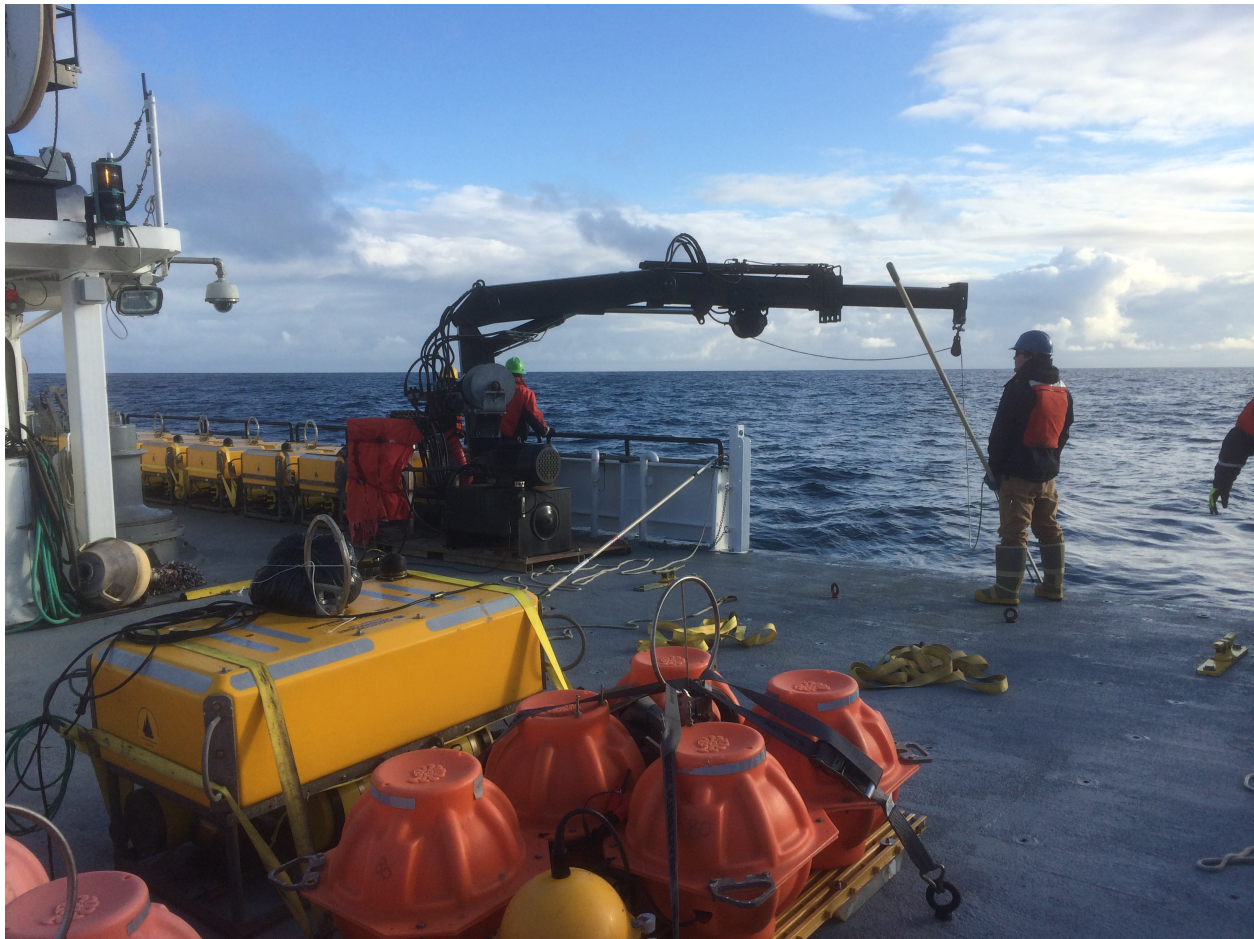


Year-3 Cascadia Initiative OBS Recovery Cruise

Cruise OC1405A R.V. Oceanus

May 13, 2014 - May 21, 2014

Newport, Oregon to Newport, Oregon



John A. Collins, Woods Hole Oceanographic Institution

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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 recover 21 of the 23 WHOI OBS deployed in August 2013 (cruise OC1307C), as part of the Year-3 Cascadia Initiative OBS array. Two of the 23 OBS deployed on cruise OC1307C did not respond to acoustics immediately on deployment, and these 2 OBS are scheduled to be recovered with the JASON ROV on cruise TN-312 of the R/V Thompson in June. The WHOI OBS were deployed in a broad array extending west from the central Juan de Fuca plate onto the Pacific plate. Three stations are located in Canadian territorial waters (Figures 1, 2). The OBS (Figures 3 and 4) were provided by the NSF-funded U. S. National Ocean Bottom Seismograph Instrumentation Pool (OBSIP) and by WHOI.

Eleven 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). Ten OBS, funded by the W.M. Keck Foundation, carry broadband seismometers and strong-motion accelerometers. All 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.

