

Cascadia Initiative
Cruise W1110B_Leg2 R/V Wecoma
November 15, 2011 - November 30, 2011
Newport, Oregon to Newport, Oregon



John Collins, Woods Hole Oceanographic Institution, Emilie Hooft, University of Oregon

Table of Contents

Background	3
Cruise Objectives and Assessment	3
W1110B_Leg2 Science Party.....	5
W1110B_Leg2 Crew.....	6
Cruise Narrative	7
OBS Operations	15
Acknowledgements.....	26

Background

As part of the 2009 American Recovery and Reinvestment Act (ARRA) spending, NSF's Earth Sciences (EAR) and Ocean Sciences (OCE) divisions each received \$5M in facility-related investment. The funds are targeted toward Facilities that support EarthScope and MARGINS science objectives, with an initial emphasis on onshore/offshore studies of the Cascadia margin. The ARRA funds have been used by UNAVCO, IRIS, and OBSIP to improve seismic and geodetic datasets in the Cascadia region including improvements to real-time GPS capabilities, densification of the onshore seismic networks, and the construction and deployment of an array of 60 ocean-bottom seismographs (OBS) for offshore community experiments.

The Cascadia Initiative (CI) is an onshore/offshore seismic and geodetic experiment that addresses questions ranging from the structure of the megathrust and its potential for large earthquakes to volcanic arc structure, and to the formation, deformation and hydration of the Juan de Fuca and Gorda plates. An article in the GeoPRISMS Newsletter (Spring 2011, issue No. 26) described CI scientific objectives, the outcome of an open community workshop held in October 2010 to develop deployment plans for the offshore component of the experiment, and formation of the Cascadia Initiative Expedition Team (CIET). Over its planned 4-year data acquisition period, the offshore portion of the Cascadia Initiative will involve the deployment and recovery of ~280 OBSs at ~160 different sites and a total of about 14 cruises.

Cruise Objectives and Assessment

The primary cruise objective was to complete deployment of the community-designed, Year-1 Cascadia Initiative OBS array by deploying 25 OBS in a broad array extending from south of the Mendocino Fracture Zone, onto the Juan de Fuca plate, to the west of the Juan de Fuca Ridge, and north into Canadian waters. The OBS were provided by the NSF-funded U. S. National Ocean Bottom Seismograph Instrumentation Pool (OBSIP) and by WHOI. We succeeded in deploying 23 OBS (Figures 1 and 2, Table 5). Because of OBS mechanical problems, we were unable to deploy 2 instruments. The OBS will record continuously until their recovery in May 2012. The OBS will then be serviced and redeployed in late summer 2012.

Thirteen OBS carry intermediate-period seismometers, and were designed and built by WHOI for the Amphibious Array with funding from the American Recovery and Reinvestment Act (ARRA). These instruments are deployed in a ~70 km spaced grid extending west from the central Juan de Fuca plate onto the Pacific plate. Ten OBS, funded by the W.M. Keck Foundation, carry broadband seismometers and strong-motion accelerometers. All 23 OBS carry a Differential Pressure Gauge (DPG). Because of their broadband response, the Keck OBS were broadly distributed across the Juan de Fuca plate and its borders to provide a reference array. These reference sites will be occupied during each of the four years of the Cascadia Initiative.

W1110B_Leg2 Ship Track

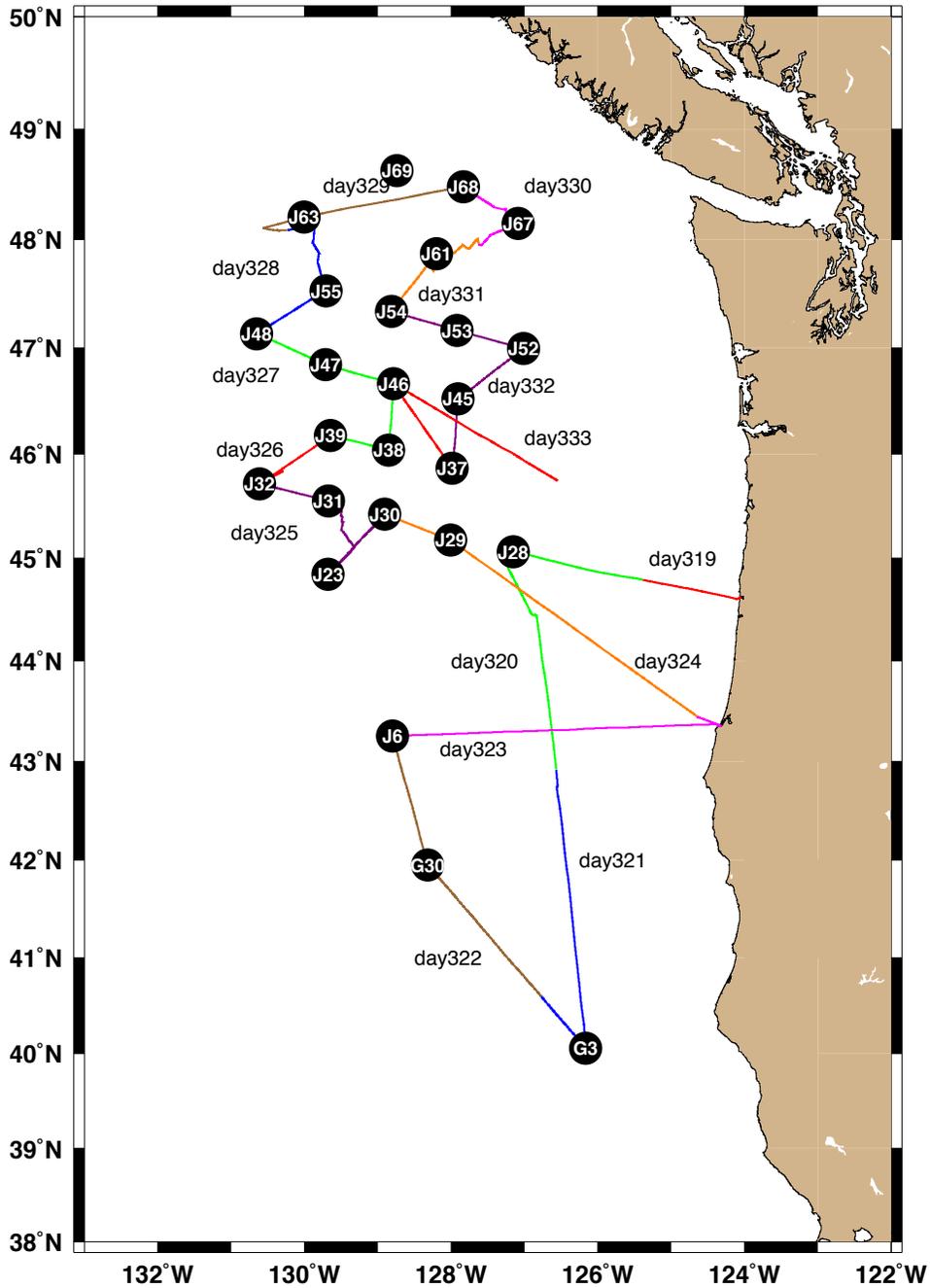


Figure 1. W1110B_Leg2 Cruise Track. Day numbers show day-of-year 2011 (UTC). Black circles and associated numbers show location and names of planned OBS sites. Because of mechanical problems, OBS were not deployed at sites J32 and J69. Cruise commenced on day 319. Ship sailed into Coos Bay, OR on day 324 to disembark one member of the ship's crew and two members of the scientific party. Cruise ended on day 334 (2011-11-30), but navigation data are not available from 19:00 UTC on day 333.

