College of Oceanic and Atmospheric Sciences

Lamont-Doherty Earth Observatory
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Cruise Report

R/V Wecoma
W1107A

Cascadia Initiative Leg 1
July 24 – Aug 2 2011
Newport, OR – Newport, OR

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(Co-Chief Scientists)

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Introduction

Leg W1107A aboard the R/V Wecoma was the first deployment leg of the Cascadia Initiative, a community experiment funded by the National Science Foundation.

Objectives for the cruise were to deploy the LDEO-OBSIP trawl-resistant mounted OBSs (TRM-OBSs) as the first stage of OBS deployments of the on-shore/off-shore seismic and geodetic Cascadia Initiative. See the following website for details of the year1 plan and for more information about the Cascadia Initiative: http://pages.uoregon.edu/drt/CIET/doku.php?id=plan:year_1

The cruise represented the first deployment of these instruments in regular at-sea circumstances and as such it was a test cruise as well as the first deployment leg for the Cascadia Initiative. Much was learned in the first few days about the best way to deploy the new instrument design, and techniques and efficiency improved considerably over the first few days of the cruise. We were only able to deploy 15 of the targeted 20 TRM OBS because of delivery problems with the final 5 frames.

OBS operations were limited to ~16 hrs per day because the OBS personnel needed to rest, and in particular the key engineer (David Gassier) who was needed to

oversee many critical aspects of the deployment preparation. The OBS personnel worked approximately 08:00-24:00. Nighttime hours were utilized to map water column methane bubbles in the vicinity of the focused array using the 4kHz and 12 kHz sonar. Night times were also utilized for longer transits between deployment sites.

We were blessed with relatively calm seas for most of the cruise. Swells were 5-8 feet and waves 2-6 feet.

Deployment Site Selection

Deployment sites were initially selected through a series of community meetings. The final plan going into the cruise was then prioritized to allow for the possibility of deploying fewer instruments than planned, and minor modifications were made where necessary based on input from the Cascadia Initiative Expedition Team (CIET) and the Amphibious Array Steering Committee (AASC). Aided by excellent maps courtesy of Chris Goldfinger (OSU) and others, locations were fine-tuned to avoid steep areas that might result in instrument tipping and areas likely to be prone to mass-wasting and/or strong currents. Finally, sites were adjusted based on detailed feedback from Scott McMullen of the Oregon Fisherman's Cable Committee (OFCC). Some sites were moved slightly to put them into nearby no-trawl zones, specifically 'essential fish habitats' (EFH) in Grays Canyon region and Nehalem Bank/Shale Pile, and others were adjusted based on specific suggestions by Scott McMullen some of which may have included known hangs. Primary hazards with the areas of deployment were shrimp trawling and fish trawling. Some areas had bans on rock fish trawling but these are lifted from time to time, so cannot be relied upon. Mr. McMullen had been at sea when originally contacted in June, and he did not get in touch until a few days before our cruise, so many of the adjustments were made at the last minute. We were able to clear most of his suggestions with the CIET during day 1 of our cruise. Mr McMullen was still at sea during our cruise, so communication with him was limited. However, he continued to provide helpful feedback, and was our interface with the shrimp fishing community while our deployments were already underway. We requested adjustments to some of his sites based on bathymetric hazards (high slope) associated with some of his suggestions. We did not have time to clear all the final location adjustments with the CIET or AASC, but used our best judgment to balance the original array design against risk to the instrument and probable best noise conditions. Final deployed locations are in Table 1. Bathymetric maps of deployment sites are in Appendix 1. A prioritized list of planned deployment sites and details of if/why they were moved is provided in Table 2.

OBS description

The OBSs being deployed during this cruise were the LDEO new design trawl resistant mounts (TRMs) developed specifically for this project. While prototypes had been tested in Long Island Sound, this cruise represented the first realistic field test of the design, so much of the first few days was spent ironing out the kinks in the deployment procedure.

Figure 1: 6 TRM frames on the dock waiting for their final coat of anti-fouling paint before being loaded aboard the *R/V Wecoma* in Newport, OR. July 23, 2011.

All the functional parts of the OBS are housed beneath the trawl mount that is designed to withstand a direct hit by a trawler (Figure 1). The trawl mounts were stacked 4-high on deck (Figure 2) and were individually craned from the stack onto the deck beneath the A-frame following the deployment of the previous OBS. Each frame then had to be individually prepared on deck with the battery pressure case, the electronics pressure case and the sensor prepared for deployment and attached to the frame and each other. The sensor was hung from the inside top of the frame and released via a burn wire following deployment.

The entire TRM OBS package was lowered to the seafloor on a wire through the A-frame, and then released from the wire using a Benthos acoustic release after it was confirmed to be on the bottom.

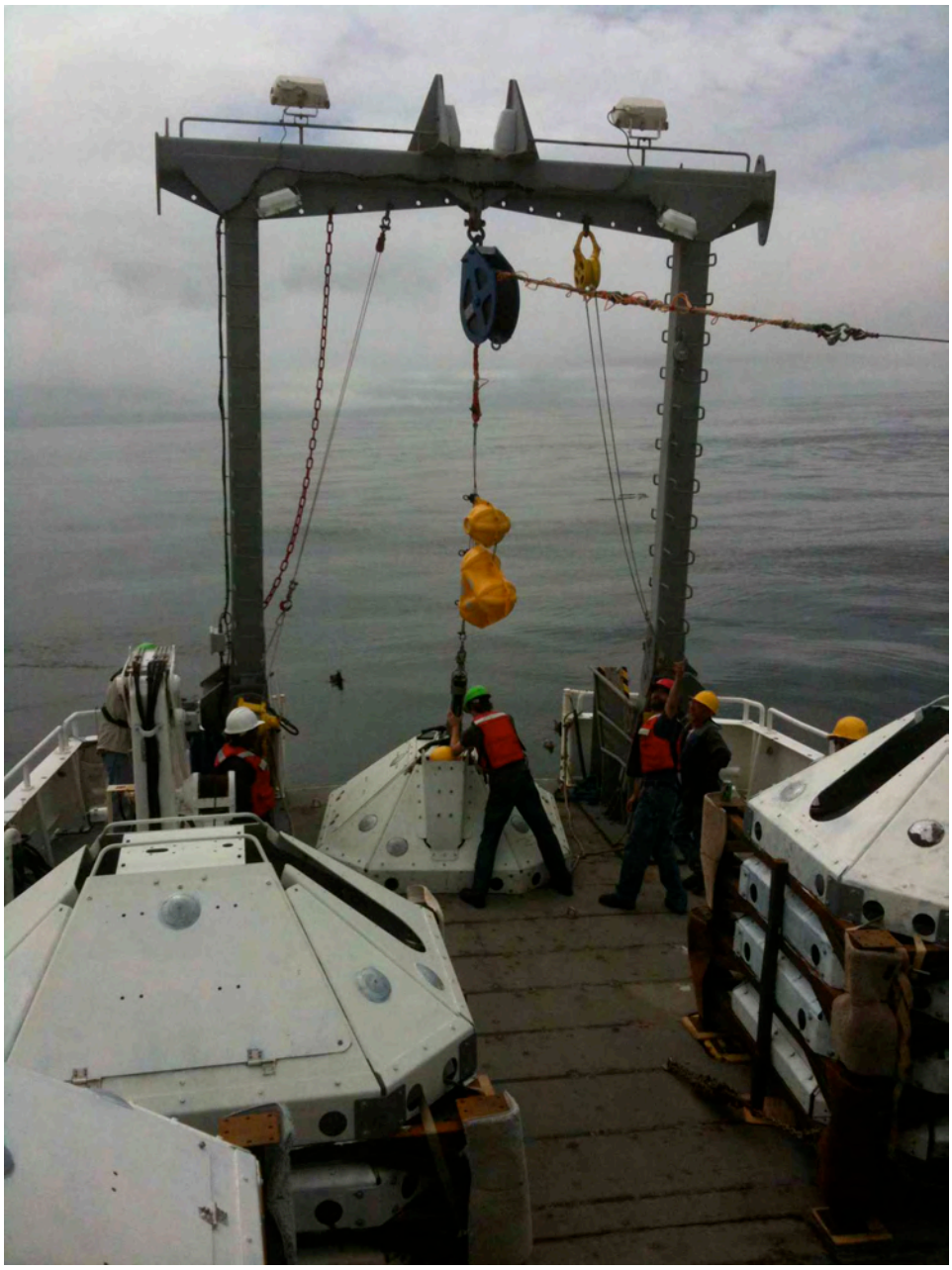


Figure 2. LDEO TRM OBS deployed on one of the best weather days of the cruise.

OBS Locations

OBSs were located using one of two techniques. For the deeper sites the instruments were ranged to in a circle with a radius of half the water depth. All these ranges were then input into the LDEO-OBSIP location script which used a simple grid-search algorithm with a 1 m grid spacing and assuming a constant water velocity of 1480 m/s. The root-mean-squared error for the optimum position was 3-5 ms, suggesting a maximum location error on the seafloor of ~4 m. The deployment seafloor depth was fixed. For the shallower sites (< 300 m) it was not

possible to do a tight enough circle so the instruments were located using a cross or plus-sign shaped survey with lines running directly N-S and E-W at approximately 2 knots, with ranges every 30-60 seconds (30 seconds as the instrument drop site was approached). The two closest ranges on each line were then interpolated for instrument latitude (N-S line) and longitude (E-W line). Formal errors were not calculated, but range spacing suggests an error on the order of +/- 10m. The shallow sites generally showed that the instrument went straight down from the fantail, because use of ship location at deployment corrected for azimuth and fantail to GPS receiver distance agreed with the ranged locations.

4 kHz and 12 kHz Echo Sounder Data

We note that 4 kHz and 12 kHz data were collected for much of the cruise and may prove useful in future analysis of the relationship between sediment properties and instrument signal to noise. Some sections of 4kHz show sub-bottom penetration that may be indicative of sediment bowls. (see Appendix 2).

CTDs

Eleven CTDs were acquired during the cruise. Most were acquired as the CTD winch was used to pressure test new instrument housings. A few additional casts were done as part of the late night acoustic imaging program. (see Appendix 3).

Temperature Sensors

In addition to temperature sensors incorporated in all the OBSs, sensitive well-calibrated autonomous temperature sensors were deployed on OBSs at sites CFN1B, CFN3B and CFN5 as part of a pilot program by Anne Trehu and Rob Harris to establish annual temperature fluctuations prior to heat-flow measurements. These will also be used to calibrate the internal temperature sensors for the TRMs.

CRUISE NARRATIVE:

Day 1: Saturday July 23, 2011

Decision was made to delay departure by ~24 hrs to allow completion on shore of frame assembly and painting (final defouling coat). Dean, Rick, Eric, Michelle, Mark and Paige were particularly notable in volunteering their time and working tirelessly to get everything done. Finished ~9.45 pm (local - PST). Preparing for 6 AM loading of final 3 frames tomorrow (Sunday July 24th), and 8 AM departure (local).

Two successful tests of the OBS deployment procedure, data collection and pop-up buoy were conducted by 'deploying' the OBS off the stern of the ship.

Day 2: Sunday July 24, 2011

Fire and boat drill at 8AM, left dock ~8.50AM (local).

