Cruise Report

R/V Thomas G. Thompson
TN-283

Cascadia Initiative Year 2 Leg 2
July 10 – July 24 2012
Seattle, WA – Seattle, WA

Maya Tolstoy & Richard Allen
(Co-Chief Scientists)

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Executive Summary

The goals of TN-283 were to deploy 6 trawl resistant mount OBSs (TRMs) for year 2 of the Cascadia Experiment, and to recover 24 OBSs deployed in 2011, including 14 TRMs and 10 regular deep water OBSs. The goals were fully achieved with 100% recovery of the TRMs and OBSs, and deployment of all 6 TRMs to begin year 2 of monitoring (Table 1 & Table 2). In addition we recovered a WHOI D2 OBS that was part of an unrelated project and had been unresponsive on an earlier cruise. While underway we also collected EM302 Multibeam, 3.5 kHz sub-bottom profiler and ADCP data at all times except when holding station, and collected one CTD cast at a deep water OBS site. Additionally we were able to use ROV Jason to deploy 2 thermal blankets and a thermistor for an unrelated project at no cost (time or otherwise) to our expedition. All data, including the seismic data, underway data, and video and stills from ROV Jason, are immediately openly available. Two marine mammal observers on board collected data on marine mammal sightings (Appendix 3), which was particularly valuable because the R/V Langseth was also operating in the area at the same time. The cruise participants also included 5 undergraduate and 2 graduate students who participated as watch standers, and 2 marine tech interns, all of whom gained at-sea experience in marine geophysics.

Many of the TRMs were recovered or aided in recovery by ROV Jason, in keeping with their original design. The pop-up buoy system that was installed as a experimental approach for recovery of the shallowest instruments (< 300 m) had mixed results, and it is not clear that they will prove to be a reliable pick-up strategy for the future, though they save significant time when they work. To overcome problems that we had with ship heave during the 2011 deployment a 'heave-compensated' winch was borrowed from the UNOLS East Coast winch pool. Unfortunately this winch proved insufficiently responsive in constant-tension mode and was missing the motion reference (MRU) unit required for active heave compensation. To overcome this we tried deploying the TRMs in free fall mode with floats attached by a release that we recovered after the TRM landed on the seafloor. This overcomes the issues associated with heave when deploying on a wire and worked well. However, the free-fall method also has drift associated with it that makes precise positioning more difficult when fishing concerns require exact deployment locations.

Very preliminary assessment of the data quality (Appendix 1) suggests that the design of the TRMs was effective in reducing shallow water current noise, and the 100% recovery rate suggests they were successful at preventing trawl damage of removal. At least one TRM show signs of having a trawl net pass over it, and later analysis of the data should help clarify this.

Given that this was the first deployment of this new instrument design, and that the construction timeline was compressed by a community desire to have them deployed for the quiet summer months last year, the first year's deployment was very successful. The use of Jason also provided an invaluable opportunity to directly observe TRM emplacement and recovery and to refine the instrument design and deployment procedures for future experiments.

Captain & Crew R/V Thompson:

Captain: John K. Wilson
Chief Engineer: Terrence S. Anderson
Chief Mate (a): Russel D. De Vaney
Chief Mate (b): Benjamin J. Elison
2nd Mate: Thomas G. Drake
3rd Mate: Matthew J. Skelley
1st Engineer: James T. Swanton
2nd Engineer: Christina A. De La Cruz
3rd Engineer: Sacha
Steward: Frank D. McBriar
2nd Cook: India M. Grammatica
AB: David L. Philbrick
AB: Frank L. Spetia Jr.
AB: Dana E. Africa
AB: Michael L. Hansen
AB: Dave M. Yurina
OS: Paul H. Benecki
OS: Jason S. Moore
Oiler: Pete A. Kriesa
Oiler: Jacob R. Halvorson
Oiler: Pamfilo P. Igama
Wiper: Thomas G. Wicker

Science Party:

Co-Chief Scientists:
Maya Tolstoy (LDEO)
Richard Allen (UC Berkley)

Marine Tech
Brandi Murphy (UW)
Tony Burke (UW)
Dolan Paris (MATE trainee)
Sammy Short (Coast Guard trainee)

OBS Team:
Andrew Barclay (LDEO)
David Gassier (LDEO)
Vince Otelu (LDEO)
Ted Koczynski (LDEO
Geetika Kapoor (LDEO)
Jennifer Granich (LDEO)

ROV Jason Team:
Matthew Heintz (WHOI)
James Varnum (WHOI)
Benjamin Tradd (WHOI)
Korey Verhein (WHOI)
Baxter Hutchinson (WHOI)
Frederick Denton (WHOI)
Lisa Borden (WHOI)
Wayne Roberts (WHOI)
James Pelowski (WHOI)

Graduate Students:
Cheng Cheng (UC Berkley)
Natsumi Shintaku (Brown Univ.)

Undergraduate Students
Hanna Asefew (Columbia Univ.)
John Clapp (Columbia Univ.)
Caitlin Dieck (Columbia Univ.)
Dale Gump (Columbia Univ.)
Astrika Wilhelm (Barnard)

Navy Representative
Jake Rhodes (SAIC)

Marine Mammal Observers
Barry Troutman
Adrianne Akmajian

1) Introduction

Leg TN-283 aboard the R/V Thomas G. Thompson was the second recovery leg and first deployment leg of the 2012 phase (year 2) of the Cascadia Initiative, a community experiment funded by the National Science Foundation.

Objectives for the cruise were to recover 14 LDEO-OBSIP trawl-resistant mounted OBSs (TRM-OBSs) and 10 regular LDEO-OBSs deployed in 2011 as the first stage of OBS deployments of the on-shore/off-shore seismic and geodetic Cascadia Initiative, and to deploy 6 TRM-OBSs as a start of the Year 2 monitoring for the Cascadia Initiative. See the following website for details of the year 1 & 2 plan and for more information about the Cascadia Initiative: http://pages.uoregon.edu/drt/CIET/

The cruise represented the first recovery of the TRM-OBS instruments in regular at-sea circumstances and as such it was partially a test cruise. Much was learned in the first few days about the best way to recover the new instrument design. Both the techniques and recovery efficiency improved considerably over the first few days of the cruise. Seas were not as good as last year with 1-3 meter swells for the first week or more of the cruise, but with calmer seas, particularly in the last few days aided completion of work and we arrived back at port one day early.

The cruise participants included a class of 5 Columbia University undergraduates who were on the cruise as part of a "Sea-going Experience in Earth Sciences" class (taught by Tolstoy in Spring 2012), and they kept a daily blog of cruise activities: http://blog.ldeo.columbia.edu/diebold-2012/. One of them (Dale Gump) also kept his own blog: http://www.travelblog.org/Bloggers/Buffalojunkie/. In addition, the two graduate students on the trip prepared daily updates for the CIET website which can be found at: http://cascadia.uoregon.edu/CIET/leg-2-july-10-july-24-2012-rv-thompson#Cruise_Narrative

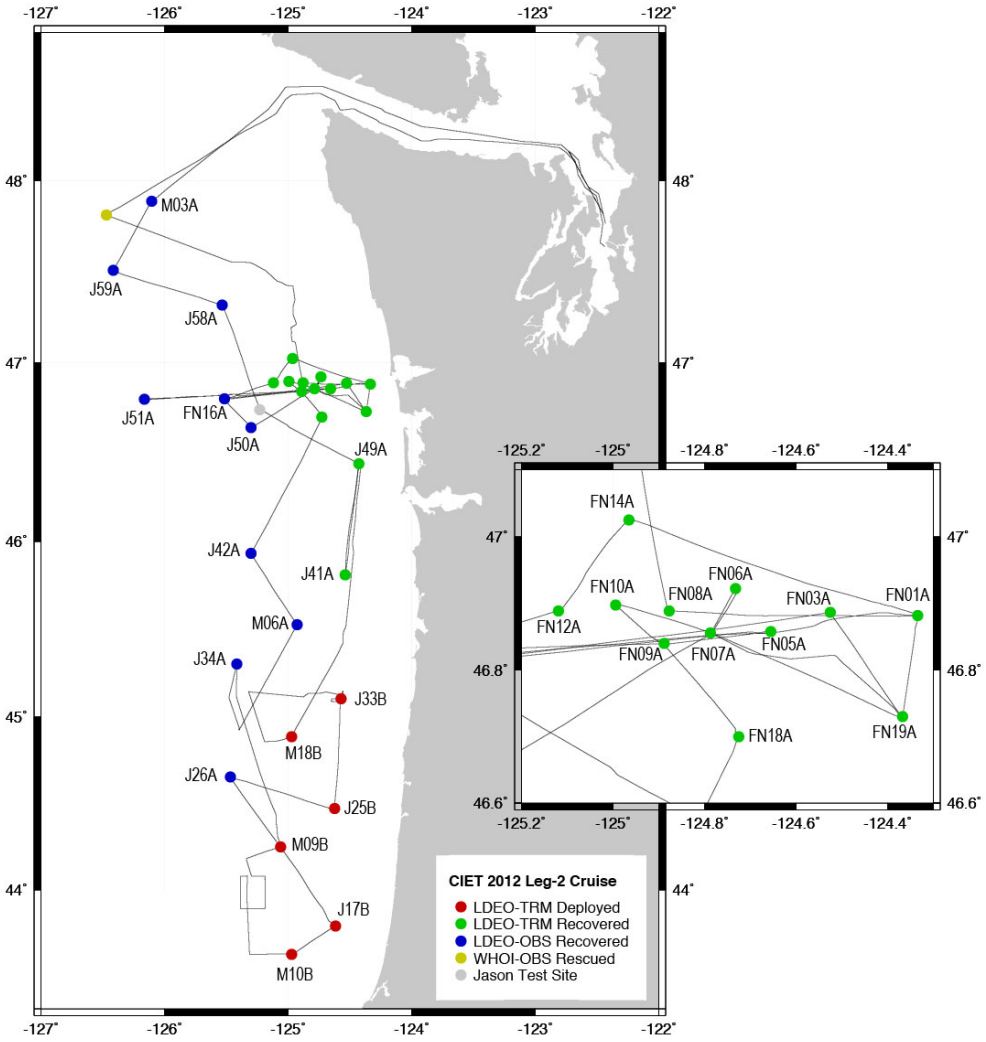


Figure 1. Map showing the locations of the OBS and TRM instruments deployed and recovered during the cruise along with the ship track. Deviations from direct paths between station sites were to collect additional "underway" data as the schedule allowed.