W110B_Leg2 Science Party

John Collins	Chief Scientist	Woods Hole Oceanographic Institution
Emilie Hooft	Chief Scientist	University of Oregon, Eugene
Alan Gardner	OBS Engineer	Woods Hole Oceanographic Institution
Matthew Gould	OBS Technician	Woods Hole Oceanographic Institution
Tim Kane	OBS Technician	Woods Hole Oceanographic Institution
Dan Kot	OBS Technician	Woods Hole Oceanographic Institution
Joseph Byrnes*	Graduate Student	University of Oregon, Eugene
Mathew Chamberlain*	Undergraduate Student	Northeastern University, Boston
David O' Gorman	Marine Technician	Oregon State University

*Disembarked Charleston Harbor, Coos Bay, OR on November 19

W1110B_Leg2 Wecoma Crew

Jeff Crews	Master
Bob Ashley	Chief Engineer
Tony Monocandilos	First Mate
Patrick Breshears	Second Mate
Jay JeanBart	Engineer
Henry "Chip" Millard	Engineer
Doug Beck	Bos'n
Doug Andrews	AB
Marc Simpson	AB
Dave Cowan*	Cook
Kody Robinson**	Cook
John Vanderbeck	Steward

*Disembarked Charleston Harbor, Coos Bay, OR on November 19

*Embarked Charleston Harbor, Coos Bay, OR on November 19

Cruise Narrative

Monday, November 14. Clearance to deploy OBS in Canadian waters arrived in late morning. After lunch, short science meeting on bridge with Captain Jeff Crews, First Mate Tony Monocandilos, Second Mate Patrick Breshears, Marine Technician David O' Gorman, and OSU Marine Superintendent Demian Bailey. Went over deployment plan and deck operations. Agreed to a request from Zen Kurokawa (OSU) to recover a glider of Jack Barth's. This necessitates a change in deployment plan. We had planned to deploy our southernmost station, G30, first. Now we will deploy station J28 first and then recover the glider at first light on Wed.

Tuesday, November 15. Depart Newport 10:50 PST after a fire and safety drill. All science personnel confined inside as we cross the bar.

Station J28

On Station:	11/16/2011 07:50 UTC (11/15/2011 23:50 PST)
OBS Type:	Keck
Deploy Time:	11/16/2011 07:58 UTC
Deployed Position:	45° 03.764' N, 127° 09.325' W
Water Depth:	2884 m
OBS on Seafloor:	11/16/2011 09:13 UTC
OBS Fall Speed:	39 m/min
Start Acoustic Survey:	11/16/2011 09:22 UTC
Disable Acoustic Release:	11/16/2011 10:36 UTC
Time on Station:	3 hrs. 46 min.

Wednesday, November 16 (PST)

OSU Glider Recovery

Time Recovered:	11/16/2011 15:49 UTC (11/16/2011 07:49 PST)
Position Recovered:	44° 26.895' N, 126° 51.033' W

Thursday, November 17 (PST)

Station G03

On Station:	11/17/2011 16:18 UTC (11/17/2011 08:18 PST)
OBS Type:	Keck
Deploy Time:	11/17/2011 16:31 UTC
Deployed Position:	40° 03.449' N, 126° 09.823' W
Water Depth:	4069 m
OBS on Seafloor:	11/17/2011 18:14 UTC
OBS Fall Speed:	40 m/min
Start Acoustic Survey:	11/17/2011 18:17 UTC
Disable Acoustic Release:	11/17/2011 20:12 UTC
CTD Cast #:	001
CTD Max. Depth:	1001 m
Time on Station:	3 hrs. 54 min.

Friday, November 18 (PST)

Station G30

On Station: 11/18/2011 11:32 UTC (11/18/2011 03:32 PST)
OBS Type: Keck
Deploy Time: 11/18/2011 12:29 UTC
Deployed Position: 41° 57.194' N, 128° 19.125' W
Water Depth: 3131 m
OBS on Seafloor: 11/18/2011 13:48 UTC
OBS Fall Speed: 40 m/min
Start Acoustic Survey: 11/18/2011 13:51 UTC
Disable Acoustic Release: 11/18/2011 15:07 UTC
Time on Station: 3 hrs. 35 min.

Station J06

On Station: 11/18/2011 23:37 UTC (11/18/2011 15:37 PST)
OBS Type: Keck
Deploy Time: 11/19/2011 01:14 UTC
Deployed Position: 43° 15.085' N, 128° 47.970' W
Water Depth: 3247 m
OBS on Seafloor: 11/19/2011 02:34 UTC
OBS Fall Speed: 40 m/min
Start Acoustic Survey: 11/19/2011 02:43 UTC
Disable Acoustic Release: 11/19/2011 04:00 UTC
Time on Station: 4 hrs. 23 min.

Saturday, November 19 (PST)

Coos Bay Diversion

Steam to Coos Bay, Oregon to disembark cook David Cowan and students Joe Byrnes and Mat Chamberlain, and embark cook Kody Robinson.

Arrive Coos Bay 11/19/2011 21:30 UTC (11/19/2011 13:30 PST)
Depart Coos Bay 11/19/2011 22:30 UTC (11/19/2011 14:30 PST)

Sunday, November 20 (PST)

Station J29

On Station: 11/20/2011 14:52 UTC (11/20/2011 06:52 PST)
OBS Type: ARRA
Deploy Time: 11/20/2011 15:53 UTC
Deployed Position: 45° 10.496' N, 128° 00.470' W
Water Depth: 2851 m
OBS on Seafloor: 11/20/2011 16:42 UTC
OBS Fall Speed: 58 m/min
Start Acoustic Survey: 11/20/2011 16:44 UTC
Disable Acoustic Release: 11/20/2011 18:06 UTC
Time on Station: 3 hrs. 14 min.

Station J30

On Station: 11/20/2011 21:40 UTC (11/20/2011 13:40 PST)
OBS Type: ARRA
Deploy Time: 11/20/2011 21:50 UTC
Deployed Position: 45° 25.464' N, 128° 54.462' W
Water Depth: 2814 m
OBS on Seafloor: 11/20/2011 22:41 UTC
OBS Fall Speed: 55 m/min
Start Acoustic Survey: 11/20/2011 22:42 UTC
Disable Acoustic Release: 11/20/2011 23:58 UTC
Time on Station: 2 hrs. 18 min.

Station J23

On Station: 11/21/2011 05:17 UTC (11/20/2011 21:17 PST)
OBS Type: Keck
Deploy Time: 11/21/2011 05:57 UTC
Deployed Position: 44° 50.693' N, 129° 40.971' W
Water Depth: 2697 m
OBS on Seafloor: 11/21/2011 07:05 UTC
OBS Fall Speed: 40 m/min
Start Acoustic Survey: 11/21/2011 07:08 UTC
Disable Acoustic Release: 11/21/2011 08:24 UTC
Time on Station: 3 hrs. 7 min.