OC1405A Ship Track

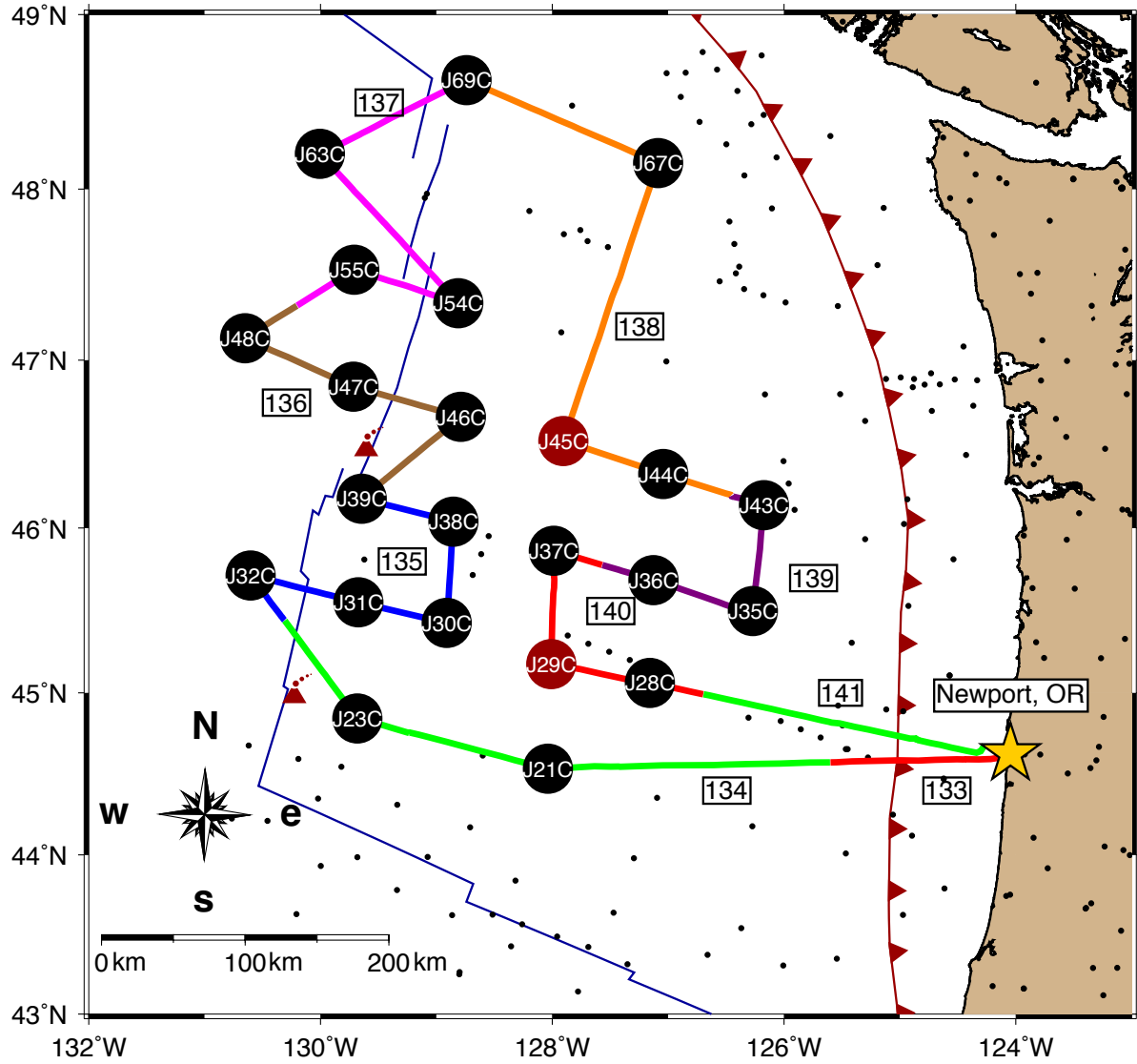


Figure 1. OC1405A cruise track. Numbers in boxes show day-of-year 2014 (UTC). Black and maroon filled-circles and associated numbers show location and names of all visited OBS sites. Cruise commenced on day 133 (2014-05-13), and ended on day 141 (2014-05-21). Small black dots show the locations of recent OBS deployments.

OC-1405A Science Party

John Collins Robert Porritt	Chief Scientist Scientist	Woods Hole Oceanographic Institution University of Southern California
Alan Gardner	OBS Engineer	Woods Hole Oceanographic Institution
Tim Kane	OBS Technician	Woods Hole Oceanographic Institution
Dan Kot	OBS Technician	Woods Hole Oceanographic Institution
Jim Ryder	OBS Technician	Woods Hole Oceanographic Institution
Duo Li	Graduate Student	McGill University, Montreal, Canada
Seth Mogk	Observer	Leidos, San Diego
David O' Gorman	Marine Technician	Oregon State University

OC-1405A R/V Oceanus Crew

Jeff Crews	Master
Mike Ribera	Chief Engineer
Todd Dussault	Chief Mate
Patrick Breshears	Second Mate
Jacques "Jay" JeanBart	Engineer
Henry "Chip" Millard	Engineer
Doug Beck	Bos'n
Kody Robinson	AB
Marc Simpson	AB
Joy DeRosa	Cook
Sean Guss	Asst. Cook
David O' Gorman	Marine Technician

Cruise Narrative

Sunday, May 11 (PDT). Gardner, Kane, Kot, and Ryder arrive Newport mid-morning. Collins arrives late afternoon.

Monday, May 12 (PDT). Loaded WHOI equipment on Oceanus. Set up main-lab. Informed by Captain that our Canadian clearance had come through some time ago. Post-doc Rob Porritt and graduate student Duo Li arrive Newport.

Tuesday, May 13 (PDT). Depart Newport ~11:10 PDT after a fire and safety drill. We plan to sail in a clockwise direction, hence J21C will be our first station. Weather very good, as is the forecast for the next few days. Making 12 knots.

Wednesday, May 14 (PDT). Still making 12 knots as we steam to station J21C

Station J21C (OBS I.D. S86)

On Station:	05/14/2014 09:05 UTC (05/14/2014 02:06 PDT)
OBS Type:	Keck
Water Depth:	2847 m
Enable Command:	05/14/2014 09:06 UTC
Lock Guralp Command:	05/14/2014 09:09:12 UTC
Release Command:	05/14/2014 09:32:18 UTC
Est. Lift-Off Time (double ping)	05/14/2014 09:36:42 UTC
Surface Time:	05/14/2014 11:00 UTC
Time On Deck:	05/14/2014 11:15 UTC
Time on Station:	2 hrs. 10 min.
Rise Rate:	34 m/min

Station J23C (OBS I.D. S82)

On Station:	05/14/2014 17:45 UTC (05/14/2014 10:45 PDT)
OBS Type:	Keck
Water Depth:	2653 m
Enable Command:	05/14/2014 17:46 UTC
Lock Guralp Command:	05/14/2014 17:48 UTC
Release Command:	05/14/2014 17:53:25 UTC
Est. Lift-Off Time (double ping)	05/14/2014 18:00:41 UTC
Surface Time:	05/14/2014 19:20 UTC
Time On Deck:	05/14/2014 19:36 UTC
Time on Station:	1 hrs. 51 min.
Rise Rate:	34 m/min

