



**CRUISE REPORT**  
**Cascadia Initiative: Year 3, LEG 3**  
**June 25 - July 9, 2013**

**R/V Atlantis**  
**CRUISE AT26-02**  
**Astoria OR - Astoria OR**

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## **AT26-02 CRUISE REPORT: Cascadia Initiative Year 3, LEG 3**

### **Mission:**

Recover 30 Lamont-Doherty Earth Observatory Ocean-bottom Seismometers (OBSs) of 3 different types:

- 10 Trawl-Resistant Mount (TRM) shallow-water OBS with Trillium compact 3-component seismometer, absolute pressure gauge (APG), acoustic release/pop-up buoy attached to TRM via line. These are deployed at depths shallower than 200m (nominal). Referred to as LDEO-TRM-P in notes below.
- 10 TRM shallow-water OBSs with Trillium compact 3-component absolute pressure gauge installed at depths from 200-1000m (nominal). These are recovered using ROV JASON, sled MEDEA, and MBARI's line elevator. Referred to as LDEO-TRM-J below.
- 10 LDEO deep water OBSs with APG. Recover by sending an acoustic release command to drop the anchor. OBS then floats to the surface a nominal rate of 50m/min. Referred to as LDEO-DW below.

If time allows: Discover and recover 2 Woods Hole Oceanographic Institution deep water OBSs.

Additional Activity: Acquire swath bathymetry, including water column data, in transit between all stations and port.

### **Outcomes:**

- All 30 LDEO OBSs were successfully recovered.
- Twelve recoveries required the JASON ROV, for a total of 13 dives.
- The MBARI line elevator was successfully used to lift OBSs from the seafloor.
- Eight out of 10 pop-up buoys on the LDEO trawl-resistant mounts (TRMs) were successful.
- Unfortunately the weather deteriorated, and JASON dives were not possible at the sites of the 2 lost WHOI OBSs.
- Time series of methane venting lasting 2-4 hours each were recovered using the water column option of the EM-122 swath bathymetry system at 3 sites.
- New bathymetric data were acquired to fill some holes in existing coverage.
- Eight XBTs were acquired.
- Underway data included ADCP and meteorological data.
- At least 20 out of 30 Trillium compact seismometers recorded good quality data for 2/3 of the deployment period.
- At least 17 out of 28 Absolute Pressure Gauges (APG) recorded good quality data for the entire deployment period.

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## **PARTICIPANTS:**

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### **SSSG:**

Ms. Arianna Johns, MATE Intern  
Mr. Rob Hagg, WHOI  
Mr. David Sims, WHOI

### **JASON:**

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Mr. Casey Agee, WHOI

Mr. Nathan Brown, WHOI  
Mr. Jefferson Grau, WHOI  
Mr. Scott Hansen, WHOI  
Mr. Nile Kevis-Stirling, WHOI  
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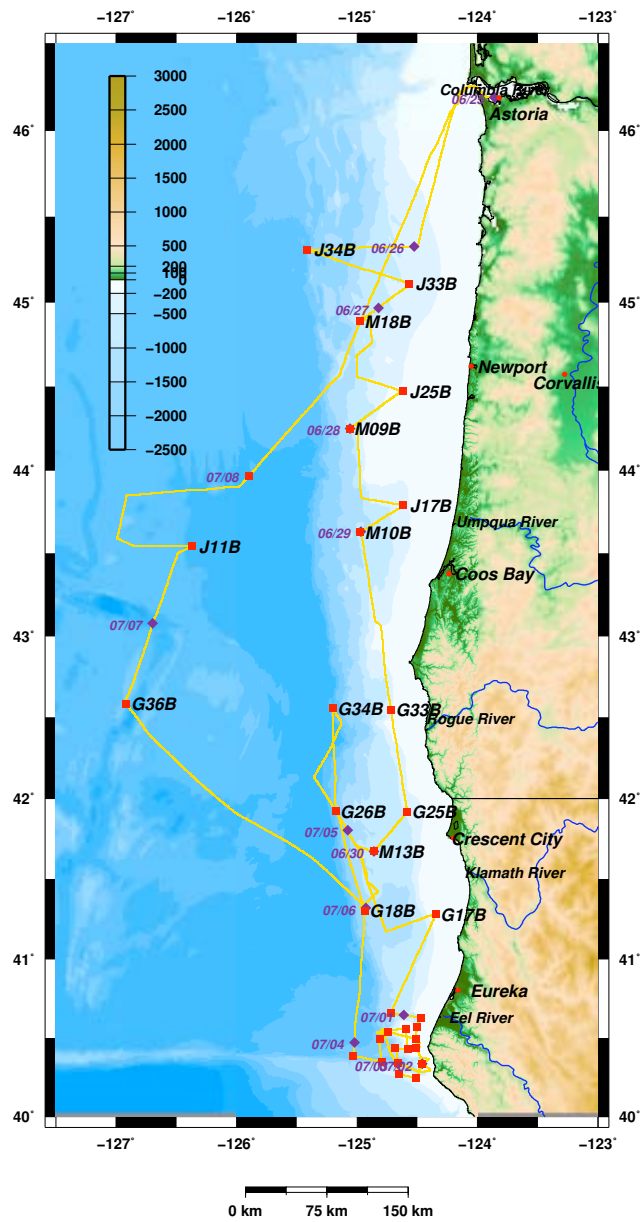
### **Ship's Crew:**

Alan Lunt, Captain  
Mitzi Crane, Chief Mate  
Jennifer Hickey, Second Mate  
Rick Bean, Third Mate  
James Brennan, Communication Electronics Tech  
Jim McGill, Bosun  
Raul Martinez, Able Bodied Seaman  
Jerry Graham, Able-bodied seaman  
Ed Popowitz., Able Bodied seaman  
Lance Wills, Able bodied seaman  
Richard Barnes, Ordinary Seaman  
Chris Morgan, Chief Engineer  
Monica Hill, First Assistant Engineer  
Phil Brennan, Second Assistant Engineer  
Richard Stairs, Third Assistant Engineer  
Paul Ruh, Oiler  
Alex Taylor, Oiler  
Leroy Walcott, Wiper/OS  
Larry Jackson, Steward  
Mark Nossiter, Cook  
Janusz Mlynarski, Mess Attendant

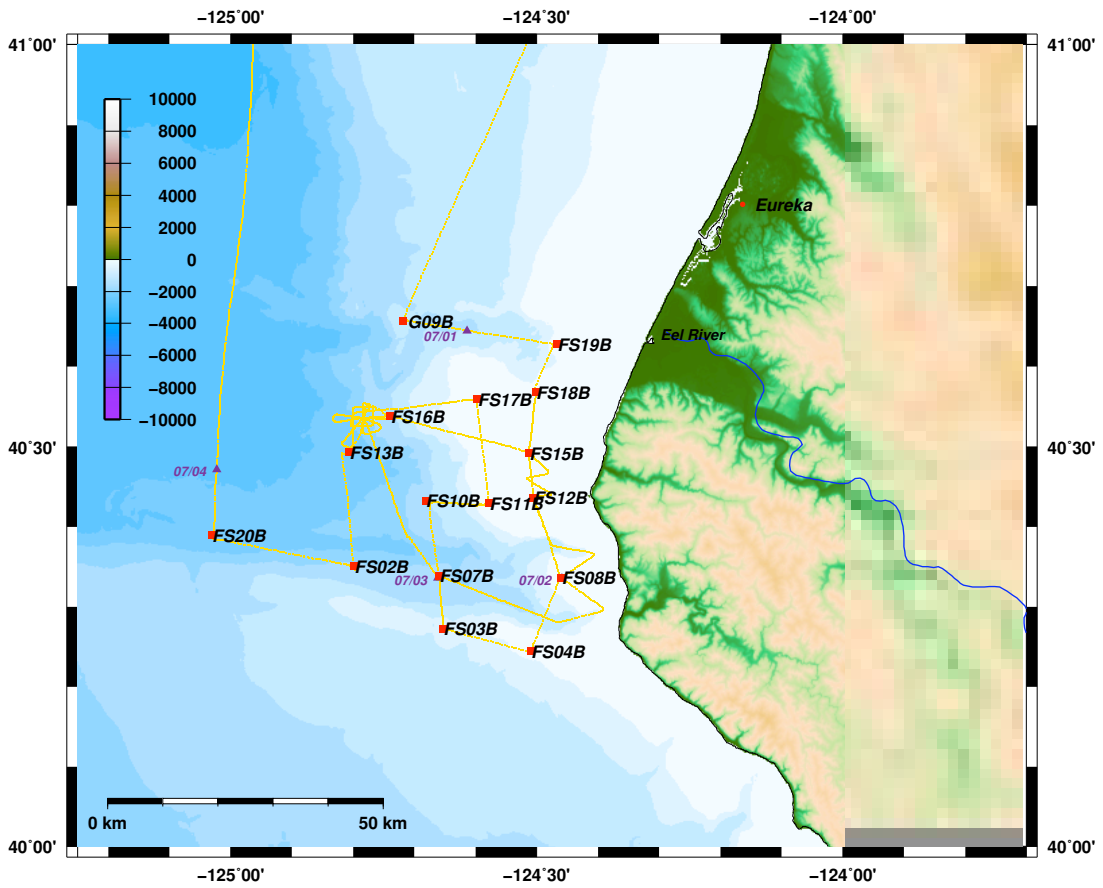
**Abbreviations:** CSN, California State University Northridge; IRIS - Incorporated Institutions for Seismology; LBCC - Linn-Benton Community College; LDEO - Lamont-Doherty Earth Observatory; OSU - Oregon State University; PCC - Portland Community College; SAIC - ; UO - University of Oregon; URI - University of Rhode Island; WHOI - Woods Hole Oceanographic Institution; WWU - Western Washington University.

AT26-02 Science Party:





Track map for AT26-02 showing locations of OBSs (red squares). The position at the beginning of each day is shown by a purple diamond. Sites are labeled except for sites in the focused array near Cape Mendocino. The focused array is shown on the next page.



Map of the track for AT26-02: focused array detail.

**Table 1. OBSs recovered during AT26-02.** Position is the position based on acoustic ranging to the instrument when it was dropped. Some shallow water instruments were lowered to the seafloor on a wire and not relocated by ranging.

Station Name	Lat	Lon	Lat deg, N	Lat min	Lon deg, W	Lon min	Depth, m	Instrument Type	Jason Dive	Deploy Date (UTC)	~Deploy Time (UTC)	Deploy Cruise (2012)	Recover Date (UTC)	~Recover Time (UTC)
LDEO-TRM-J: TRM instrument with required Jason recovery														
LDEO-TRM-P: TRM instrument with pop-up buoy; Jason as backup. RELEASE IN DAYLIGHT ONLY														
LDEO-DW: Deep water OBS; recover night or day; OBS has strobe light and radio transmitter														
FS02B	40.3511	-124.7980	40	21.0650	124	47.879	1403	LDEO-DW		9/13/2012	6:00	L6	7/3/2013	20:07
FS03B	40.2731	-124.6526	40	16.3889	124	39.158	345	LDEO-TRM-J	J-708	9/13/2012	19:31	L6	7/1/2013	17:03
FS04B	40.2447	-124.5097	40	14.6808	124	30.581	159	LDEO-TRM-P		9/14/2012	1:33	L6	7/1/2013	19:56
FS07B	40.3392	-124.6596	40	20.3511	124	39.576	1297	LDEO-DW		9/13/2012	1:00	L6	7/3/2013	0:42
FS08B	40.3367	-124.4598	40	20.1992	124	27.591	120	LDEO-TRM-P	J-709	9/14/2012	7:14	L6	7/2/2013	0:30
FS10B	40.4330	-124.6819	40	25.9774	124	40.915	1076	LDEO-DW		9/12/2012	22:03	L6	7/2/2013	22:28
FS11B	40.4292	-124.5778	40	25.7517	124	34.667	132	LDEO-TRM-P		9/15/2012	6:21	L6	7/2/2013	18:37
FS12B	40.4371	-124.5059	40	26.2242	124	30.354	60	LDEO-TRM-P		9/14/2012	12:00	L6	7/2/2013	2:24
FS13B	40.4931	-124.8065	40	29.5885	124	48.391	2332	LDEO-DW		9/12/2012	9:30	L6	7/3/2013	18:03
FS15B	40.4926	-124.5126	40	29.5545	124	30.758	52	LDEO-TRM-P		9/15/2012	2:34	L6	7/2/2013	4:26
FS16B	40.5381	-124.7395	40	32.2886	124	44.367	1073	LDEO-DW		9/12/2012	18:00	L6	7/3/2013	15:34
FS17B	40.5598	-124.5965	40	33.5859	124	35.792	146	LDEO-TRM-P		9/15/2012	21:12	L6	7/2/2013	16:20
FS18B	40.5682	-124.5016	40	34.0908	124	30.094	107	LDEO-TRM-P		9/16/2012	3:00	L6	7/1/2013	3:28
FS19B	40.6279	-124.4667	40	37.6769	124	28.003	87	LDEO-TRM-P		9/16/2012	16:43	L6	7/1/2013	1:29
FS20B	40.3896	-125.0311	40	23.3731	125	1.868	2378	LDEO-DW		9/12/2012	6:30	L6	7/3/2013	22:03
G09B	40.6568	-124.7187	40	39.4100	124	43.120	842	LDEO-TRM-J	J-707	9/16/2012	22:56	L6	6/30/2013	23:20
G17B	41.2839	-124.3446	41	17.0360	124	20.677	123	LDEO-TRM-P		9/17/2012	7:54	L6	6/30/2013	14:16
G18B	41.3016	-124.9363	41	18.0976	124	56.179	1464	LDEO-DW		9/17/2012	20:10	L6	7/5/2013	13:15
G25B	41.9199	-124.5861	41	55.1953	124	35.166	430	LDEO-TRM-J	J-705	9/18/2012	21:33	L6	6/29/2013	18:44
G26B	41.9249	-125.1775	41	55.4955	125	10.650	2357	LDEO-DW		9/13/2012	6:00	L6	7/5/2013	18:36
G33B	42.5483	-124.7162	42	32.8995	124	42.971	213	LDEO-TRM-J	J-704	9/13/2012	19:31	L6	6/29/2013	10:36
G34B	42.5554	-125.2010	42	33.3260	125	12.058	2954	LDEO-DW		9/14/2012	1:33	L6	7/6/2013	6:14
J17B	43.7900	-124.6148	43	47.3973	124	36.885	286	LDEO-TRM-J	J-701/702	7/15/2012	20:54	L2	6/28/2013	16:57
J25B	44.4713	-124.6217	44	28.2762	124	37.300	147	LDEO-TRM-P	J-699	7/15/2012	2:56	L2	6/27/2013	17:49
J33B	45.1066	-124.5706	45	6.3972	124	34.234	350	LDEO-TRM-J	J-697	7/14/2012	15:00	L2	6/26/2013	20:45
J34B	45.3059	-125.4136	45	18.3568	125	24.817	2583	LDEO-DW		9/19/2012	23:58	L6	6/26/2013	5:08
M09B	44.2497	-125.0589	44	14.9802	125	3.535	914	LDEO-TRM-J	J-700	7/16/2012	16:31	L2	6/28/2013	3:35
M10B	43.6248	-124.9728	43	37.4859	124	58.369	675	LDEO-TRM-J	J-703	7/16/2012	2:40	L2	6/29/2013	1:30
M13B	41.6714	-124.8596	41	40.2869	124	51.579	909	LDEO-TRM-J	J-706	9/18/2012	7:30	L6	6/30/2013	4:14
M18B	44.8871	-124.9712	44	53.2267	124	58.270	720	LDEO-TRM-J	J-698	7/13/2012	21:40	L2	6/27/2013	6:22