Monday, November 21 (PST)

Station J31

On Station: 11/21/2011 15:30 UTC (11/21/2011 07:30 PST)
OBS Type: ARRA
Deploy Time: 11/21/2011 16:29 UTC
Deployed Position: 45° 33.155' N, 129° 40.360' W
Water Depth: 2654 m
OBS on Seafloor: 11/21/2011 17:15 UTC
OBS Fall Speed: 58 m/min
Start Acoustic Survey: 11/21/2011 17:23 UTC
Disable Acoustic Release: 11/21/2011 18:45 UTC
Time on Station: 3 hrs. 15 min.

Tuesday, November 22 (PST)

Station J32

On Station: 11/22/2011 14:07 UTC (11/22/2011 06:07 PST)
OBS Type: ARRA
No OBS deployed. Two anchors lost.

Station J39

On Station: 11/22/2011 22:29 UTC (11/22/2011 14:29 PST)

OBS Type: ARRA
Deploy Time: 11/22/2011 23:00 UTC
Deployed Position: 46° 10.638' N, 129° 38.719' W
Water Depth: 2686 m
OBS on Seafloor: 11/22/2011 23:49 UTC
OBS Fall Speed: 55 m/min
Start Acoustic Survey: 11/23/2011 00:06 UTC
Disable Acoustic Release: 11/23/2011 01:08 UTC
CTD Cast #: 002
CTD Max. Depth: 500 m
Time on Station: 2 hrs. 39 min.

Station J38

On Station: 11/23/2011 04:15 UTC (11/22/2011 20:15 PST)
OBS Type: ARRA
Deploy Time: 11/23/2011 04:55 UTC
Deployed Position: 46° 02.300' N, 128° 51.204' W
Water Depth: 2763 m
OBS on Seafloor: 11/23/2011 05:44 UTC
OBS Fall Speed: 56 m/min
Start Acoustic Survey: 11/23/2011 05:45 UTC
Disable Acoustic Release: 11/23/2011 07:01 UTC
Time on Station: 2 hrs. 46 min.

Wednesday, November 23 (PST)

Station J46

On Station: 11/23/2011 10:19 UTC (11/23/2011 02:19 PST)
OBS Type: Keck
Deploy Time: 11/23/2011 10:35 UTC
Deployed Position: 46° 39.837' N, 128° 47.252' W
Water Depth: 2767 m
OBS on Seafloor: 11/23/2011 11:44 UTC
OBS Fall Speed: 40 m/min
No Acoustic Survey: No survey. Move to next station before weather window closes.
Acoustic survey completed on Nov 28.
Time on Station: 1 hr. 25 min.

Station J47

On Station: 11/23/2011 15:41 UTC (11/23/2011 07:41 PST)
OBS Type: ARRA
Deploy Time: 11/23/2011 16:12 UTC
Deployed Position: 46° 50.538' N, 129° 42.735' W
Water Depth: 2709 m
OBS on Seafloor: 11/23/2011 17:01 UTC
OBS Fall Speed: 55 m/min
Start Acoustic Survey: 11/23/2011 17:03 UTC
Disable Acoustic Release: 11/23/2011 18:19 UTC
Time on Station: 2 hrs. 38 min.

Station J48

On Station: 11/23/2011 22:02 UTC (11/23/2011 14:02 PST)
OBS Type: Keck
Deploy Time: 11/23/2011 22:47 UTC
Deployed Position: 47° 07.900' N, 130° 39.154' W
Water Depth: 2980 m
OBS on Seafloor: 11/24/2011 00:00 UTC
OBS Fall Speed: 40 m/min
No Acoustic Survey: No survey. Move to next station before weather window closes.
Time on Station: 1 hr. 58 min.

Station J55

On Station: 11/24/2011 03:57 UTC (11/23/2011 19:57 PST)
OBS Type: ARRA
Deploy Time: 11/24/2011 04:38 UTC
Deployed Position: 47° 31.760' N, 129° 42.414' W
Water Depth: 2787 m
OBS on Seafloor: 11/24/2011 05:29 UTC
OBS Fall Speed: 54 m/min
Start Acoustic Survey: 11/24/2011 05:31 UTC
Disable Acoustic Release: 11/24/2011 06:49 UTC
Time on Station: 2 hrs. 52 min.

Thursday, November 24 (PST) Thanksgiving Day.

Severe Storm. Winds gusting to greater than 70 knots. Sea state 10.

Friday, November 25 (PST)

Station J63

On Station: 11/25/2011 11:17 UTC (11/25/2011 03:17 PST)
OBS Type: Keck
Deploy Time: 11/25/2011 13:04 UTC
Deployed Position: 48° 12.366' N, 130° 00.186' W
Water Depth: 2876 m
OBS on Seafloor: 11/25/2011 14:14 UTC
OBS Fall Speed: 41 m/min
Start Acoustic Survey: 11/25/2011 14:25 UTC
Disable Acoustic Release: 11/25/2011 15:39 UTC
CTD Cast #: 003
CTD Max. Depth: 1000 m
Time on Station: 4 hrs. 22 min.

Station J68

On Station: 11/25/2011 23:24 UTC (11/25/2011 15:24 PST)
OBS Type: Keck
Deploy Time: 11/26/2011 00:05 UTC
Deployed Position: 48° 29.011' N, 127° 49.826' W

Water Depth: 2579 m
OBS on Seafloor: 11/26/2011 01:09 UTC
OBS Fall Speed: 40 m/min
Start Acoustic Survey: 11/26/2011 01:11 UTC
Disable Acoustic Release: 11/26/2011 02:17 UTC
Time on Station: 2 hrs. 55 min.

Saturday, November 26 (PST)

Station J67

On Station: 11/26/2011 16:23 UTC (11/26/2011 08:23 PST)
OBS Type: ARRA
Deploy Time: 11/26/2011 17:05 UTC
Deployed Position: 48° 08.855' N, 127° 05.082' W
Water Depth: 2609 m
OBS on Seafloor: 11/26/2011 17:51 UTC
OBS Fall Speed: 57 m/min
Start Acoustic Survey: 11/26/2011 18:39 UTC
Disable Acoustic Release: 11/26/2011 19:56 UTC
CTD Cast #: 004
CTD Max. Depth: 1001 m
Time on Station: 3 hrs. 33 min.

Sunday, November 27 (PST)

Station J61

On Station: 11/27/2011 17:00 UTC (11/27/2011 09:00 PST)
OBS Type: ARRA
Deploy Time: 11/27/2011 17:19:43 UTC
Deployed Position: 47° 52.324' N, 128° 11.871' W
Water Depth: 2673 m
OBS on Seafloor: 11/27/2011 18:07 UTC
OBS Fall Speed: 57 m/min
Start Acoustic Survey: 11/27/2011 18:08 UTC
Disable Acoustic Release: 11/27/2011 19:22 UTC
Time on Station: 2 hrs. 22 min.