Station J32C (OBS I.D. S81)

On Station:	05/15/2014 01:46 UTC (05/14/2014 18:46 PDT)
OBS Type:	Keck
Water Depth:	2756 m
Enable Command (rel. # 2):	05/15/2014 03:30:01 UTC

Lock Guralp Command: N/A
Release Command: 05/15/2014 03:33:00 UTC
Est. Lift-Off Time (double ping) N/A
Surface Time: 05/15/2014 05:04:30 UTC
Time On Deck: 05/15/2014 05:11 UTC
Time on Station: 3 hrs. 25 min.
Rise Rate: 31 m/min
Comments: Confirm enable, but no ranges or Guralp lock on release #1. Switch to release # 2 for successful release.

Thursday, May 15 (PDT).

Station J31C (OBS I.D. T104)

On Station: 05/15/2014 09:25 UTC (05/15/2014 02:25 PDT)
OBS Type: ARRA
Water Depth: 2624 m
Enable Command: 05/15/2014 09:26:15 UTC
Release Command: 05/15/2014 09:29:31 UTC
Est. Lift-Off Time (double ping) 05/15/2014 09:34:00 UTC
Surface Time: 05/15/2014 10:34 UTC
Time On Deck: 05/15/2014 10:45 UTC
Time on Station: 1 hr. 20 min.
Rise Rate: 44 m/min
Comments: Seismometer now has additional 10 lbs weight => rise rate is less than what we had for CIET_1 and CIET_2 (48 m/min).

Station J30C (OBS I.D. T103)

On Station: 05/15/2014 14:00 UTC (05/15/2014 07:00 PDT)
OBS Type: ARRA
Water Depth: 2786 m
Enable Command: 05/15/2014 14:00:18 UTC
Release Command: 05/15/2014 14:03:25 UTC
Est. Lift-Off Time (double ping) 05/15/2014 14:08:50 UTC
Surface Time: 05/15/2014 15:10:00 UTC
Time On Deck: 05/15/2014 15:15 UTC
Time on Station: 1 hr. 15 min.
Rise Rate: 46 m/min

Station J38C (OBS I.D. T113)

On Station: 05/15/2014 18:46 UTC (05/15/2014 11:46 PDT)
OBS Type: ARRA
Water Depth: 2731 m
Enable Command: 05/15/2014 18:46:54 UTC
Release Command: 05/15/2014 18:49:35 UTC
Est. Lift-Off Time (double ping) 05/15/2014 18:54:00 UTC
Surface Time: 05/15/2014 19:53 UTC
Time On Deck: 05/15/2014 20:02 UTC
Time on Station: 1 hr. 16 min.
Rise Rate: 46 m/min

Station J39C (OBS I.D. T102)

On Station: 05/15/2014 23:26 UTC (05/15/2014 16:26 PDT)
OBS Type: ARRA
Water Depth: 2656 m
Enable Command: 05/15/2014 23:26:13 UTC
Release Command: 05/15/2014 23:27:54 UTC
Est. Lift-Off Time (double ping) N/A
Surface Time: 05/16/2014 00:32 UTC
Time On Deck: 05/16/2014 00:45 UTC
Time on Station: 1 hr. 19 min.
Rise Rate: 44 m/min

Friday, May 16 (PDT).

Station J46C (OBS I.D. T107)

On Station: 05/16/2014 04:58 UTC (05/16/2014 21:58 PDT)
OBS Type: ARRA
Water Depth: 2744 m
Enable Command: 05/16/2014 04:58:18 UTC
Release Command: 05/16/2014 05:00:04 UTC
Est. Lift-Off Time (double ping) 05/16/2014 05:04:28 UTC
Surface Time: 05/16/2014 06:05 UTC
Time On Deck: 05/16/2014 06:14 UTC
Time on Station: 1 hr. 26 min.
Rise Rate: 45 m/min

Station J47C (OBS I.D. T110)

On Station: 05/16/2014 14:26 UTC (05/16/2014 07:26 PDT)
OBS Type: ARRA
Water Depth: 2679 m
Enable Command: 05/16/2014 14:27:17 UTC
Release Command: 05/16/2014 14:29:16 UTC
Est. Lift-Off Time (double ping) 05/16/2014 14:34:45 UTC
Surface Time: 05/16/2014 15:29 UTC
Time On Deck: 05/16/2014 15:35 UTC
Time on Station: 1 hr. 9 min.
Rise Rate: 50 m/min

Station J48C (OBS I.D. S88)

On Station: 05/16/2014 19:58 UTC (05/16/2014 12:58 PDT)
OBS Type: Keck
Water Depth: 2940 m
Enable Command: 05/16/2014 19:58:14 UTC
Lock Guralp Command: 05/16/2014 20:00:05 UTC
Release Command: 05/16/2014 20:04:13 UTC
Est. Lift-Off Time (double ping) 05/16/2014 20:09:32 UTC
Surface Time: 05/16/2014 21:35 UTC
Time On Deck: 05/16/2014 21:48 UTC

Time on Station: 1 hr. 50 min.
Rise Rate: 35 m/min

Station J55C (OBS I.D. S89)

On Station: 05/17/2014 01:58 UTC (05/16/2014 18:58 PDT)
OBS Type: Keck
Water Depth: 2755 m
Enable Command: 05/17/2014 01:58:30 UTC
Lock Guralp Command: 05/17/2014 01:59:59 UTC
Release Command: 05/17/2014 02:04:22 UTC
Est. Lift-Off Time (double ping) 05/17/2014 02:08:37 UTC
Surface Time: 05/17/2014 03:27 UTC
Time On Deck: 05/17/2014 03:33 UTC
Time on Station: 1 hr. 35 min.
Rise Rate: 35 m/min

Saturday, May 17 (PDT).

