description

- Attempt at a hydrate core, in the vicinity of previously collected hydrate
- Gassy sediments, very smelly, sulfur rich
- Total length recovered 3.41 meters
- Split into 3 sections
- Bottom section not intact enough to measure phys. prop.

Detailed Description

C20S1 (286-341 cm BSF)

Took 2 samples
- bottom sample: B116
- top sample: B117

C20S2 (136-286 cm BSF)

Whole Section Scrape at 45μm: #1451

136-286cm BSF
- gray silty clay with dark black horizons
- many gas expansion cracks
- cracks at depths of 160cm, 190cm, 215cm, 235cm, 260cm BSF
- many stripped layers, alternating greenish-gray, to gray- to dark gray silty clay
- samples: B118, B119, B120, B121

C20S3 (0-136 cm BSF)

Whole Section Scrape at 45μm: #1452

0-40cm BSF
- very mushy wet silty clay
- sample: B122

40-136cm BSF
- gray silty clay, drier
- uniform, no horizons
- expansion cracks at 100cm and 115cm BSF
- samples: B123, B124

CORE 21

General Description

- Gas Hydrate Core
- Total length 5.68 meters
- Split into 2 sections
- Top 264 cm sediment sampled by chemists (no hydrate)
- Bottom 304 cm (contained hydrate) was sampled by everyone
- Michael took 4 sections and froze them in liquid nitrogen in the following canisters:
  Black (264-284cm BSF), Yellow (284-294cm BSF), Red (460-481cm BSF), White (548-568cm BSF)