Arrived at site for first deployment (**J41B**) 4.35 PM (local). The first objective was to conduct a test deployment for several hours to practice deployment procedure, test that the instrument recorded data, and test the pop-up buoy. First test deployment released the OBS from the wire at 206 00:53Z (205 17:53 pm local). It was left to record until 03:00 Z (8 pm local). Shortened test deployment so that it could be recovered in daylight.

Figure 3: Deformed top bails on the OBS frame. Rope lashings were attached across the bails on advice of the fishermen to reduce risk of snagging.

Upon recovery it was discovered that the top bails were bent (Figure 3) and two of the three lanyards holding the seismometer to the frame had sheared off. This was likely due to the extreme stresses from deployment (and possibly recovery) from kiting of the OBS and pulling from the wire due to ship heave. It was noted on the way down that tensions on the wire were going from close to zero to over 4000 lbs with the swell. Data from the seismometer looked good however, as did pressure and temperature data (see Figure 4 and Appendix 4).

To mitigate the stress on the frame and the seismometer lanyards the following modifications were tried: 1) We removed black plate from the top of the frame to allow more water to get through; 2) We added a section of rope between the wire and the instrument to allow for some elasticity on the line. 3) We may try deploying with the ship more in line with the trough so that pitching would be minimized. We also intend to deploy at more of an angle. Will first conduct a test deployment with only a tiltmeter on board.

11.25pm – Captain decided to suspend activity until 8 am (after breakfast) to allow everyone to rest.

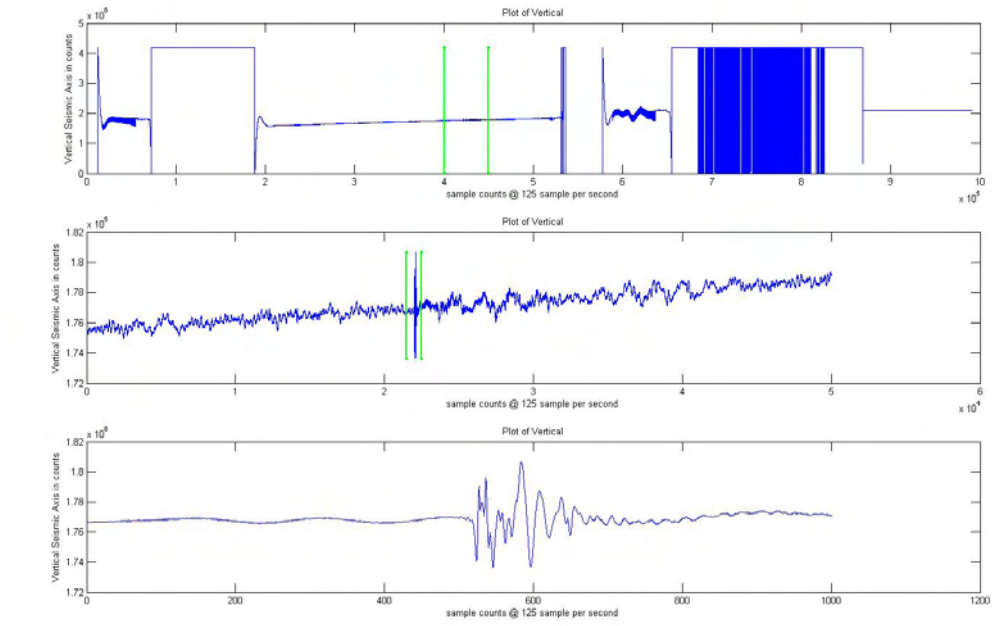


Figure 4: Vertical channel of the seismometer during the test deployment at three different scales, showing 'fish bump'. Other data in Appendix 4.

Day 3: Monday July 25, 2011 – Deploy J41B, J49B

Successfully tested the new configuration with extra top plate removed and a rope with some stretch inserted into the line. Did not adjust the ship to go in the trough because seas were reasonably calm. The variability on the wire tensions was much improved with only one really large excursion over 4000 lbs. Not clear if this is due to the adjustments we made or the improved weather.

Tiltmeter was deployed during the test to be sure that the instrument was landing level and not flipped over. The tilt data confirmed a successful level seafloor deployment.

At ~20:00Z (~13.00 local) the OBS was released from the wire at **Site J41B**. Nearest ranged location (based on N-S, E-W lines closest points of approach) 45°48.716'N 124°32.230'W. Water depth 173m. Ship's heading on deployment 341°.

Three pressure cases were tested to 200m in Astoria canyon part way to site J49B.

Deployed (released) OBS at **Site J49B** on July 26th 05:00 (UTC) (July 25th 22:00 local). Water depth 112m. Ship's heading on deployment 001°. **Site J49B** was surveyed (circle) in to: **46° 26.267'N 124° 25.65'W**.

Day 4: Tuesday July 26, 2011 – Deploy CNF10D, CFN9C, CFN12D

Overnight, Anne & students conducted a methane bubble survey using the 4 & 12 kHz sonar at a known site of methane venting (Salmi et al., in press) (see Appendix 2). Way points between 46°52.80'N 124° 46.40'W and 46° 53.12'N 124°47.00'W were surveyed. It was interesting to note that while the 12 kHz picked up a lot more reflections from bubbles, the 4 kHz seemed to be sensitive to the stronger (presumably larger) more focused features. A distinct vertical banding in the bubble plumes was noted with 5-10 m spacing that also seemed to be at a similar frequency to the seafloor topography (or possibly the swell).

We finished the survey and arrived at **Site CFN10D** at 08:00 local to begin preparations for deploying the deepest OBS site (795 m). The decision was made to move to the deepest site and deploy out of order because the forecast is for a worsening of weather conditions tomorrow afternoon, and we wanted to get the deepest sites deployed while the seas were still calm. Ship motion from the swell appears to be the primary driver of see-sawing tension on the wire as we deploy and this is putting considerable stress on the instrument and release structure as evidenced by abrasion of the sling used to attach the instrument to the release (Figure 5). The deeper the site, the longer the instrument will be on the wire, so the greater the abrasion on the sling. We tried to minimize this by prioritizing deep water deployments during the best weather windows.

In addition, we had to modify the sling for **Site CFN10D** (depth ~800m) since it was abrading almost half way through at sites less than a quarter the depth. A design was resolved that significantly decreased the chances of the instrument breaking off the wire on the way down, but significantly increased the probability of unwanted noise on the instrument. The sling will now stay attached to the instrument with two small shackles holding it to the wire loops atop the frame and a larger shackle that will fall with the shackle presumably onto the top or side of the frame. There is a significant chance that this could create noise if the shackles move around in the bottom currents. This site was chosen because it was in a bathymetric hole, and it was hoped this would provide some shelter from the currents.

Dolphins came to greet us while we were waiting to deploy around 10:30 local.

Figure 5: Abraided slings

The OBS for **Site CFN10D** was in the water at 19:05 Z (12:05 local), and released at 19:59 Z (12:59 local) at 46°53.865 124°59.596'W – water depth ~800m. Ship's heading on deployment 282°. Ranged (cross-only) location for **CFN10D** is **46°53.869'N 124°59.618'W**.

Following CFN10D deployment we adapted the sling to try to avoid the potential noise source of the shackle. We doubled up the slight and wrapped it heavily in tape thus minimizing abrasion, and providing back-up (with the double sling) in case it does abrade through. This technique was used on Sites CFN9D through CFN 8B when we lost the release. The replacement release we received from Walt Waldorf requires a larger shackle – details below starting at CFN19B.

The OBS for **Site CFN9D** was in the water day 208 (July 27th) 01:17Z, or (July 26th, 18:17 local), and released at JD 208 01:34Z (or 18:34 local) at 46°50.409'N 124°53.256'W. Water depth was 195m. Ship's heading on deployment 327°. Ranged (cross) lat/long is **46°50.407'N 124°53.264'W.**

Arrived near site **CFN12C** around sunset. Conducted two passes NE-SW 0.5 nautical miles to either side of site **CFN12C** running the 4 & 12 kHz echo-sounders to check the bathymetry profile of site provide by Scott McMullen. It appears that the site is in a slight dip which may be advantageous noise wise, but it's also possible it is in a small channel. Possibly near a known hang, and we didn't hear back from McMullen on our preferred site of CFN12D, so we are sticking with the co-ordinates he provided.

At 22:25 local (05:25Z JD 208) pressure test two cases with CTD to ~640m at site **CFN12C**.

OBS for site **CFN12C** was in the water at 208 06:49Z (23:50 local, day 207). Depth 645m. Ship's heading on deployment 030°. Released at 208 07:30Z (00:30 local, day 208). Position at release 46°53.328'N, 125°07.135'W. Ships heading was 030°. Final ranged position for **CFN12C** (circle only) is: **46° 53.31'N 125° 07.152'W.**

Day 5: Wednesday July 27, 2011 – Deploy CFN1, CFN3B

Overnight another successful bubble survey was conducted using the 4 & 12 kHz echosounders over the same site as previously with repeat transects (3 full surveys).

OBS for site **CFN1B** was in the water at 208 21:32Z, Released at 208Z 21:39UTC, (14:39 local July 27) at 46°52.931'N 124°20.039'W. Water depth 54m. Ship's heading on deployment 005°. Final ranged location for **CFN1B** based on cross lines (S-N/E-W) is: **46°52.917'N 124° 20.023'W**. (Note final location for CFN1 was moved (to CFN1B) at the last moment following an email request from Scott McMullen despite this having been a previously approved site.)

Problems with an OBS leveling motor delayed deployment of this instrument, meaning we will probably only get two deployed today. However this is still within available time and we are not yet concerned about the schedule. Swell's today are slightly larger than previous days and so tensions on the wire are notably higher today (around levels seen on first test deployment, despite new deployment style aimed at reducing these). Forecast was for 7-8 feet swell today vs 6 feet yesterday, and this seems to be about the increase we are seeing.

Note that following concern about seismic noise with the deployment strap utilized for CFN10D we successfully adapted the original deployment plan to use two slings, but wrapped in tape.

OBS for site **CFN3B** was in the water at 209 02:49Z (19:49 local, July 27, 2011). OBS was released at 209 (July 28th, 2011) 03:00Z (20:00 local, July 27, 2011). Water depth 90m. Ship's heading on deployment 304°. Release location was 46° 53.223'N 124°31.509'W. Ranged location of **CFN3B** (cross) was: **46°53.210'N 124°31.508'W**

Acoustic response from site **CFN3B** indicate that the transponder is at an angle of greater than 45° (7 return pings rather than 15). This indicates that the instrument may have landed at an angle > 45°. The wire on deployment underwent tensions higher than previously recorded (~6500lbs), which is a double alarm level on the winch. Possibilities include a broken bar on the frame (deemed unlikely) leading to steep angle landing, the instrument simply landing too steeply and sticking in the mud, the possibility that the transponder sheared off on landing (so only the transponder is at an angle). The latter is thought quite likely since something similar happened in a test deployment when the instrument was dropped on the deck from several feet (the transponder sheered off from the pop-up buoy).

Day 6: Thursday July 28th, 2011- Deploy CFN5, CFN7B, CFN8B

Another successful bubble survey was conducted overnight in the same area as previously to look for temporal variability in the venting.