Station J54

On Station: 11/27/2011 22:55 UTC (11/27/2011 14:55 PST)
OBS Type: ARRA
Deploy Time: 11/27/2011 23:31 UTC
Deployed Position: 47° 20.187' N, 128° 48.649' W
Water Depth: 2662 m
OBS on Seafloor: 11/28/2011 00:18 UTC
OBS Fall Speed: 54 m/min
Start Acoustic Survey: 11/28/2011 00:22 UTC
Disable Acoustic Release: 11/28/2011 01:36 UTC
Time on Station: 2 hrs. 41 min.

Station J53

On Station: 11/28/2011 04:43 UTC (11/27/2011 20:43 PST)
OBS Type: Keck
Deploy Time: 11/28/2011 05:23 UTC
Deployed Position: 47° 09.811' N, 127° 55.334' W
Water Depth: 2714 m
OBS on Seafloor: 11/28/2011 06:31 UTC
OBS Fall Speed: 40 m/min
Start Acoustic Survey: 11/28/2011 06:33 UTC
Disable Acoustic Release: 11/28/2011 07:51 UTC
CTD Cast #: 005
CTD Max. Depth: 1019 m
Time on Station: 3 hrs. 8 min.

Monday, November 28 (PST)

Station J52

On Station: 11/28/2011 10:56 UTC (11/28/2011 02:56 PST)
OBS Type: ARRA
Deploy Time: 11/28/2011 11:49 UTC
Deployed Position: 46° 59.526' N, 127° 00.933' W
Water Depth: 2634 m
OBS on Seafloor: 11/28/2011 12:36 UTC
OBS Fall Speed: 56 m/min
Start Acoustic Survey: 11/28/2011 12:39 UTC
Disable Acoustic Release: 11/28/2011 13:43 UTC
Time on Station: 2 hrs. 51 min.

Station J45

On Station: 11/28/2011 17:36 UTC (11/28/2011 09:36 PST)
OBS Type: ARRA
Deploy Time: 11/28/2011 18:09 UTC
Deployed Position: 46° 31.188' N, 127° 54.310' W
Water Depth: 2773 m
OBS on Seafloor: 11/28/2011 19:02 UTC
OBS Fall Speed: 52 m/min
Start Acoustic Survey: 11/28/2011 19:04 UTC
Disable Acoustic Release: 11/28/2011 20:19 UTC
Time on Station: 2 hrs. 43 min.

Station J37

On Station: 11/28/2011 23:57 UTC (11/28/2011 15:57 PST)
OBS Type: ARRA
Deploy Time: 11/29/2011 00:08 UTC
Deployed Position: 45° 51.898' N, 127° 59.110' W
Water Depth: 2884 m
OBS on Seafloor: 11/29/2011 00:59 UTC
OBS Fall Speed: 57 m/min
Start Acoustic Survey: 11/29/2011 01:05 UTC

Disable Acoustic Release: 11/29/2011 02:17 UTC
CTD Cast #: 006
CTD Max. Depth: 1000 m
Time on Station: 2 hrs. 20 min.

Station J46

On Station: 11/29/2011 07:18 UTC (11/27/2011 14:55 PST)
Start Acoustic Survey: 11/29/2011 07:24 UTC
Disable Acoustic Release: 11/29/2011 08:47 UTC
Time on Station: 1 hr. 29 min.

Wednesday, November 30 (PST)

Carried out a visual inspection of OSU mooring NH-10 that had apparently dragged its anchor ~10 nm north of its deployed position during the Thanksgiving Day storm. Initial two attempts to cross the bar were aborted on the advice/instructions of the U.S. Coast Guard. Lots of white water across the channel entrance. Eventually crossed at ~12:00 PST with the help of two USCG boats, one outside, and one inside sitting in the middle of the channel and acting as a visual marker. We came in between large wave sets. First line on dock ~12:40 PST.

OBS Operations

We deployed 23 OBS at sites extending from south of the Mendocino Fracture Zone, onto the Juan de Fuca plate, to the west of the Juan de Fuca Ridge, and north into Canadian waters (Figures 1–2). We had planned to deploy 25 OBS, but because of mechanical issues we were unable to deploy OBS at stations J32 and J69.

Of the 23 OBS deployed, 13 were of a new WHOI design, the construction of which was funded through the American Recovery and Reinvestment Act (ARRA). The WHOI-designed ARRA OBS (Figure 3, Table 1) carry a Trillium Compact intermediate-period seismometer and a Cox-Deaton-Webb Differential Pressure Gauge (DPG). The Quanterra Q330 datalogger and Quanterra Baler-44 storage device are housed in a short aluminum (7075) pressure housing, while a smaller diameter but longer aluminum cylinder holds the lithium battery pack. The ARRA OBS carry a new chip-scale atomic clock (CSAC) manufactured by Symmetricom that we anticipate will provide more accurate timing than the Seascan timebase used on our other OBS. Floatation is provided by a syntactic foam pack. For this deployment, the seismometer channels are recorded at 50 Hz and 1 Hz, and the DPG is recorded at 40 Hz and 1 Hz (Table 3). The remaining 10 OBS were funded by the W.M. Keck Foundation (Figure 3, Table 2), and carry a Guralp CMG-3T broadband seismometer, a Kinometrics Episensor strong-motion accelerometer, and a DPG. Timing on the Keck OBS is provided by a Seascan timebase. For this deployment, the seismometer and accelerometer channels are recorded at 50 Hz and 1 Hz, and the DPG is recorded at 40 Hz and 1 Hz (Table 3).

All of the OBS were deployed off the starboard side using the Wecoma's Morgan knuckle-boom crane. Because of extensive periods of bad weather (Figure 4), little of no work could be done between stations, and final OBS preparation and electronics check-out took place when we were on site. The OBS were tracked acoustically as they fell to the seafloor, and then their on-bottom location determined in the usual manner by ranging to the instrument from a number of locations at varying ranges and azimuths (Table 4). We used the ship's hull-mounted 12 kHz transducer for all acoustic communication other than on-deck testing. The Wecoma's acoustics were excellent even in heavy weather. Mean descent rates for the ARRA and Keck OBS were 55 ± 1.5 m/minute and 40 ± 0.7 m/minute, respectively.

The surveyed OBS locations are listed in Table 5. These locations were determined using a linear least-squares technique, and assume an iso-velocity ocean (Table 4). Forward modeling through the observed sound-velocity profiles suggests that the error associated with using a single "sounding velocity" to represent the actual vertically-varying sound-velocity profile is substantially smaller than 1 ms at the short horizontal ranges ($\leq 0.5 \cdot$ water depth) over which the travel time measurement were made. This error is less than the precision of the measured travel times (~ 1 -2 ms). The formal errors from the least squares procedure (Table 4) are modest. However, the inversion does not account for a variety of possible errors. The station depth is very sensitive to the ocean sound speed profile, which was measured in 5 locations only (Table 6), and to a maximum depth of 1,000 m. The sound speed at depth was inferred from the Levitus database. Another unaccounted source of error is brought about by the fact that the ship was typically steaming at 4-5 knots during the survey.

The OBS deployment locations were shifted relative to the planned pre-cruise locations (Table 7) in order to ensure the OBS were deployed at sites with multibeam bathymetry coverage. For four stations, the location shifts exceeded 15 km. One station was deployed in Canadian territorial waters. In the Canadian clearance, received November 14, we were asked (see below) to move station J67 by approximately 10 nautical miles. We complied with this request.