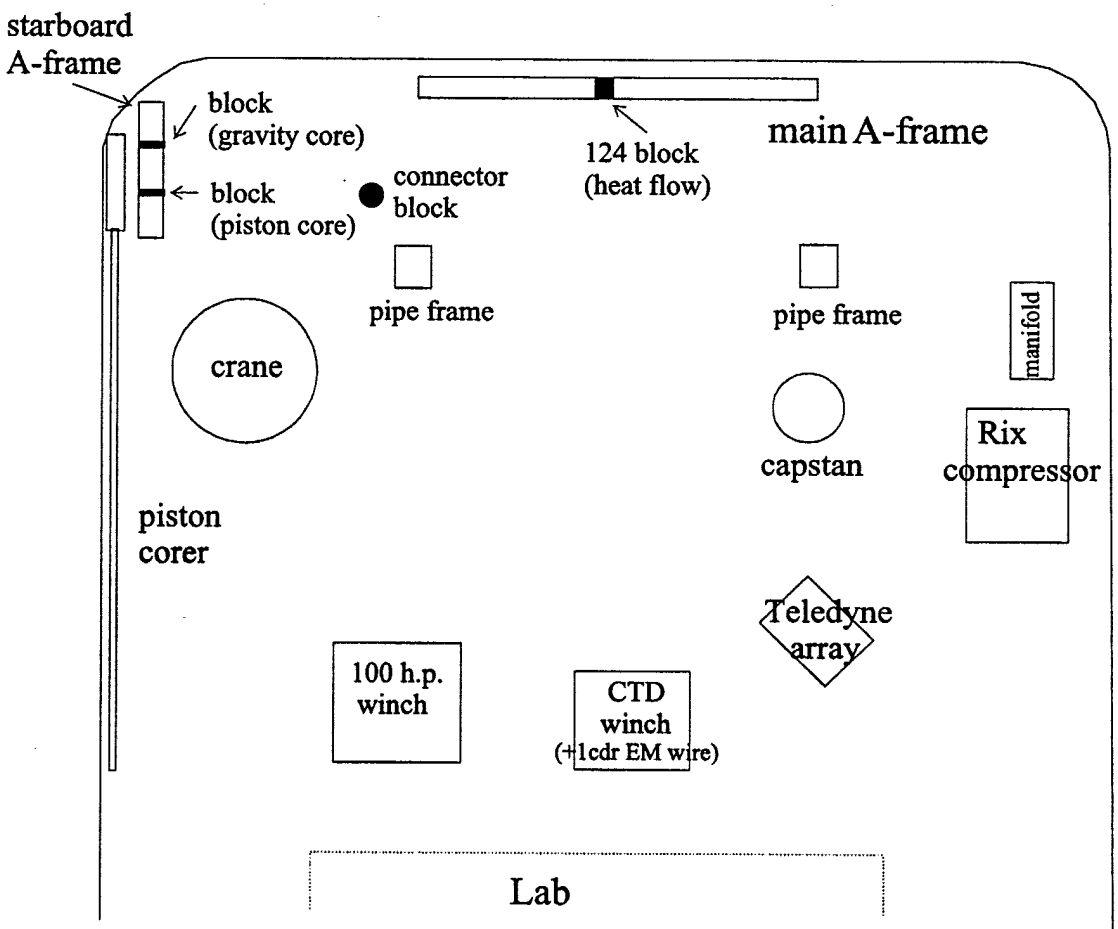


Fig. 17 Deck layout