The format of the cruise report is daily reports based on local times, but recoveries, deployments and other events are reported in UTC (Zulu) time.

Underway data
We collected 12 kHz EM302 multibeam, 3.5 kHz Knudsen sub-bottom profiler, and adcp data while we were underway. These data are not featured in this cruise report, but are available through R2R. As data collected as part of a community experiment all these data are considered open immediately. See Figure 1 for track information.

2) Deployment site selection

For the six TRM deployments three were new sites, selected for year 2 and three were reoccupation of year 1 sites. All were originally selected through a series of community meetings. Of the 3 sites being reoccupied, 2 (J33B and J25B) were positioned in essentially exactly the same place, with ~3 days of overlap with the year 1 SIO-Abalone instruments already on site. The third "reoccupation" site could not be placed in exactly the same location as the year 1 instrument (M07A) was a deep-water OBS deployed at 1351m depth, and the year 2 TRM instrument had a maximum depth capability of 1000m. The year-2 instrument site was therefore moved eastward by ~11.5 km to shallower waters and given a new name (M18B). Exact site locations were refined based on advice from the fishing community (see Appendix 2).

The locations of the final deployment sites are provided in Table 1.

3) Daily Logs

Tuesday July 10th, 2012

Left the dock at 08:30 local (15:30 Z) and spent the day steaming toward the recovery site.

Wednesday July 11th, 2012

Recovered 3 regular LDEO-OBSs at sites **M03A, J59A & J58A**. Recoveries were quick and efficient, with immediately acknowledgements and releases and good ship handling ensuring recoveries only took 1-2 hours. **M03A** at ~1798m water depth was released at 08:44 Z and on deck by 09:44 Z. **J59A** in 2370 m of water was released at 12:31 Z and on deck by 13:48 Z. **J58A** in 1517 m of water was released at 17:33 Z and on deck by 18:25 Z.

All three instruments **M03A, J59A & J58A** had good data on all seismometer channels, and the APG, but no hydrophone data.

Jason needed to do some acoustic calibration of their navigation equipment in water at least as deep as we plan to go, and also do a dip test of Jason itself to ensure no shorts etc. were present following it's demob, shipping, mob cycle. We arrived at the chosen site (46.740762°N -125.227583°W) at 22:00 Z and began Jason operations. The elevator was deployed and navigation work began.

At the same time it was decided that we should practice deployment plans with the new winch-pool heave-compensated winch to be sure that its use was well understood. Unfortunately, after lowering the TRM over the side and just below the water line a large swell came through and the line broke just above the knot that had it attached to the frame. Post-mortem concluded that the knot weakened the line slightly (which had a breaking strength of ~14,000 lbs, with a TRM weight of 1,200-1,400 lbs), but was most likely due to the fact that the tension compensation was too slow and so actually made swell forcing worse by the time it worked.

The TRM was dropped right over the site of the Jason elevator so it was decided that when Jason went in the water it would look for and recover the TRM frame if possible.

Thursday July 12th, 2012

Once the navigation tests were complete, Jason went in the water at 08:50 Z (July 12th, Zulu) on dip-dive test J2-644, to look for the TRM, and to release the sea-bottom elevator that had been deployed for the testing. Jason was on the bottom at 09:40. The TRM was spotted at 10:13 Z. It had landed very close to the drop location and upside-down. In it's upside-down configuration it made a strong sonar target (Figure 2).

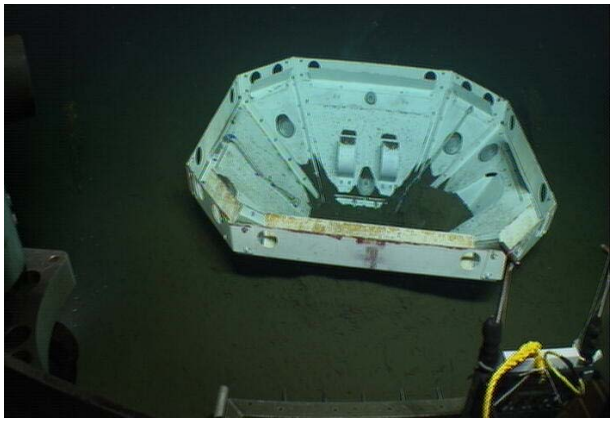


Figure 2. Upside-down TRM frame dropped unintentionally following line break during winch testing. Note the sediment piled up around the sides and in the center implies the TRM hit the ground with some force.

It had fallen almost straight down in the ~950 m of water, offset only by about 120 m from it's drop point, consistent with the ~150 m offset of the Jason elevator in the direction of the prevailing currents in the area. This is useful to know that when in

free-fall it does not kite (travel horizontally) significantly. Location was noted, but retrieval would require a second dive with the appropriate equipment (although with same dive number J2-644). Jason continued on to recover the elevator, and deployed a micro-mooring for Paul Johnson (thermistor) at 11:03 at 46deg 44.456'N, 125deg 13.744'W at a water depth of ~947m and a temperature of 3.721°C (see Figure 3).

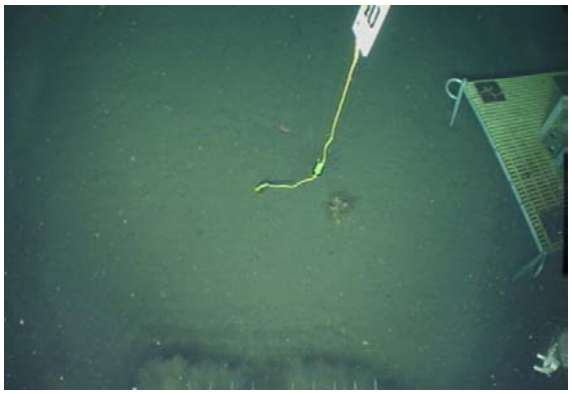


Figure 3. A micro-mooring with a thermistor was deployed for Paul Johnson (UW) to aid in interpretation of data from his thermal blankets being deployed next to two of our TRM sites. We were able to accomplish this ancillary deployment at no time cost to our cruise.

After returning to the surface to set up the recovery line, the TRM frame was recovered after some deft manipulator work by Matt Heintz (Figure 4) to attach a line. It was on deck by 11:03L (18:03Z) after retrieving Jason and Medea. Following this we transited to the first TRM recovery site, **J49A**.

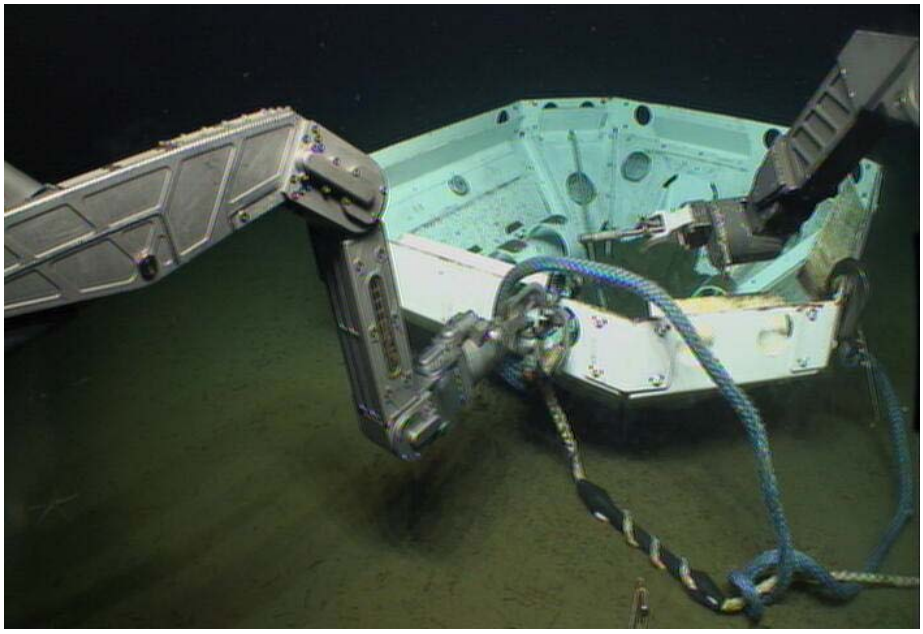


Figure 4. Jason hooking a line to the dropped TRM frame.

We arrived on site at **J49A** at 14:32 L (21:32Z) and began communication with the TRM. It responded immediately, a release command was sent and acknowledged, and we waited for the float to appear. However, it rapidly became apparent that the float not coming up as it should only take a matter of minutes given the shallow water depth (120m). After multiple attempts to release the buoy, it was concluded that we would have to send Jason down to inspect it. Jason was still some hours away from being ready to dive, so we decided to go south to **J41A** first and come back for J49A when Jason was ready. The pop-ups can only be recovered during daylight hours because of the line in the water and lack of light on the float, so we just had time to get down to **J41A**, another pop-up TRM, before sunset.

We arrived at **J41A** and immediately established communication at 18:51 L. The release command was sent at 19:12L when the ship had backed off 300m. The float was spotted at the surface within 3 minutes and recovery of the TRM on the line that the pop-up buoy had brought to the surface commenced smoothly. **J41A** was on deck by 20:24L, and we began the transit back to **J49A**.

Friday July 13, 2012

In the wee hours of the morning, Jason was deployed at **J49A** on dive *J2-645* to investigate why the pop-up acknowledged it had released, but never came to the surface. The TRM was spotted at 02:29L (09:29Z). A formal orientation was not attempted at this site, however, the Jason heading was 217 when approximately aligned with the TRM bail-bars as shown in Figure 5. What we found was a lot of biofouling on the release. Re-sending the release command while we were watching with Jason revealed that the latch was wiggling, i.e. it was receiving the release command and trying to release, but it was unable to open the latch sufficiently to release properly. A small tap with the Jason manipulator resulted in the release being immediately triggered and the TRM was then recovered using the line attached to the pop-up buoy. **J49A** was on the deck by 07:25L (14:25Z).