Station J54C (OBS I.D. S83)

On Station: 05/17/2014 07:19 UTC (05/17/2014 00:19 PDT)
OBS Type: Keck
Water Depth: 2666 m
Enable Command: 05/17/2014 07:19:06 UTC
Lock Guralp Command: 05/17/2014 07:20:49 UTC
Release Command: 05/17/2014 07:26:02 UTC
Est. Lift-Off Time (double ping) 05/17/2014 07:30:17 UTC
Surface Time: 05/17/2014 08:44 UTC
Time On Deck: 05/17/2014 08:51 UTC
Time on Station: 1 hr. 32 min.
Rise Rate: 36 m/min

Station J63C (OBS I.D. S84)

On Station: 05/17/2014 15:11 UTC (05/17/2014 08:11 PDT)
OBS Type: Keck
Water Depth: 2845 m
Enable Command: 05/17/2014 15:11:05 UTC
Lock Guralp Command: 05/17/2014 15:13:05 UTC
Release Command: 05/17/2014 15:18:05 UTC
Est. Lift-Off Time (double ping) 05/17/2014 15:24:25 UTC
Surface Time: 05/17/2014 16:46 UTC
Time On Deck: 05/17/2014 16:52 UTC
Time on Station: 1 hr. 41 min.
Rise Rate: 35 m/min

Station J69C (OBS I.D. S85)

On Station: 05/17/2014 21:58 UTC (05/17/2014 14:58 PDT)
OBS Type: Keck
Water Depth: 2544 m

Enable Command: 05/17/2014 21:58:35 UTC
Lock Guralp Command: 05/17/2014 22:00:28 UTC
Release Command: 05/17/2014 22:03:50 UTC
Est. Lift-Off Time (double ping) 05/17/2014 22:07:05 UTC
Surface Time: 05/17/2014 23:21 UTC
Time On Deck: 05/17/2014 23:29 UTC
Time on Station: 1 hr. 31 min.
Rise Rate: 34 m/min

Station J67C (OBS I.D. S80)

On Station: 05/18/2014 05:52 UTC (05/17/2014 22:52 PDT)
OBS Type: Keck
Water Depth: 2581 m
Enable Command (rel. #2): 05/18/2014 06:11:05 UTC
Lock Guralp Command: N/A
Release Command: 05/18/2014 06:12:53 UTC
Est. Lift-Off Time (double ping) 05/18/2014 06:16:22 UTC
Surface Time: 05/18/2014 07:20 UTC
Time On Deck: 05/18/2014 07:48 UTC
Time on Station: 1 hr. 56 min.
Rise Rate: 40 m/min
Comments: Confirm enable, but no ranges or Guralp lock on release #1. Switch to release # 2 for successful release. Bridge had difficulty making recovery despite excellent conditions.

Sunday, May 18 (PDT)

Station J45C (OBS I.D. T105)

On Station: 05/18/2014 16:54 UTC (05/18/2014 09:54 PDT)
OBS Type: ARRA
Water Depth: 2775 m
Enable Command: 05/18/2014 16:54:01 UTC,

Release Command: N/A
Est. Lift-Off Time (double ping) N/A
Surface Time: N/A
Time On Deck: N/A
Time on Station: 0 hr. 18 min.
Rise Rate: N/A
Comments: This OBS failed to communicate on deployment last year. Sent 10 enables, but no reply. Put deck-box in "echo-sounding" mode (12 kHz/12 kHz), and found bottom successfully, => deck-box working correctly. Finally, sent 5 disables, last one at 17:10:55 UTC.

Station J44C (OBS I.D. T101)

On Station: 05/18/2014 20:31 UTC (05/18/2014 13:31 PDT)
OBS Type: ARRA

Water Depth: 2715 m
Enable Command: 05/18/2014 20:31:18 UTC
Release Command: 05/18/2014 20:33:56 UTC
Est. Lift-Off Time (double ping) 05/18/2014 20:39:21 UTC
Surface Time: 05/18/2014 21:35 UTC
Time On Deck: 05/18/2014 21:43 UTC
Time on Station: 1 hr. 12 min.
Rise Rate: 48

Station J43C (OBS I.D. T111)

On Station: 05/19/2014 01:03 UTC (05/18/2014 18:03 PDT)
OBS Type: ARRA
Water Depth: 2645 m
Enable Command: 05/19/2014 01:03:28 UTC
Release Command: 05/19/2014 01:05:19 UTC
Est. Lift-Off Time (double ping) 05/19/2014 01:09:44 UTC
Surface Time: 05/19/2014 02:00 UTC
Time On Deck: 05/19/2014 02:09 UTC
Time on Station: 1 hr. 6 min.
Rise Rate: 52

Monday, May 19 (PDT)

Station J35C (OBS I.D. T114)

On Station: 05/19/2014 14:00 UTC (05/19/2014 07:00 PDT)
OBS Type: ARRA
Water Depth: 2655 m
Enable Command: 05/19/2014 14:27:34 UTC
Release Command: 05/19/2014 14:29:11 UTC
Est. Lift-Off Time (double ping) 05/19/2014 14:32:36 UTC
Surface Time: 05/19/2014 15:34 UTC
Time On Deck: 05/19/2014 15:39 UTC
Time on Station: 1 hr. 39 min.
Rise Rate: 44

Station J36C (OBS I.D. T108)

On Station: 05/19/2014 20:28 UTC (05/19/2014 13:28 PDT)
OBS Type: ARRA
Water Depth: 2812 m
Enable Command: 05/19/2014 20:28:45 UTC
Release Command: 05/19/2014 20:30:16 UTC
Est. Lift-Off Time (double ping) 05/19/2014 20:33:42 UTC
Surface Time: 05/19/2014 21:33 UTC
Time On Deck: 05/19/2014 21:37 UTC
Time on Station: 1 hr. 9 min.
Rise Rate: 48

Station J37C (OBS I.D. T106)