**Table 2. Summary of data quality and measured clock drifts.** Positive drift means that the OBS clock was fast.

Station Name	Water Depth	Z	H1	H2	APG	Clock drift (s)	Comment
FS02B	1403	g	g	g	g	0.358996	
FS03B	345	nd	nd	nd	nd	-0.234003	No data
FS04B	159	g	g	g	g	0.795989	
FS07B	1297	g	g	g	g	-28.114002	Timing problem
FS08B	120	g	g	nd	g	0.153998	
FS10B	1076	f	g	g	?	1.889002	Error reading HDH data with pql
FS11B	132	g	g	g	g	-0.419998	A few data dropouts
FS12B	60	g	g	g	nd	-0.194997	
FS13B	2332	g	g	g	g	0.455991	
FS15B	52	g	g	g	g	0.377998	
FS16B	1073	g	g	g	g	-0.719991	
FS17B	146	g	g	g	nd	-0.634006	
FS18B	107	g	g	g	g	-0.496998	
FS19B	87	g	g	g	g	-0.483008	
FS20B	2378	g	g	g	nd	-0.980006	
G09B	842	g	g	g	g	432.919011	Timing problem
G17B	123	g	g	g	g	-0.293002	
G18B	1464	g	g	g	g	1.097993	
G25B	430	g	g	g	g	-0.153001	
G26B	2357	g	g	g	g	-1.317	
G33B	213	p	nd	nd	na	0.421993	No APG deployed
G34B	2954	g	g	g	nd	0.201001	
J17B	286	nd	nd	nd	nd	-2.606012	
J25B	147	f	f	f	?	-0.389005	Waveform quality gradually deteriorates after day 298, 2012
J33B	350	g	g	g	nd	-0.166996	High frequency "noise" on Z and H1 above 10 Hz. Clipped on Haida Gwaii earthquake.
J34B	2583	?	?	?	na	-0.533009	Navy interest; no APG deployed.
M09B	914	g	g	g	?		
M10B	675	nd	nd	p	g		
M13B	909	nd	nd	nd	g		
M18B	720	nd	nd	p	nd		

Categories are Good, Fair, Poor, No Data (nd), Not Applicable (na) and not yet determined (?)

After approximately day 60 of 2013, all seismometer data deteriorate (~2/3 of the way into the deployment). Preliminary analysis suggests this was due to defective batteries packs.

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**CRUISE NARRATIVE:**

**Day 1, 25-June-2013 (JD 176-177):**

Atlantis left the dock in Astoria, OR, at 10:00 PDT (17:00 GMT) on schedule as planned and crossed the Columbia bar at ~12:00 PDT. ETA at the first site was ~16:30 PDT. During the transit, the science party had its orientation meeting followed by a fire and boat drill for all hands. Seas were rough and getting rougher (wind gusts to ~32 kts), and a number of people were seasick. It was decided that it was too rough to attempt a JASON-assisted OBS recovery. Instead, we decided to proceed to Site **J34B** (2583 m water depth) to recover a LDEO-DW instrument.

We arrived at Site J34B at 20:35 PDT (03:35 GMT on day 177). Acoustic ranging confirmed that OBS was at the expected depth and position. A release command was sent and accepted. Rise time was estimated to be 51 minutes based on a 50 m/min rise rate. OBS was spotted on the surface by the Bridge at 04:55 GMT and recovered over the starboard side using the starboard crane at 05:08 GMT.

Seas had improved since evening. After discussion among the Captain, co-Chief, and leaders of the JASON and LDEO-OBS teams, the decision was made to transit back to Site **J33B** (124 m) and begin a JASON-assisted recovery at first light.

Transit began at 06:24 GMT. EM122 data were acquired during transit. The LDEO team cut and spooled line during the transit, making for a very long day for them.

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**Day 2, 26-June-2013 (JD 177-178):**

We arrived at Site **J33B** at 02:50 PDT (09:50 GMT) and waited until first light to observe the sea state. At 06:30 PDT, it was decided that conditions were okay for a Jason-assisted recovery. The MBARI line elevator was deployed ~50 m from **J33B**.

Jason and Medea were deployed at 07:22 PDT (dive **J2-697**). JASON picked up the end of spooled line and chain from the elevator and carried it to the OBS, attached it to the handle on top with a shackle, and stood back to watch as a release command was sent to the line elevator. The line elevator release worked as expected. Jason then backed off and returned to the surface at a rate of 30 m/min. Medea was out of the water and on deck at 16:42 GMT followed by Jason at 16:50 GMT.

Attention then turned to the line elevator. Unfortunately both the visual and radio fix on the line elevator buoy were lost during Jason recovery operation. All available eyes were recruited to search for the line elevator. Current was strong (0.18 kts to the east), and it was concluded that the line elevator buoy was probably being dragged beneath the surface. Sharp eyes caught the flag occasionally emerging above the sea surface. The

line elevator was hooked and on deck at 19:55 GMT. The line was detached from the elevator buoy and shackled to the lead line connected to the heave-compensated winch (HCW). Line for the winch passes through lower pulley, up to additional pulley attached (down-boom) to starboard crane, with the latter set at fixed azimuth/elevation to fix distances to HCW. LDEO-TRM-J was on board at 20:44 GMT, and transit to site M18B began at 16:09 PDT (23:09 GMT).

We arrived at **M18B** (an LDEO-TRM-J at 720 m) at 01:11 GMT on JD 178 and were greeted by humpback whales and dolphins. Line was added to the Elevator for a recovery in 720 m water depth. The line elevator was modified by addition of an extra flag and of a float to assist in sighting the buoy.

Jason/Medea were launched at approx. 0158 GMT and descended to the line elevator (dive **J2-698**). The line elevator was found and transported to ~20 m of the reported OBS location. The OBS was found xx m north of the expected position. Jason then returned to the line elevator to pick up the shackle and line and then attached it to the OBS.

Jason stood back to stay clear of the tag line on the float, and a release command was sent to the line elevator. The line elevator and Jason returned to the surface at the same time. Jason/Medea on board at 0410 GMT. Elevator on board at 0500 GMT. OBS on board at 0622 GMT.

### **Day 3, June 27, 2013 (JD 178-179):**

Began transit to site **J25B**, with planned arrival time at 0600 PDT (1300 GMT). Several waypoints were added so that the track would follow the up-dip edge of the gas hydrate stability field and a region of subsurface "gas chimneys" on the slope east of Hydrate Ridge. Water column data as well as swath bathymetry were acquired with the EM122 system during transit. Several possible sightings of water column arrivals were reported in the log.

We had been experiencing errors in the GPS delivery to swath bathymetry. The source of this problem is being tracked down.

We arrived at Site **J25B** (147 m) at 0519 PDT (1219 GMT). This is a LDEO-TRM-P (pop-up) OBS. A signal was sent to the pop-up to release, but the float did not appear on the surface. A decision was made to deploy Jason/Medea (dive **J2-699**). With Jason watching, a release signal was sent to the pop-up. The release mechanism rotated as expected but the release lever did not move. A nudge from the Jason arm resulted in release of the float. Jason returned to the surface and recovery of J25B proceeded normally. On recovery, it was discovered that washers in the release mechanism had corroded, which probably impeded operation of the release.

*Ling cod lounging on J25B:*



*Release mechanism for pop-up float. A little nudge from Jason was all it needed!*



We then transited to Site **M09B** (914 m) to release an LDEO-TRM-J with Jason (dive **J2-700**). The elevator was deployed followed by Jason/Medea. Jason encountered a strong bottom current flowing west, which is a different direction from the strong NE current above 400 m ( $\sim 0.25$  m/s from 75 kHz ADCP). In spite of the strong current, the

seafloor is covered by soft sediment with many worm holes, and scattered white spots that may be clams (try to confirm with high resolution video). There are also occasional fish and starfish.

OBS is not at expected position but is located on the sonar ~25 m north of the position obtained from the 2012 post-deployment survey. OBS is sighted. There are paint chips on the sediment, perhaps indicating contact with a trawler. Jason dropped 2 ballast "cookies" and then proceeded to move the line elevator closer to the OBS. After attaching the line, chain and shackle to the OBS, Jason surfaced and was brought on board at 1740 PDT (0040 GMT on JD 179). The release signal was then sent to the line elevator. The elevator and OBS were recovered without incident and were on deck at 2035 PDT.

*Site M09B showing evidence of having been hit by a trawler.*



The EM122 was restarted for the transit to Site **J17B** and the track was modified to run along the seaward edge of Heceta Bank. Watchstanders reported possible bubble plumes in the data, although this needs to be confirmed through reprocessing of the data.

#### **Day 4, June 28, 2013 (JD 179-180):**

Ship turned east towards Site **J17B** (286 m) at 0043 PDT (0743 GMT) and arrived at the site at 0246 PDT. Logging of EM122 was turned off and we waited on station. The line elevator went over the side at 0441 followed shortly by Jason/Medea (dive **J2-701**). The OBS was sighted soon after Jason reached bottom. Current was mild. Seafloor was covered with soft sediment. There were a few fish and many shrimp. A fish may have been inside the TRM although this should be confirmed by reviewing the video. Jason

attached the line elevator to the OBS and returned to the surface at 0621 PDT and was back on board at 0635.

The reason for bringing Jason back before releasing the line elevator was to avoid the possibility of entanglement with the satellite float on the elevator and because the remote release mechanism had worked during previous deployments. However, this time the elevator did not release and Jason was re-deployed (dive **J2-702**) at 0717 PDT. JASON found the Elevator and poked at the release wire. This dislodged it, and the elevator released. Jason/Medea were back on board at 0824 PDT, followed by the elevator at 0911 PDT and the OBS at 0957 PDT.

Logging of EM122 data was restarted at 1713 GMT for the transit to Site **M10B** (675 m). We arrived at the site at 1933 GMT and deployed the elevator at 1955. Jason was deployed at 2027 GMT for dive **J2-703**. Jason was on board at 2250 GMT, and the OBS was on board at 0139 GMT. The elevator was almost submerged when it was time to recover it because of strong near-surface currents.

The seafloor in the vicinity of the OBS was rocky with a slight covering of sediments, although the bottom current was light (unlike M09B, where seafloor was covered by fine sediment in spite of a strong current). The largest rocks were on the order of a few 10s of cm high and were slab-like, similar to carbonate substrates seen in other similar places on the margin. Occasional corals were observed along with a variety of fish (rockfish, flatfish, wolf eels). The OBS was found ~22 m N10°E from the nominal site obtained in the 2012 post-deployment survey. Paint chips indicated possible scraping by a trawler.

*Rocky seafloor at M10B. There was considerable biological activity at this site.*



The day ended with a 66 nm transit at 12.4 kts on flat seas to Site **G33B**.