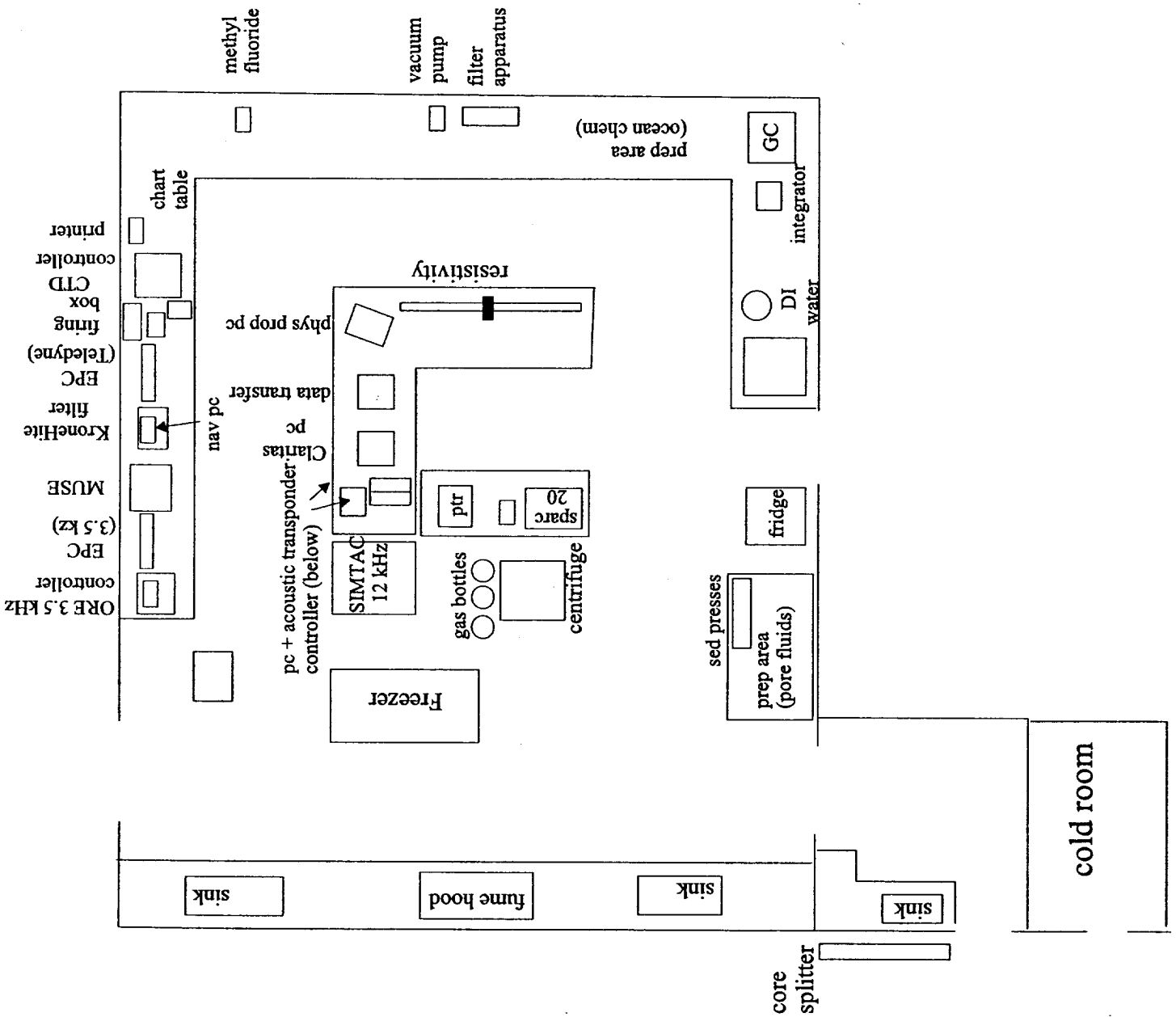
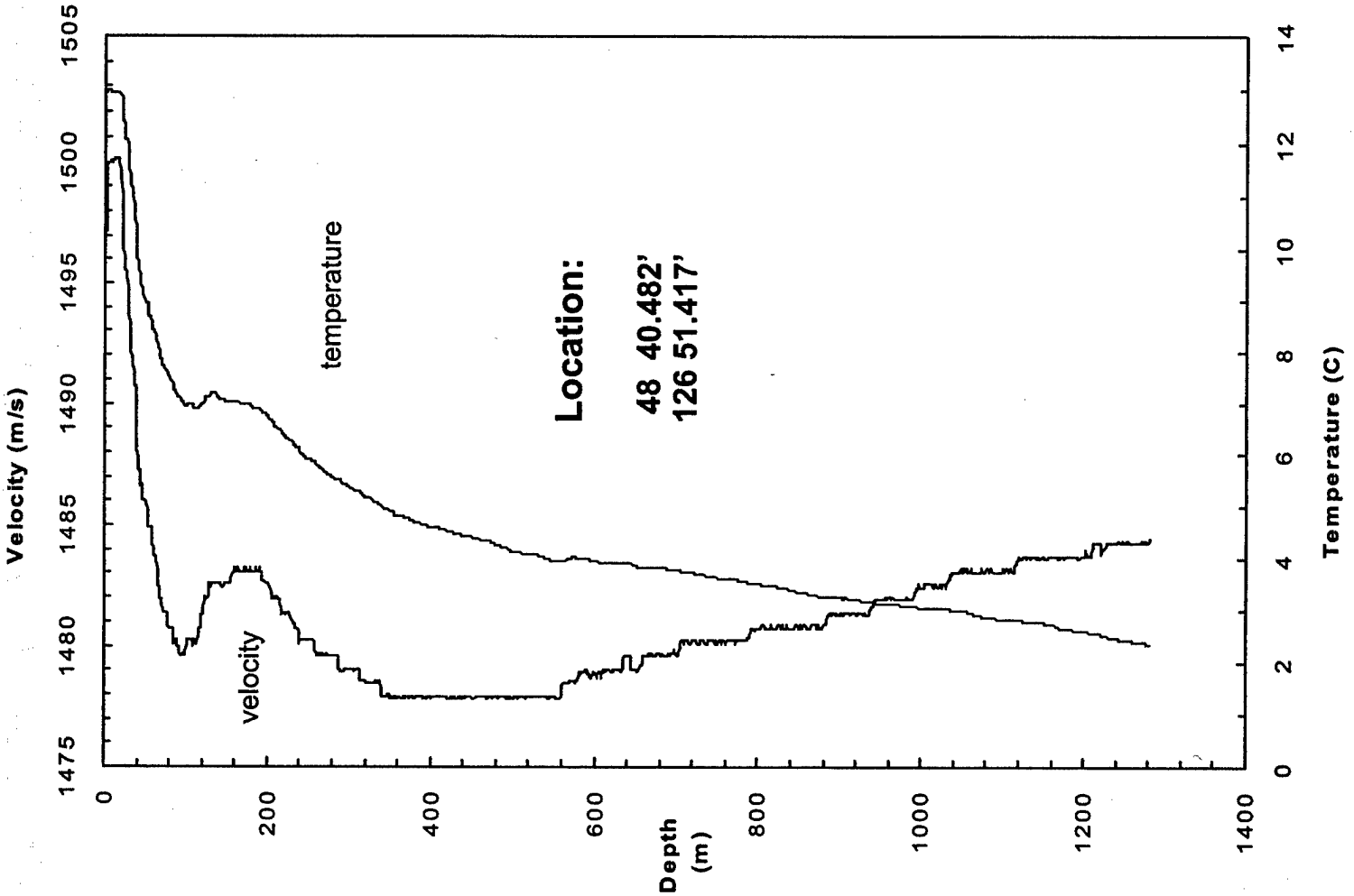