On Station: 05/20/2014 01:50 UTC (05/19/2014 18:50 PDT)
OBS Type: ARRA
Water Depth: 2886 m
Enable Command: 05/20/2014 01:50:42 UTC
Release Command: 05/20/2014 01:52:15 UTC
Est. Lift-Off Time (double ping) 05/20/2014 01:55:41 UTC
Surface Time: 05/20/2014 02:56 UTC
Time On Deck: 05/20/2014 03:01 UTC
Time on Station: 1 hr. 11 min.
Rise Rate: 48

Tuesday, May 20 (PDT)

Station J29C (OBS I.D. T109)

On Station: 05/20/2014 13:57 UTC (05/20/2014 06:57 PDT)
OBS Type: ARRA
Water Depth: 2853 m
Enable Command: 05/20/2014 13:57:27 UTC ,
Release Command: N/A
Est. Lift-Off Time (double ping) N/A
Surface Time: N/A
Time On Deck: N/A
Time on Station: 21 minutes
Rise Rate: N/A
Comments: This OBS failed to communicate on deployment last year. Sent 10 enables, but no reply. Put box in "echo-sounding" mode (12 kHz /12 kHz), and found bottom successfully, => deck-box working correctly. Finally, sent 5 disables, last one at 14:16:05 UTC.

Station J28C (OBS I.D. S87)

On Station: 05/20/2014 19:00 UTC (05/20/2014 12:00 PDT)
OBS Type: Keck
Water Depth: 2889
Enable Command: 05/20/2014 19:02:15 UTC
Lock Guralp Command: 05/20/2014 19:03:48 UTC
Release Command: 05/20/2014 19:08:26 UTC
Est. Lift-Off Time (double ping) 05/20/2014 19:12:43 UTC
Surface Time: 05/20/2014 20:45 UTC
Time On Deck: 05/20/2014 20:55 UTC
Time on Station: 1 hr. 55 min.
Rise Rate: 31 m/min

21:15 UTC. Steaming back to Newport.

Wednesday, May 20 (PDT)

Steaming back to Newport.

First line on dock at 10:11: PDT.

OBS Operations

We recovered 21 OBS deployed in a broad array extending west from the central Juan de Fuca plate onto the Pacific plate (Table 1). These OBS were deployed from the R/V Oceanus in August 2013 on cruise OC1307C. A total of 23 WHOI OBS were deployed on that cruise, but two of these (stations J45C/T105 and J29C/T109) did not respond to acoustics immediately on deployment, and these 2 OBS are scheduled to be recovered with the JASON ROV on cruise TN-312 of the R/V Thompson in June/July. (The cause of this acoustics problem seems to be a manufacturing flaw in assembling the navigation transducers.) As we had no weather-related schedule delays, we were able to visit sites J45C and J29C, but we were not able to communicate with the OBS at either station.

All of the OBS were recovered off the starboard side using the knuckle-boom crane. The crane was positioned just forward of the instrument recovery location. We did not utilize space on the O-1 deck. OBS recoveries went well. We used the starboard hull-mounted 12 kHz transducer for all acoustic communication other than on-deck testing. Acoustics were excellent. Mean ascent rates for the Keck and ARRA OBS were 33 ± 2 m/minute and 46 ± 2 m/minute, respectively (Tables 2 and 3). Median on-station time was 91 ± 19 minutes.

Tables 4 and 5 list the clock drifts for the Keck and ARRA OBS. The Keck OBS is equipped with a Seascan temperature-compensated crystal oscillator. The median clock drift rate for the Keck OBS was 0.82 ± 0.65 ms/day. The ARRA OBS are equipped with a Symmetricom chip-scale atomic clock (CSAC) that has much better performance than the Seascan clock, at the cost of increased power (120 mW versus 5 mW). The median clock drift for the ARRA OBS was 0.03 ± 0.01 ms/day.

Data Screening

Some of the ~60 OBS deployed as part of the Year-3 array are located in areas of U.S. Navy operations, and consequently there is the potential that the OBS might record information that should not be made public for reasons of national security. In accordance with an MOU between the U.S. Navy and the National Science Foundation (NSF), the U.S. Navy have the right to redact portions of high-sample-rate (>6 Hz sampling frequency) ground-motion and pressure data that it considers of national security interest. In order to minimize the impact on science, the U.S. Navy agreed to provide low-pass filtered versions of the high-sample-rate data as soon as possible after OBS retrieval. The redacted data will be provided to the OBS group within 90 days of the end of the OBS recovery cruise.

For OC1405A, Seth Mogk from Leidos (San Diego office) participated in the cruise in order to protect the Navy's interests and to provide low-pass filtered data. All data (high- and low-sample rate) from all stations (whether or not of Navy concern) were downloaded over a private I.P. network to WHOI-owned external hard-drives attached to a Windows laptop or an Apple laptop. The WHOI network was firewalled from the ship's network, and access to the private network was restricted to 3 individuals only (Mogk, Gardner, and Collins). The Keck OBS data were downloaded via the Windows laptop using the Quanterra program *BalerAdmin*, while the data from the ARRA OBS were downloaded via the Apple laptop using the GNU program *wget*. These data were then copied by Mogk onto one or more of his own computers and/or storage devices where all the high-sample-rate data

were then low-pass filtered. The Navy representative then made a data volume containing: (i) low-pass filtered versions of all high sample-rate data from all stations; (ii) unfiltered versions of the low sample-rate data from all stations; and (iii) unfiltered high-sample rate data from stations not of interest to the Navy. This “clean” data volume was then copied by Mogk to a WHOI external drive.

As a safeguard against loss of the original data, a single WHOI-owned disk drive containing all of the original data from all stations was retained by WHOI. This disk drive was labeled appropriately, hand-carried back to WHOI, and handed to the WHOI Security Officer for safekeeping. This drive will eventually be returned to an authorized U.S. Navy representative upon receipt of the screened data set. As a precaution against data offloading mistakes (e.g. networking outages, operator errors, blunders) the original data were retained on the OBS. These data will be erased from the OBS recording media within 15 days of the return of the OBS to the WHOI OBS Lab.