During the dive it quickly became apparent that the TRM had been deployed near a known 'hang' for nets (based on advice from the fishing community). We found the hang before the TRM, which was of unclear origin (possibly a large rock but it was covered in biology making it hard to tell). It was densely populated with fish and anemones and bacterial mat/dark goop. It was this same dark goop that was covering the release mechanism on the TRM and various other parts of it. The large panels on the TRM seemed to have resisted the biofouling well, whereas the corner panels seemed to have lost more paint. A large fish (grouper?) was seen exiting the top hatch of TRM, a large star fish was near the top, and a crab was observed in the release mechanism. Clearly there were substantial amounts of biology that had collected on and near the TRM and we expect that 'fish-bumps' and other biological noise might be considerable. Also the pop-up buoy was broken off the main frame and sticking out slightly, which may also explain why it was difficult to release. (Figure 5)

Figure 5. Grouper exiting the frame of **J49B**, and star fish crawling down the side (top left); biofouling (+crab) on pop-up release (top right); pop-up sticking out of main frame (possibly due to corrosion of brackets) (bottom left); pop-up line going straight up upon release with a cloud of bio-gunk. Note we did not formally orient this site, but the for the grouper shot, Jason was at a heading of 217 (errors larger than normal because care was taken for other measurements that the center of Jason was well aligned with the axis of the OBS – note picture can be deceptive because it varies dependent on how the camera was oriented)

Following recovery of **J49A** we transited to site **M18B** to deploy our first TRM. We were initially going to deploy **J33B** first to maximize the time it was operating adjacent to the SIO Abalone OBS at **J33A**. However, Matt offered to have Jason deploy **J33B** which would allow precisely positioning adjacent to **J33A**, but the ramp-up time for Jason meant it was more efficient to deploy site **M18B** first. We decided that the benefit of precise location using Jason outweighed a slightly earlier deployment.

M18B was deployed successfully and without incident using the winch.
M18B was in the water at 21:15L, and deployed on the seafloor at 21:40. It was located through OBSIP ranging software with final location of 44N 53.2267 124W 58.2703 (44.88711°N 124.97117°W) at a depth of 720m.

Saturday July 14th, 2012

We surveyed overnight at ~8 knots based on way-points provided by Chris Goldfinger. The survey ran from site **M18B** to survey waypoints 18 and 17, then cut into the northern line from 17, and went to 7 through 1 (see Figure 1). We then surveyed a box near and around site **J33B** to the south and east.

On site at **J33B** at 11:35L (18:35Z). Sent single disable command to SIO Albalone to confirm that it was still on site, and got weak response of possibly 3 pings. We did not send further pings because SIO were concerned about weak acoustics batteries.

The plan was to deploy the TRM by hanging it beneath Medea rather then on a direct line from the ship. Medea (on a wire from the ship) would then be moved into location guided by visuals from Jason, and the TRM lowered to the sea floor. The TRM was in the water at 13:14L followed by Jason (13:43L) and Medea (13:46L).

Figure 6. TRM at **J33B** (white blob to the left) and SIO Abalone **J33A** (yellow blob on right with red blob above it), positioned about 4 meters apart at the J33 site.

We could see immediately from the Medea downward looking camera that the TRM was tossing around fairly violently resulting from the vertical motion of the line resulting from the heave of the ship. This was resulting in it turning upside down on

several occasions. When it was first lowered to the seafloor as gently as possible by Medea it ended up upside down because it happened to be flipped at the moment of lowering (Jason had backed away to avoid potential damage). It was lifted slightly and quickly righted before being placed in the correct position on the seafloor, approximately 4 meters from the SIO Abalone (Figure 6).

We got orientations for both instruments at **J33** as per photographs below (Figure 7). The final location of TRM **J33B** as recorded by Jason is: 45°6.379905'N 124°34.248944' W (45.10633175, -124.570815733) at a depth of 350m. However, we recommend using the original SIO location (45.10662°N 124.57057°W), which is about 35m different, because we found Jason locations to be inconsistent later in the cruise.

Figure 7. Site **J33B** (TRM left) and **J33A** (Abalone right). TRM aligned with Jason on a heading of 066 (left) SIO – Abalone aligned with Jason on a heading of 333 (right).

Arrived on site at **J25B** at 03:40Z (July 15th) with OBS almost ready to go. However, after long conversation with Matt, it was decided that we would try an alternative method of deploying the TRM because of concern that it would deploy upside down as we saw happen on the previous dive. The concern is less for this site when we have Jason to right it, but we wanted to test a different concept for other sites where we don't plan to use Jason including the September 2012 deployment cruise when Jason will not be on board. We are concerned that regular winch deployments may end up upside-down, so a good alternative is needed.

Sunday July 15, 2012

After some trial and error we settled on a test deployment with ~1100 lbs of floatation in the form of glass ball floats strung together. These came from the already recovered regular OBSs (Figure 8). The string of floats was placed in the water first, followed by the attached TRM, which rapidly pulled the float string down to the bottom under free-fall. The TRM **J25B** was in the water at 08:53 Z at which time the ship's A-frame was located at 44.472598°N -124.621553°W.

A Jason dive commenced immediately (dive J2-647) and we discovered that the TRM had drifted ~100 m south of its drop location, which was rather remarkable given that it was only ~147 m of water. Jason was unable to lift and reposition the TRM, so it remained where it was, approximately 150 m south of the SIO Abalone OBS. An orientation of the TRM was recorded (Figure 9).

We then inspected the SIO Abalone deployed last year (**J25A)**, confirmed that it was in position and in good shape, and got a heading reading on it also to help with orientation of the seismometer (Figure 9).

Final location of TRM **J25B** as recorded by Jason is 44° 28.2756' N 124° 37.300' W (44.471267°N -124.621667°W). HOWEVER – later in the cruise we began to have doubts about Jason's navigation, so we recommend that this site is acoustically relocated on the recovery leg. Although we are concerned about the Jason-based location for J25B, J25A (the SIO Abalone) was where it was expected based on it survey location from last year and Jason's navigation. This means that the Jason-based location for J25B is probably good.

Figure 8: String of 11 single floats and six 4-pack floats strung together in a line and attached to the TRM deployed at **J25B** with an acoustic release.

Figure 9. Orientations for **J25B** (TRM left) and **J25A** (SIO Abalone right). When Jason was directly aligned with TRM J25B from the angle shown, it had a heading of 305. For SIO abalone J25A (deployed in 2011) it had a heading of 230 when aligned as shown. The TRM was located approximately 150 m to the south of the Abalone, and the overlap in recording period is anticipated to be several days starting on Sunday July 15, 2012.

Following deployment of **J25B** we recovered **J26A**, a deep water OBS. The OBS acknowledged the release on first attempt and on deck by 11:46L (18:46Z).

We arrived at site **J17B** to deploy our next TRM at 20:15L, which we deployed using the floats since the depth was relatively shallow, making potential drift less significant and exact location did not appear to be critical from a fishing perspective. This deployment method worked smoothly, and the final location was only about 80 m off from the drop location. This is potentially a good deployment method where precise positioning of the instrument is not required. Final ranged location of **J17B** was 43° 47.3973'N 124° 36.8851'W (43.78996°N 124.61475°W) at a depth of 286m.

Monday July 16th 2012

We arrived on site at **M10B** at 00:30L (07:30Z) and the TRM was in the water at 02:07L. This site was lowered by wire as precise positioning was required. The target location was atop a small high, and that we had been warned that we should deploy on the northern end as fishing nets had been hung on the southern end. Bathymetry from the multibeam proved to be critical in this position, since the position we had chosen based on geomapapp bathymetry proved to be on the southern end of the high. So the final position was a little north of the original planned position. The deployment on a line proceeded without incident. The heave of the ship had subsided significantly thanks to improved weather since the previous line-based deployments. Final ranged location for **M10B** is: 43° 37.4859'N 124° 58.3689'W (43.62477N 124.97282W) at a depth 675 m.

We then surveyed over night to give the OBS team a chance to get some sleep. Waypoints were provided by Chris Goldfinger and the track can been seen in Figure 1.

We arrived at **M09B** at 14:44L (21:44Z) for our final TRM deployment. The TRM was again deployed on a wire as precise positioning was needed based on fishermen recommendations, and proceeded without incident. **M09B** was deployed at 23:31Z at a depth of 914 m, with a final ranged location of: 44° 14.9802'N 125°03.5354'W (44.24967N 125.05892W).

Tuesday July 17th 2012

Overnight we recovered OBS **J34A** at a depth of 2577m, with the instruments on deck at 07:52Z. In the morning we recovered OBS **M06A** at a depth of 1436m, with the instrument on deck at 08:09 L (15:09 Z), and then moved straight onto OBS **J42A** at a depth of 1540m with the instrument on deck at 10:34 L (18:34 Z). All three OBSs released on first attempt. However, upon examining the data there appears to be a problem, to varying degrees, with all three, which was not observed on the previous 4 recovered. The problem appears to be related to sensor leveling and the fact that the burn wire didn't burn quickly enough to drop the sensor before it leveled. This led to varying degrees of problems with the sensor not being level and draining power as a result.

We arrived at the focused array site **FN18A** at 15:48L, and it immediately acknowledged the release when sent. The float was at the surface a few minutes later. However, during recovery the line snapped right down at the TRM as it was lifting off the sea floor. Large swells have made the ship's heave quite significant. Jason was deployed at ~20:00 to recover it (dive J2-648), and it was found upside down at 21:00L (~04:00Z 7/18/12). It was hooked and brought aboard at 23:08L (06:08Z). There was difficulty with the final step of getting the TRM on deck due to a deformed shackle on the bridle assembly that was used for recovery beneath Medea. One of the shackles had to be ground off during the recovery. An improved design was developed for the next Jason/Medea recovery.