Figure 18. Laboratory Layout


Velocity (m/s)
1475
1480
1485
1490
1495
1500
1505
temperature
velocity
Location:
48 40.482'
126 51.417'
0
200
400
600
800
1000
1200
1400
Depth (m)
0
2
4
6
8
10
12
14
Temperature (C)

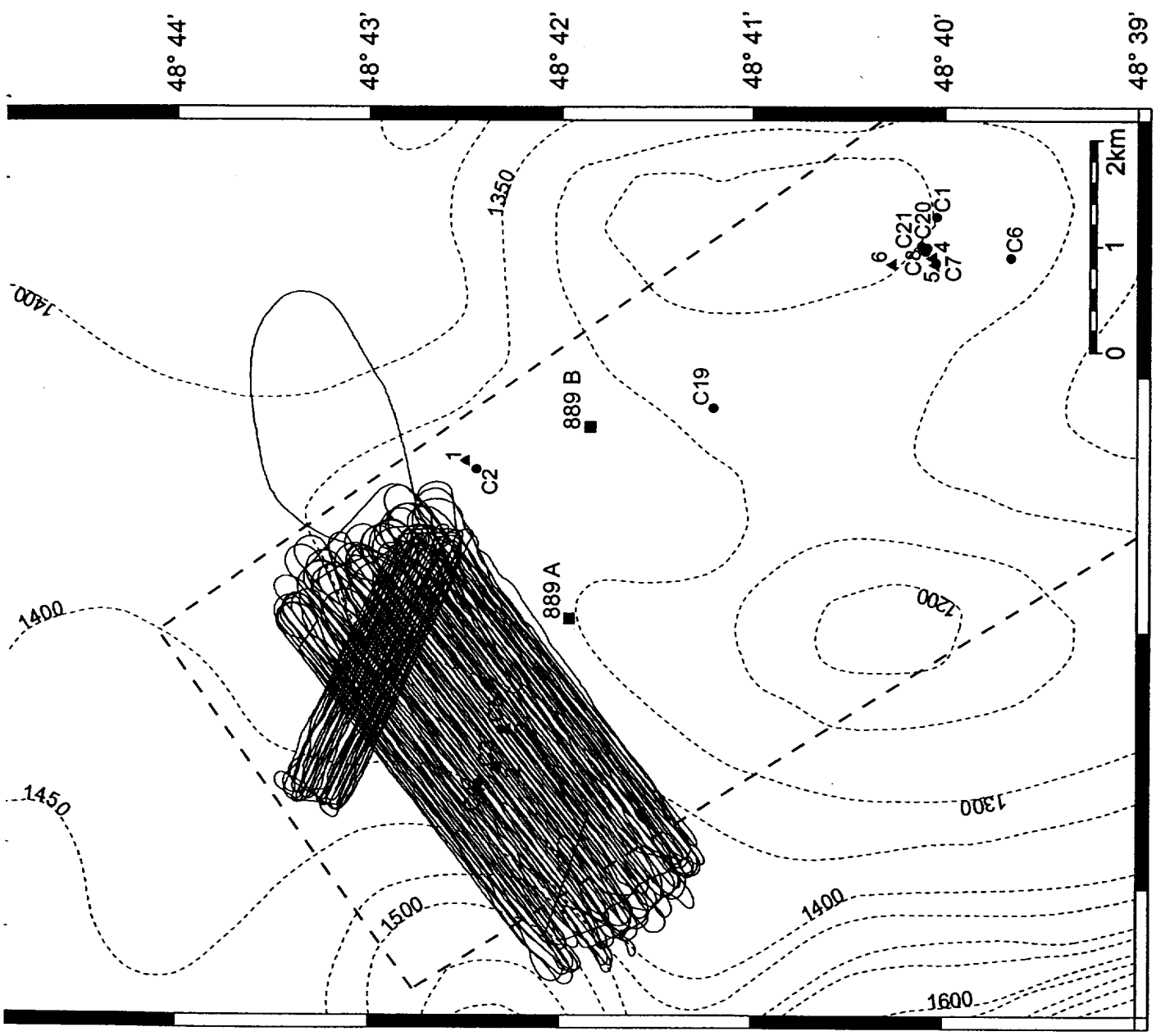


Figure 20. Seismic lines, piston core and CTD cast locations in the region of ODP site 889.