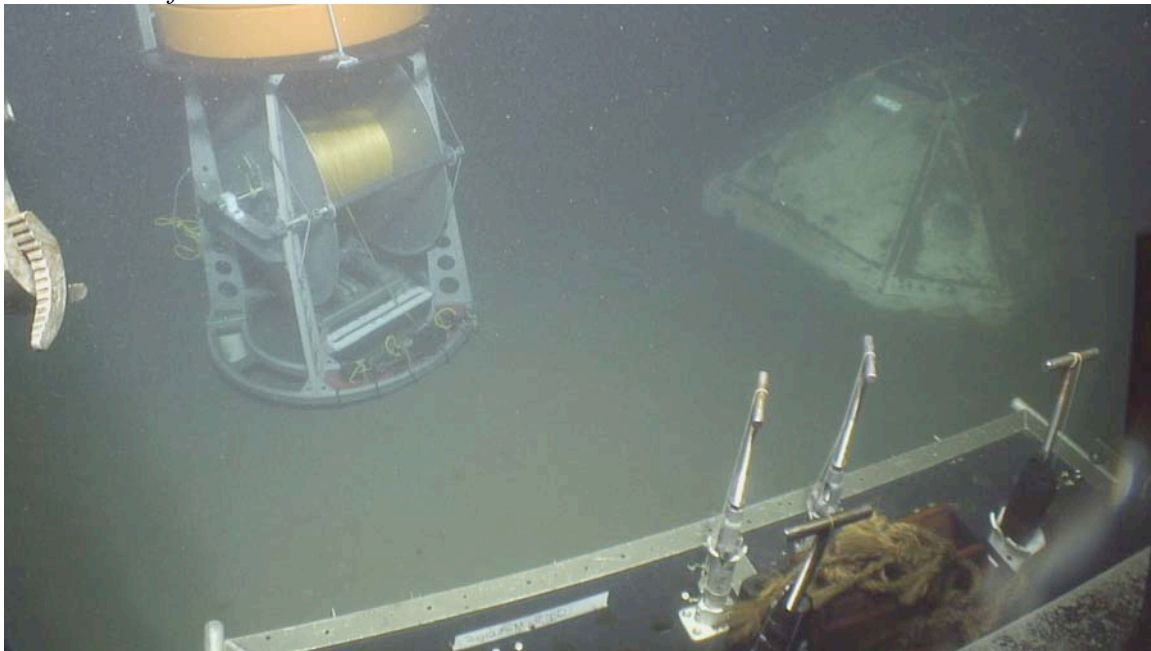
**Day 5, June 29, 2013 (JD 180-181):**

We arrived on station **G33B** at 07:07 GMT. The elevator was deployed at 07:18 and Jason was deployed shortly thereafter (**J2-704**). Ship had set up facing north, anticipating south current noted as adding ~1 kts to normal transit from previous station. Recovery was uneventful and efficient. Noted strong east-trending currents at bottom. Jason crew moved ship due south after attaching the elevator shackle to the OBS to reduce ship maneuvering necessary for elevator recovery. Jason/Medea were recovered before burn signal was sent. Elevator release burned in 6 minutes and elevator left bottom at 08:33 GMT.

Transit to Site **G25B** commenced at 10:53 GMT. Arrived at Site **G25B** at 14:25GMT. The elevator was deployed at 15:37 and Jason/Medea were in the water at 15:48. Moments after finding the elevator, we saw that it had fallen only ~1 m from the TRM (picture). Several rockfish were sleeping next to the OBS, and one may have been observed emerging from one of the holes in the base. Sensor package appeared to have deployed. Bottom current was weak, as was the surface current.

Attaching the shackle to the TRM and recovery of Jason/Medea, the elevator, and the TRM went smoothly.

*Elevator 1 m from the TRM at G25B.*



*Fish resting in the lee of the TRM at G25B*



Transit (18 nm) to site **M13B** began at 19:11 GMT. Transit was short, arriving on site at 21:28. This was a deep site (910m), so spooling the elevator from the winch took about an hour. The elevator was lowered and Jason/Medea were then deployed (**J2-706**). A stiff current to the NE was noted, as the elevator drifted considerably from its drop point and Jason was challenged to move up current, especially when carrying the elevator to the TRM. Elevator line was attached and Jason withdrew to 100 m depth while Atlantis was positioned for starboard quarter pickup of elevator. Elevator released successfully, TMR was on-board by 04:31 GMT.

We began an overnight swath bathymetry survey outboard of and then across two N-S trending ridges on the continental slope to detect whether methane plumes were present, then across an embayment with a clear drainage system flowing W. Plans were to be on pop-up site early the morning of 30-June.

**Day 6, June 30, 2013 (JD 181-182):**

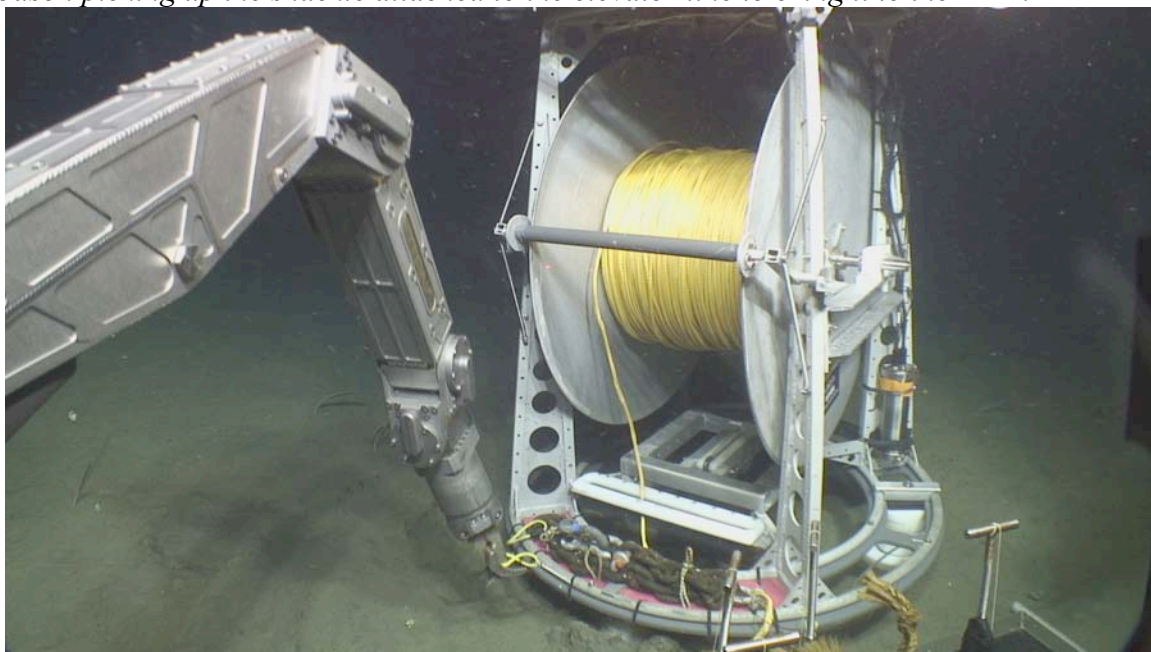
The day began auspiciously, with a trouble-free recovery of the pop-up TRM at station **G17B** at 07:00 PDT. We also acquired XBT 1.

We arrived at station **G09B** at 18:58 GMT and promptly deployed the elevator for Dive **J2-707**. Jason was deployed in calm seas, no strong currents detected. This recovery was uneventful, excepting an abundance of sea life noted on a thinly-sedimented seafloor. We used the Scorpio camera a bit more extensively on this site. Upon withdrawing from the TRM after attaching the elevator line, Jason stayed close to the

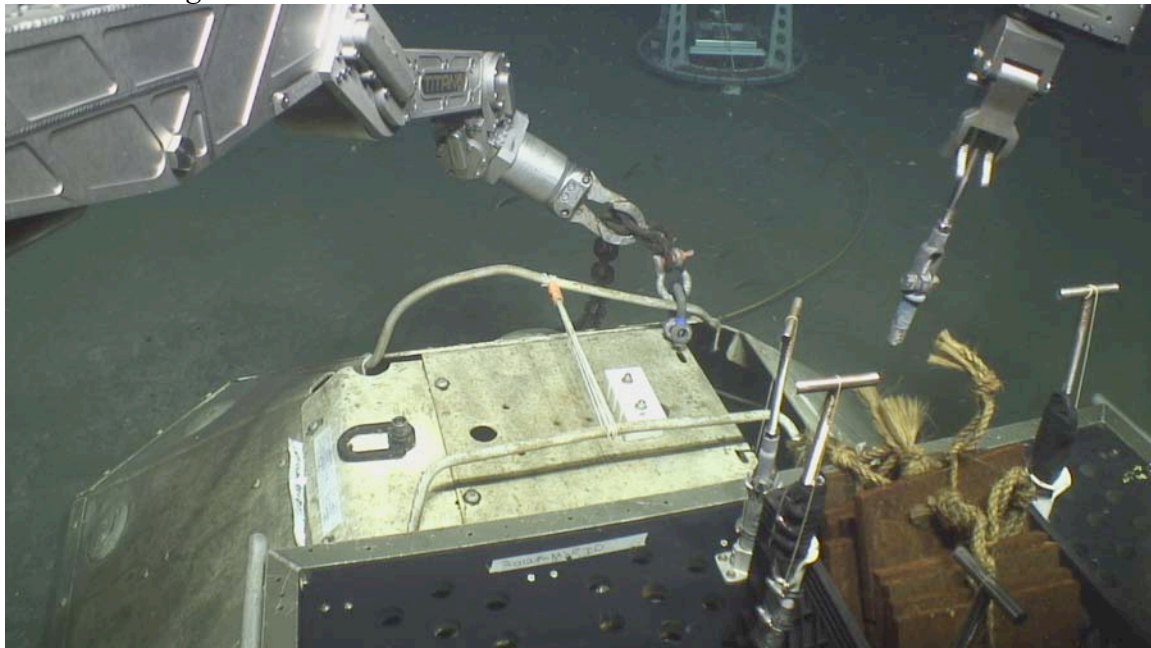


ocean floor and collected a sample rock with attached marine life. Release signal was sent with Jason in 100 m water; elevator released; etc. TRM was on board at 23:20 GMT.

*Jason picking up the shackle attached to the elevator line to bring it to the TRM.*



*Jason attaching the shackle to the the TRM.*



*Seascape at site G09B.*



After a short 1-hour commute to pop-up TRM station **FS19B**, we arrived and sent a signal for the pop-up to deploy in somewhat foggy seas. Buoy was sighted forward starboard quadrant of Atlantis and brought alongside for grapple. Site was shallow (87 m) so popup deployed quickly and winching aboard was also efficient. Time on station from start to finish was about 1.4 hours, concluding at 01:49 GMT (JD 182).

We then steamed to station **FS18B**, sitting in 107 m of water and used the same procedure to recover, concluding at about 03:40 GMT. As it was now sundown, we set a course to acquire shallow-water swath bathymetry over the heads of the Mendocino canyon. Course was cruised at 6 knots and timed to arrive on Jason-recovery site **FS03B** at 05:00 PDT (12:00 GMT) on JD181.

**Day 7, July 1, 2013 (JD 182-183):**

The day began with Jason and Medea in the water at 05:30 PDT at Site **FS03B** in calm, foggy weather. The seafloor for Dive **J2-708** was covered with brittle stars, sponges, anemones, corals and other sea life (**PIX**). Visibility was excellent because of a strong north current. Jason returned to near the surface for the elevator release. When the elevator failed to release, Jason went back down to nudge the release.

The pop-up OBS at **FS04B** was recovered normally. Time on station was 1 hr 30 min.

*TRM at FS03B.*

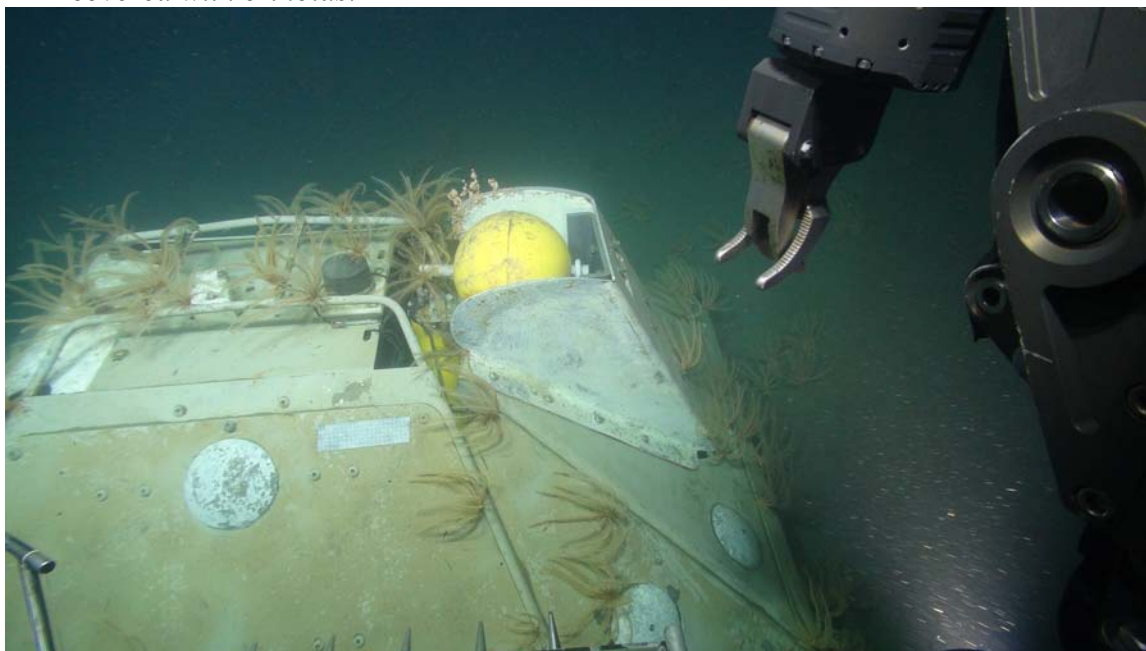


*Closeup of the seascape at FS03B.*

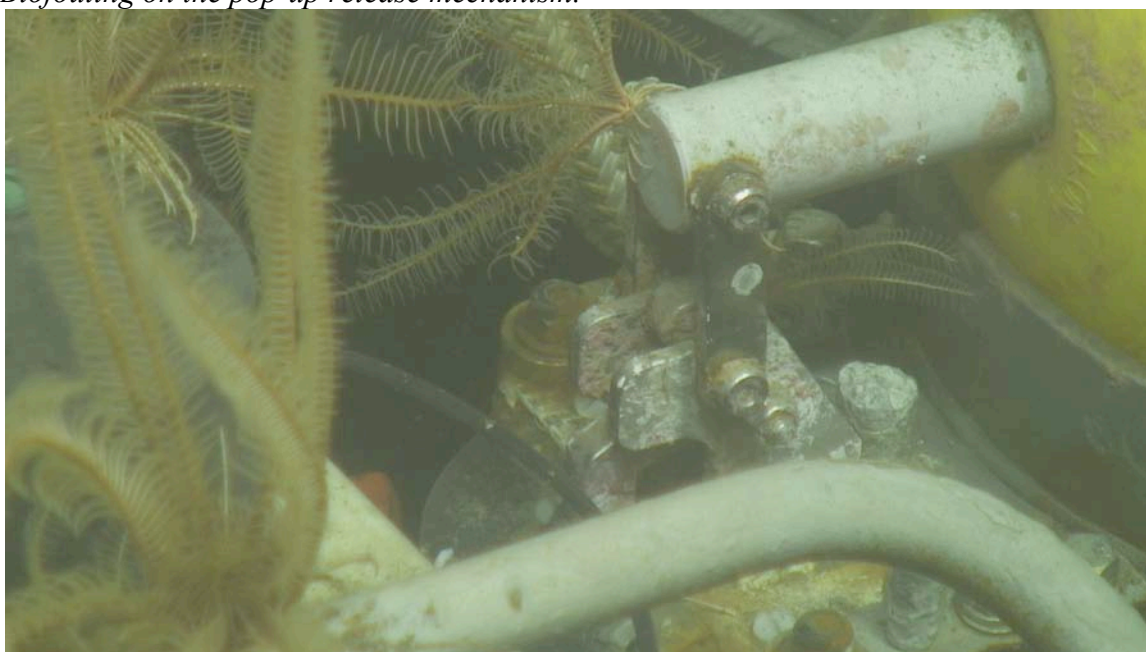


At Site **FS08B**, the pop-up responded to the release command but the float did not appear at the surface. Jason (without the line elevator) was sent down for **Dive J2-709** to investigate. The TRM was covered with a variety of animals that impeded the release mechanism (**PIX**). A new release command and a nudge from Jason were adequate to release the float, and recovery proceeded as for a normal pop-up.