OBS for site **CFN5** was in the water at 209 18:28 Z (11:28 local, July 28th, 2011). The instrument was released at 209 (July 28th, 2011) 18:42 Z (11:42 local – PST) at 46° 51.482'N 124° 39.318'W at a water depth of 124 m. Ship's heading on deployment 333°. Ranged location (using cross) was: **46° 51.467'N 124° 39.318'W.**

CFN5 transponder was checked and confirmed to be level prior to releasing the wire. (This had not been done previously because during earlier deployments the instrument was released as quickly as possible to limit risk of it being dragged on the bottom by the ship's drift or heave. However, after the problems with CFN3B it was decided that we should try and do this as quickly as possible prior to wire release).

Following deployment of CFN5 a CTD survey of the bubble site was conducted (which is very nearby) while the OBS group prepared the next OBS for deployment at CFN7B.

OBS for site **CFN7B** was in the water at 210 00:13 Z (July 29th), or 209 17:13 local (PST), July 28th 2011. The instrument was released at 210 (July 29th) 00:30 Z or 209 17:30 local, July 28th, 2011, at 46°51.342'N 124°47.187'W at a water depth of 154m. Ship's heading on deployment 330°. The instrument was confirmed level on deployment. The ranged location (using cross) was: **46°51.330'N 124°47.191'W.**

Following deployment of CFN7B and ranging, we held station to rearrange the frames on the back deck and to allow time to prepare two more pressure cases for pressure testing while we were at this relatively deep station.

The OBS at site **CFN8B** was in the water at 210 05:45Z (July 29th) 22:45 local (Thursday July 28th, 2011). At 70m the instrument broke off. Inspection on deck revealed that the wire broke between the release and the floats. Interrogation of the release confirms that instrument is at angle > 45°. Deemed likely to be upside down. The captain saw it falling rapidly on the bridge fish-finder echo-sounder. Our major challenge now is that the Benthos release used for deployment is on the bottom with the instrument, so our options for deploying the remaining instruments are limited. Daryl emailed Walt Waldorf and Maya emailed William Wilcock asking about the possibility of getting a replacement release from OSU or UW respectively. At 23:00 local decision was made to wait until sunrise to review options.

Ranged location for **CFN8B** based on cross-ranging is 46°53.325'N 124°52.576'W.

Day 7: Friday July 29, 2011 – Grapple for CFN8B, Get replacement release

06:00 local the decision was made to try to release the float (deemed unlikely to work) with the theory that later grappling might succeed in flipping the instrument over and releasing the pop-up buoy. 06:20 the pop-up release command was sent and acknowledged. 06:50 – after a 300 meter track down current from the deployment site with no sign of the float the decision was made to prepare for grappling. Maya raised concerns about whether we were allowed to grapple within the protected habitat. The Captain said it was okay because we were grappling not trawling. A copy of the law was scanned and no mention of grappling was found.

We grappled from ~07:45 local until ~11:45 local with no success, though several increases in tension were noted suggesting the instrument was snagged at various times. Sent another release at 11:00 local and got another confirmed, but still 7 pings (so tilted). We relocated the instrument to see if it had moved, and it appears to have shifted to the west by about 80m, confirming that the grappling had indeed snagged it at some point but was clearly unable to either pull it up, or flip it over enough for the pop-up buoy to work. Relocated location for **CFN8C** (renamed from **CFN8B**) is now **46° 53.325'N 124° 52.615'W**. (see Figure 6).

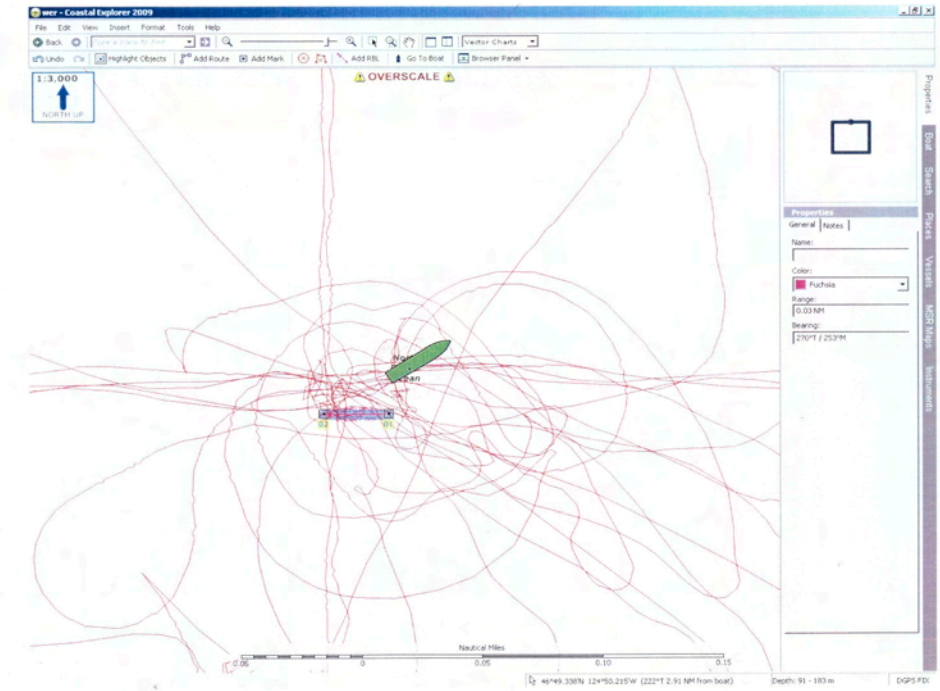


Figure 6: Ship's track while grappling and surveying site. Yellow boxes indicate initial location (eastern site) and location following grappling (western site).

We disabled the pop-up (i.e. unreleased) before leaving site incase it were to slowly work its way loose and release after we had left. However we note that since this instrument is in a protected environmental habitat, it is unlikely to be fished up.

Pressure test conducted at 12:15 local.

Following this work we went into Westport, WA to pick up a release kindly loaned to us by Walt Waldorf of OSU, and driven from Corvallis to Westport by Dan Brusa. A small boat was lowered and taken into the fuel port at Westport where it was met by Dan with the equipment. Back onboard by ~21:30 local, we secured the new gear and the small boat and got underway.

Day 8: Saturday July 30, 2011 – Deploy CFN19B, CFN18C, CFN6B, CFN4B

Once onsite for **CFN19B** we tested the new release system using some anchor chain with a back up line keeping it attached to the wire. We confirmed that the release worked. Because of the new release design we had to use a larger shackle to attach the sling that was deemed to have a significant risk of getting stuck upon release. So it was decided to release leaving the shackle and sling on the OBS, again introducing a possible noise problem. To try and mitigate against this a piece of carpet was wrapped around the shackle (Figure 7). **CFN19B** was in the water at 211 07:51Z (July 30th 2011) (00:51 local, July 30th), and was released at 211 08:04Z (01:04 local). Water depth was 75m. . Ship's heading on deployment 333°. The release location was 46°43.814'N 124° 22.027'W. Ranged location (cross) **46°43.788'N 124° 22.027'W** (*Note: Longitude based on drop location only – not constrained by survey*)

Figure 7: Carpet wrapped around shackle from the sling on CFN19B to minimize noise.

For **CFN18C** we decided to mitigate the potential shackle noise problem even further by adding a triangle of carpet to the instrument (tie-wrapped on). This was nick-named the bikini by a person who shall not be named. All sorts of jokes of questionable appropriateness followed (see Figure 8).

OBS for site **CFN18C** was in the water at 211 18:55Z (July 30th), 11:55 local (Saturday July 30th, 2011) and released at 19:14Z (13:14 local). OBS was confirmed level prior to and following release. Release location was 46° 41.992'N 124° 43.490'W. Water depth 163m. Ship's heading on deployment 334°. Ranged location (cross): **46° 41.988'N 124° 43.490'W**.

On our way to the next site (CFN6B) we detoured via **CFN8D** just to be sure that the pop-up float hadn't somehow worked its way loose. We saw no sign of the float but were able to communicate with the instrument, confirm it was still 7 pings, and disable and relock the release (un-release). We also conducted a ranging survey on the release transducers since there was some indication they might be ~20m apart from the pop-up buoy transducer. However, differences in the latency of the transponder responses may account for the ~20ms difference. Analysis still to be conducted of the survey may reveal if there is a significant difference.

Figure 8: 'Bikini' carpet section protecting the panel from any knocking by the carpet covered shackle.

Figure 9: The fishing vessel *Sea Toi* trawling for shrimp as we prepare to deploy CFN6B.

OBS for site **CFN6B** was in the water at 212 01:30Z (July 31st, 2011), or July 30th 18:30 local, and released at 212 01:46Z or 18:46 local. The release location was 46° 55.354'N and 124° 43.897'W at a water depth of 134m. Ships heading was 337°. Instrument was confirmed disabled and level. Final ranged location for **CFN6B** is: **46° 55.340 124°43.897'W.**

It is notable that there were a lot of fishing boats in the area when we deployed **CFN6B**, and one (Sea Toi) was very close by the ship (perhaps 0.2 nm) (Figure 9) but did not respond to multiple radio calls, as apparently is common for fishing boats when contacted by research vessels. We double-checked the site given to us by Scott and he had suggested we move our site north (to the place we deployed) out of a heavily fished area. However, it was only ~100m north of the site we originally proposed so we are a little unsure if this was a mistake or if he put us near a known hang. However this site promises to be possible test of the effectiveness of our trawl mounts.

The OBS at site **CFN4B** was in the water at 212 05:08Z (July 31st, 2011) (22:07 local, July 30th, 2011), and released at 212 05:26Z (July 31st, 2011) (22:26 local, July 30th 2011). Release location was 46° 55.048'N 124° 36.089'W. Ships heading at release was 282°.

Unfortunately, shortly after deployment it was realized that the bridge had failed to update the location for this site from the way points we provided, and had instead used the old site location that Scott McMullen had asked us to change because of shrimpers concerns. The site is about 1.5 nm too far south. It was decided to recover in the morning and redploy at the correct location.

Day 9: Sunday July 31, 2011 – Deploy CFN14C

Overnight we interrogated CFN1B, CFN9D, CFN10D, and CFN12C to confirm that they were level (these were deployed prior to the issues at CFN3 when we were not routinely checking level status before release). CFN1B and CFN9D were confirmed level (15 pings). CFN10D and CFN12D gave 7 pings but these are both deep sites, already set for ROV recovery, and they have their transponders deployed at a 50° angle so a tilted signal (7 pings) was expected.

We attempted to recover **CFN4B** in the morning. The pop up release worked, but after pulling in ~200m of line the line broke. Acoustics showed that the instrument had gone from level to tilted, so it is suspect that it is flipped over. Final ranged for **CFN4B** location is **46° 55.065'N 124° 36.090'W.** Our options for recovery from the Wecoma were essentially used up.

We investigated nearby ships and ROV and discover that the R/V Atlantis was transit nearby with Jason on board the next day (August 1st), but Chief Scientist Bill Chadwick said they were unable to divert to recover the instrument because the Jason team would need more time to prepare. NSF was supportive of providing the additional ship time required. The next possibility will be Paul Johnsons' Jason cruise leaving Astoria on the Saturday August 6th. We have asked for confirmation from the Jason group that they are willing to try this.
[Post-cruise post-script: Instrument CFN4B was successfully recovered by ROPOS on August 13, 2011 during the Visions'11 cruise aboard the R/V Thompson, led by John Delaney and Deb Kelley who generously made time to do this during their very busy cruise]

The OBS at site **CFN14C** was in the water at 212 22:38Z (July 31st, 2011) or 15:38 local and was released at ~22:56Z, 15:56 local at ships position 47°01.508'N 124°57.869'W with a ship's heading of 342°. Water depth was 173m. Ranged (cross) location is: **47° 01.485'N 124° 57.880'W**. Tension on the wire was particularly bad during this deployment because of large swells. We reached a record 6950 lbs of tension at one point. Acoustics confirmed disabled and instrument confirmed level (15 pings).