Wednesday July 18th 2012

Recovery for **FN09A** began with Jason going in the water at ~01:30 L for dive J2-649, and finding the TRM at 02:52 L and hooking it at 03:29. At 03:42, as we were about 100 m off the seafloor waiting to bring it up the bridle holding the TRM to Medea snapped just below the splice, and so **FNO9A** fell back to the seafloor. Fortunately it's in an essential fish habitat so it was not a fishing hazard. This was fortunate as the swells were too high to continue recovery efforts. While we were on the seafloor with Jason, Medea recorded a vertical pull of 9m, implying a similar sized swell (~27 ft). We left site to go recover the regular deep water OBS **J51A** while we wait for the forecasted drop in swells this evening.

J51A, in 2618 m of water, released at 9:29L (16:29Z) on the first try, and was on deck by 10:55 L (17:55Z). Following recovery we did a **CTD** right at the site of **J51A** (46.79696N 126.16411W) to provide a deep water sound speed profile for the area,

and to provide a calibration for the temperature sensors on the OBSs (Figure 10). The forecast was for decreasing swells, so we decided to head back toward the focused array with the hope of bringing up a pop-up prior to Jason going in the water at 8pm (Jason is on a night ops schedule from 8pm-8am since the pop-ups can only be recovered in daylight because of the floating line and the unlighted float).

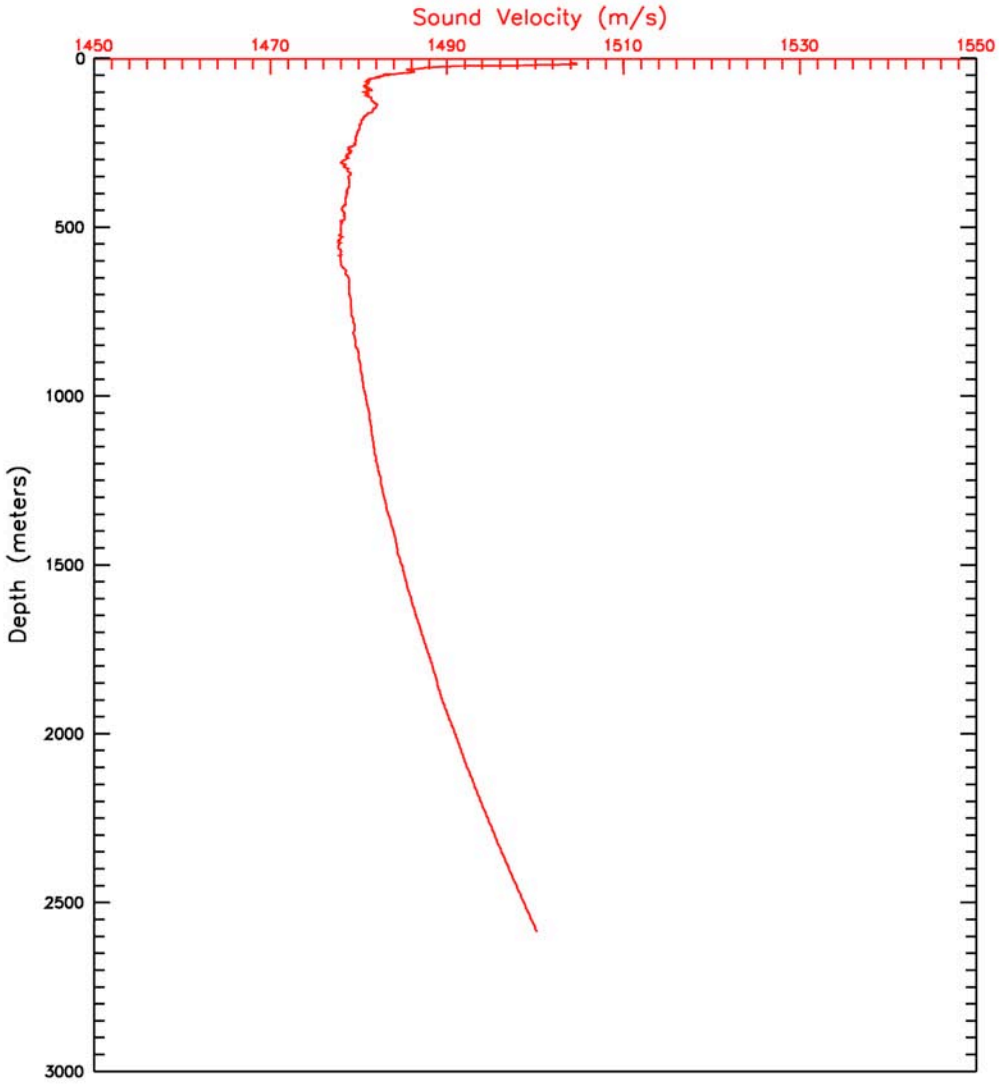


Figure 10. Sound velocity profile from CTD Cast taken at OBS site **J51A**.

We went to **FN05A** to try another pop-up recovery before the Jason night-ops started, arriving on site at 18:40L. The TRM float released and surfaced without a problem but as recovery was underway the line got stuck in the prop. We cut it loose from the deck, but then the captain was able to grapple the line connecting the

ship's screws and the TRM, and it was cut again, with a float reattached to the TRM line. An underwater camera was used to inspect the remaining line in the screws. This took quite some time to resolve, but eventually it was determined that the line in the screws would not be a problem. We then re-recovered the **FN05A** float, and recovered the TRM on the pop-up line. The TRM was on deck at 20:41 L (03:41Z).

We then transited back to **FN09A**, resurveyed its location since it had dropped from Medea last night, and began the dive at 23:40 L.

Thursday July 19th, 2012.

Dive J2-650 proceeded cautiously due to concerns about free line from the bridal that had broken off yesterday. Still, the dive and recovery proceeded without incident and **FN09A** was on deck by 04:17L , and we moved on to site **FN10A**.

FN10A was relocated prior to the dive at 46° 53.8362'N 124° 59.5712'W with a 300m circle and the OBSIP ranging software. This was about 80 m south-east of the original ranged position. The position where Jason found the instrument (according to Jason's navigation) was between the two, but closer to the original at about 40 m S of it: 46°53.837754' N 124°59.617632'W (Figure 11).

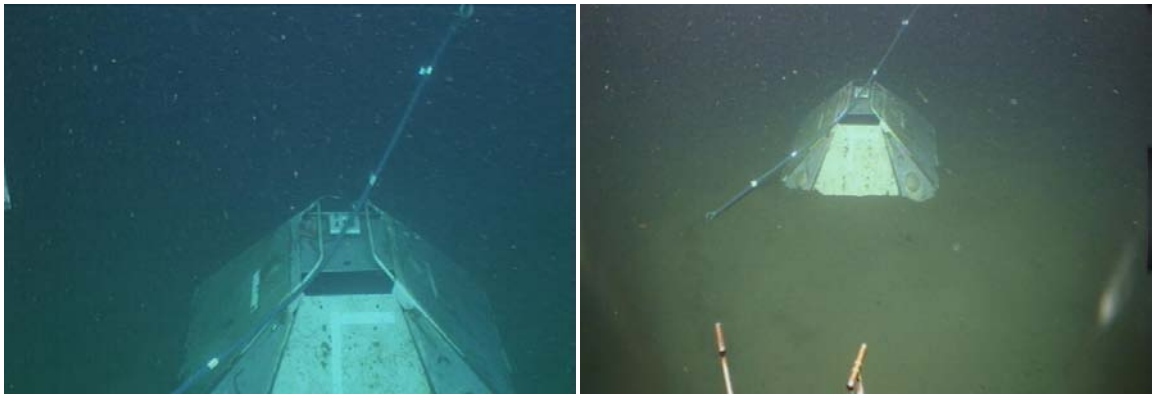


Figure 11. FN10A aligned with Jason on a heading of 280. This site had very oozy sediments and the TRM appeared to have either sunk in quite deeply, or a lot of sediment had gathered around its skirt through time.

We also deployed **thermal blanket M** for Paul Johnson near **FN10A** while we were waiting for Medea to reposition. It was deployed at: **Date/Time:** 2012/07/19 15:16:42 GMT; **Lat:** 46 53.831724 N; **Lon:** 124 59.595804 W; **Depth:** 795 m (see Figure 12). Again, this was an ancillary project at no cost or time to our primary objectives.

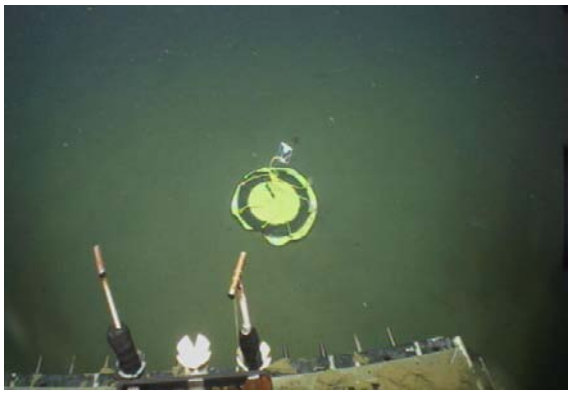


Figure 12. Paul Johnson's thermal blanket M, deployed near the FN10A recovery site. It will be picked up next year as part of a heatflow experiment funded separately by NSF.

FN10A was brought on board at 10:07L but the sensor had become detached from its plate and was hanging from just the battery cable. Remarkably they managed to get it safely on deck.

Next we went to TRM pop-up site **FN07A**, where a release was acknowledged but the float never appeared. We are assuming possibly biofouling of the release again because fishermen in the area said it was near a reef (known hang) and we know from the previous site where this happened that there was a concentration of biology near the hang and on the TRM. Because the R/V Langseth is due to transit over the area this evening we decided not to use Jason to recover in the evening because of the risk we were still on site when they passed 0.4 nm to the north (with feathering generally toward the south in this area). So we moved onto **FN06A**.

Recovery of TRM pop-up **FN06A** went smoothly, getting on site by 12.25, it released as soon as the command was sent and the float was at the surface by 12.30 L. The TRM was on board by 13:30L (20:30Z).