*TRM covered with crinoids.*



*Biofouling on the pop-up release mechanism.*



We then proceeded to pop-up site **FS07B**. Another smooth recovery.

We then proceeded to pop-up site **FS15B**. Yet another smooth recovery. Five recoveries in 1 day!

The night was spent surveying the water column at a known methane vent.

### **Day 8, July 2, 2013 (JD 183-184)**

We arrived at **FS17B** at 05:45 PDT (12:45 GMT). Recovery was eventful. After the float was released, we discovered that the heave-compensated winch was not working. The instrument was recovered using the capstan and human labor to measure and coil the 250 m of line coming on board. Just as the TRM was being lowered onto the deck, the line parted and the TRM fell to the deck. Fortunately no one was injured.

We began the transit to the next site while discussing various scenarios for recovering the one remaining TRM without the heave-compensating winch. However, we did not need to implement any of the scenarios because James Brennan (Atlantis communication electronics tech), working with Rob Hagg (WHOI SSSG), found a bad connection. The winch was repaired and tested, and the recovery process for **FS11B** proceeded. The pop-up release worked on the first command. Recovery with the winch was uneventful. .

After several hrs of slow transit while rearranging TRM frames on deck, we arrived at LDEO-DW Site **FS10B**. Recovery was quick and efficient - 1 hr 41 min between arrival at site and instrument on board.

After a 1.5 hr transit, recovery of LDEO-DW OBS at site **FS07B** proceeded quickly and efficiently (1.5 hr from release to on-board).

We transited to FS13B but arrived too late to attempt a recovery in the prevailing weather conditions. The night was spent holding station to obtain a time-series record of methane venting at a known vent located ~2 nm from both FS13B and FS16B.

### **Day 9, July 3, 2013 (JD 184-185)**

We were at **FS16B** at daybreak to recover an LDEO-DW OBS. In spite of deteriorating weather conditions, the recovery went smoothly.

On the transit between FS16B and FS13B, we went once more over the methane vent site and acquired 2 XBTs at stations **XBT2** and **XBT3**.

Recovery of an LDEO-DW OBS at **FS13B** went smoothly, with 1 h 8 min between release sent and on board.

After a 10.8 nm transit to **FS20B**, and other smooth recovery was accomplished.

We then transited to **G18B** in rapidly deteriorating weather conditions. We were beating into the wind and seas at 6-8 kts. We arrived at G18B at 23:58 PDT (06:57 GMT) and decided to wait until daylight to attempt a recovery.

### **Day 10, July 4, 2013 (JD 185-186)**

The night was spent hove to into the weather. Gusts as high as 52 kts were recorded. Seas were confused. When it was clear that no recovery attempt would be possible until daylight at the earliest, we transited 10 nm to a vent site that had been discovered during OC1209A to record a time-series of the bubble plume during 2012. This effort was aborted after 2 hrs when it was apparent that no plume was observable above the background noise level. We returned to G18B.

Daybreak brought no break in the weather. After considerable discussion of strategies, priorities and the weather forecast, we decided around mid-day to transit to the northernmost of the 3 remaining LDEO-DW instruments and try to recover them from north to south.

We arrived at site G34B at 00:19 PDT (07:19 GMT). The weather was somewhat better than at G18B, but still too rough to attempt a recovery. A decision was made to wait until daylight. Watchstanders made 4th of July hats (and other assorted articles of clothing) from old rags and marker pens and non-seasick members of the science party and crew spent the evening playing poker, reading, and watching movies.

#### **Day 11, July 5, 2013 (JD 185-186)**

The LDEO-DW OBS at Site **G18B** was released at 05:00 PDT and surfaced, as expected, at 06:15 PDT. Recovery was smooth but challenging in choppy seas. By 06:49 PDT we were underway to G26B hoping that the weather would hold.

We arrived at **G26B** at 10:00 PDT. The OBS was released and recovered smoothly in spite of high seas. Gear was on board and secured by 11:36 PDT, and we headed toward G18B, starting at 19:01 GMT.

We arrived (again) at G34B at 15:19 PDT (22:19 GMT) and sent the release signal after prompting an acknowledge signal from the (LDEO) OBS. The OBS was recovered and on board about an hour later at 23:14 GMT.

#### **Day 12, July 6, 2013 (JD 186-187)**

At 00:25 GMT we began the long (117 nm) transit outboard to site G36B to attempt to recover a lost WHOI OBS. The overnight transit was marked by increasing gales (up to 35 knots) and growing swells (est. 11 feet) and our course into these made for a rough ride.

We arrived at **G36B** before 15:40 GMT (08:40 PDT) and began pinging the OBS from more or less directly above the last reported position. Hearing no response, we moved to a new listening point approx. 0.5nm to the NNW of the last reported position for G36B and pinged for approximately ½ hour. We then moved to LP2 at 42 35.365, 126 54.890, approx. 0.57 miles nm to the ENE of last location for G36B. We pinged for another 20 minutes, then moved to west of the known location at LP4 (42 35.161, 126 55.824) to ping to no avail. At this point we contacted the Jason team leader to ask if he

would dive. He deemed the seas to be too unpredictable (winds were ~25 kts, sea swells were at least 9 feet) and so, at 21:13 GMT, we started transit towards J11B.

### **Day 13, July 7, 2013 (JD 187-188)**

In transiting to J11B we detoured slightly to record swath bathymetry in the vicinity of 43° 29.324' 126° 29.539' (south end of N-S swath). We arrived on station **J11B** at 05:31 GMT (22:31 PDT). We set up for successive pinging points approx. 1000m to the north, west, south and east, successively. We pinged with no acknowledgement between 05:31 and 07:10 GMT. Afterwards, the weather forecast for the morning gave some hope that it might be possible to dive at first light, so we stayed on station for the remainder of the night.

Winds, which had dropped to an average of 24 kts during the evening of July 6<sup>th</sup>, rose to ~29 kts on the morning of the 7<sup>th</sup>, and at 07:01 PDT the Jason team leader notified us that a dive was not in the cards. We then transited W, N then E to acquire three lines of swath bathymetry, starting at J11B to 43° 35.479 126° 59.4, then N to 43° 51.033 126° 54.708, then E to 43° 54.045 125° 58.710. Swath targets were chosen to fill gaps in existing swath bathymetric data. We reached the end of third swath at 17:02 GMT

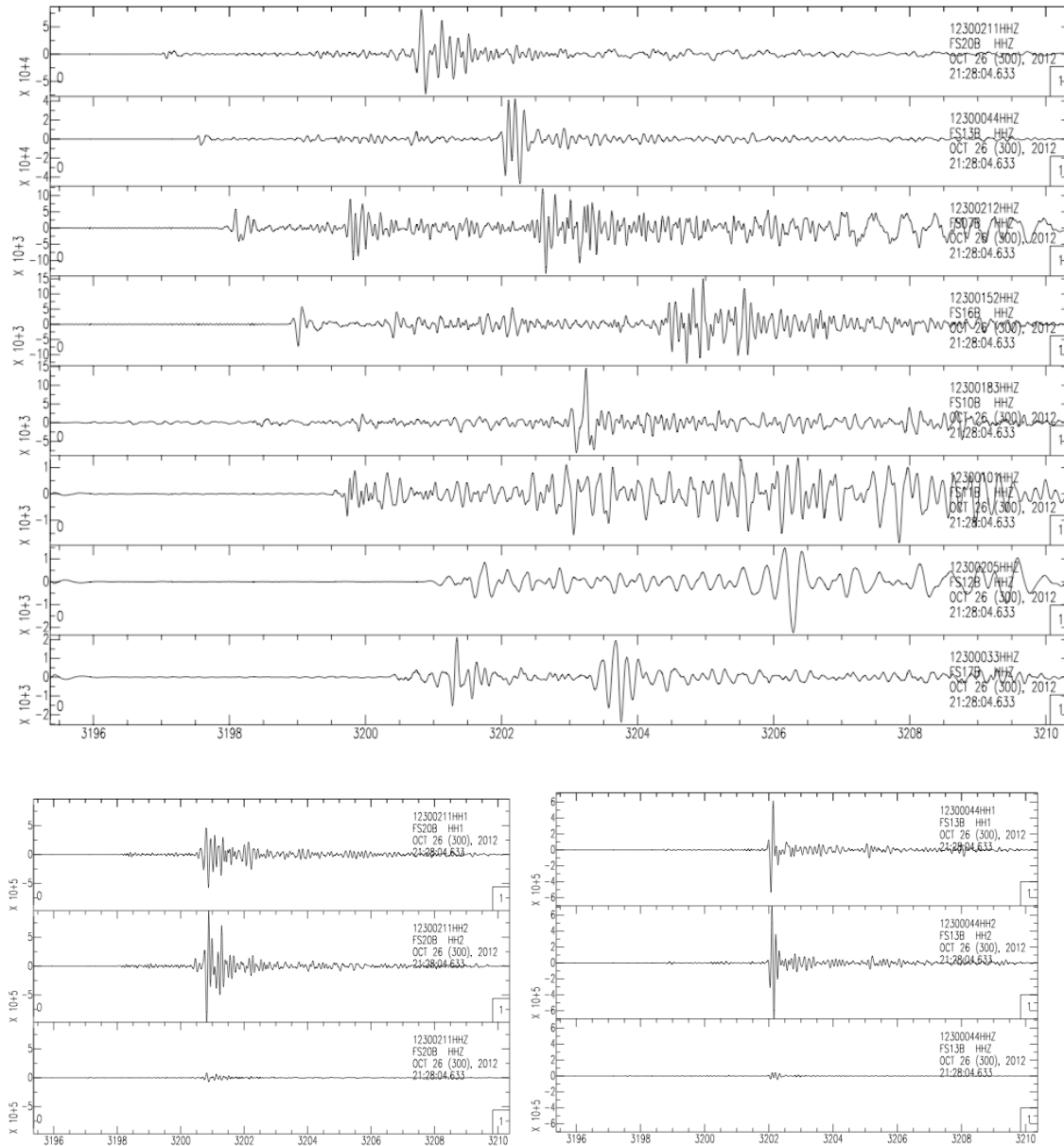
At 17:02 GMT (10:02), just after passing the third waypoint given above, we slowed and launched an XBT and acquired data to a depth of 1850m. Afterwards we began transit to port, passing over Hydrate Ridge on the way to Astoria.