Upon review of the marine scientific research request by the U.S. Marine Scientific Research Vessel R.V. WECOMA we have concerns with the J67 site. We would ask that the applicants be made aware that there has been some limited commercial fishing around the J67 site. This fishing was conducted by sablefish trap fishing vessels and a bottom trawl vessel in the vicinity of the planned deployment position. We suggest moving this deployment position by approximately 10 nautical miles to 48 degrees 08 minutes 50 second N 127 degrees 05 minutes 05 seconds W to an area that has not been subject to fishing activity in the past decade. In addition, it could be pointed out that the J67 position is within an area identified on Canadian Nautical charts 3001 as one with explosives/chemicals. Deployment to the position set out above would avoid that zone.

Table 1. ARRA OBS Configuration

Site Number	OBS I.D.	Nanometrics Trillium Compact S/N	DPG S/N	DPG Version	Q330 Tag I.D.	Q330 Firmware Vers.	Baler Tag I.D.	Baler Firmware Version	CSAC S/N	Edgetech Acoustic Release Board	Int./Repl. (kHz)	Novatech VHF Radio S/N	Radio Frequency (MHz)
J29	T102	3002	60	old	4513	1.142	16500	BALER44-20091229-16K	1103CS00255	35731	11/13	u03-075	154.585
J30	T106	3020	042	6.0	4517	1.142	16502	BALER44-20091229-16K	1102CS00239	35745	11/13	u03-087	160.725
J31	T105	3023	004	6.2	4516	1.142	16501	BALER44-20091229-16K	1104CS00379	35747	11/13	v10-092	159.480
J37	T109	3029	44	old	4520	1.142	16504	BALER44-20091229-16K	1104CS00362	35733	11/13	y05-011	154.585
J38	T114	3021	005	6.2	4525	1.142	17061	BALER44-20091229-16K	1102CS00227	35734	11/13	u03-076	154.585
J39	T101	3022	43	old	4512	1.142	16503	BALER44-20091229-16K	1103CS00300	35744	11/13	u03-073	154.585
J45	T111	3024	005	6.0	2024	1.142	16286	BALER44-20091229-16K	1106CS00594	35735	11/13	v10-091	160.725
J47	T108	3001	012	6.2	4519	1.142	71951	BALER44-20091229-16K	1101CS00193	35748	11/13	u03-093	160.785
J52	T107	3018	56	old	4518	1.142	16499	BALER44-20091229-16K	1104CS00304	35740	11/13	u03-079	159.480
J54	T115	3007	41	old	4526	1.142	17063	BALER44-20091229-16K	1101CS00199	35736	11/13	v10-093	160.785
J55	T112	3008	002	6.0	4523	1.142	16497	BALER44-20091229-16K	1104CS00372	35739	11/13	v10-082	154.585
J61	T113	3027	6004	6.3	4524	1.142	16511	BALER44-20091229-16K	1102CS00209	35732	11/13	u03-077	159.480
J67	T104	3004	45	old	4515	1.142	17062	BALER44-20091229-16K	1106CS00447	35738	11/13	v10-094	160.785

Table 2. Keck OBS Configuration

Site Number	OBS I.D.	Guralp CMG-3T S/N	DPG S/N	DPG Version	Kinematics Episensor Number	WHOI Episensor Board	Q330 Tag I.D.	Q330 Firmware Version	Baler Tag I.D.	Baler Firmware Version	QEP-1 Tag I.D.	EP-ADC-1 Tag I.D.	Seascan Timebase	Edgetech Acoustic Release Board #1	Int./Repl. (kHz)	Edgetech Acoustic Release Board #2	Int./Repl. (kHz)	Novatech VHF Radio S/N	Radio Frequency (MHz)
G03	S87	T33999	6014	6.3	2866	07	2015	1.142	06399	2.26	117273	116652	1213	31666	11/12	31663	11/12	U10-086	159.480
G30	S88	T34001	6006	6.3	2863	04	2016	1.142	06514	2.26	117271	116639	1217	31650	11/12	31661	11/13	U03-094	160.785
J06	S81	T3L03	6020	6.3	2864	08	2007	1.142	06393	2.26	117246	116635	0133	31665	11/12	31654	11/13	E03-082	160.725
J23	S80	T3K49	6023	6.3	2867	11	2190	1.142	06402	2.26	117270	116632	1223	31642	11/11.5	31653	11/12	V10-088	159.480
J28	S84	T3L68	6018	6.3	2865	02	2010	1.142	06396	2.26	117274	116625	1043	31646	11/12	31657	11/13	B10-087	159.480
J46	S86	T3J96	6003	6.3	2870	05	2012	1.142	06398	2.26	117269	116631	1050	31648	11/11.5	31659	11/12	Y05-013	154.585
J48	S85	T3G92	6005	6.3	2862	09	2011	1.142	06397	2.26	117268	116638	1044	31647	11/13	31658	11/12	V10-089	159.480
J53	S82	T3L01	6019	6.3	2797	01	2140	1.142	06394	2.26	117244	116637	1040	31644	11/13	31630	11/12	Y05-016	160.785
J63	S83	T3G33	6015	6.3	2836	03	2009	1.142	06395	2.26	117245	116636	0318	31645	11/11.5	31656	11/13	U03-074	154.585
J68	S89	T33993	6021	6.3	2868	10	2188	1.142	06401	2.26	117272	116634	1221	31651	11/11.5	31662	11/13	V10-085	159.480

Table 3. Sampling Rates for the OBS Deployed on W1110B_Leg2

OBS Type	Sensor	Sample Rates	SEED Channel Names
ARRA OBS	Trillium-Compact Seismometer	50 Hz, 1 Hz	BH?, LH?
	DPG	40 Hz, 1 Hz	BD?, LD?
Keck OBS	Guralp CMG-3T Seismometer	50 Hz, 1 Hz	BH?, LH?
	Kinometrics Episensor	50 Hz, 1 Hz	BN?, LN?
	DPG	40 Hz, 1 Hz	BD?, LD?