We then returned to **FN07A** in advance of the Langseth pass nearby to confirm that the float really wasn't at the surface, and had not come up in our absence. We then moved onto **FN19A**.

We were on site at **FN19A** by 16:37L (23:37Z) and a release was immediately acknowledged, but again the float did not surface. We sent repeat commands including lock and release commands to 'wiggle' the release incase it was simply minor biofouling. But ultimately we were not able to get the float to come up.

We then moved onto **FN01A** where the TRM was silent, despite attempts to communicate from both the ships hull ducer at a range of angles and an over the side ducer. Communication was good when it was deployed in 2011, so we will have to come back with Jason to investigate this site. It was decided not to issue a release command because then Jason would be more comfortable recovering it (assuming it's still there).

Jason operations commenced at 21:37L (04:37Z) at station **FN14A** on dive J2-652. Dive proceeded smoothly, and **FN14A** was found (47°1.495410' N 124°57.875628'W), oriented (Figure 13), lifted off the seafloor at 22:38L (05:38Z), and on deck by 23:38L. Note that the bikini shackle buffer (see 2011 cruise report for W1107A) did not appear to work, with the shackle (albeit carpeted) hanging on top of the TRM near the bails rather than on its bikini buffer (Figure 13, right).

Figure 13. FN14A aligned perpendicular to the bail bars with Jason on a heading of 078 (left). The shackle that had been covered in carpet for release was atop the TRM rather than hanging to the side on its bikini buffer as we'd hoped (right). This site was notable for a large red fish/krill/shrimp swarm!

Friday July 20, 2012

After the smooth recovery of **FN14A**, we then moved onto site **FN12A** with Jason going in the water at 01:18L on dive J2-653. The TRM was found approximately 70 m away from its original location. It isn't clear if this is location uncertainty from the original location or issues with Jason navigation. **FN12A** was surrounded by trawl scarps that showed up in Jason's sonar. The direction of the trawl scarps seemed to be approximated in the directly that the TRM was offset from it's original position, but it otherwise didn't show signs of having been moved significant distances (i.e. piling up of sediments). It did show signs of possibly having had a trawler go over it, with chipped paint along the side at one edge, and the frame looking fairly battered, with reflective tape peeling off in one location (Figure 14).

Otherwise, the **FN12A** recovery went smoothly, and it was hooked at 03:03L and on deck by 04:23L.

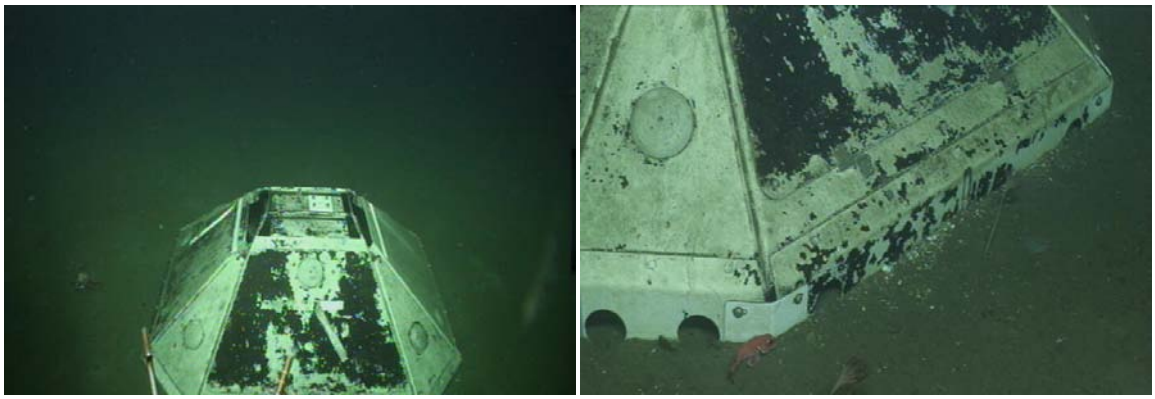


Figure 14. FN12A Oriented with respect to Jason's heading (left) which was 286 (perpendicular to the bails). Note the peeling reflective tape, perhaps indicative that the instrument was hit by a trawler. The frame also showed signs of having been scraped with chips of white paint visible at the base and consistent with directions of trawling marks observed on the sonar.

We also deployed the second thermal blanket for Paul Johnson at this site – **thermal blanket F** at **Lat:** 46 53.274084 N **Lon:** 125 7.107612 W, with a temperature of 4.566°C, at a depth of 649m (Figure 15).

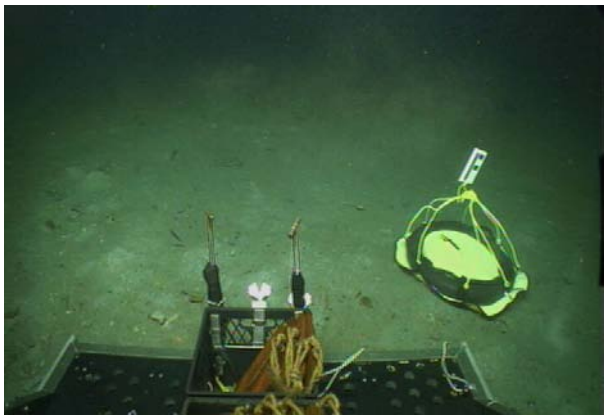


Figure 15. Thermal blanket F, deployed near **FN12A**

After completing Jason dive J2-653, the Jason crew went to bed in order to prepare for daylight hours operations (starting at 12:30L) required for releasing the stuck pop-ups on the TRMs. So we spent the rest of the night and morning trying to recover the remaining deep water OBSs (**FN16A & J50A**).

We got to the **FN16A** site at 06:15L and began communications with the OBS. At first only the internal release acknowledged us, but eventually both did. However, despite multiple attempts to burn both releases the instrument did not leave the seafloor and by 07:30 we disabled it and left site, to return later with Jason.

At **J50A** the OBS immediately acknowledged our communications and release command, and left the seafloor within about 7 minutes. It was at the surface at ~09:45L and on deck by 10:00L.

Jason ops began with Medea going in the water at 12:30 as planned for dive J2-654 to attempt to release the pop-up on **FN07A**. The seafloor was heavily pock marked in the ~150m or so south of the TRM that we transited over on approach. Possible methane venting? This is the closest site to the methane bubble sites we were surveying last year. There were also a lot of shrimp on the seafloor. We found **FN07A** pretty much right where we thought it was, and in addition to heavy sedimentation on top of the float (which we concluded was no factor) there was a large star-fish that had inserted itself between the release lock and the float (Figure 16). At first it appeared dead, and Jason prodded it a little to move, but couldn't get it to move far. However, eventually it livened up a little and got out of the way at which point a few more wiggles of the release—by reissuing the acoustic release command from the surface—and the float popped up. Jason was on deck at 14:08L (21:08Z). The TRM was on deck 14:52L (21:52Z).

Figure 16. Star-fish blocking the latch release for the pop-up buoy (left). **FN07A** was oriented parallel to the bails with Jason's heading at 294.

We moved back site **FN19A** arriving at 16:30L, and Medea went in the water at around 17:00L on Jason dive J2-655. After a little searching around on the seafloor we located the TRM in what was the worst visibility conditions we have seen to date. It was very heavily covered in biology, with two enormous starfish on the float, a large anemone attached to the float casing and large fish around and atop the TRM (see Figure 17). The release would not trigger when trapped or shaken by Jason's arm, and eventually we managed to get it to release by inserting Jason's knife into the latch and prying it open. We did orient the instrument before releasing it as per Figure 17.

Figure 17. FN19A aligned with Jason on heading of 100 (left). Starfish and anemone with barnacles on pop-up buoy (that wouldn't release) (right).

Bringing it aboard proved challenging as the line ended up underneath the boat, threatening another prop snarl, but the small rescue boat was deployed and the line was held away from the boat while Jason and Medea were recovered (Figure 18). The TRM was then recovered on the winch without further incident.

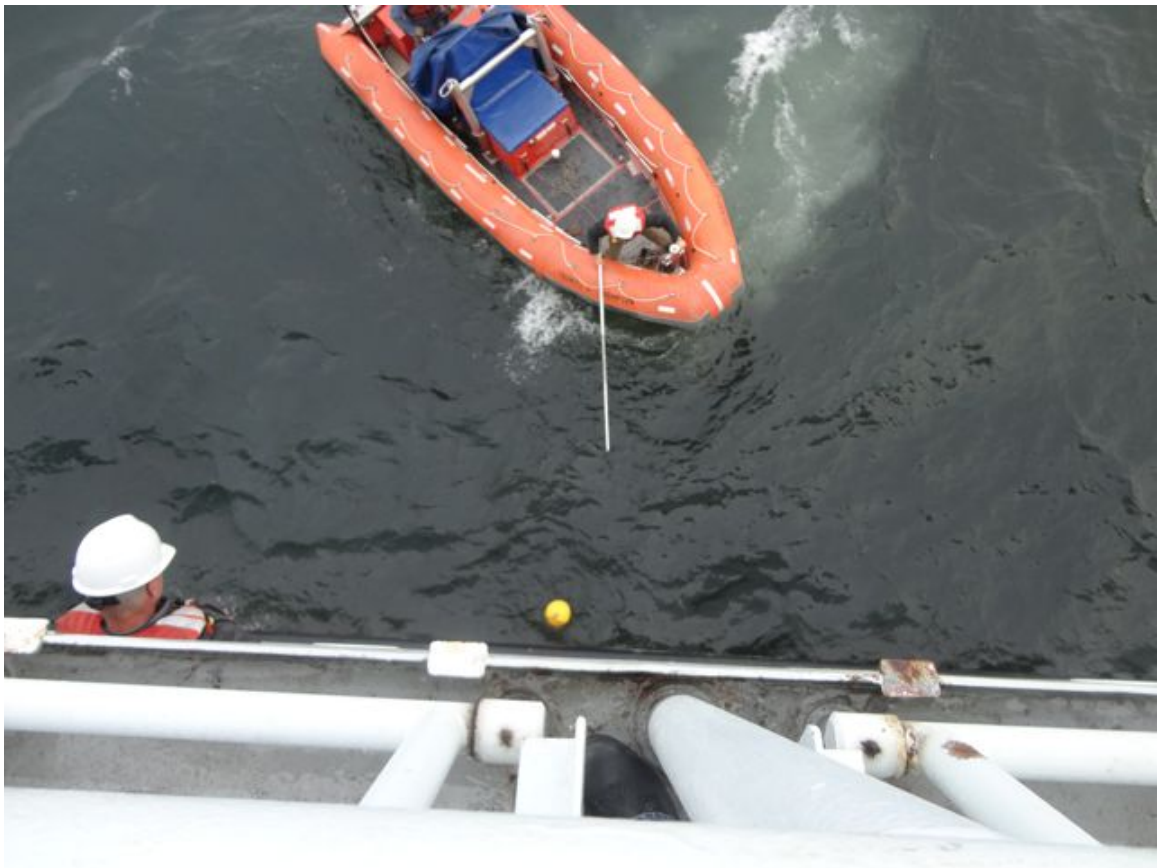


Figure 18. Small boat snagging the TRM line to take it safely away from the boat during recovery of FN19A.