### **Day 14, July 8, 2013 (JD 188-189)**

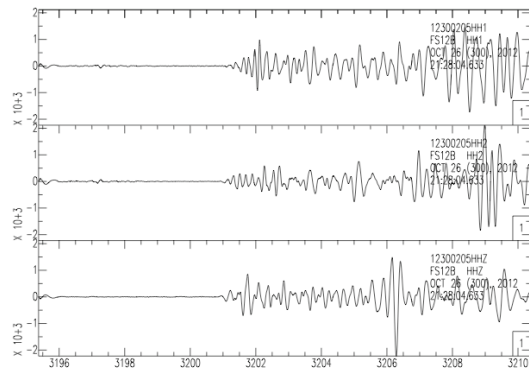
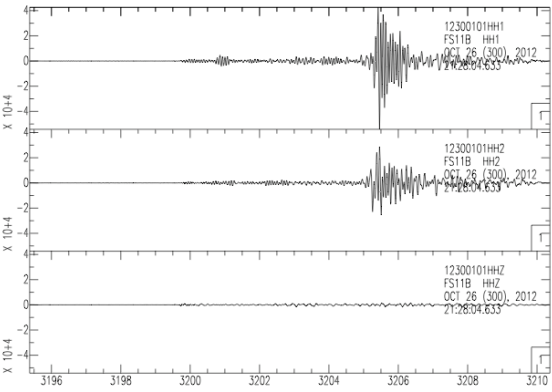
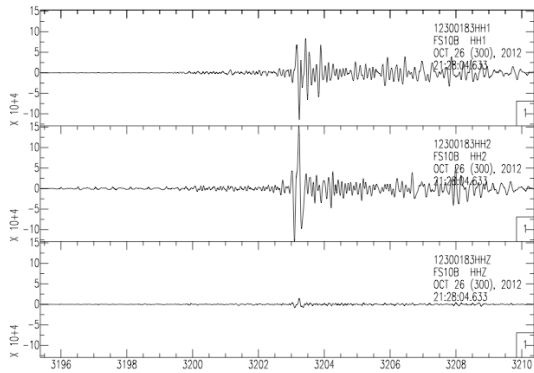
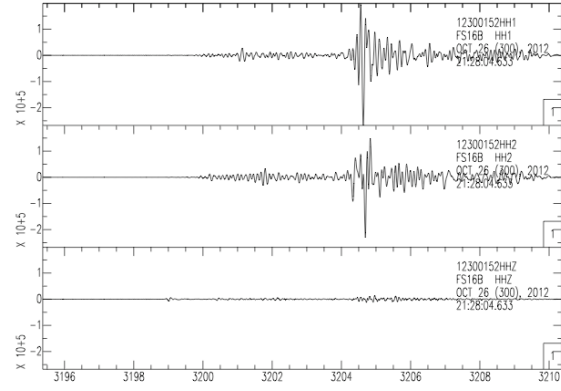
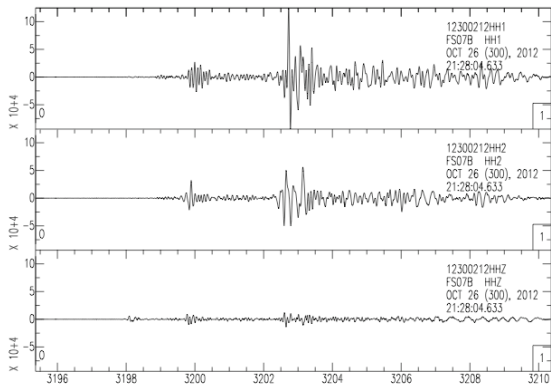
We arrived at the summit of South Hydrate Ridge at 04:22 GMT and spent ~2 hrs on sites recording the acoustic signature of venting in the water column. An XBT was acquired at 06:22 GMT at 44° 34.366', -125° 08.631'. We then moved to North Hydrate Ridge, arriving there at 07:22 GMT. We deployed another XBT at 09:42 and resumed transit to Astoria at 10:30 GMT. We met the pilot at 19:06 GMT (12:06 PDT).

## Examples of data:

An overview of data recovery was given in Table 2. The following figure shows the Z component from a local earthquake on the Mendocino transform fault recorded on 8 of the stations of the focused array scaled to the maximum amplitude in each trace. This is followed by the Z, H1 and H2 for each of these instruments with all three components plotted with the same scale factor. All OBS data will be available from the IRIS DMC.







### **Cascadia 2013 Leg 3 Broader Impacts:**

**URI-hosted museum and aquarium outreach—‘telepresence:’** Education and Outreach efforts for Leg 3 2013 (AT26-02) included live broadcasts to museums and aquariums around the country as organized by the University of Rhode Island Graduate School of Oceanography Inner Space Center (ISC for short) and the Ocean Exploration Trust. While in port in Woods Hole Atlantis was outfitted with a van on the O2 deck with a satellite tracking dish atop capable of broadcasting streaming HD video. Science party member Mike Durbin of URI managed this dish and the 10 Mb (outbound) and 512 Kb (inbound) network connection it provided. Cabling was run between this van, the Jason control van and the bow end of the main lab, providing live feed of the Jason dive composite image (configurable) and that from a high quality Canon HD video camera hung from the main lab ceiling. A console was mounted at the front of the main lab that allowed switching of audio signals from both vans (satellite and Jason), as well as two-way audio communications with ISC production facilities and studio, the URI phone system, and outreach sites equipped with appropriate facilities. Jason composite video or a feed from a laptop computer hosting Skype were fed to a 56” LED monitor mounted on the front wall of the main lab. Thus an ‘outreach studio’ comprising the Canon camera, the console electronics, and the 56” monitor was established at the front of the main lab.

We also established Skype communications with a laptop connected to the 56” monitor via the ship’s wireless video camera monitor network. Thus we were able to host Skype shows from on deck using an iPad, near wireless hotspots, and transmit the imagery to the laptop, project it onto the 56” monitor, and stream that off-ship via the Canon camera HD feed to the ISC satellite feed.

Thus equipped, Greg Mulder, Jonas Cervantes and Dean Livelybrooks organized our hosting of ~10 minute ‘shows’ to:

- The Mystic Aquarium in Connecticut
- The Houston Museum of Science
- The Texas State Aquarium
- The Aquarium of the Pacific in Long Beach, CA

A table of these shows can be found below. Those named above, along with members of the science party (students, Anne Tréhu, Jason crew member Jefferson Grau, LDEO engineers David Gassier and Carlos Becerril all took turns hosting these programs and answering questions live from audiences at the sites named above. As the camera feeds from Jason and the main lab were (more-or-less) live 24/7, we hosted programs for those viewing the live internet broadcast (on the web) during events such as Jason dives and other recoveries. Some of these were hosted partially in Spanish, French and German.

All science party members contributed photos and movies shot during the cruise to a digital library. Contents of the library were replayed on a large LCD screen hung in the front of the main lab and within view of the ceiling camera mentioned above. These,

along with Google Earth and other figures were used to explain our particular mission, some of the Earth science at play in Cascadia, and our scientific goals. The ‘CC@Sea’ participants Domer, Cervantes and Mulder also made informative videos from contributed clips, including a powerpoint that gave information about the Linn-Benton ROV club and the MATES ROV competition.

**CC@Sea students** also conducted and recorded interviews of various crew, including Grau (about manned submersible Alvin, which was on board) and Chief Mate Crane. These have been made into a video which is in post-production, and made into posters, copies of which will be placed at Portland Community College campuses (where Domer is enrolled), at the Linn-Benton CC main campus (Cervantes and Mulder), and at the OSU and UO campuses in appropriate places. We will organize for CC@Sea student Domer and Cervantes to give talks about their CC@Sea experiences to core science courses at PCC and LBCC this coming year.

**Embedded Reporter:** University of Oregon reporter Matt Cooper also accompanied the cruise, interviewing members of the science party, observing Jason dives from the control van, recording videos of various cruise activities, and writing, daily, a column for the UO web site AroundtheO about his experiences. Cooper also coordinated interviews and information for use by external agencies, including the Discovery Channel of Canada and Oregon Public Broadcasting.

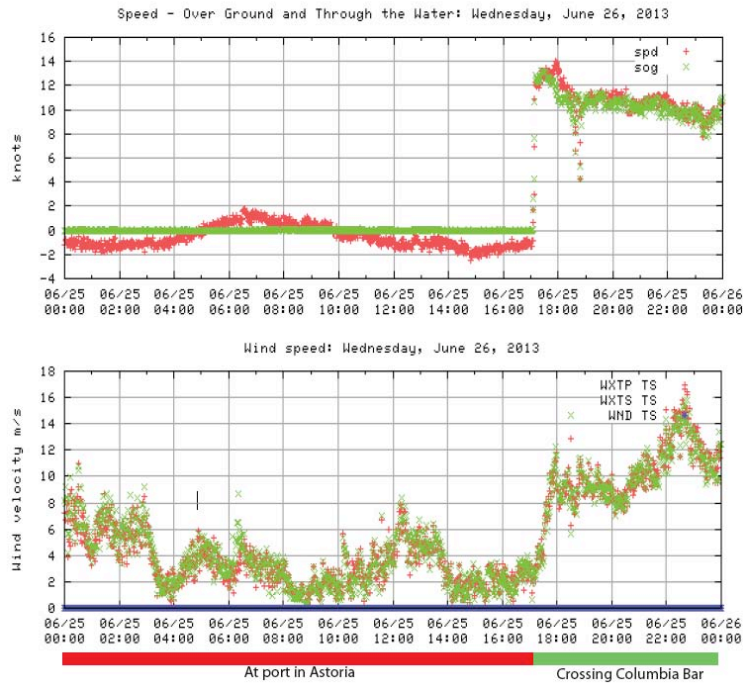
**Apply to Sail:** A number of students and faculty from elsewhere participated in the cruise, including OSU Marine Science REU intern Elizabeth Davis, IRIS undergraduate intern David Clemens-Sewall, OSU graduate student Bridget Hass, and ‘apply-to-sail’ participants Lexine Black (incoming graduate student at Cal State Northridge), Katie Kirk (marine engineering student at WHOI and Cornell), Anton Ypma (graduate student at Western Washington Un.) and Samantha Bruce (instructor at the College of Charleston). Columbia University undergraduate engineering student John Clapp and K-12 teacher Jennifer Granich participated as members of the Lamont-Doherty OBS group. Students stood regular 4-hour watches twice daily, maintained an accurate log of cruise activities, worked in the Jason control van during dives, assisted the LDEO OBS group with instrument deconstruction and refurbishment during the cruise, took video clips and pictures for the common good, made figures illustrative of cruise logistics, and generally assisted the chief scientists.

#### **Data access:**

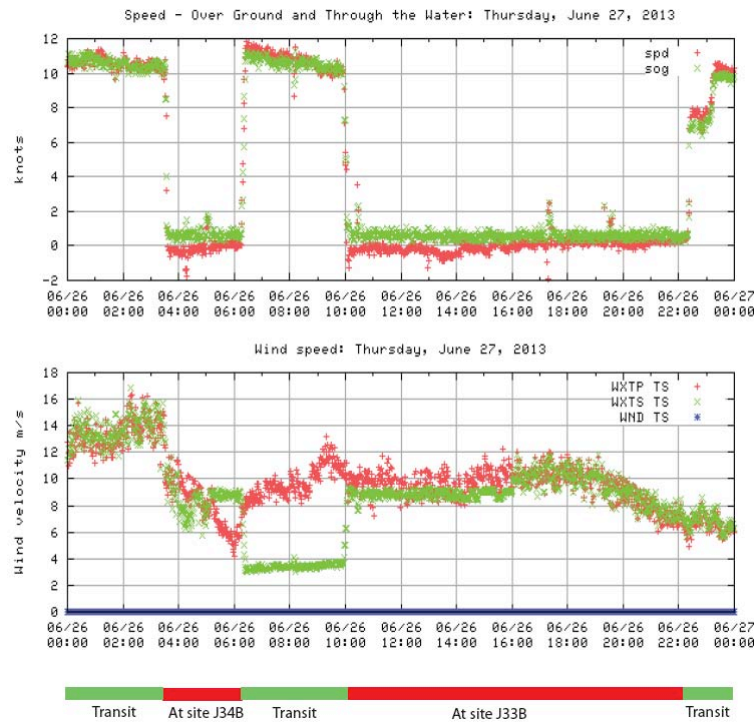
All OBS data will be available from the IRIS DMC by fall 2013. Other data (navigation, meteorological, acoustic doppler current profiler, EM122, cruise log) are available from the R2R data repository. A digital copy of this report is also available there.