Table 4. OBS Acoustic Survey Results

Site Number	OBS I.D.	Drop Date (UTC)	Drop Time (UTC)	Launch Latitude (deg)	Launch Latitude (min)	Launch Latitude (hemi)	Launch Longitude (deg)	Launch Longitude (min)	Launch Longitude (hemi)	Water Depth at Launch Position (m)	Sounding Velocity from Levitus Data Base (m/s)	Sounding Velocity from CTD and Data Base (m/s)	Surface Transducer Depth (m)	Bottom Transducer Height (m)	Depth From Data Inversion (m)	Station Depth (m)	Station Depth at Inverted Coords from Multibeam (m)	Distance Shift (m)	Direction Shift (deg east of north)	Initial Misfit (ms)	Final Misfit (ms)	95% Confidence Half-Width in E/W (m)	95% Confidence Half-Width in N/S (m)	95% Confidence Half-Width in Depth (m)	
J28	S84	11/16/2011	07:58	45	03.764	N	127	09.325	W	2884	1486.9	1487.1	5.2	0.5	2853	2859	2867	121	322	24	1	1.6	1.8	0.4	
G03	S87	11/17/2011	16:30	40	03.449	N	126	09.823	W	4069	1495.2	1496.4	5.2	0.5	4052	4058	4113	206	29	33	1	1.1	1.2	0.3	
G30	S88	11/18/2011	12:29	41	57.194	N	128	19.125	W	3131	1488.8	1490.3	5.2	0.5	3109	3115	3124	203	347	28	1	1.9	1.7	0.5	
J06	S81	11/19/2011	01:14	43	15.085	N	128	47.970	W	3247	1489.4	1489.4	5.2	0.5	3218	3224	3224	123	274	24	1	1.6	1.6	0.4	
J29	T102	11/20/2011	15:53	45	10.496	N	128	00.470	W	2851	1486.6	1486.8	5.2	1.0	2821	2827	2849	96	335	20	1	1.4	1.4	0.4	
J30	T106	11/20/2011	21:50	45	25.464	N	128	54.462	W	2814	1486.3	1486.6	5.2	1.0	2785	2791	2824	64	112	16	1	1.5	1.3	0.4	
J23	S80	11/21/2011	05:57	44	50.693	N	129	40.971	W	2697	1485.6	1484.6	5.2	0.5	2643	2649	2655	100	164	30	1	1.3	1.5	0.4	
J31	T105	11/21/2011	16:29	45	33.155	N	129	40.360	W	2654	1485.2	1484.4	5.2	1.0	2618	2624	2657	56	355	24	1	1.3	1.3	0.3	
J39	T101	11/22/2011	23:00	46	10.638	N	129	38.719	W	2686	1485.3	1484.6	5.2	1.0	2647	2653	2659	170	146	25	1	1.3	1.4	0.3	
J38	T114	11/23/2011	04:55	46	02.300	N	128	51.204	W	2763	1485.8	1485.0	5.2	1.0	2727	2733	2734	135	10	26	1	1.2	1.2	0.3	
J46	S86	11/23/2011	10:35	46	39.837	N	128	47.252	W	2767	1485.8	1485.0	5.2	0.5	2735	2741	2744	62	266	20	1	1.4	1.4	0.4	
J47	T108	11/23/2011	16:12	46	50.538	N	129	42.735	W	2709	1485.2	1484.7	5.2	1.0	2673	2679	2685	143	319	26	1	1.5	1.5	0.4	
J48	S85	11/23/2011	22:47	47	07.900	N	130	39.154	W	2980	1486.8	No Survey	No Survey	No Survey	No Survey	No Survey	No Survey	No Survey	No Survey	No Survey	No Survey	No Survey	No Survey	No Survey	No Survey
J55	T112	11/24/2011	04:38	47	31.760	N	129	42.414	W	2787	1485.6	1486.0	5.2	1.0	2750	2756	2800	136	338	25	1	1.5	1.6	0.4	
J63	S83	11/25/2011	13:04	48	12.366	N	130	00.186	W	2876	1486.0	1486.6	5.2	0.5	2841	2847	2882	44	342	22	1	1.1	1.2	0.3	
J68	S89	11/26/2011	00:05	48	29.011	N	127	49.826	W	2579	1484.5	1484.8	5.2	0.5	2548	2554	2590	295	162	41	1	1.5	1.4	0.4	
J67	T104	11/26/2011	17:05	48	08.855	N	127	05.082	W	2609	1484.9	1485.0	5.2	1.0	2574	2580	2612	266	7	39	1	1.4	1.5	0.4	
J61	T113	11/27/2011	17:19:43	47	52.324	N	128	11.871	W	2673	1485.1	1485.9	5.2	1.0	2641	2647	2644	69	49	19	1	1.3	1.2	0.3	
J54	T115	11/27/2011	23:31	47	20.187	N	128	48.649	W	2662	1485.0	1485.8	5.2	1.0	2630	2636	2662	89	220	21	1	1.5	1.3	0.4	
J53	S82	11/28/2011	05:23	47	09.811	N	127	55.334	W	2714	1485.5	1486.1	5.2	0.5	2685	2691	2686	77	6	19	1	1.2	1.2	0.3	
J52	T107	11/28/2011	11:49	46	59.526	N	127	00.933	W	2634	1485.2	1485.7	5.2	1.0	2608	2614	2613	29	235	17	1	1.7	1.6	0.4	
J45	T111	11/28/2011	18:09	46	31.188	N	127	54.310	W	2773	1485.9	1486.5	5.2	1.0	2744	2750	2757	120	11	23	1	1.5	1.5	0.4	
J37	T109	11/29/2011	00:08	45	51.898	N	127	59.110	W	2884	1486.7	1487.1	5.2	1.0	2851	2857	2862	88	186	21	1	1.3	1.2	0.3	

Confidence Interval calculated assuming data error is 2 ms
 Delay in Acoustic Release Board is 13 ms.

Table 5. Final Station Locations

Site Number	OBS I.D.	Drop Date (UTC)	Drop Time (UTC)	Station Latitude (deg)	Station Latitude (min)	Station Latitude (hemi)	Station Longitude (deg)	Station Longitude (min)	Station Longitude (hemi)	Station Latitude (decimal degrees)	Station Longitude (decimal degrees)	Station Depth from Inversion (m)	Station Depth at Inverted Coords from Multibeam (m)
J28	S84	11/16/2011	07:58	45	3.8155	N	127	9.3823	W	45.063592	-127.156372	2859	2867
G03	S87	11/17/2011	16:30	40	3.546	N	126	9.7517	W	40.059100	-126.162528	4058	4113
G30	S88	11/18/2011	12:29	41	57.3008	N	128	19.1573	W	41.955013	-128.319288	3115	3124
J06	S81	11/19/2011	01:14	43	15.0891	N	128	48.0613	W	43.251485	-128.801022	3224	3224
J29	T102	11/20/2011	15:53	45	10.5429	N	128	0.5016	W	45.175715	-128.008360	2827	2849
J30	T106	11/20/2011	21:50	45	25.4509	N	128	54.4167	W	45.424182	-128.906945	2791	2824
J23	S80	11/21/2011	05:57	44	50.6412	N	129	40.9497	W	44.844020	-129.682495	2649	2655
J31	T105	11/21/2011	16:29	45	33.185	N	129	40.3638	W	45.553083	-129.672730	2624	2657
J39	T101	11/22/2011	23:00	46	10.5623	N	129	38.6449	W	46.176038	-129.644082	2653	2659
J38	T114	11/23/2011	04:55	46	2.3717	N	128	51.1865	W	46.039528	-128.853108	2733	2734
J46	S86	11/23/2011	10:35	46	39.8347	N	128	47.3006	W	46.663912	-128.788343	2741	2744
J47	T108	11/23/2011	16:12	46	50.5963	N	129	42.8088	W	46.843272	-129.713480	2679	2685
J48	S85	11/23/2011	22:47	47	07.900	N	130	39.154	W	47.131667	-130.652567	2980	2988
J55	T112	11/24/2011	04:38	47	31.8279	N	129	42.4542	W	47.530465	-129.707570	2756	2800
J63	S83	11/25/2011	13:04	48	12.3884	N	130	0.1971	W	48.206473	-130.003285	2847	2882
J68	S89	11/26/2011	00:05	48	28.8602	N	127	49.7502	W	48.481003	-127.829170	2554	2590
J67	T104	11/26/2011	17:05	48	8.9975	N	127	5.054	W	48.149958	-127.084233	2580	2612
J61	T113	11/27/2011	17:19:43	47	52.3485	N	128	11.8294	W	47.872475	-128.197157	2647	2644
J54	T115	11/27/2011	23:31	47	20.1501	N	128	48.6948	W	47.335835	-128.811580	2636	2662
J53	S82	11/28/2011	05:23	47	9.8524	N	127	55.3279	W	47.164207	-127.922132	2691	2686
J52	T107	11/28/2011	11:49	46	59.517	N	127	0.9516	W	46.991950	-127.015860	2614	2613
J45	T111	11/28/2011	18:09	46	31.2515	N	127	54.2927	W	46.520858	-127.904878	2750	2757
J37	T109	11/29/2011	00:08	45	51.8509	N	127	59.1166	W	45.864182	-127.985277	2857	2862