Table 1. WHOI OBS Year-3 Station Locations and Deployment Time-Line

Station Name	WHOI OBS I.D.	OBS Type	Drop Date (UTC)	Launch Time (UTC)	Station Lat. (deg)	Station Lat. (min)	Station Lat. (hemi)	Station Long. (deg)	Station Long. (min)	Station Long. (hemi)	Station Lat (dec. deg)	Station Long. (dec. deg)	Station Depth (m)	Recovery Date (UTC)	Recover Time (UTC)	Deploy Duration (days)
J21C	S86	Keck	08/08/2013	21:52	44	32.0531	N	128	2.2556	W	44.5342	-128.0376	2847	5/14/2014	11:15	278.6
J23C	S82	Keck	08/08/2013	13:21	44	50.6286	N	129	40.8625	W	44.8438	-129.6810	2653	5/14/2014	19:36	279.3
J28C	S87	Keck	08/02/2013	06:43	45	3.7031	N	127	9.3993	W	45.0617	-127.1567	2889	5/20/2014	20:55	291.6
J29C	T109	ARRA	08/02/2013	13:23	45	10.555	N	128	0.509	W	45.1759	-128.0085	2853	N/A	N/A	N/A
J30C	T103	ARRA	08/07/2013	19:18	45	25.5647	N	128	54.5990	W	45.4261	-128.9100	2786	5/15/2014	15:15	280.8
J31C	T104	ARRA	08/08/2013	00:01	45	33.1146	N	129	40.3437	W	45.5519	-129.6724	2624	5/15/2014	10:45	280.4
J32C	S81	Keck	08/08/2013	05:21	45	42.8711	N	130	36.1770	W	45.7145	-130.6030	2756	5/15/2014	01:46	279.9
J35C	T114	ARRA	08/09/2013	08:29	45	29.9697	N	126	16.0953	W	45.4995	-126.2683	2655	5/19/2014	15:39	283.3
J36C	T108	ARRA	08/09/2013	23:51	45	41.1879	N	127	7.5111	W	45.6865	-127.1252	2812	5/19/2014	21:37	282.9
J37C	T106	ARRA	08/02/2013	19:56	45	51.8081	N	127	59.1163	W	45.8635	-127.9853	2886	5/20/2014	03:01	290.3
J38C	T113	ARRA	08/07/2013	14:15	46	2.3311	N	128	51.2145	W	46.0389	-128.8536	2731	5/15/2014	20:02	281.2
J39C	T102	ARRA	08/06/2013	22:06	46	10.5688	N	129	38.6295	W	46.1761	-129.6438	2656	5/16/2014	00:45	282.1
J43C	T111	ARRA	08/09/2013	13:39	46	8.2199	N	126	10.3478	W	46.1370	-126.1725	2645	5/19/2014	02:09	282.5
J44C	T101	ARRA	08/09/2013	18:45	46	19.4388	N	127	2.4422	W	46.3240	-127.0407	2715	5/18/2014	21:43	282.1
J45C	T105	ARRA	08/03/2013	01:35	46	31.255	N	127	54.29	W	46.5209	-127.9048	2775	N/A	N/A	N/A
J46C	T107	ARRA	08/07/2013	09:08	46	39.8713	N	128	47.3665	W	46.6645	-128.7894	2744	5/16/2014	06:14	281.9
J47C	T110	ARRA	08/07/2013	03:26	46	50.6418	N	129	42.8339	W	46.8440	-129.7139	2679	5/16/2014	15:35	282.5
J48C	S88	Keck	08/06/2013	13:37	47	7.7698	N	130	39.0418	W	47.1295	-130.6507	2940	5/16/2014	21:48	283.3
J54C	S83	Keck	08/03/2013	15:26	47	20.1486	N	128	48.6796	W	47.3358	-128.8113	2666	5/17/2014	08:51	286.7
J55C	S89	Keck	08/06/2013	04:35	47	31.8901	N	129	42.4652	W	47.5315	-129.7078	2755	5/17/2014	03:33	284.0
J63C	S84	Keck	08/05/2013	22:31	48	12.2818	N	130	0.3162	W	48.2047	-130.0053	2845	5/17/2014	16:52	284.8
J67C	S80	Keck	08/05/2013	06:12	48	9.0594	N	127	5.2051	W	48.1510	-127.0868	2581	5/18/2014	07:48	286.1
J69C	S85	Keck	08/05/2013	15:33	48	37.6226	N	128	44.3175	W	48.6270	-128.7386	2544	5/17/2014	23:29	285.3

Table 2. WHOI Keck OBS Rise Rates**CIET Year 3; Keck OBS Rise Rates**

Station Name	WHOI OBS I.D.	OBS Type	Depth (m)	Rise Rate from Seafloor to 1,000 m (m/min)
J21C	S86	Keck	2847	34
J23C	S82	Keck	2653	31
J32C	S81	Keck	2756	31
J48C	S88	Keck	2940	34
J55C	S89	Keck	2755	33
J54C	S83	Keck	2666	35
J63C	S84	Keck	2845	33
J69C	S85	Keck	2544	33
J67C	S80	Keck	2581	41
J28C	S87	Keck	2889	31
			Median	33
			MAD	2

Table 3. WHOI ARRA OBS Rise Rates**CIET Year 3; ARRA OBS Rise Rates**

Station Name	WHOI OBS I.D.	OBS Type	Depth (m)	Rise Rate from Seafloor to 1,000 m (m/min)
J31C	T104	ARRA	2624	44
J30C	T103	ARRA	2786	45
J38C	T113	ARRA	2731	47
J39C	T102	ARRA	2656	43
J46C	T107	ARRA	2744	46
J47C	T110	ARRA	2679	49
J44C	T101	ARRA	2715	48
J43C	T111	ARRA	2645	51
J35C	T114	ARRA	2655	42
J36C	T108	ARRA	2812	46
J37C	T106	ARRA	2886	47
			Median	46
			MAD	2

Table 4. Keck OBS Clock Performance (Seascan)**CIET Year 3; Keck OBS Clock-Corrections Table**