**Appendix 1: Ship's speed and wind speed. Bar at the bottom of each plots shows activity during that time period.**

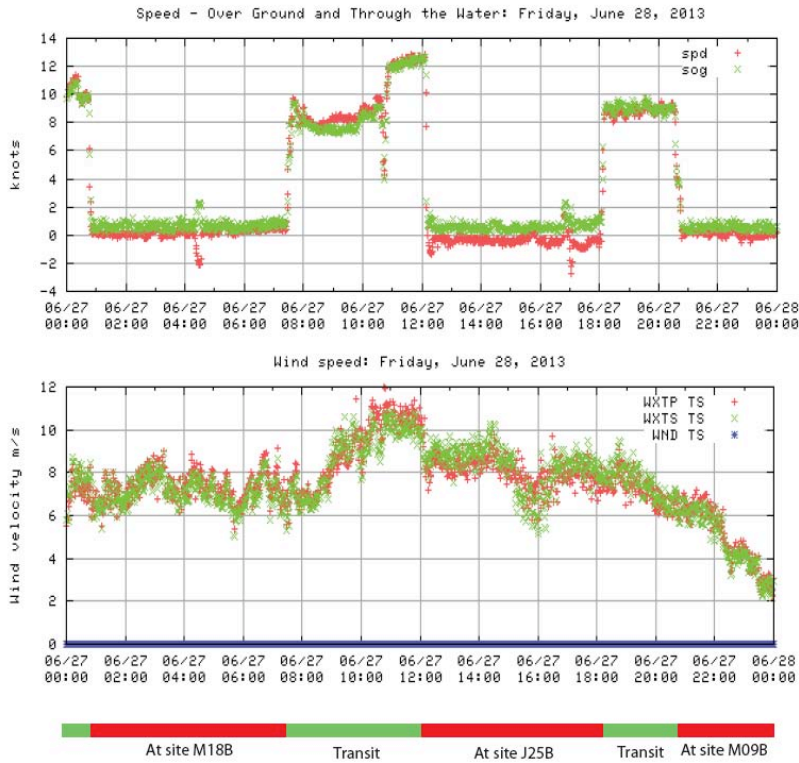
25 June 2013



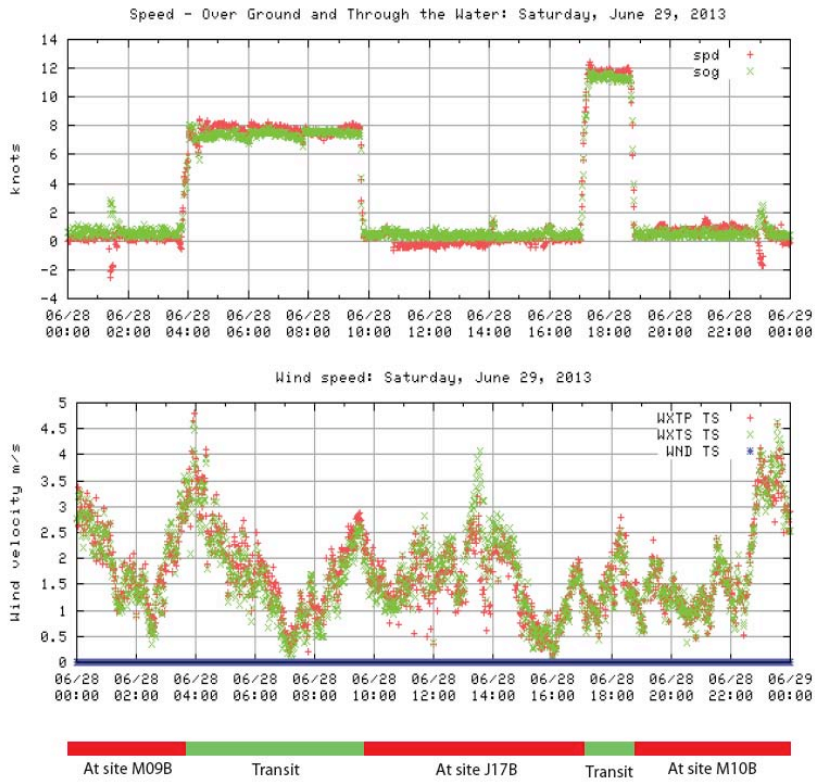
26 June 2013  
JD 177



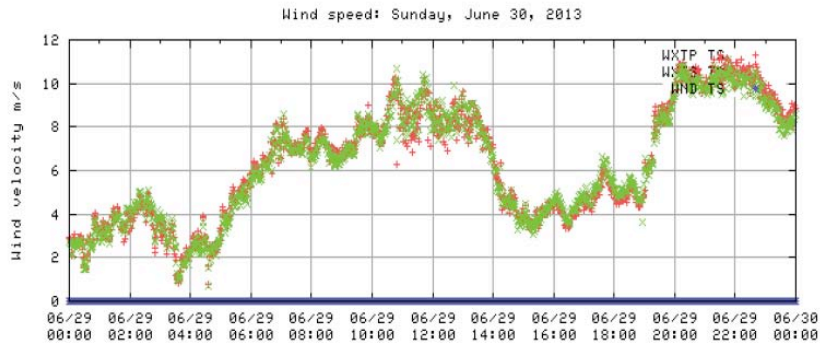
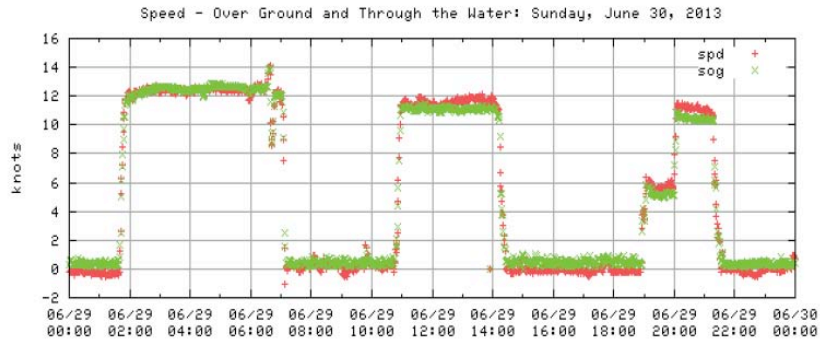
27 June 2013  
 JD 178



28 June 2013  
 JD 179

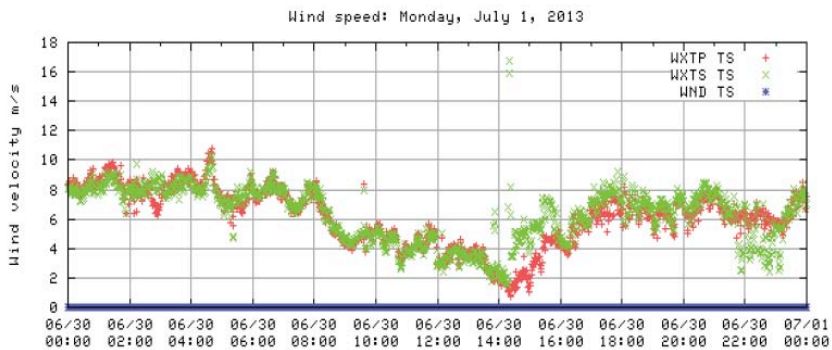
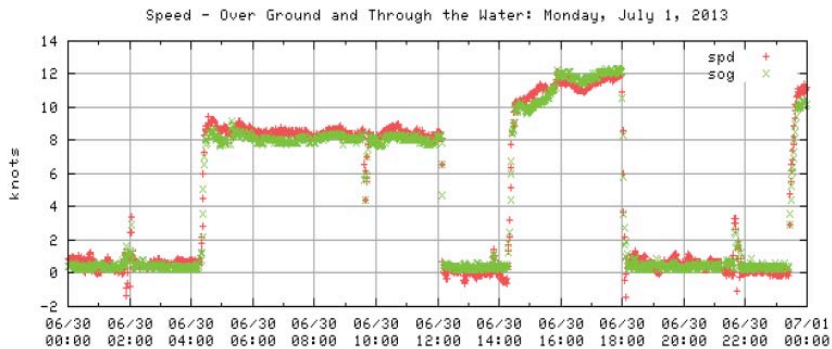


29 June 2013  
 JD 180



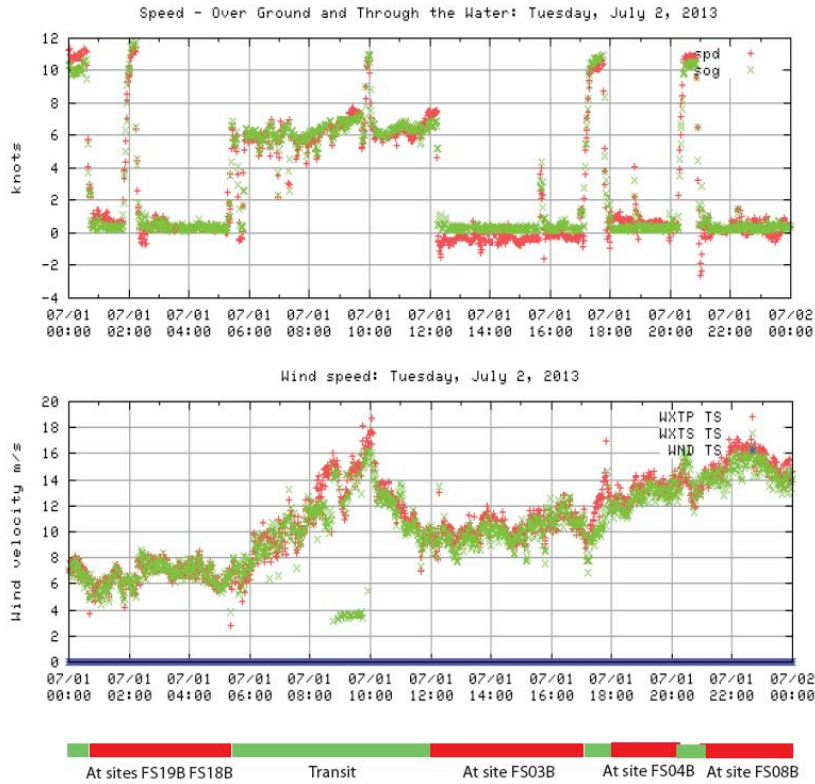
At site M10B    Transit    At site G33B    Transit    At site G25B    Transit    At site M13B

30 June 2013  
 JD 181

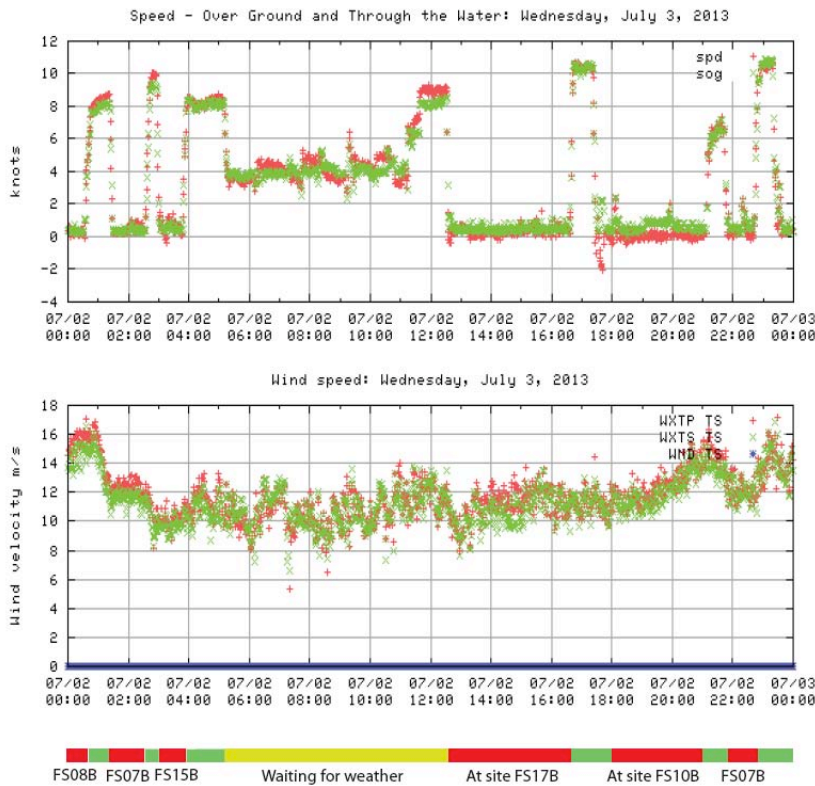


At site M13B    Transit    At site G17B    Transit    At site G09B

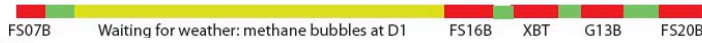
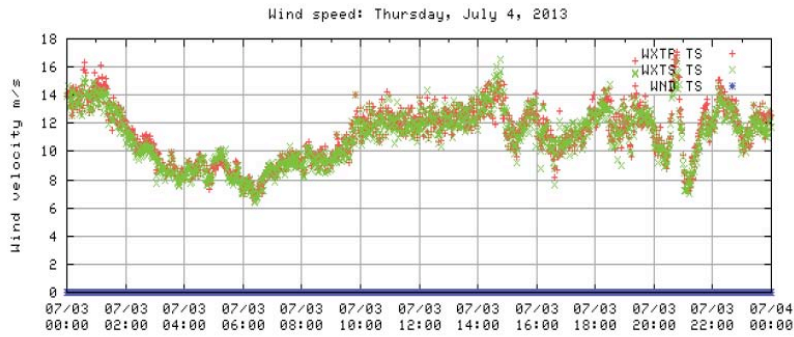
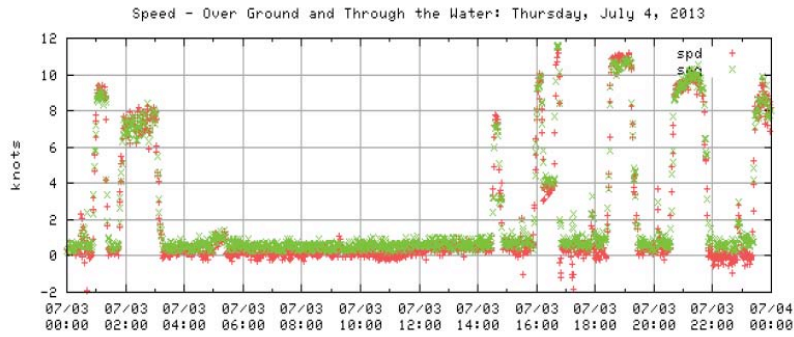
1 July 2013  
JD 182



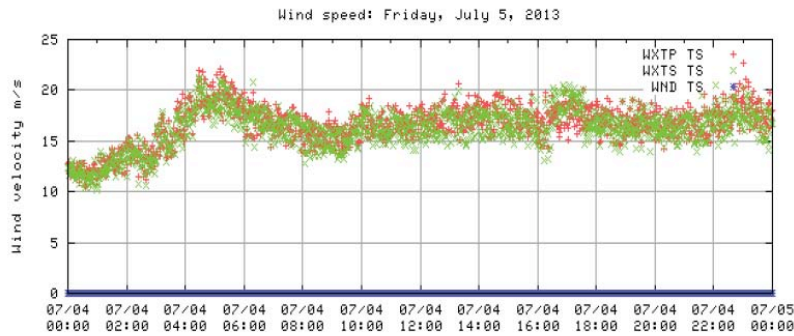
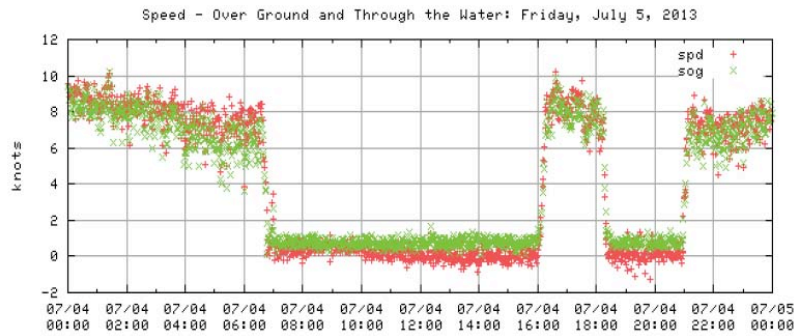
2 July 2013  
JD 183