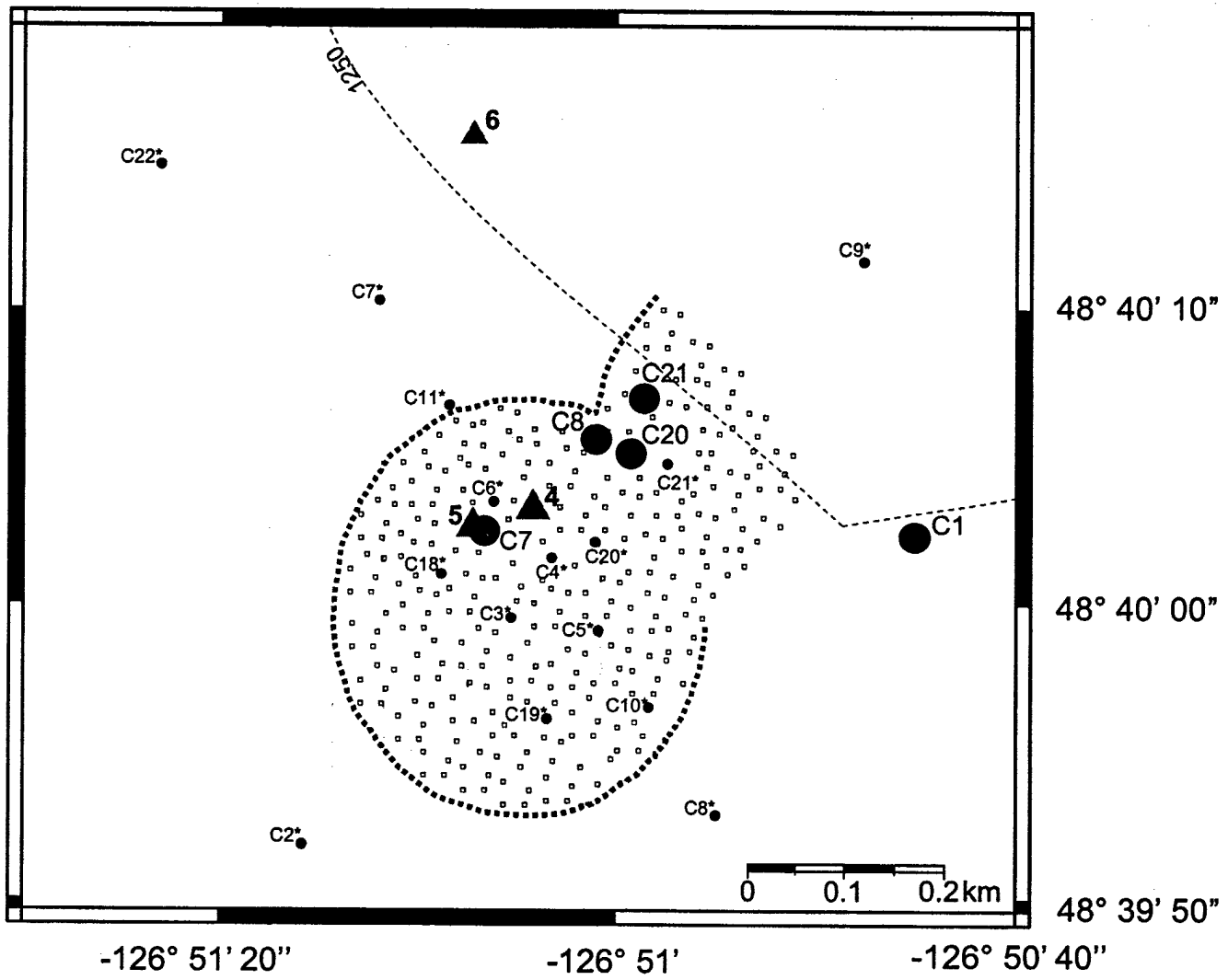


Figure 21. Piston core and CTD locations in the region of the bullseye vent site. Piston core locations are indicated by large solid circles. CTD casts are indicated by grey triangles. Small solid circles with an asterix are locations of cores recovered in 2000 during VentFlux cruise (PGC 00-02). Cores C7, C8 and C21 from 2001 contained hydrate samples, as well as cores C4*, C6*, C18* and C20* from 2000. The stippled region indicates the area of seismic blanking mapped with 1999 3D data (COAMS 99, cruise PGC 99-02).