The OBS for site **J57** was to use the prototype trawl mount which was slightly different dimensions than the final model. As such many of the standard ways used to attach things (the pop-up, battery, data logger etc) could not be used. The pressure cases were going to be hose-clamped because the brackets used for the others would not fit. The burn-wire was found to be faulty (and it was the last one), so the seismometer would need to hang from the lanyards on deployment. While we'd done this before, the large swells and excessive wire tensions in the previous deployment were of great concern in this situation. Ultimately the decision was made that it was not wise to attempt this deployment in less than ideal swell conditions, particularly with uncertainty about how well the hose clamps would

work (risking a tube of lithium batteries being left on the seafloor which would represent a significant fishing hazard).

For similar weather reasons (large 6+ ft swell) it was decided not to deploy the ROV to try and image the seafloor and/or the tilted/flipped OBSs. We had no experience deploying it in deep water and poor weather conditions and it was determined that the risk to the vehicle was too great and we were unlikely to be successful. Since we will get into port early (Monday afternoon) we plan to test some of the ROV maneuvers over the side in port.

We received confirmation that the ROV Jason group is willing to try the recovery of CFN4B, and Paul Johnson (Chief Scientist on next *Atlantis*) is willing to consider adding the extra time required to his cruise. Excellent news! If it all works out this is expected to happen on Saturday August 6th 2011 shortly after *Atlantis* leaves Astoria.

At 23:14 (local) we headed to port with two planned stops along the way at J49B and J41B. Goals were to ensure that J49B and J41B were level and to disable J49B.

Day 10: Monday August 1, 2011 – Transiting to port

Overnight we disabled the transponder on J49B (which we weren't sure had been disabled) and confirmed that both J49B and J41B gave level signals (15 pings). ETA into port was 14.30 (local) at the sea-buoy and 15.15 dockside.

TABLE 1

FINAL TRM OBS DEPLOYMENT DETAILS FOR 2011 LEG 1: CRUISE W1107A

Station Name^	Latitude (decimal degrees)	Longitude (decimal degrees)	Depth (m)	Latitude (deg.)	Latitude (min.)	Latitude (hemi.)	Longitude (deg.)	Longitude (min.)	Longitude (hemi.)	Notes
J41B	45.8119	-124.5372	-175	45	48.71600	N	124	32.23000	W	
J49B	46.4378	-124.4275	-120	46	26.26800	N	124	25.65000	W	
FN10D	46.8978	-124.9936	-795	46	53.86900	N	124	59.61800	W	Non-Pop-up Sling with shackle attached
FN9D	46.8401	-124.8877	-198	46	50.40700	N	124	53.26400	W	Non-Pop-up
FN12C	46.8885	-125.1192	-650	46	53.31000	N	125	7.15200	W	Non-Pop-up
FN1B	46.8820	-124.3337	-54	46	52.91700	N	124	20.02300	W	
FN3B	46.8868	-124.5251	-90	46	53.21000	N	124	31.50800	W	Possibly tilted/upside down
FN5	46.8578	-124.6553	-124	46	51.46700	N	124	39.31800	W	
FN7B	46.8555	-124.7865	-154	46	51.33000	N	124	47.19100	W	
FN8C	46.8888	-124.8769	-177	46	53.32500	N	124	52.61500	W	Likely upside down
FN19B	46.7298	-124.3671	-75	46	43.78800	N	124	22.02700	W*	Sling with carpeted shackle attached (Fig 7)
FN18C	46.6998	-124.7248	-163	46	41.98800	N	124	43.49000	W	Sling with bikini carpeted shackle attached (Fig 8)
FN6B	46.9223	-124.7316	-134	46	55.34000	N	124	43.89700	W	Sling with bikini carpeted shackle attached
FN4B**	46.9178	-124.6015	-104	46	55.06500	N	124	36.09000	W	Tipped over - in heavy fishing zone (sling with bikini - Fig8)
FN14C	47.0248	-124.9647	-173	47	1.48500	N	124	57.88000	W	Non-Pop-up Sling with bikini carpeted shackle.

^ - NOTE - Station names were changed from original cruise report, dropping the 'C' at the start of the focused site names to accommodate 5 character limit.

* - longitude based on drop site

** - FN4B Recovered August 13, 2011 - ROV ROPOS

TABLE 2

Final OBS deployment locations vs planned locations

Priority	Planned Station Name	Latitude (decimal degrees)	Longitude (decimal degrees)	Depth (m)	Actual Station Name	Actual Latitude	Actual Longitude	Actual Depth	Distance from planned site (km)
1	J41 *	45.7447	-124.4585	-175	J41B	45.8119	-124.5372	-175	9.1
2	J49 ^	46.4026	-124.4297	-116	J49B	46.4378	-124.4275	-120	3.7
3	CFN1	46.8830	-124.3950	-64	CFN1B	46.882	-124.3337	-54	4.6
4	CFN3 ^	46.8705	-124.5252	-92	CFN3B	46.8868	-124.5251	-90	1.8
5	CFN5	46.8580	-124.6554	-125	CFN5	46.8578	-124.6553	-124	0
6	CFN7 ^	46.8454	-124.7856	-160	CFN7B	46.8555	-124.7865	-154	4.6
7	CFN9 *	46.8329	-124.9157	-366	CFN9D	46.8401	-124.8877	-198	2.2
8	CFN11 #	46.8203	-125.0458	-640	not deployed	replaced by CFN12			
9	J57	47.0800	-124.4500	-59	not deployed	see comment			
10	CFN19 ^	46.7300	-124.4000	-82	CFN19B	46.7298	-124.3671	-75	2.4
11	CFN17 #	46.6700	-125.0000	-1031	not deployed	replaced by CFN18			
12	CFN14 ^	47.0300	-125.0000	-745	CFN14C	47.0248	-124.9647	-173	2.7
13	CFN2	46.9302	-124.4711	-80	not deployed				
14	CFN4 +	46.9176	-124.6013	-104	CFN4	46.9178	-124.6015	-104	0
15	CFN6 ^	46.9051	-124.7315	-137	CFN6B	46.9223	-124.7316	-134	1.8
16	CFN8 *	46.8925	-124.8616	-222	CFN8C	46.8888	-124.8769	-177	1.3
17	CFN10 *	46.8800	-124.9917	-777	CFN10D	46.8978	-124.9936	-795	1.9
18	CFN12 ^	46.8674	-125.1218	-710	CFN12C	46.8885	-125.1192	-650	1.9
19	CFN15	47.0600	-124.7000	-110	not deployed				
20	CFN18 ^	46.7000	-124.7000	-155	CFN18C	46.6998	-124.7248	-163	2.1

* Moved into the Nehalem Bank or Grays Canyon Essential Fish Habitat (EFH), where this is no trawling activity.

^ Moved to less heavily fished site.

+ Deployed upside-down in heavily fished area, creating a serious fishing hazard. Recovered by the ROPOS ROV on August xx, 2011.

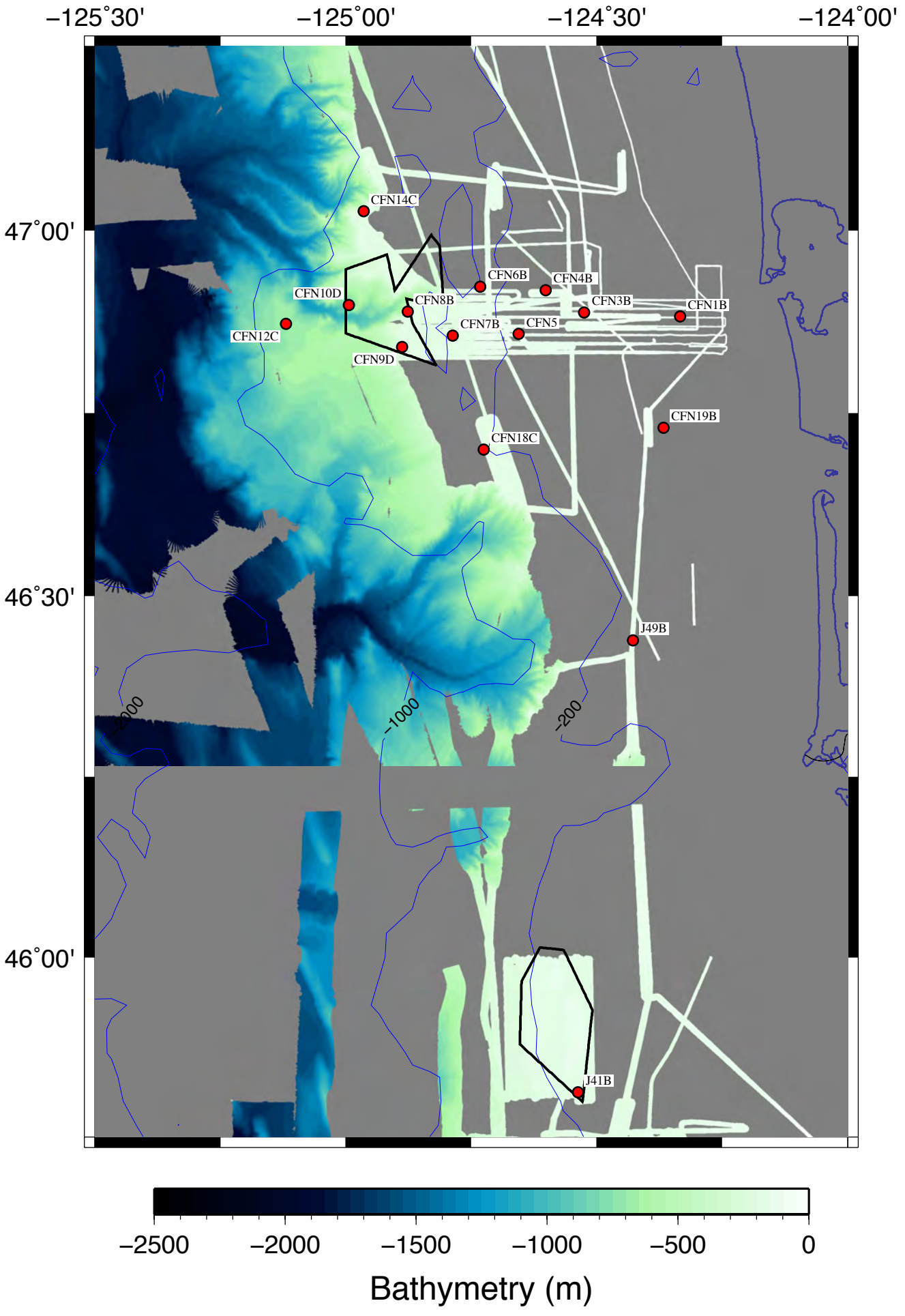
Fishing hazard. Replacement site found.