Station Name	WHOI OBS I.D.	Total Seascan Drift (s)	Deployment Duration (days)	Seascan Drift Rate	Drift per Day (ms)	Absolute Drift per Day (ms)
J21C	S86	0.2011	278.58	8.354506E-09	0.72	0.72
J23C	S82	0.4813	279.28	1.994575E-08	1.72	1.72
J32C	S81	0.4942	280.04	2.042614E-08	1.76	1.76
J48C	S88	0.0060	283.36	2.462225E-10	0.02	0.02
J55C	S89	0.2603	283.97	1.060996E-08	0.92	0.92
J54C	S83	0.5095	286.77	2.056439E-08	1.78	1.78
J63C	S84	-0.0095	284.78	-3.857580E-10	-0.03	0.03
J69C	S85	0.1967	285.35	7.978314E-09	0.69	0.69
J67C	S80	0.3812	286.09	1.542226E-08	1.33	1.33
J28C	S87	-0.0976	291.63	-3.874654E-09	-0.33	0.33
Median Absolute Drift Per Day (ms)						0.82
MAD (ms)						0.65

Table 5. ARRA OBS Clock Performance (CSAC)**CIET Year3; ARRA OBS Clock-Corrections Table**

Station Name	WHOI OBS I.D.	Total CSAC Drift (s)	Deployment Duration (days)	CSAC Drift Rate	Drift per Day (ms)	Absolute Drift per Day (ms)
J31C	T104	-0.0099	280.49	-4.079881E-10	-0.0353	0.0353
J30C	T103	0.0121	280.87	4.969313E-10	0.0430	0.0430
J38C	T113	0.0140	281.29	5.776495E-10	0.0500	0.0500
J39C	T102	-0.0248	282.15	-1.016241E-09	-0.0880	0.0880
J46C	T107	0.0113	281.92	4.652427E-10	0.0400	0.0400
J47C	T110	0.0035	282.54	1.420800E-10	0.0120	0.0120
J44C	T101	0.0085	282.17	3.473546E-10	0.0300	0.0300
J43C	T111	0.0059	282.56	2.407515E-10	0.0210	0.0210
J35C	T114	0.0001	283.34	4.873212E-12	0.0004	0.0004
J36C	T108	0.0001	282.95	5.227696E-12	0.0005	0.0005
J37C	T106	-0.0078	290.34	-3.096747E-10	-0.0268	0.0268
Median Absolute Drift Per Day (ms)						0.0300
MAD (ms)						0.0130

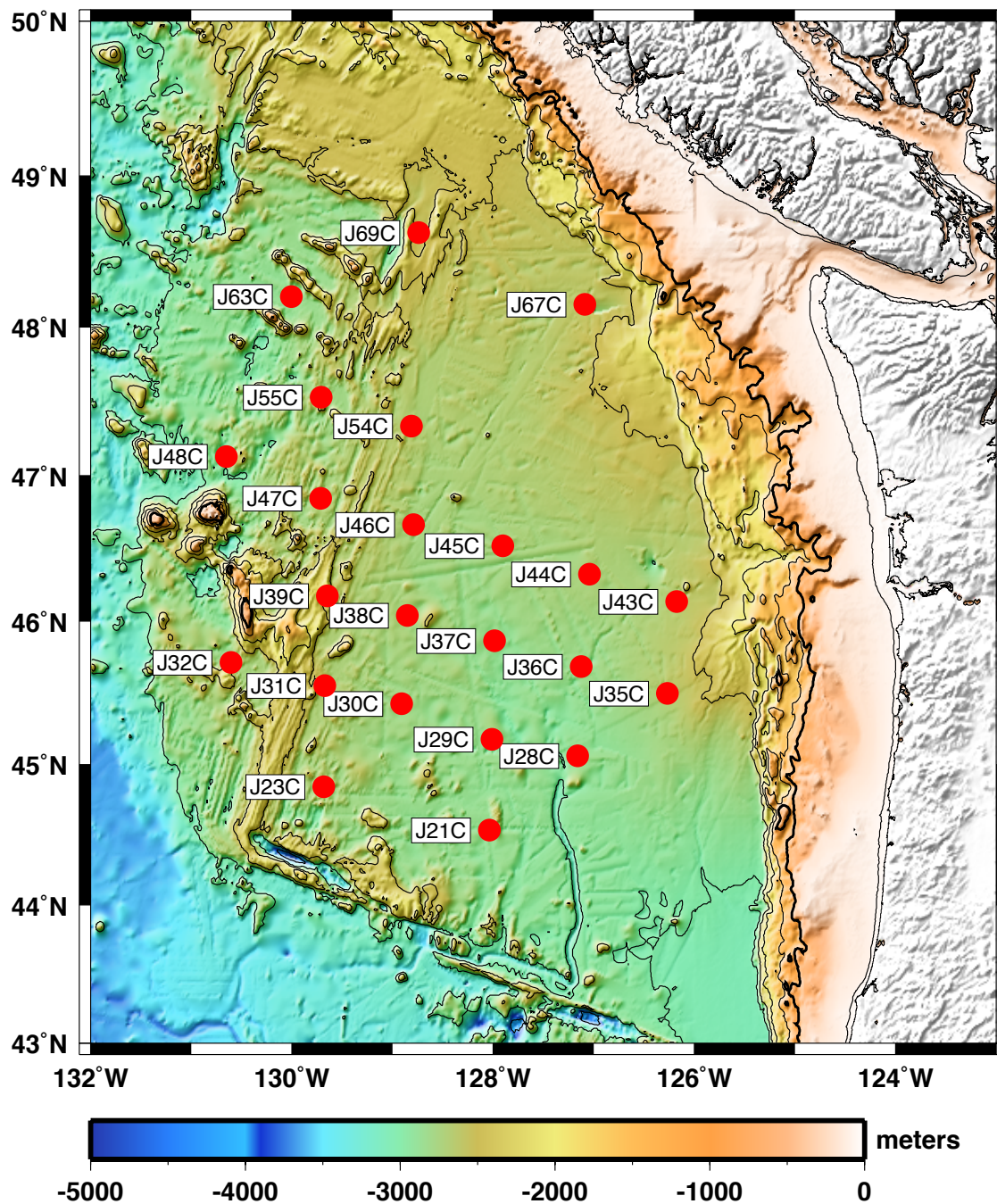


Figure 2. Locations of the stations visited on cruise OC1405A of the R.V. Oceanus are shown as labeled red circles superimposed on satellite-derived bathymetry. The OBS at all stations except J29C and J45C were successfully recovered.