The next dive, J2-656, began at 22:20L to retrieve **FN03A** which was deployed without problems in 2011, but gave a tilted signal when acoustically interrogated, so we suspected it might be upside down, particularly after we'd seen that happen during the Medea deployment at **J33A**. It was indeed upside-down and surrounded by large ling cod fish that even showed up on the sonar as we were looking for the TRM (Figure 19). We hadn't popped the pop-up release and so it was a smooth and relatively straight-forward recovery by Jason, with the TRM on deck by 01:00L (7/21/12).

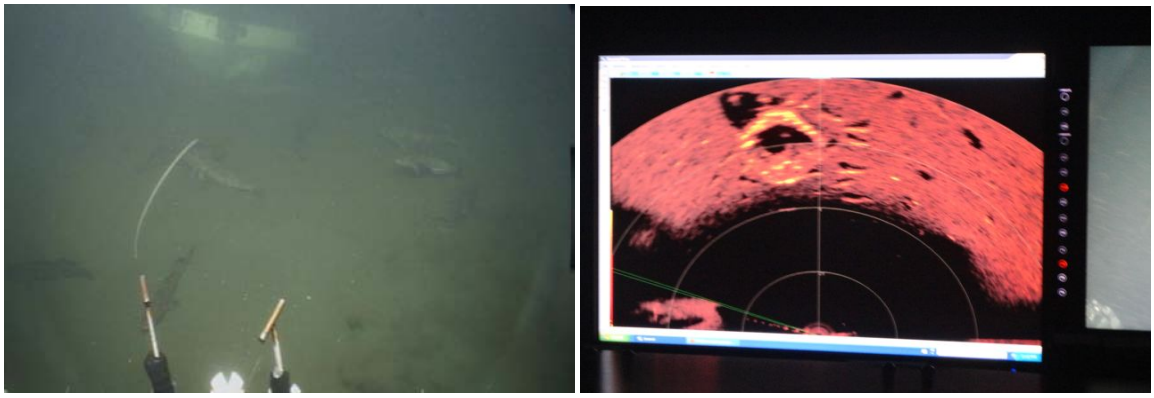


Figure 19. Ling cod surrounding the upside-dowe TRM at **FN03A** (left) which can be seen in Jason's sonar data (right).

Saturday July 21, 2012

While the Jason crew slept, we returned to site **FN16A**, the deep water OBS that did not release from the seafloor. On arrival it responded to acoustic interrogation. The release command was re-sent and this time it did lift off from the sea floor. It left the sea floor at 04:27L (11:27Z) was spotted on the surface at 05:12L, and was on deck at 05:26L. It is not clear why it did not release yesterday.

Jason dive J2-657 began at **FN01A** at 10:43 after an extended effort to locate the nearby ship-wreck that was marked on the charts using the multibeam and 3.5 kHz. We weren't convinced that we had found it, but the possible location was ~100 m to our NW. It was decided it was safe to go ahead with a Jason dive from the south. Visibility was terrible, but the TRM was located quickly (Figure 20) using the sonar, that also showed some impressive ripples on the seafloor nearby (Figure 21). The release was covered in barnacles, and sticking out of the TRM making it apparent why the acoustics might not have been working. The safety line holding the pop-up case to the TRM had broken meaning that only the pop-up line was holding the pop-up case to the TMW. This line also had a number of twists in it. We decided the integrity of the line was likely compromised and so recovered it with Jason/Medea. On the way up the pop-up buoy broke off or broke apart, and line was twisted around the TRM and extended out a long way beyond the ship. Fortunately the

recovery was carefully planned with the currents pushing the line away from the ship and the line was successfully retrieved without any problems entangling it in the props, Jason or Medea.

Figure 20. Dive J2-657 at TRM **FN01A**. The release was covered in barnacles and the safety line securing it the TRM had broken, leaving just the pop-up line hold it to the bail (left). Jason aligned perpendicular to bails at heading of 302 (right).

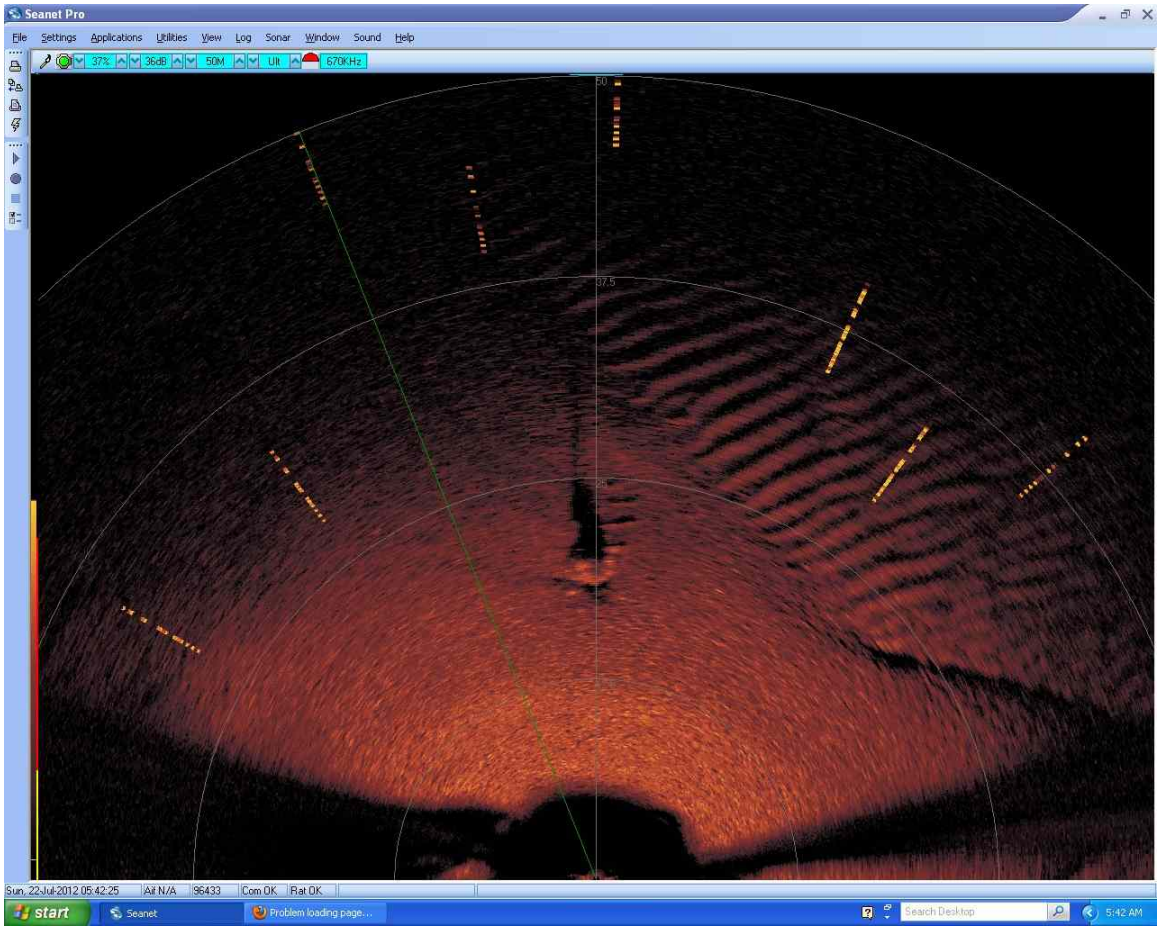


Figure 21. Jason sonar for TRM **FN01A** showing the TRM (center), sand ripples off to the upper right, and a few smaller ripples behind (above) the TRM.

The Jason dive J2-658 began around 18:00L to recover the final TRM **FN08A**, which last year fell to the seafloor after the wire deploying it broke just above to the release. It was discovered upside on the seafloor (not a surprise) (Figure 22), a line was attached and it was brought aboard at ~20:45L. The benthos release was also retrieved, still attached to the top of the TRM (Figure 23).

Figure 22. FN08A – upside down after being dropped in 2011 when the wire deploying it broke just above the acoustic releases. This one was not a fishing hazard because it was deployed in an essential fish habitat where trawling isn't permitted.