Appendix 1:

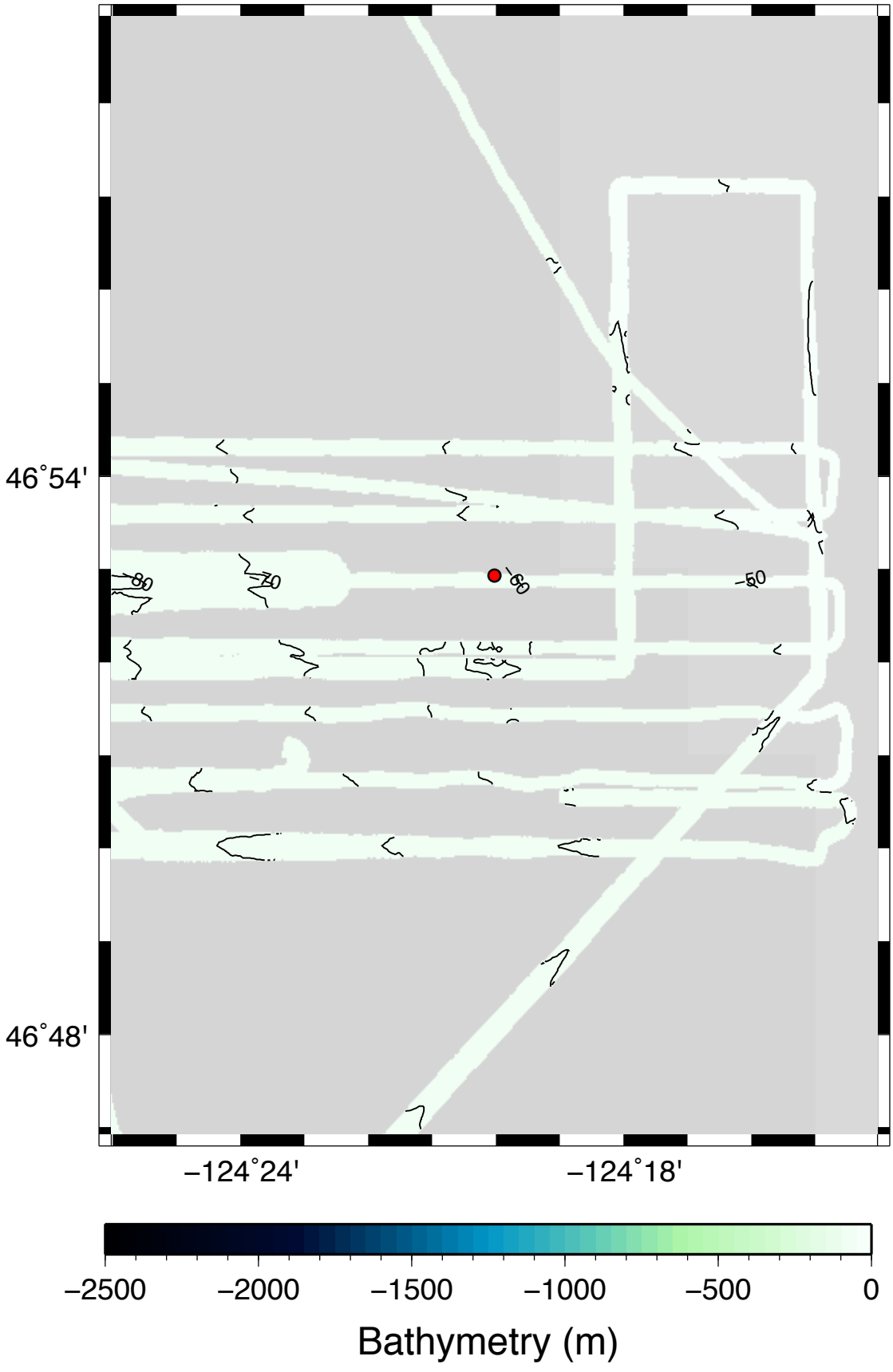
Site Bathymetry

The following plots show the overall site bathymetry and deployment locations as well individual site bathymetry at 0.2 x 0.2° scale for each site. For these latter maps the contours were at 10m intervals for 0-200m and at 100m intervals thereafter.

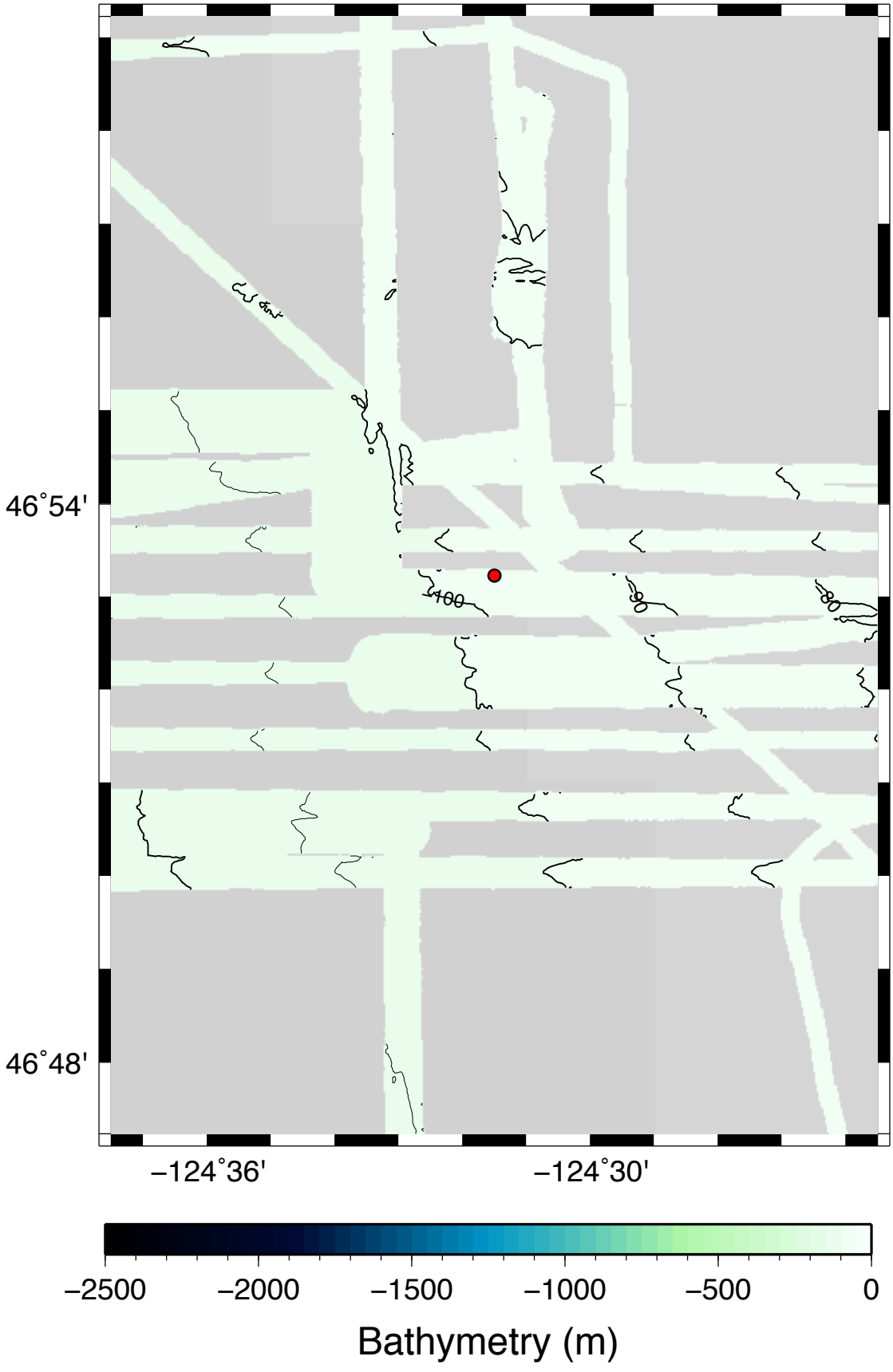
Colored bathymetry was provided by Chris Goldfinger and his team from OSU. Most of it was collected in June 2011 aboard the R/V Thompson. Some was collected recently for other projects (e.g. OOI, EFH). The greyscale background bathymetry is from GeoMapApp.


−125˚30'
−125˚00'
−124˚30'
−124˚00'
47˚00'
46˚30'
46˚00'
CFN14C
CFN6B
CFN4B
CFN10D
CFN8B
CFN3B
CFN1B
CFN12C
CFN7B
CFN5
CFN9D
CFN19B
CFN18C
J49B
−2000
−1000
−200
J41B
−2500
−2000
−1500
−1000
−500
0
Bathymetry (m)

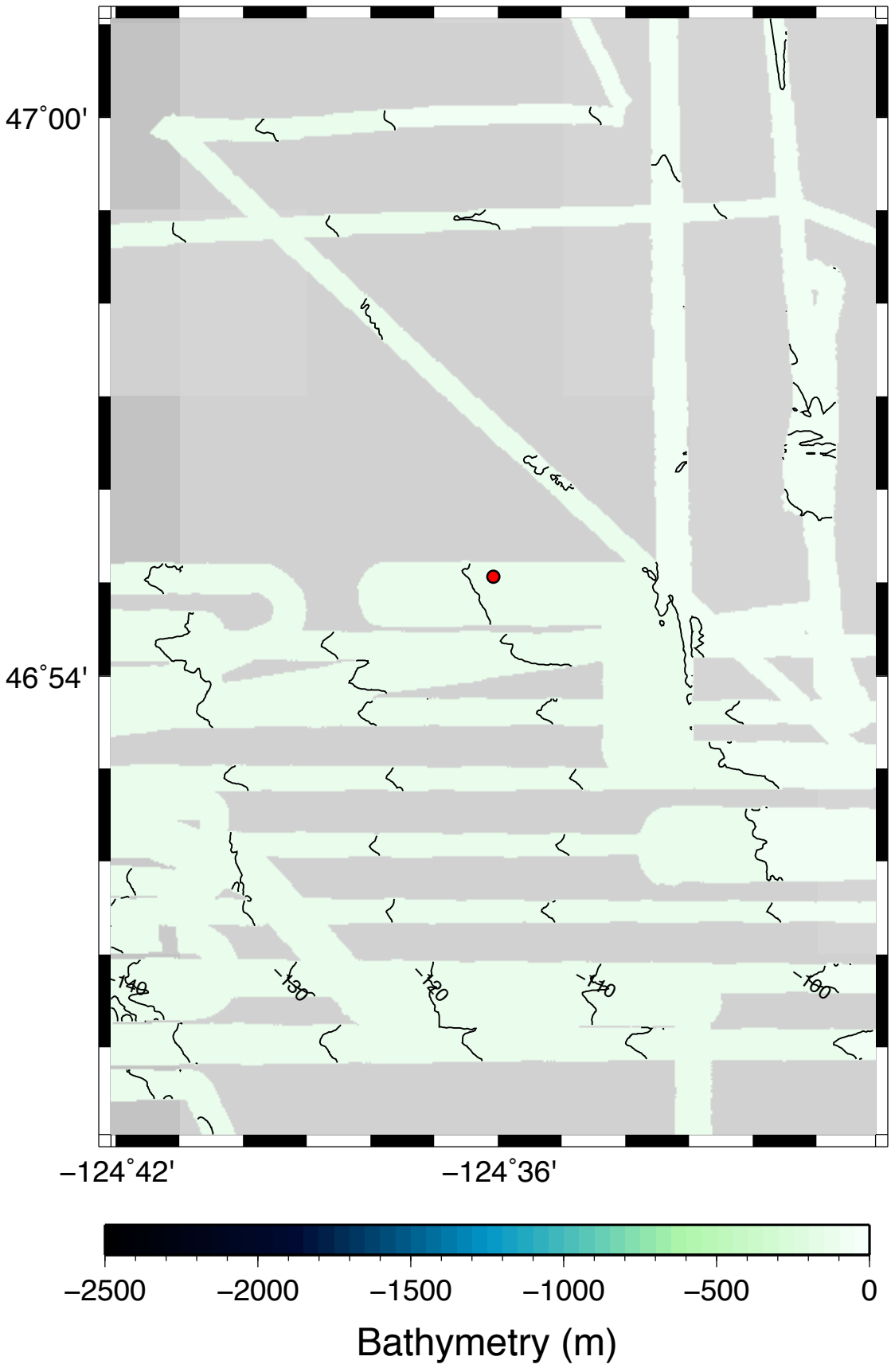
CFN1B


46˚54'
46˚48'
−124˚24'
−124˚18'
−80
−50
−2500
−2000
−1500
−1000
−500
0
Bathymetry (m)