3 July 2013  
JD 184

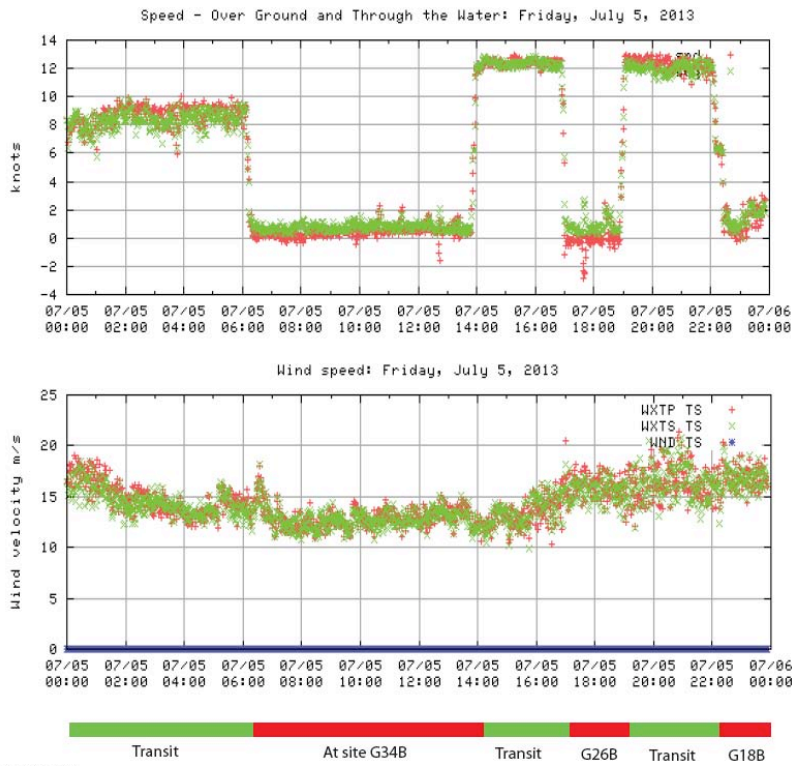


4 July 2013  
JD 185

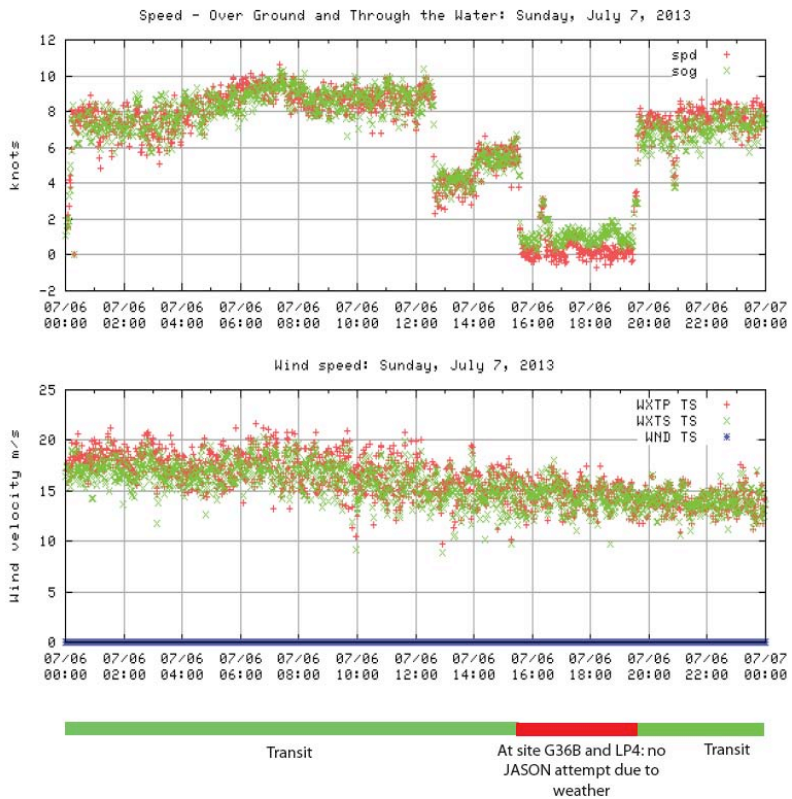




5 July 2013  
JD 186

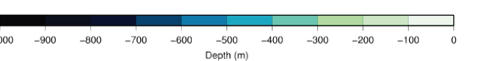
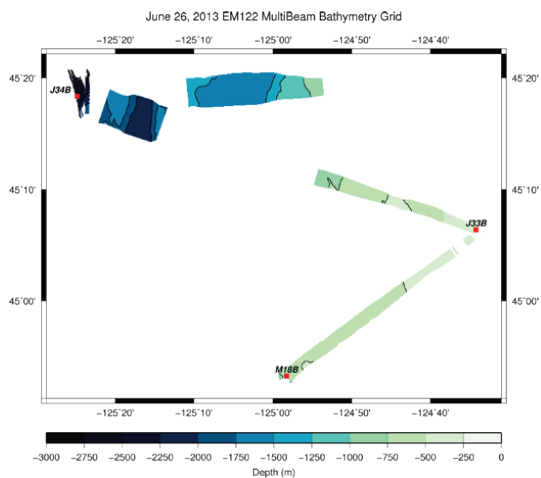
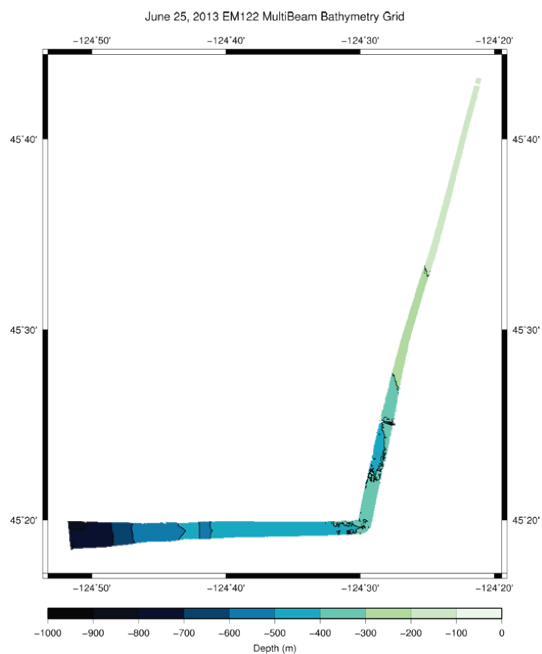


6 July 2013  
JD 187

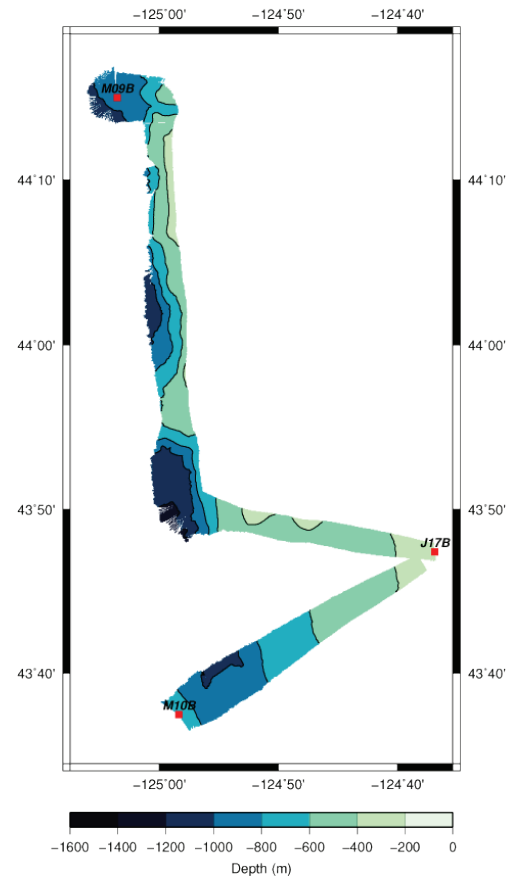




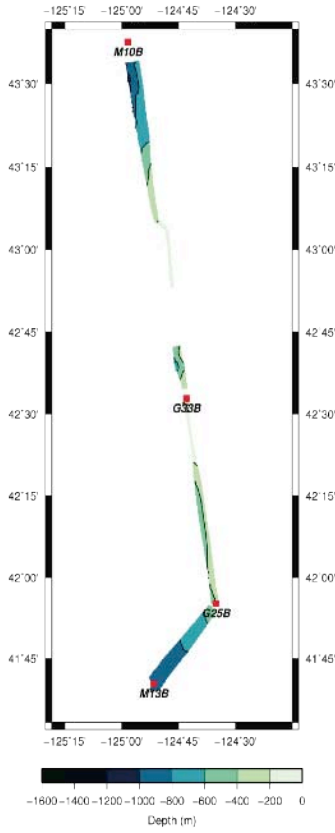
Appendix 2: Daily EM122 bathymetric grids (generated with MBsystem).



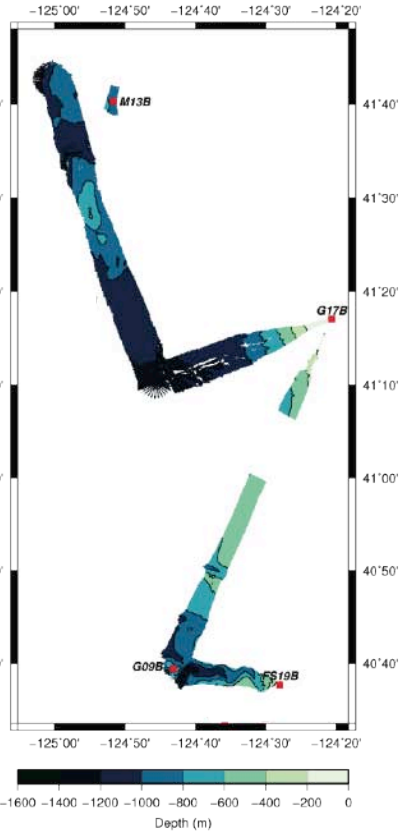
June 28, 2013 EM122 MultiBeam Bathymetry Grid



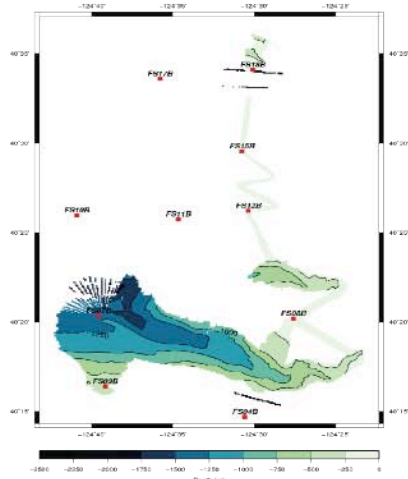
June 29, 2013 EM122 MultiBeam Bathymetry Grid



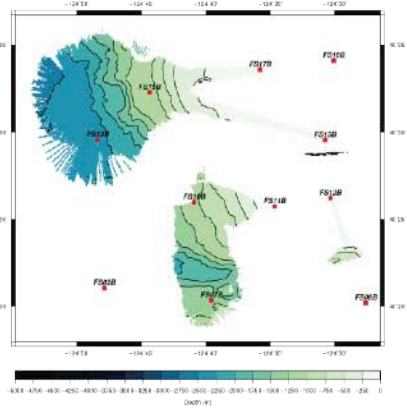
June 30, 2013 EM122 MultiBeam Bathymetry Grid

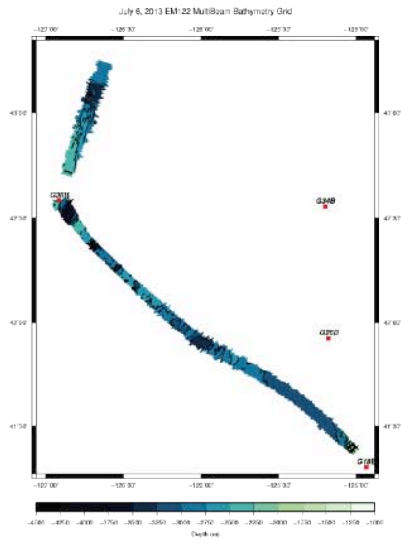
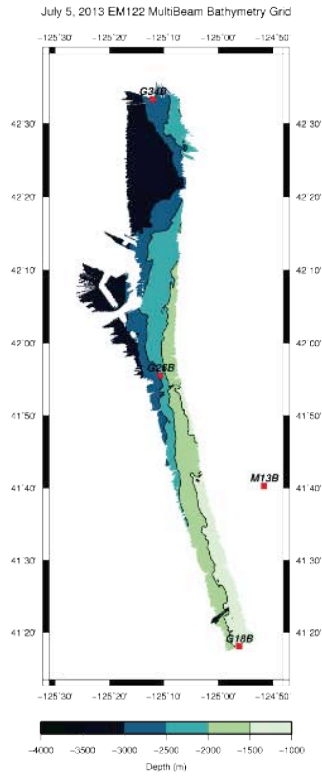
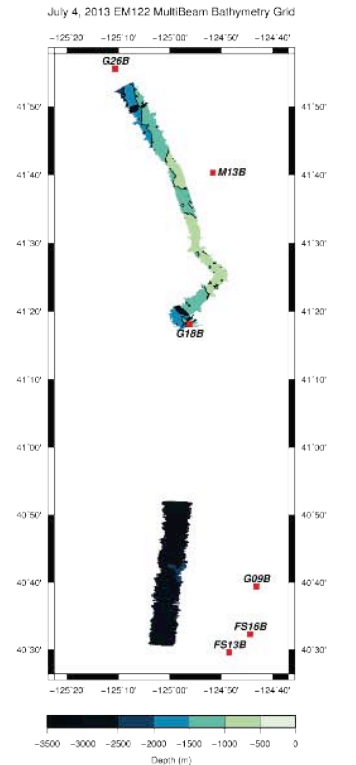
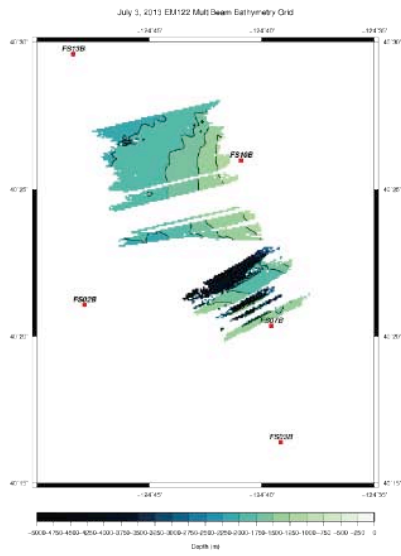