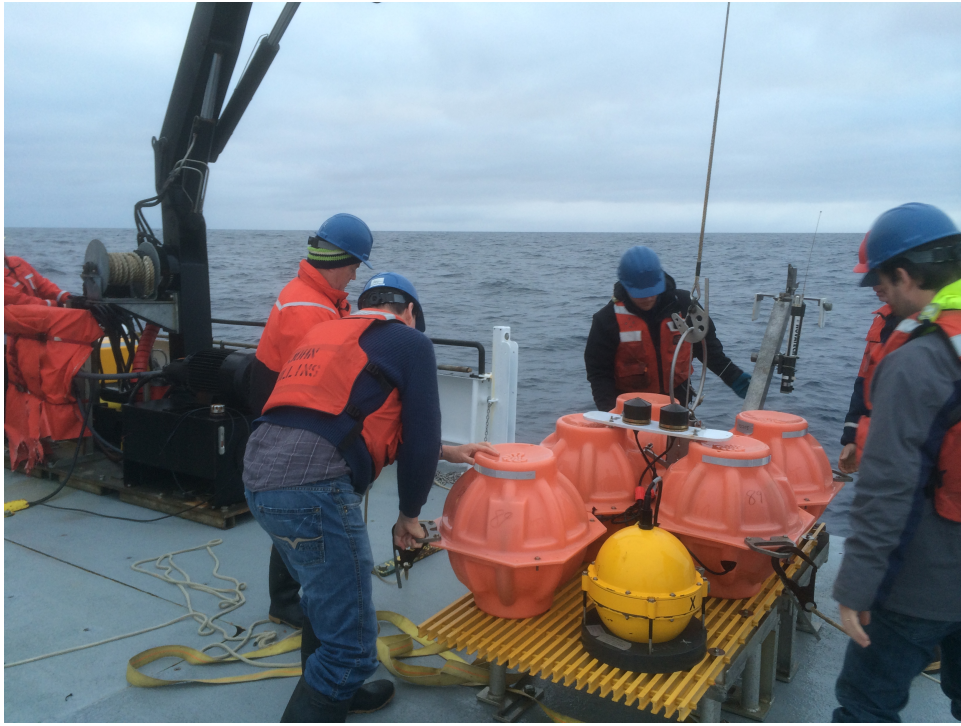


Figure 3. Recovery of a WHOI Keck OBS (top) and a WHOI ARRA OBS (bottom).

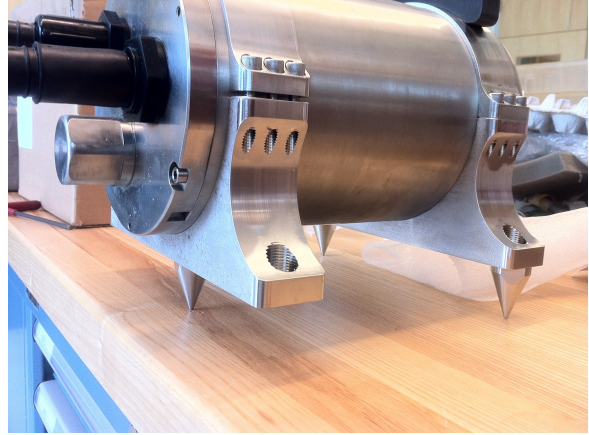
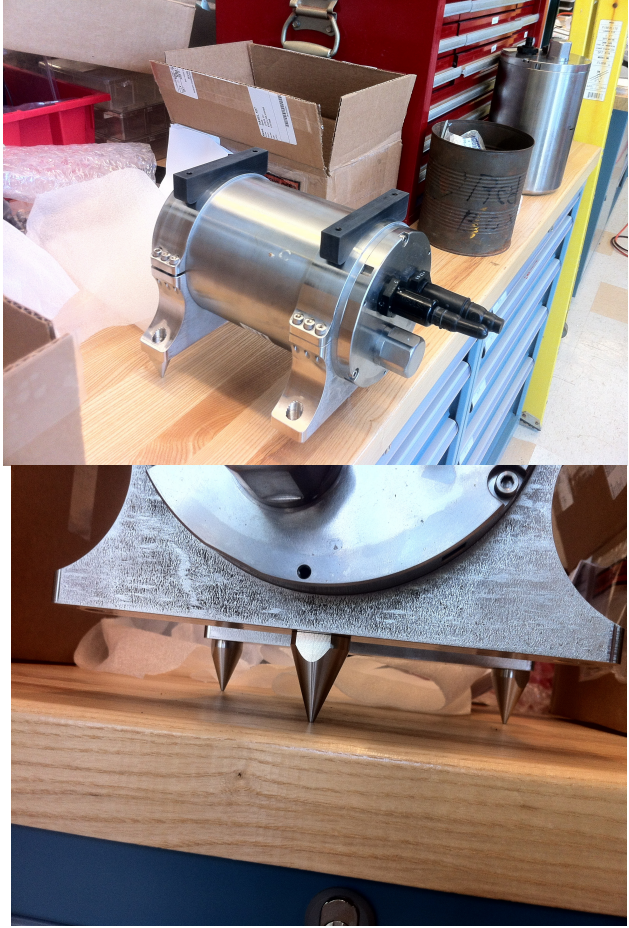


Figure 4. Views of the “feet” added to the WHOI Trillium Compact seismometer for the Year-3 deployment. The goal was to improve coupling to ground. The in-water weight of the seismometer increased by ~10 lbs.

Acknowledgements

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