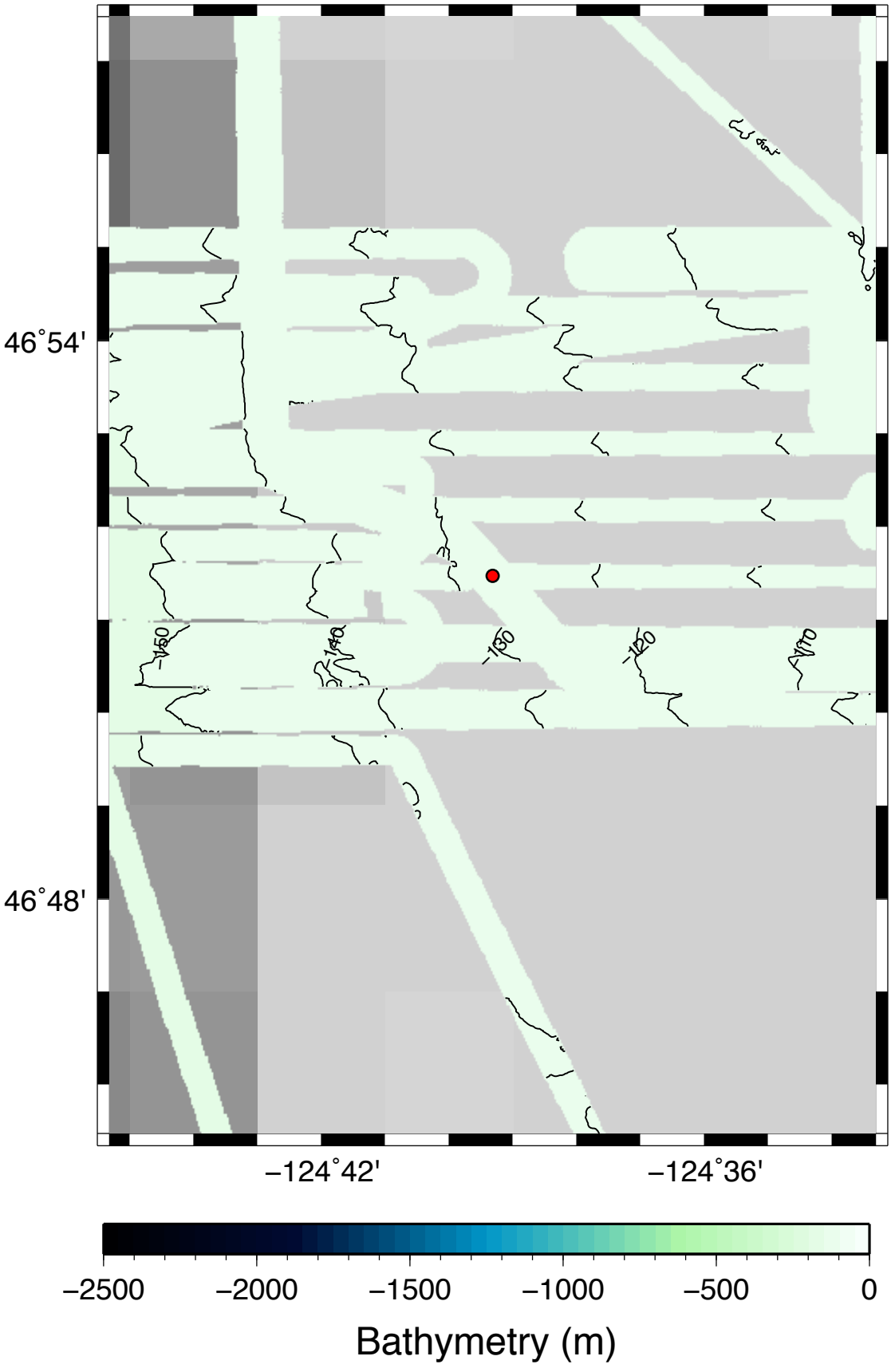
CFN3B


46°54'
46°48'
−124°36'
−124°30'
100
80
80
−2500
−2000
−1500
−1000
−500
0
Bathymetry (m)

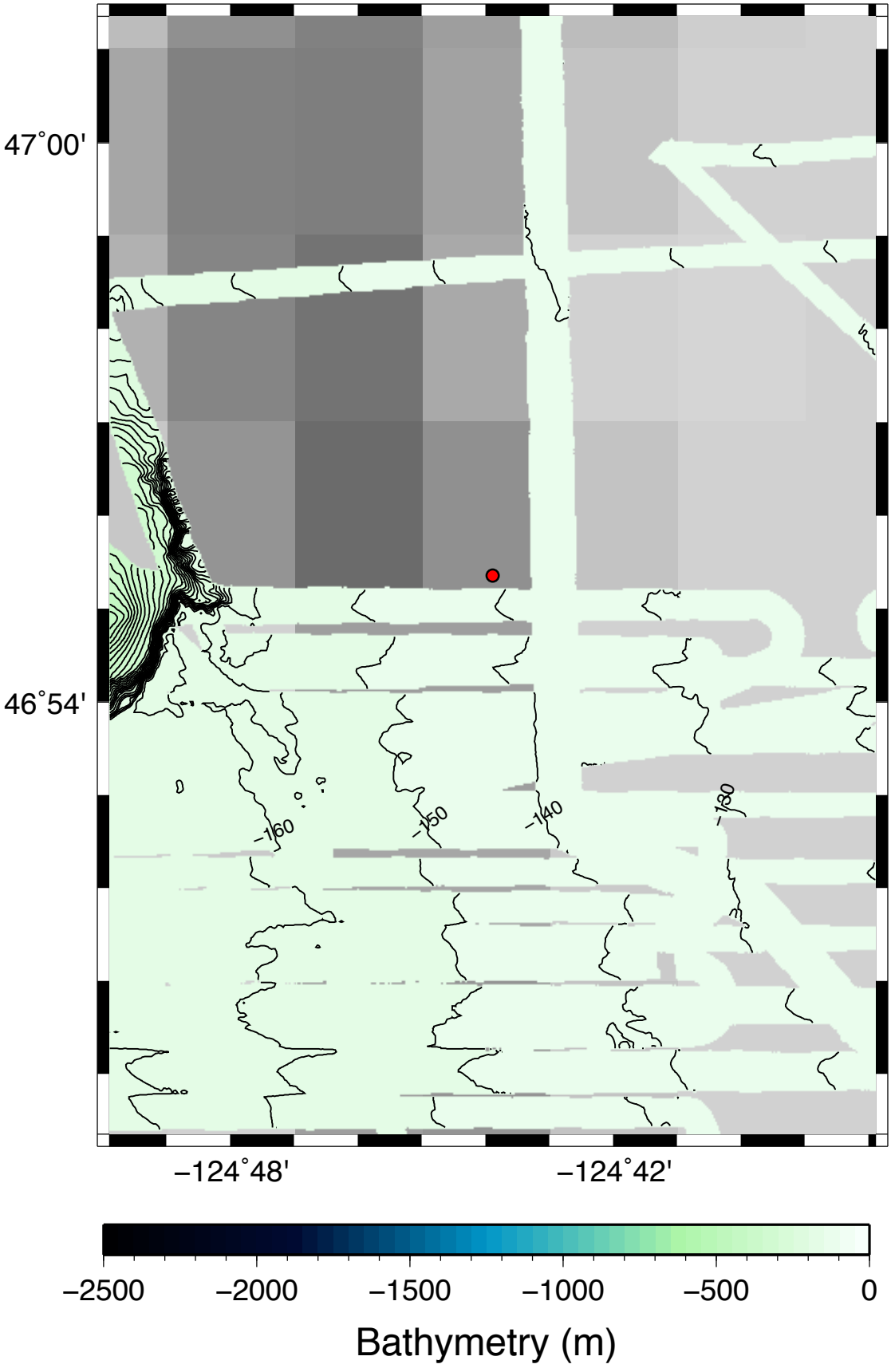
CFN4B


47˚00'
46˚54'
−124˚42'
−124˚36'
−140
−130
−120
−110
−160
−2500
−2000
−1500
−1000
−500
0
Bathymetry (m)

CFN5


46˚54'
46˚48'
−124˚42'
−124˚36'
−150
−140
−130
−120
−110
−2500
−2000
−1500
−1000
−500
0
Bathymetry (m)