J48 Not Surveyed on Deployment Leg

Table 6. CTD Locations and Depths

CTD Number	Station Name	Deployment Date (UTC)	Deployment Time (UTC)	CTD Station Latitude (deg)	CTD Station Latitude (min)	CTD Station Latitude (hemi)	CTD Station Longitude (deg)	CTD Station Longitude (min)	CTD Station Longitude (hemi)	CTD Station Latitude (decimal degrees)	CTD Station Longitude (decimal degrees)	CTD Max Depth (m)	Filename
001	G03	11/17/2011	16:51	40	3.458	N	126	9.815	W	40.05763	-126.16358	1001	cast001-bin_averaged_final.cnv
002	J39	11/22/2011	23:32	46	10.618	N	129	38.850	W	46.17697	-129.64750	500	cast002-bin_averaged_final.cnv
003	J63	11/25/2011	13:44	48	12.367	N	130	0.221	W	48.20612	-130.00368	1000	cast003-bin_averaged_final.cnv
004	J67	11/26/2011	17:47	48	8.871	N	127	5.078	W	48.14785	-127.08463	1001	cast004-bin_averaged_final.cnv
005	J53	11/28/2011	05:40	47	9.806	N	127	55.362	W	47.16343	-127.92270	1019	cast005-bin_averaged_final.cnv
006	J37	11/29/2011	00:21	45	52.016	N	127	59.012	W	45.86693	-127.98353	1000	cast006-bin_averaged_final.cnv

Table 7. Station Location Shifts Relative to Pre-Cruise Plans

Site Name	Planned Deployment Site Latitude (decimal degrees)	Planned Deployment Site Longitude (decimal degrees)	Water Depth at Planned Deployment Site (m)	Station Latitude (decimal degrees)	Station Longitude (decimal degrees)	Station Depth from Inversion (m)	Station Depth at Inverted Coords from Multibeam (m)	Distance Shift (km)	Direction Shift (deg. east of north)
G03	40.05770	-126.11590	4020	40.059100	-126.162528	4058	4113	4.0	272
G30	41.93230	-128.53930	3276	41.955013	-128.319288	3115	3124	18.4	82
J06	43.41040	-128.79580	3222	43.251485	-128.801022	3224	3224	17.7	181
J23	44.88680	-129.65100	2654	44.844020	-129.682495	2649	2655	5.4	208
J32	45.71360	-130.59460	2766	N.D.	N.D.	N.D.	N.D.	N/A	N/A
J31	45.55350	-129.72790	2360	45.553083	-129.672730	2624	2657	4.3	91
J30	45.38670	-128.86550	2839	45.424182	-128.906945	2791	2824	5.3	322
J29	45.21340	-128.00780	2808	45.175715	-128.008360	2827	2849	4.2	181
J28	45.03350	-127.15520	2865	45.063592	-127.156372	2859	2867	3.4	358
J37	45.86490	-127.98570	2858	45.864182	-127.985277	2857	2862	0.1	158
J38	46.03820	-128.85330	2776	46.039528	-128.853108	2733	2734	0.2	6
J39	46.20480	-129.72560	2179	46.176038	-129.644082	2653	2659	7.0	117
J48	47.00570	-130.55730	2913	47.131667	-130.652567	2980	2988	15.8	333
J47	46.84590	-129.67040	2685	46.843272	-129.713480	2679	2685	3.3	265
J46	46.67920	-128.78820	2751	46.663912	-128.788343	2741	2744	1.7	180
J45	46.50560	-127.91090	2747	46.520858	-127.904878	2750	2757	1.8	15
J52	46.98330	-127.04040	2620	46.991950	-127.015860	2614	2613	2.1	63
J53	47.16340	-127.92270	2688	47.164207	-127.922132	2691	2686	0.1	26
J54	47.33670	-128.81050	2667	47.335835	-128.811580	2636	2662	0.1	220
J55	47.50280	-129.70340	2717	47.530465	-129.707570	2756	2800	3.1	354
J63	48.20620	-130.00350	2856	48.206473	-130.003285	2847	2882	0.0	28
J69	48.62750	-128.73900	2566	N.D.	N.D.	N.D.	N.D.	N/A	N/A
J61	47.87220	-128.19820	2639	47.872475	-128.197157	2647	2644	0.1	69
J68	48.45430	-127.83020	2588	48.481003	-127.829170	2554	2590	3.0	1
J67	48.27390	-126.92700	2556	48.149958	-127.084233	2580	2612	18.1	220