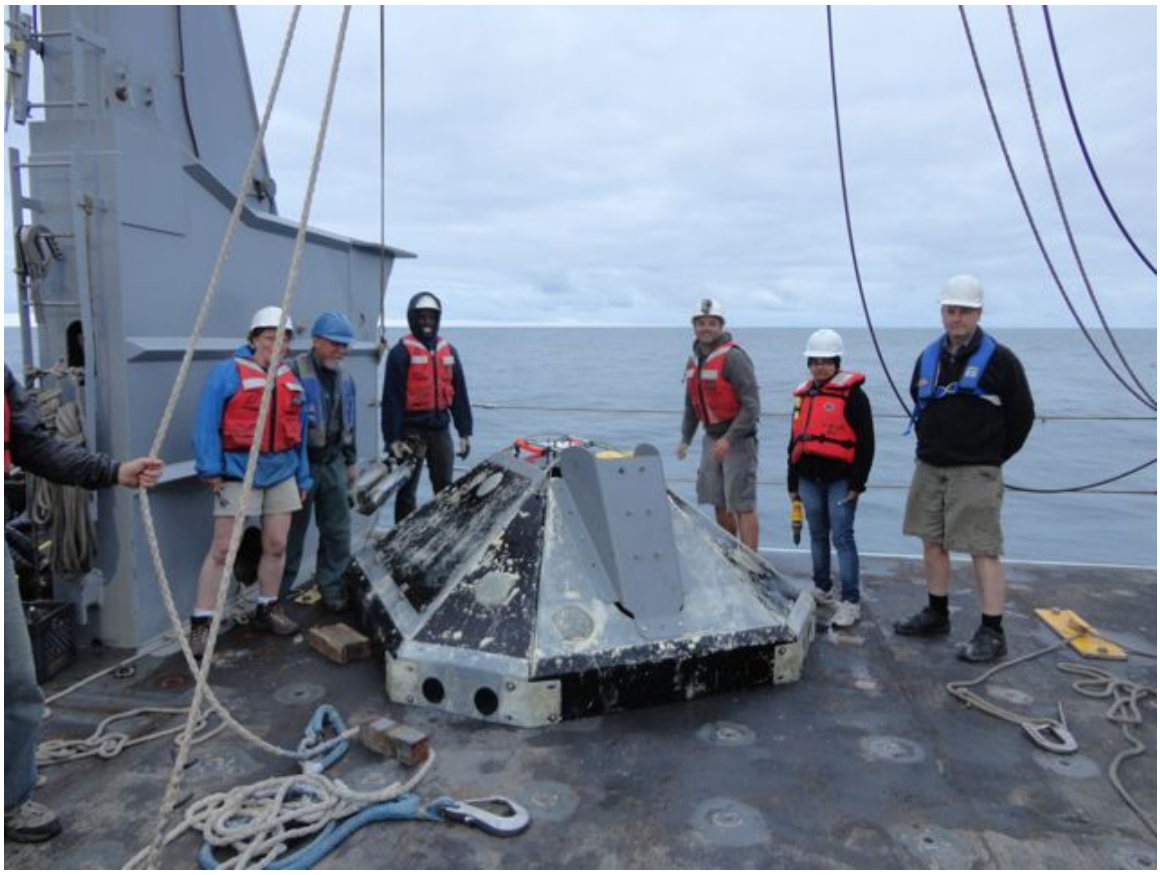


Figure 23. The LDEO-OBSIP team glad to have the final TRM onboard (**FN08A**) onboard along with the acoustic release lost last year during deployment.

Sunday July 22, 2012

Overnight we transited through some more surveying waypoints supplied by Chris Goldfinger and arrive at the site of a WHOI D2-OBS (47° 48.7494' N, -126° 28.2481'W, water depth 2235m) that we had been asked to try and rescue by the Chief Scientists of an earlier unrelated cruise (Canales, Carbotte, Collins). The instrument (D62) had been unresponsive to acoustics shortly following deployment, and remained so during attempted recovery. So we were asked to pick it up with Jason if we could find it. Jason went in the water at 8:17 L and commenced a search for the OBS without a precise location because of the failed acoustics. However, during the dive Andrew Barclay, having just obtained the release codes from John Collins, was able to communicate with the OBS and it acknowledged a release and came to the surface itself. It was on deck by 11:21, and the Jason dive was aborted, with Jason back on deck by 12:30. We then began the transit back to port, which will include a brief stop just after Neah Bay to do some LDEO ROV test as well as Jason winch tests.

Monday July 23, 2012

Overnight (~04:30L), on our way into port, there was a loud thud against the hull of the ship, and the starboard z-drive had to be shut down as it began to make sounds it shouldn't. It is speculated that we hit a log. We arrived on one thruster at Pier 91 around 13:20L and divers inspected the hull and z-drive. While they could find nothing wrong on the surface it was determined that an interior part of the z-drive was bent and the ship must go into dry-dock.

Table 1
Cascadia Initiative Community Experiment
CIET - 2012 - Leg 2 - Tolstoy/Allen
Deployed station locations

Station	Latitude (decimal deg)	Longitude (decimal deg)		Depth (m)	Latitude (deg)	(min)		Longitude (deg)	(min)	
J17B	43.78996	-124.61475	(1)	286	43	47.3973	N	124	36.8851	W
J25B	44.47127	-124.62167	(2)	147	44	28.2762	N	124	37.3002	W
J33B	45.10662	-124.57057	(3)	350	45	6.3972	N	124	34.2342	W
M09B	44.24967	-125.05892	(1)	914	44	14.9802	N	125	3.5354	W
M10B	43.62477	-124.97282	(1)	675	43	37.4859	N	124	58.3689	W
M18B	44.88711	-124.97117	(1)	720	44	53.2267	N	124	58.2703	W

(1) Survey location determined by ranging to the TRM from a 300m radius circle.

(2) Location recorded by Jason ~150 meters south of J25A. Range locate in 2013.

(3) Survey location of J33A, i.e. SIO Abalone deployed in 2011. This instrument is 4 meters from TRM J33B.

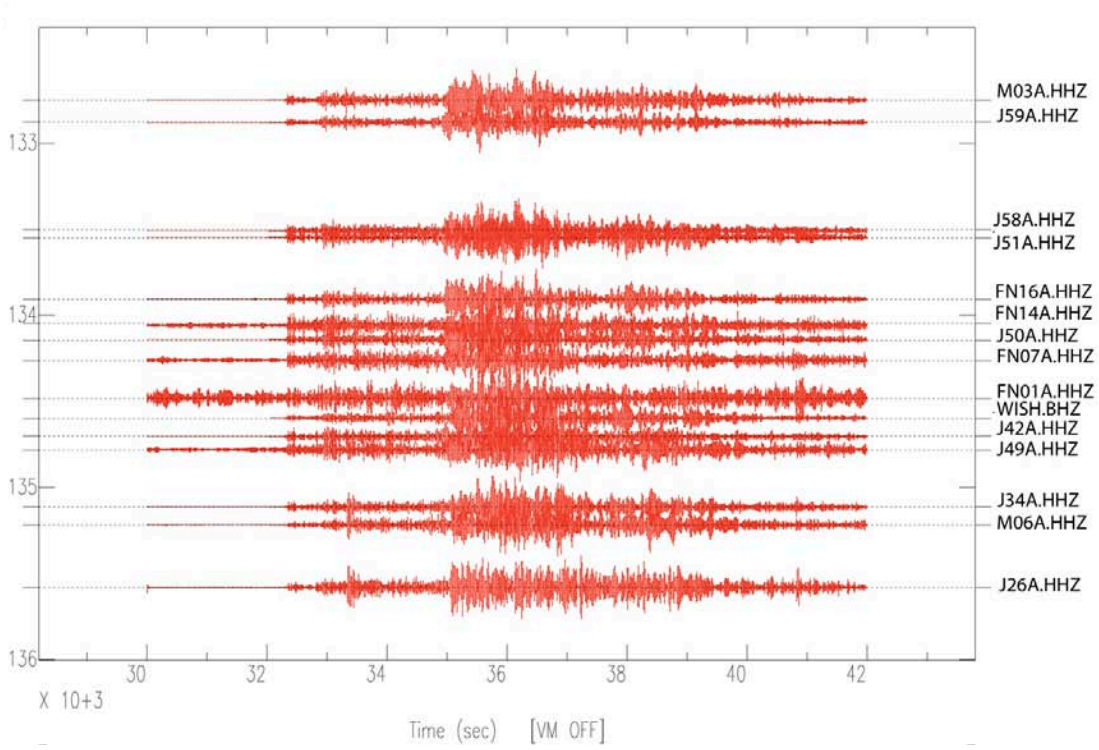
Table 2

TYPE	Site	Z	H1	H2	APG quality (days)
OBS	M03A	Good (266)	Good (266)	Good (266)	Good (266)
OBS	J59A	Good (266)	Good(266)	Good (266)	Good (266)
OBS	J58A	Good (150)	Good (150)	Good (268)	Good (268)
TRM	J49A	Good (353)	Good (353)	Good (353)	Good (353)
TRM	J41A	Fair (353)	Fair (353)	Fair (353)	Good (353)
OBS	J26A	Good (178)	Flatlined	Flatlined	Good (268)
OBS	J34A	Good (275)	Good (13)	Good (13)	Good (275)
OBS	M06A	Good (232)	Good (232)	Flatlined	Good (274)
OBS	J42A	Good (275)	Good (275)	Good (275)	Good (275)
TRM	FN18A#	Fair (354)	Fair (354)	Fair (354)	Good (354)
OBS	J51A	Good (273)	Good (273)	Good (273)	Good (273)
TRM	FN05A	Poor (71)	Poor (71)	Poor (71)	Drive error
TRM	FN09A#	Flatlined	Flatlined	Flatlined	Good (358)
TRM	FN10A	Flatlined	Flatlined	Flatlined	Good (107)
TRM	FN07A	Good (358)	Good (358)	Good (358)	Good (358)
TRM	FN06A	Flatlined	Flatlined	Flatlined	Good (354)
TRM	FN19A	Flatlined	Flatlined	Flatlined	Good (357)
TRM	FN01A	Poor (214)	Flatlined	Flatlined	Good (360)
TRM	FN14A	Good (354)	Good (354)	Good (354)	Good (354)
TRM	FN12A	Poor (359)	Poor (359)	Poor (359)	Good (359)
OBS	FN16A	Good (278)	Good (278)	Good (278)	Good (278)
OBS	J50A	Good (277)	Good (277)	Good (277)	Good (277)
TRM	FN08A*	Poor (359)	Poor (359)	Poor (359)	Good (359)
TRM	FN03A*	Flatlined	Flatlined	Flatlined	Good (353)