CFN6B


47˚00'
46˚54'
−124˚48'
−124˚42'
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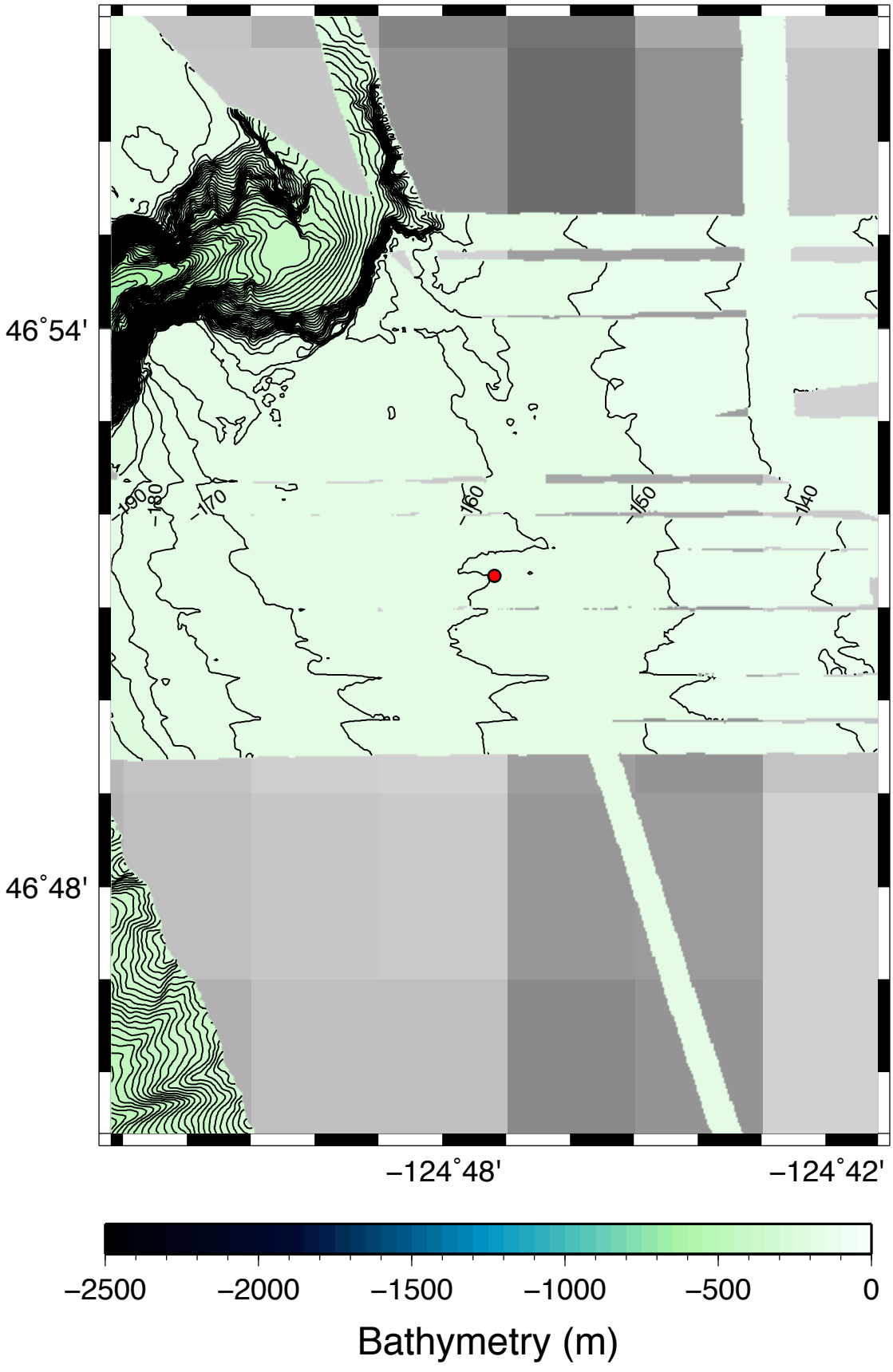
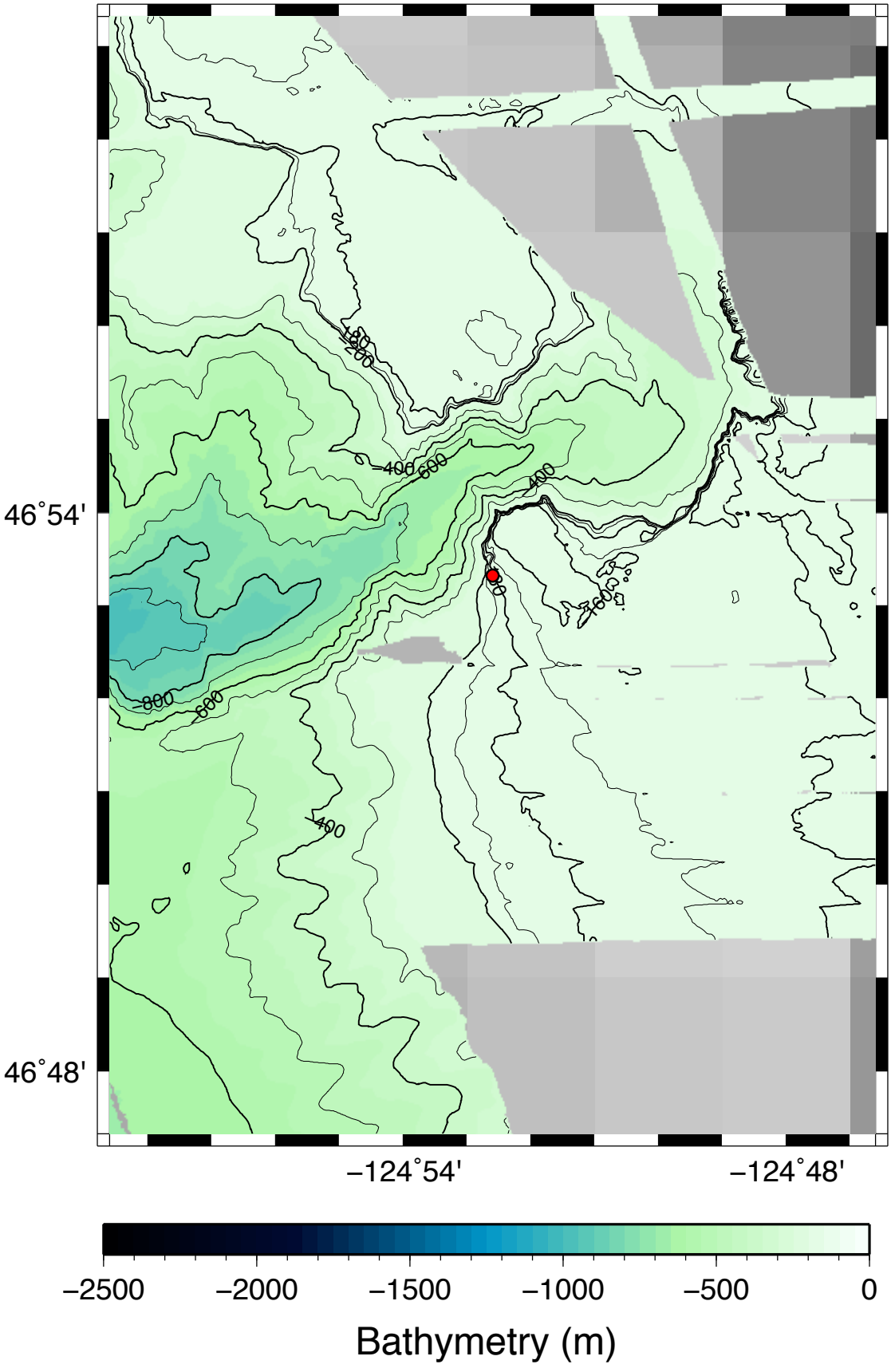
−150
−140
−130
−2500
−2000
−1500
−1000
−500
0
Bathymetry (m)

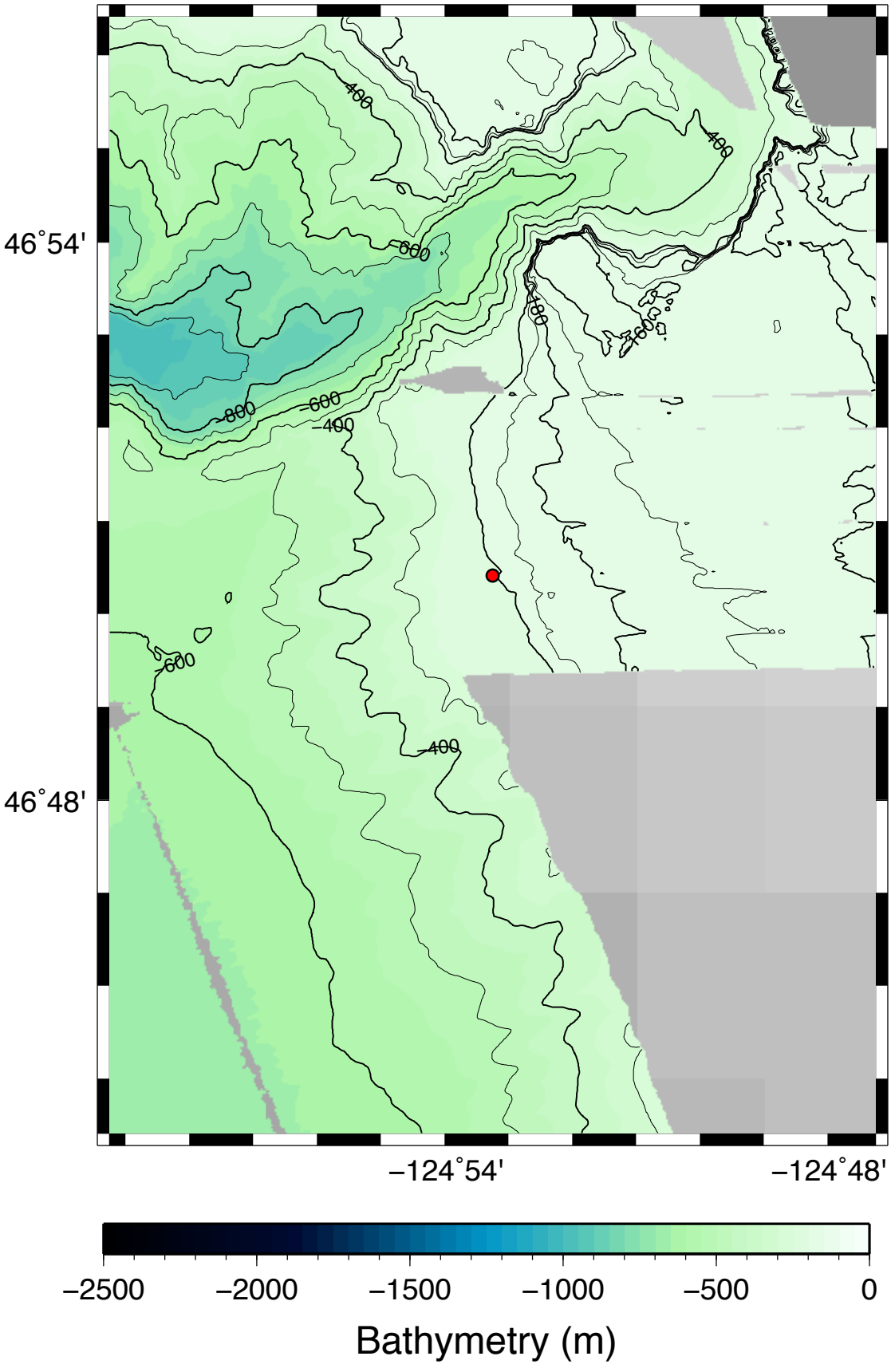
CFN7B


46˚54'
46˚48'
−124˚48'
−124˚42'
−190
−180
−170
−160
−150
−140
−2500
−2000
−1500
−1000
−500
0
Bathymetry (m)