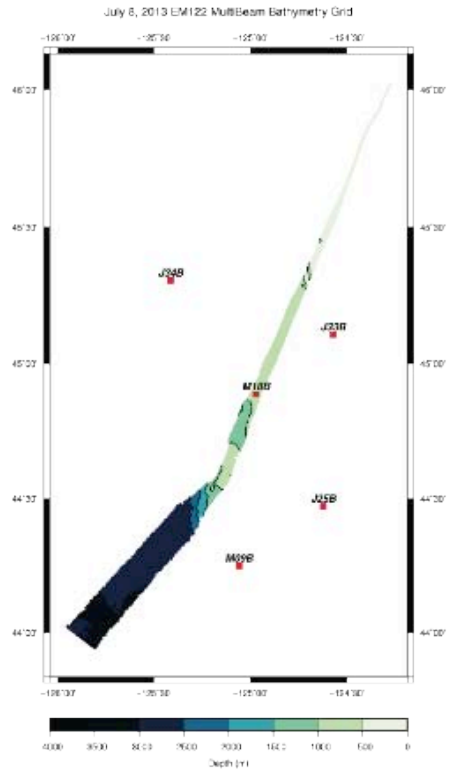
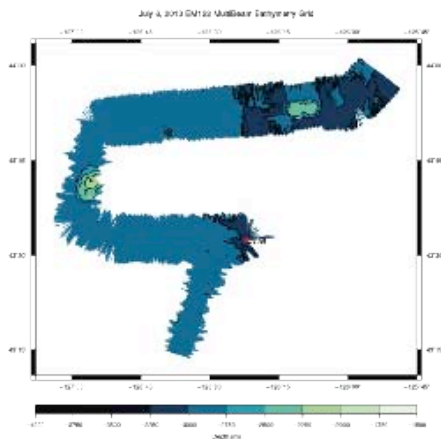
July 1, 2013 EM122 MultiBeam Bathymetry Grid



July 2, 2013 EM122 MultiBeam Bathymetry Grid

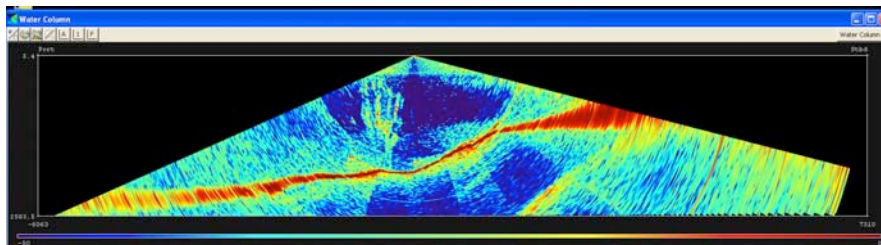
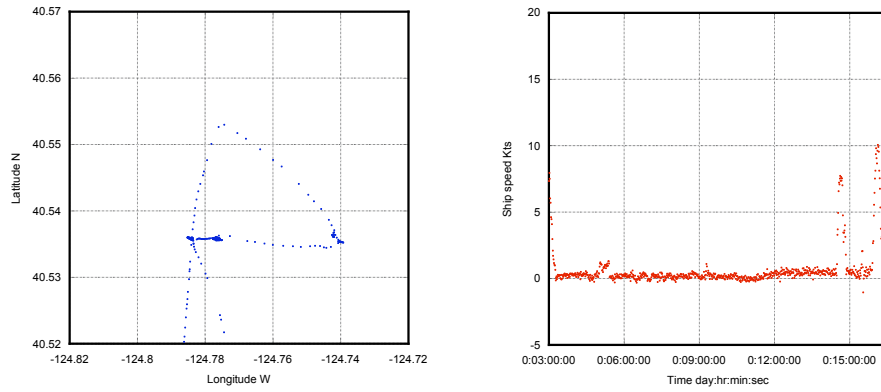




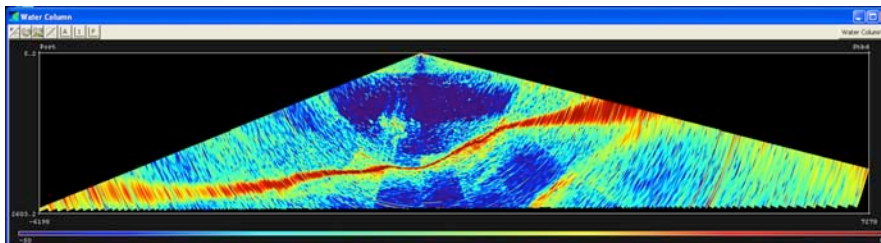


**Appendix 3: Examples from the acoustic water column survey over a previously discovered plume on the outer slope of the Eel River basin.** The map at upper left shows the track line. Map at the upper right shows ship's speed. The three panels are screen grabs from different times and show changes in the plume with time.

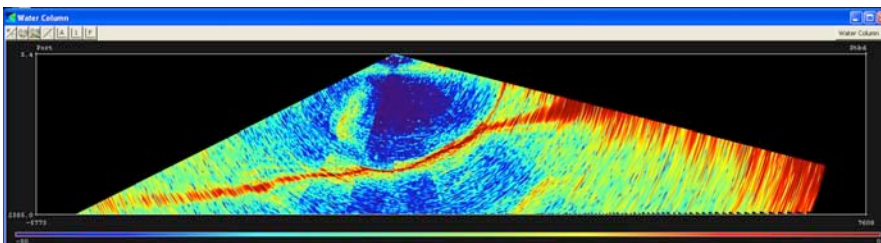
Vent time series from EM122 data, AT26-02, July 3, 2013



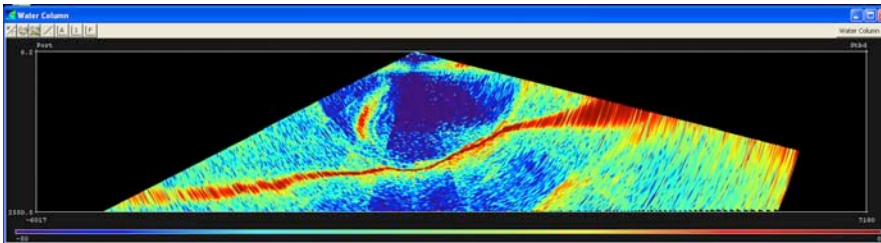
hr:min  
05:30



07:00



14:14



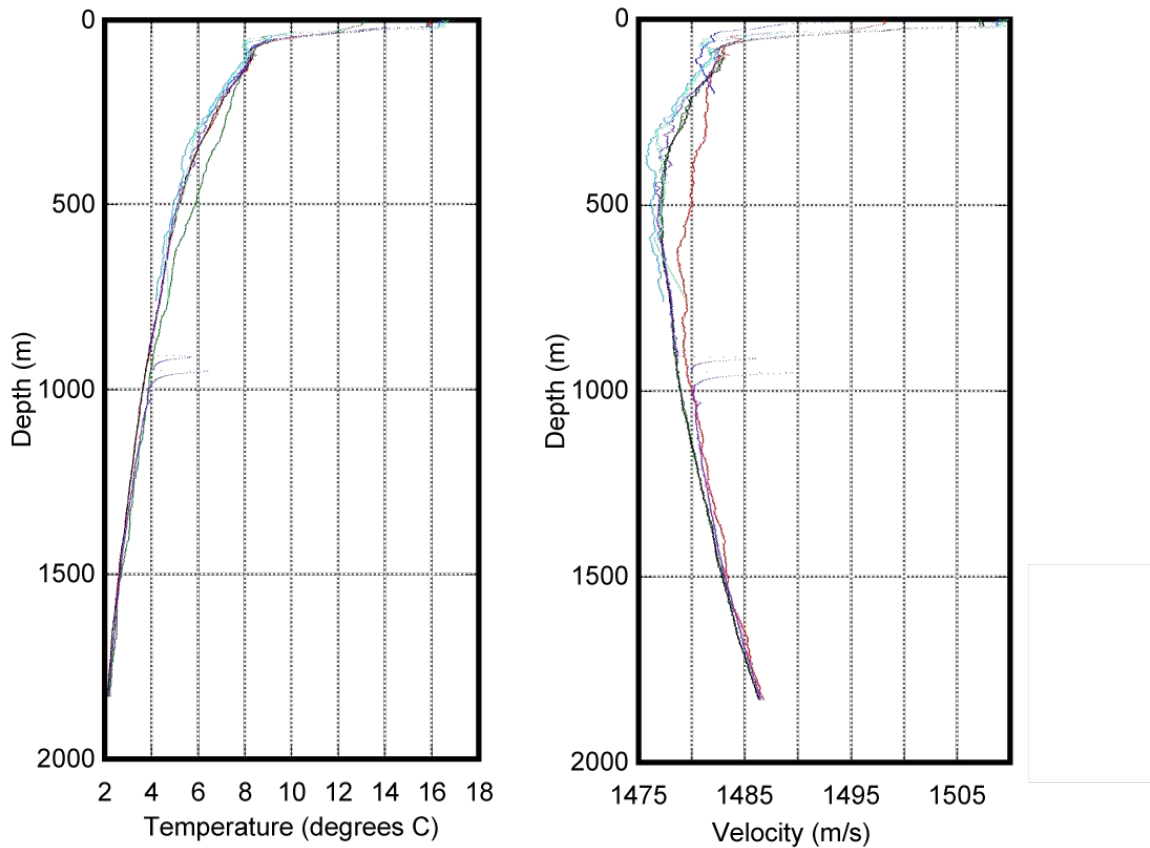
14:19

## Appendix 4: XBT data.

Table showing time and location of XBTs:

cast #	GMT date	GMT time	filename	Latitude	Longitude	Lat degrees	Lat minutes	Lon degrees	Lon minutes
1	6/30/13	12:18	T0_00001, T0_00001.rdf	41.284187	-124.34387	41	17.05122	124	20.6322
2	7/3/13	16:21	T5_00001.edf, T5_00001.rdf	40.544067	-124.752397	40	32.64402	124	45.14382
3	7/3/13	16:29	T5_00002.edf, T5_00002.rdf	40.527817	-124.785105	40	31.66902	124	47.1063
4	7/7/13	17:02	T5_00004.edf, T5_00004.rdf	43.584317	-126.974532	43	35.05902	126	58.47192
5	7/7/13	17:10	T5_00005.edf, T5_00005.rdf	43.590233	-126.990232	43	35.41398	126	59.41392
6	7/7/13	23:08	T5_00006.edf, T5_00006.rdf	43.898927	-126.026832	43	53.93562	126	1.60992
7	7/8/13	6:23	T7_00007.rdf, T7_00007.edf	44.57279	-125.143825	44	34.3674	125	8.6295
8	7/8/13	9:43	T7_00008.rdf, T7_00008.edf	44.66675	-125.101045	44	34.3674	125	8.6295

Plot of XBT data.





**Appendix 5: Summary of Jason data.**  
(to be added)

## Appendix 6: Telepresence Log:

Telepresence session log

Date	Time (EDT)	Presenters	Audience	Notes	
7/2/13	12:20	DL	TSA	audio problems	TSA = Texas State Aquarium (
7/5/13	11:10	GM	Mystic		Mystic = Mystic Aquarium, M
7/5/13	12:10	GM	Mystic		AOP = Aquarium of the Pacific
7/5/13	13:00	DL/KK	AOP		Houston = Houston Museum
7/5/13	13:10	DL/KK	Mystic		
7/5/13	13:20	DL/DCS	TSA		DL = Dean Livelybrook
7/5/13	14:00	GM	AOP		GM = Greg Mulder
7/5/13	14:10	GM/JC	Houston		AT = Anne Trehu
7/5/13	14:25	DL/LB	Mystic		KK = Katherine Kirk
7/5/13	15:00	DL/LB	AOP		DCS = David Clements-Sewall
7/5/13	15:10	DL/DCS	Mystic		LB = Lexine Black
7/5/13	16:00	DL/DCS	AOP		JC = Jonas Cervantes
7/5/13	16:10	GM	Houston		HD = Haley Domer
7/5/13	16:25	GM/JC	Mystic		ED = Elizabeth Davis
7/6/13	11:10	GM/JC	Mystic		AY = Anton Ypma
7/6/13	12:10	GM/HD	Mystic		
7/6/13	13:00	GM/HD	AOP		
7/6/13	13:10	GM	Mystic		
7/6/13	13:20	GM	TSA		
7/6/13	14:00	GM	AOP		
7/6/13	14:10	DL/AT	Houston		
7/6/13	14:25	DL/AT	Mystic		
7/8/13	11:10	DL/ED	Mystic		
7/8/13	12:10	DL/ED	Mystic		
7/8/13	13:00	DL/ED	AOP		
7/8/13	13:10	GM	Mystic		
7/8/13	13:20	GM	TSA		
7/8/13	14:00	GM	AOP		
7/8/13	14:10	GM	Houston		
7/8/13	14:25	DL/AY	Mystic		
7/8/13	15:00	DL/AY	AOP		
7/8/13	15:10	DL/KK	Mystic		
7/8/13	16:00	DL/KK	AOP		
7/8/13	16:10	GM	Houston		
7/8/13	16:25	GM	Mystic		