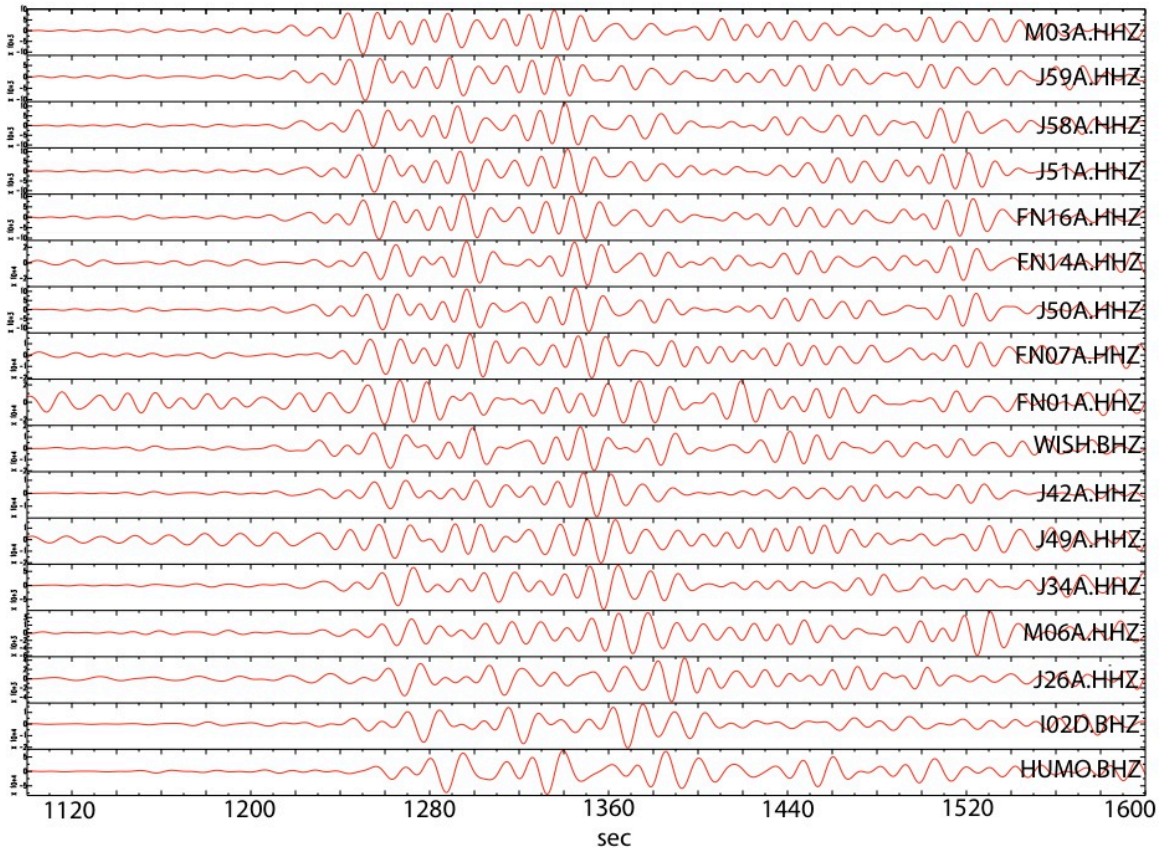
*Instrument upside-down on deployment (FN08 dropped from 100m, FN03, deployed on wire, but still upside-down)
#Dropped on recovery (FN09A – Medea bridal snapped, FN18A – line snapped).

Appendix 1

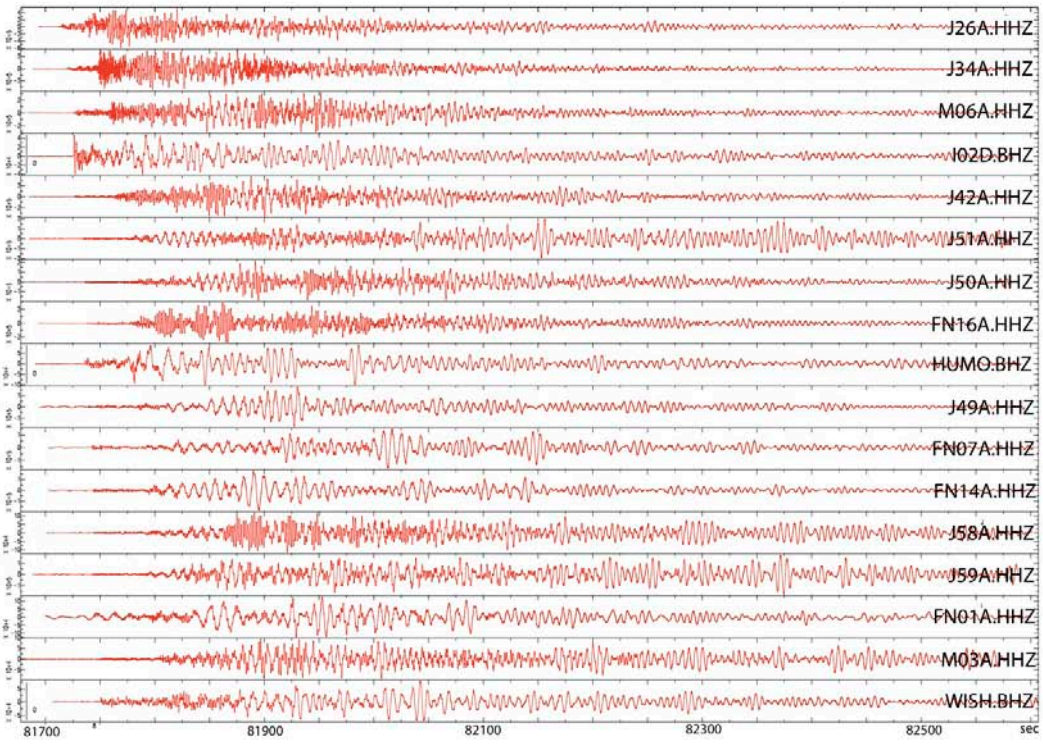
Vertical channel earthquake recordings from OBSs, TRMs, and land stations WISH, HUMO & I02D.



Arrivals from Mw 8.6 earthquake off Sumatra on April 11, 2012 at 08:38:36 (2.33°N, 93.06°E). Note that land stations are essentially indistinguishable from the seafloor stations. Each waveform is scaled to its maximum amplitude, and stations are ordered by distance. A band-pass filter of 10- 25 seconds was applied to the data.



Zoom on the P-wave arrivals from Mw 8.6 earthquake off Sumatra on April 11, 2012 at 08:38:36 (2.33°N, 93.06°E). Note that land stations are essentially indistinguishable from the seafloor stations. Each waveform is scaled to its maximum amplitude, and stations are ordered by distance. A band-pass filter of 10-25 seconds was applied to the data.



Local Mw 6.0 earthquake on April 11th 2012 at 22:41:46 from the Blanco Fracture Zone at 43.5840°N -127.6380'W. Note the difference in the ratio between the P-waves and the surface-waves of the on-shore (WISH, HUMO, I02D) vs off-shore stations. Each waveform is scaled to its maximum amplitude, and stations are ordered by distance.

Appendix 2

Cascadia Initiative – CIET – 2012 Leg 2 Cruse – Tolstoy/Allen Fisheries issues

Deploying 6 LDEO-TRM sites. The following locations were proposed to the fishing community

	Latitude			Longitude				Depth (approximate)
Name	deg	min		deg	min			(Fathoms)
J33B	45	6.408	N	124	34.248	W	191	- reoccupying this site so presumably OK?
M07B	44	53.244	N	124	58.278	W	519	- new site, proposed location
J25B	44	27.402	N	124	37.848	W	82	- reoccupying this site so presumably OK?
M09B	44	14.994	N	125	3.54	W	492	- new site, possible location 1
~~M09B~~	~~44~~	~~15.552~~	~~N~~	~~124~~	~~58.176~~	~~W~~	~~246~~	~~- possible location 2 (alternative for M09B)~~
J17B	43	47.262	N	124	36.798	W	164	- new site, proposed location
~~M10B~~	~~43~~	~~36.816~~	~~N~~	~~125~~	~~3.096~~	~~W~~	~~519~~	~~- new site, possible location 1~~
M10B	43	37.254	N	124	58.272	W	383	- possible location 2 (alternative for M10B)

Contacts:

Suggested contacts from Bob/Anne – all contacted

- Kaety Hildenbrand Kaety.Hildenbrand@oregonstate.edu
- "Scott R. McMullen" smcmullen@ofcc.com
- "B. Pettinger" <bpettinger@ortrawl.net>

Feedback from:

Robert Eder 1roberteder@gmail.com

- Responded about coordinate units…but no feedback on sites…

Rudy Moon – OR State Extension - Ruby Sue - ONID Moon moonr@onid.orst.edu - Cell 541-272-9096 Office 541-574-6537 X18

- Not possible: **M09B** 44 15.552 N 124 58.176 W 246 - possible location 2 (alternative site for M09B) – this is considered a "job site"!
- But option 1 for **M09B** is OK: M09B 44 14.994 N 125 3.54 W 492 - new site, possible location 1

Brad Pettinger webmaster@ortrawl.net

- **M10B** location 1 is regularly trawled – avoid
- **M10B** location 2 is OK. This does have a cobble bottom although our location is "a little inside of that". There are also some lost nets at the southern end of this high.

Appendix 3

THOMPSON CRUISE PRELIMINARY MARINE MAMMAL SIGHTING SUMMARY

*****The following data are preliminary and not for distribution or publication*.****

Species	#Sightings	Total # Animals
Humpback Whale	49	67
Fin Whale	4	5
Sperm Whale	1	1
Unidentified large whale	29	39
Killer Whale	2	3
Risso's Dolphin	2	26
Pacific White-sided Dolphin	19	180
Dall's Porpoise	8	24
Harbor Porpoise	1	2
Unidentified small cetacean	4	10
Steller Sea Lion	4	5
Fur Seal (Northern or Guadalupe)	6	6
Harbor Seal	1	1
Totals	130	369