J32 and J69 not deployed

J48 Not Surveyed on Deployment Leg

Year 1 – Leg 3

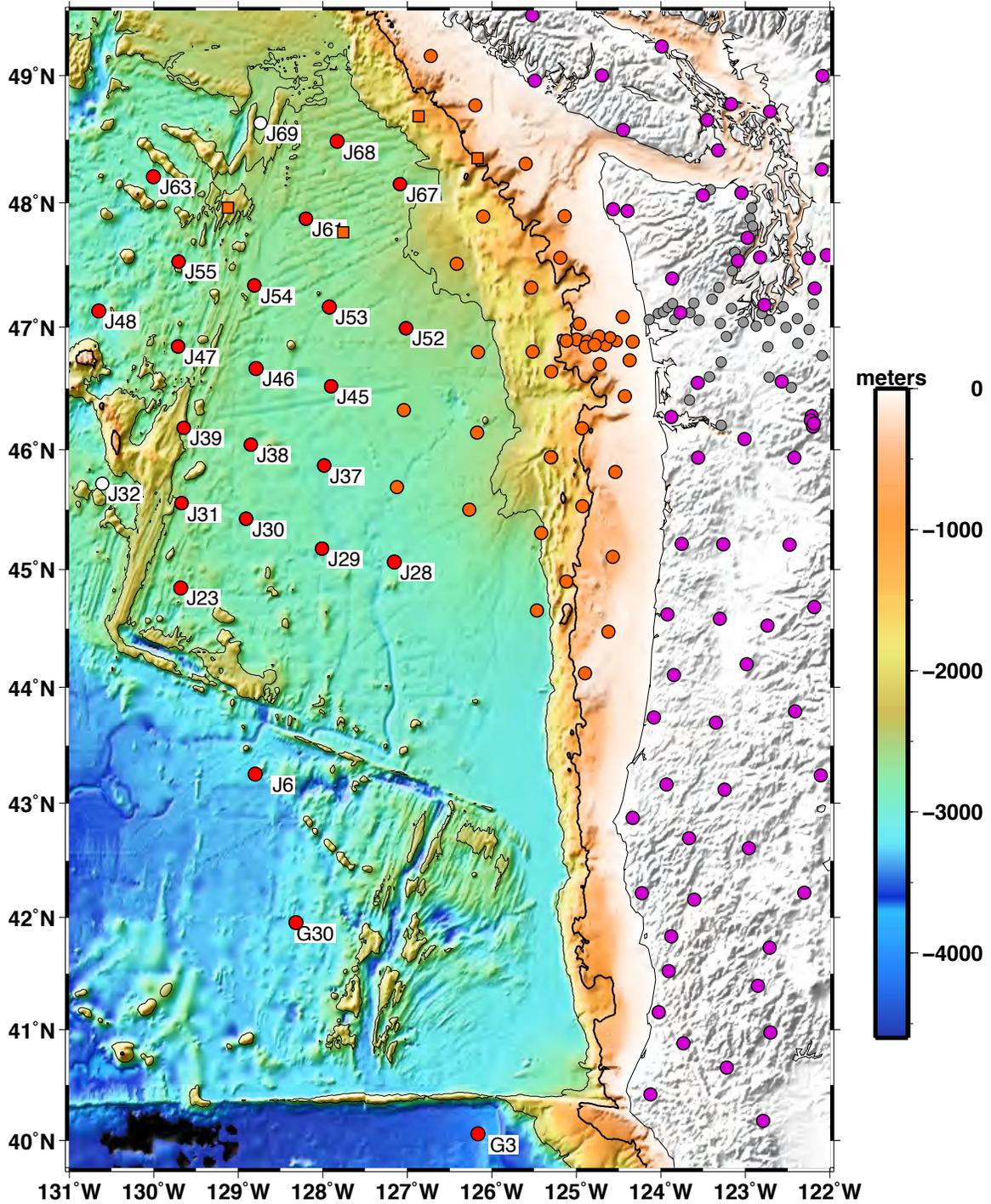


Figure 2. Locations of the OBS deployed on cruise W110B_Leg2 are shown as labeled red circles. OBS were not deployed at locations J32 and J69 (open circles). Stations deployed on Wecoma cruises W1107A and W1110B_Leg1 are shown as unlabeled red circles.

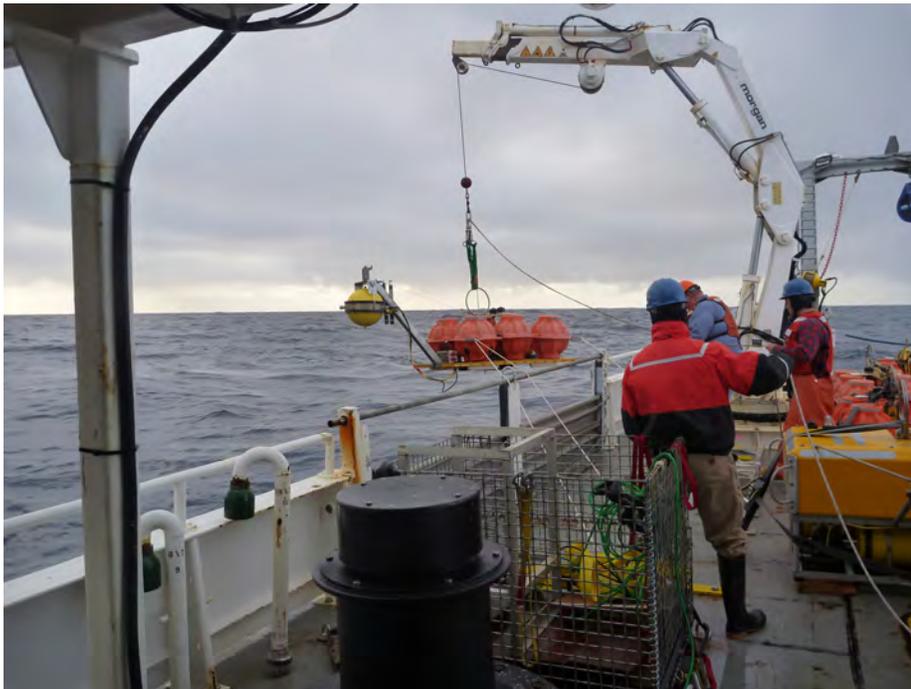
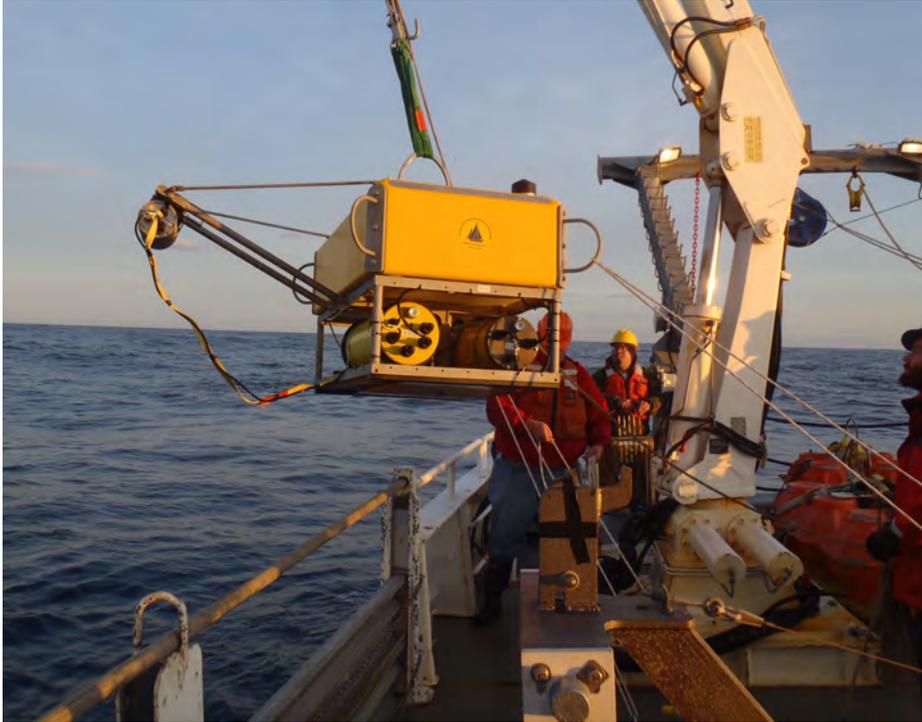


Figure 3. A WHOI ARRA OBS (top) and a WHOI Keck OBS (bottom) go over the rail on a rare calm day.



Figure 4. Weather conditions for much of the cruise were less than ideal.

Acknowledgements

This cruise was supported by the U.S. National Science Foundation. We thank Captain Jeff Crews, Chief Engineer Bob Ashley, and the officers and crew of the Research Vessel Wecoma for helping to make this weather-challenged cruise a success. Shipboard technician David O' Gorman ensured OBS deck operations went smoothly. Engineer Chip Millard assisted in modifications to the ARRA OBS.