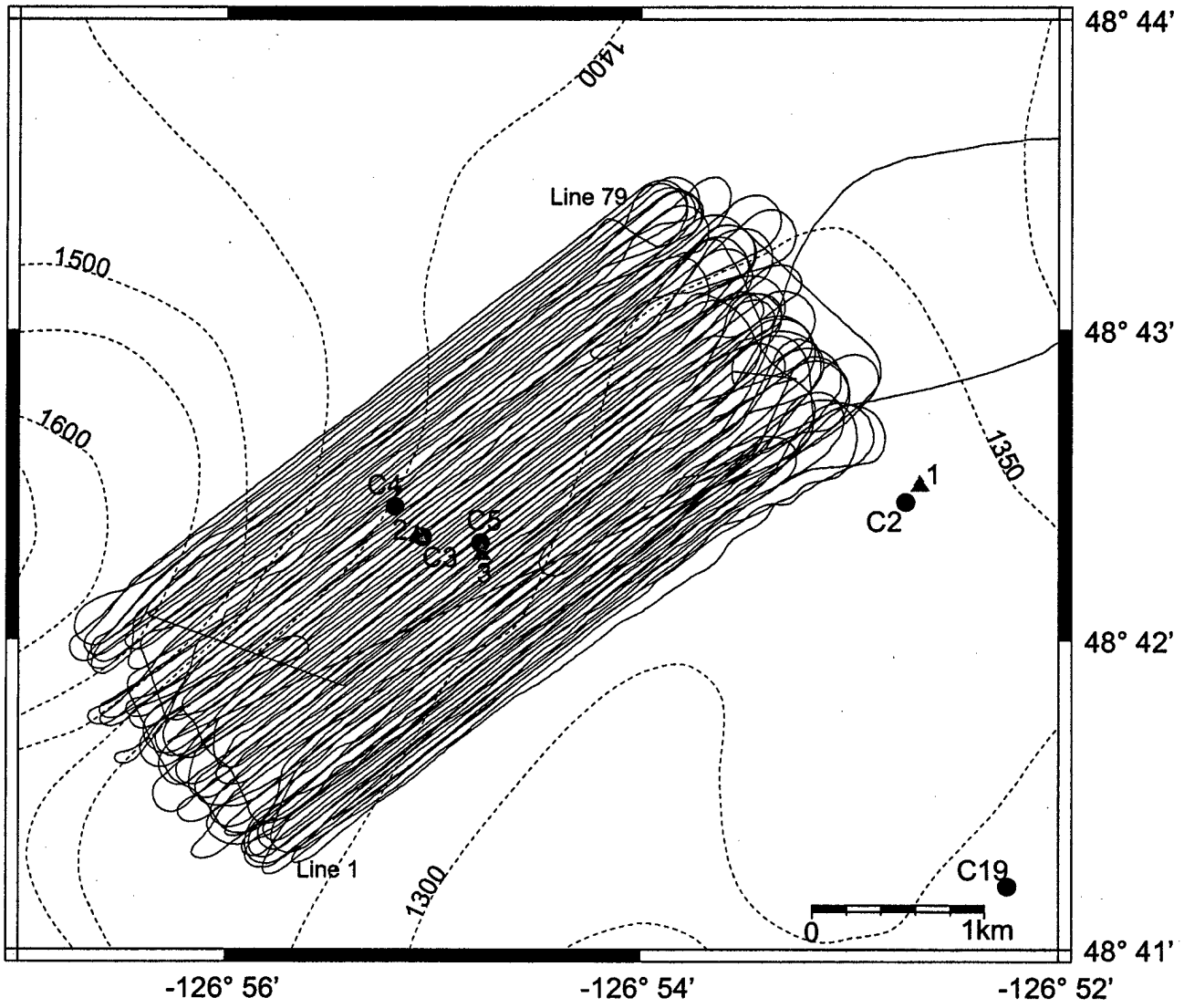


Figure 22. Seismic line locations at Cucumber Ridge. Line separation is 25 meters. Data were collected between July 27th and 31st (days 208-212), 2001. Abundant tube worm bushes, clam fields and carbonate rocks had been found on the ridge during a ROPOS dive in May 2001. Piston core locations are indicated by solid circles, CTD locations are indicated by grey triangles.