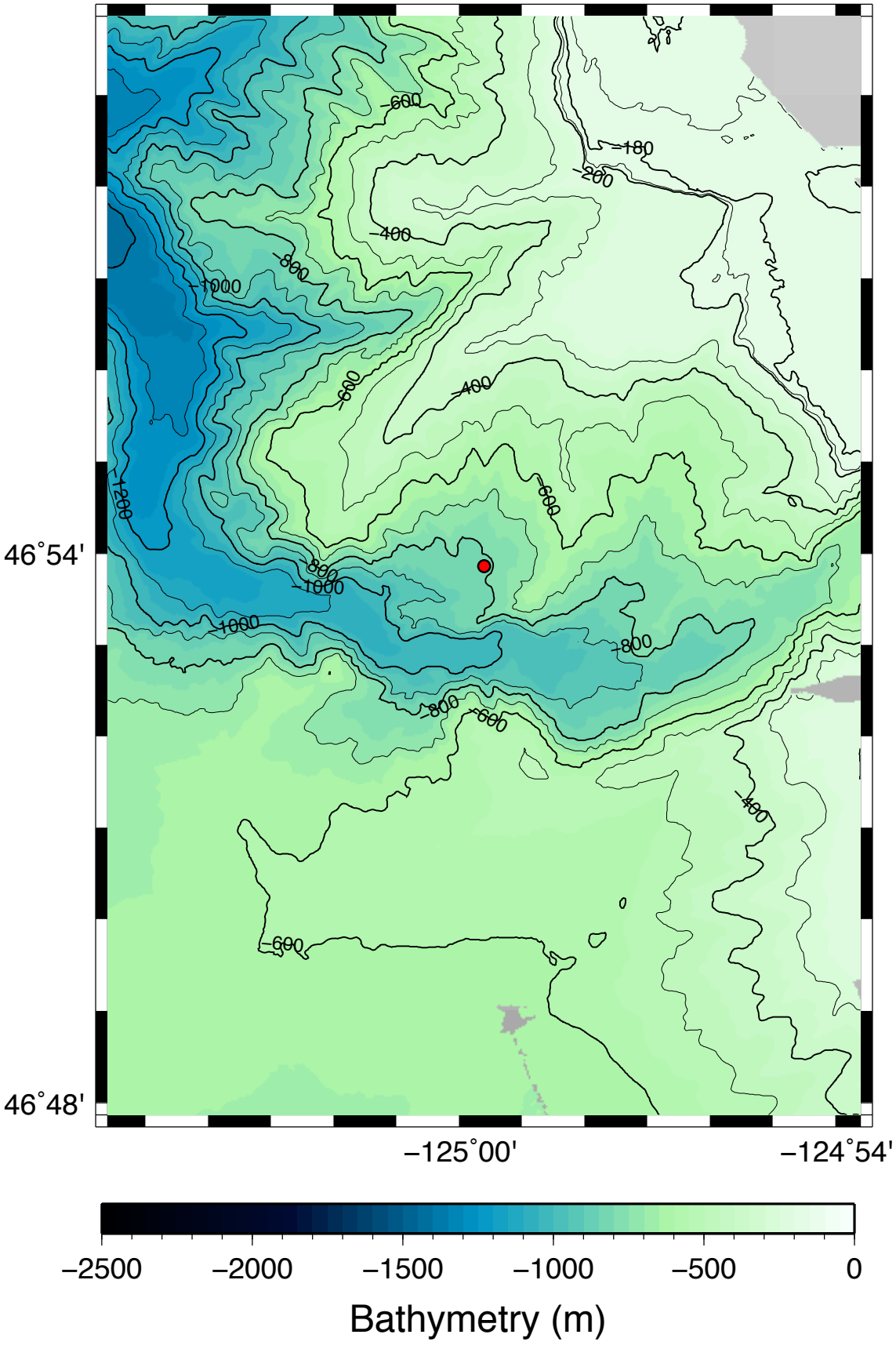
CFN8B


46˚54'
46˚48'
−124˚54'
−124˚48'
1200
400
600
400
800
600
400
−2500
−2000
−1500
−1000
−500
0
Bathymetry (m)

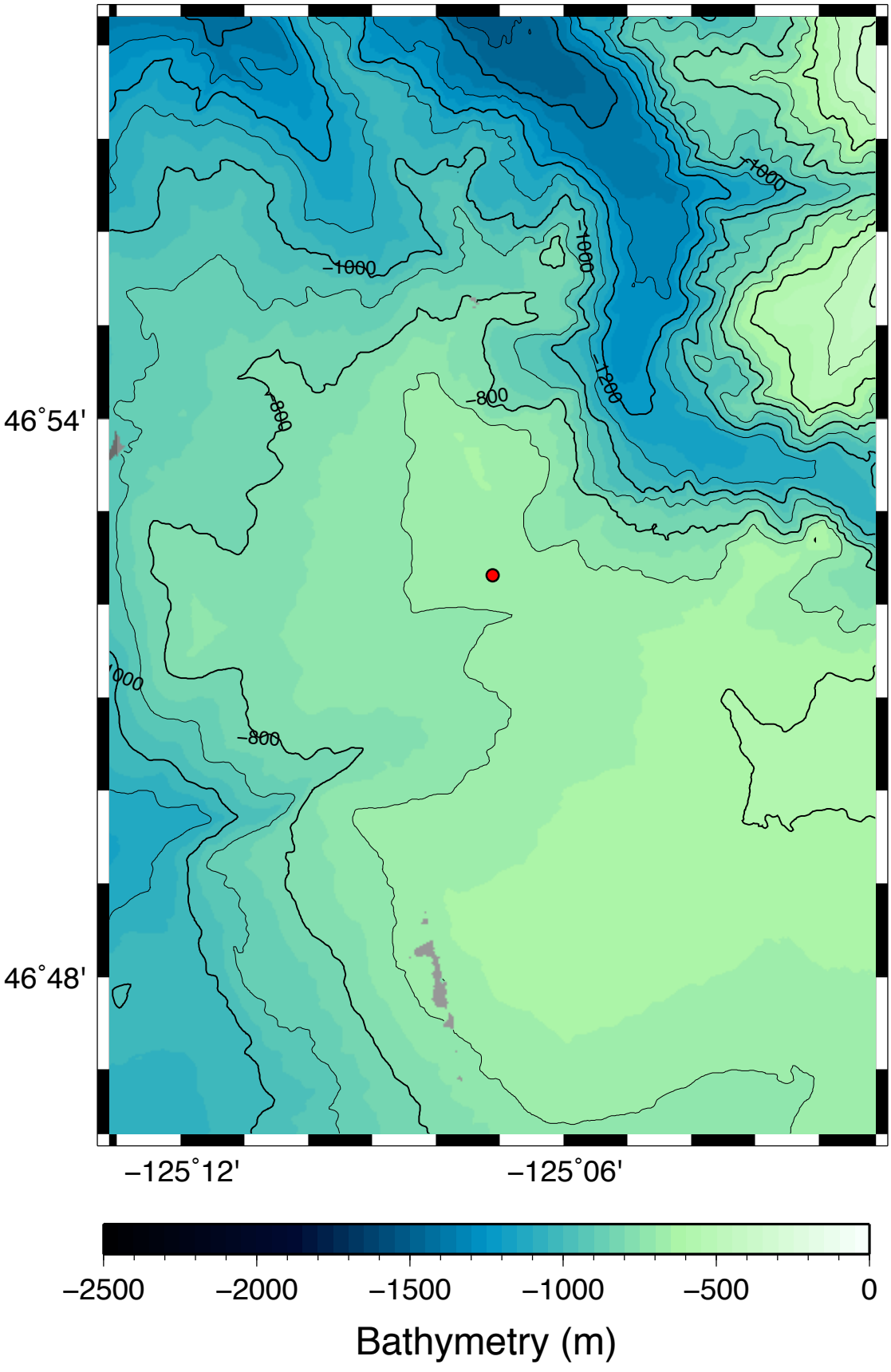
CFN9D


46˚54'
46˚48'
400
600
800
1000
−124˚54'
−124˚48'
−2500
−2000
−1500
−1000
−500
0
Bathymetry (m)

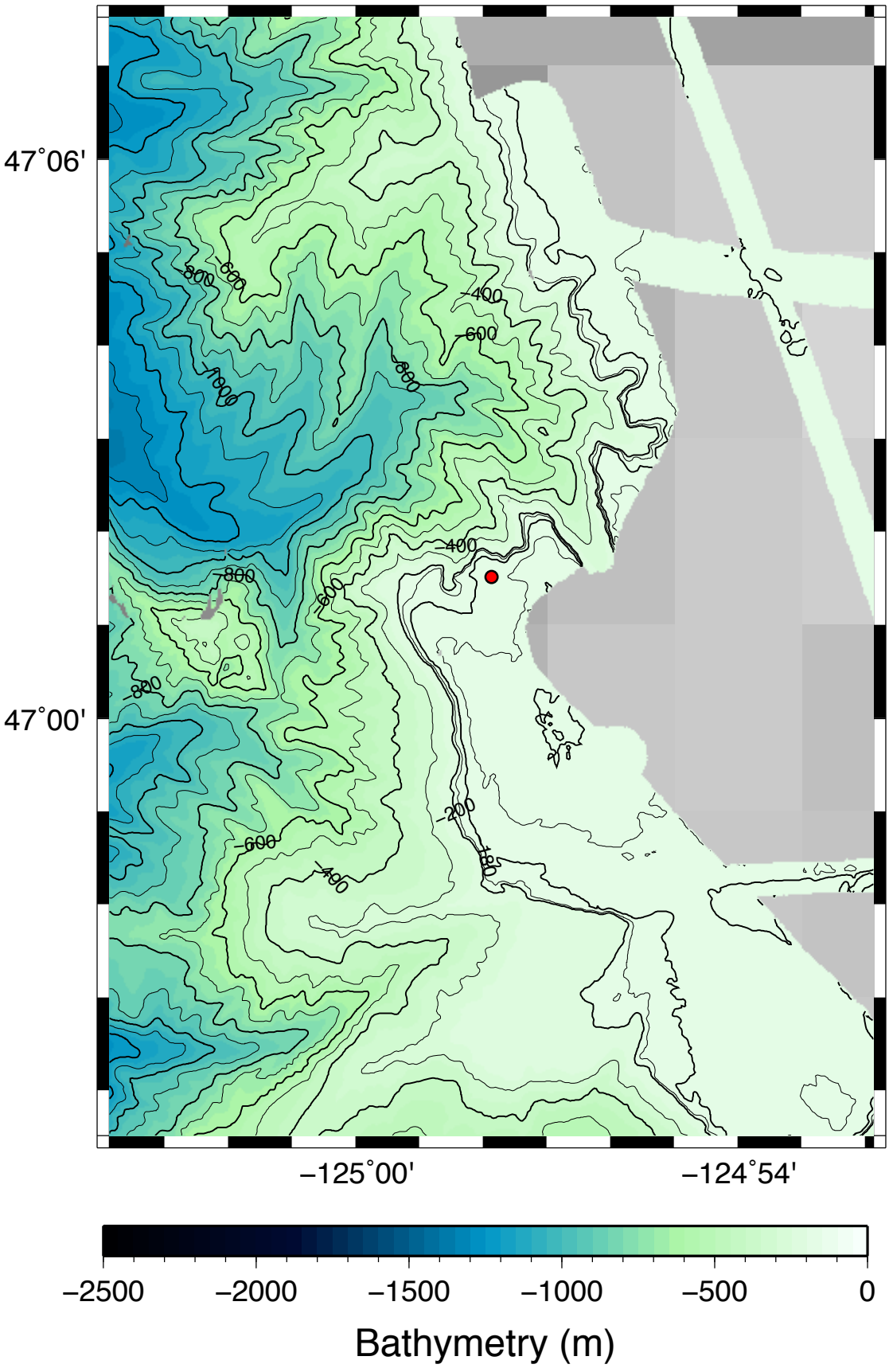
CFN10D


-600
-180
-200
-400
-800
-1000
-600
-400
-1200
-600
-800
-1000
-1000
-800
-800
-600
-400
-600
46˚54'
46˚48'
−125˚00'
−124˚54'
−2500
−2000
−1500
−1000
−500
0
Bathymetry (m)

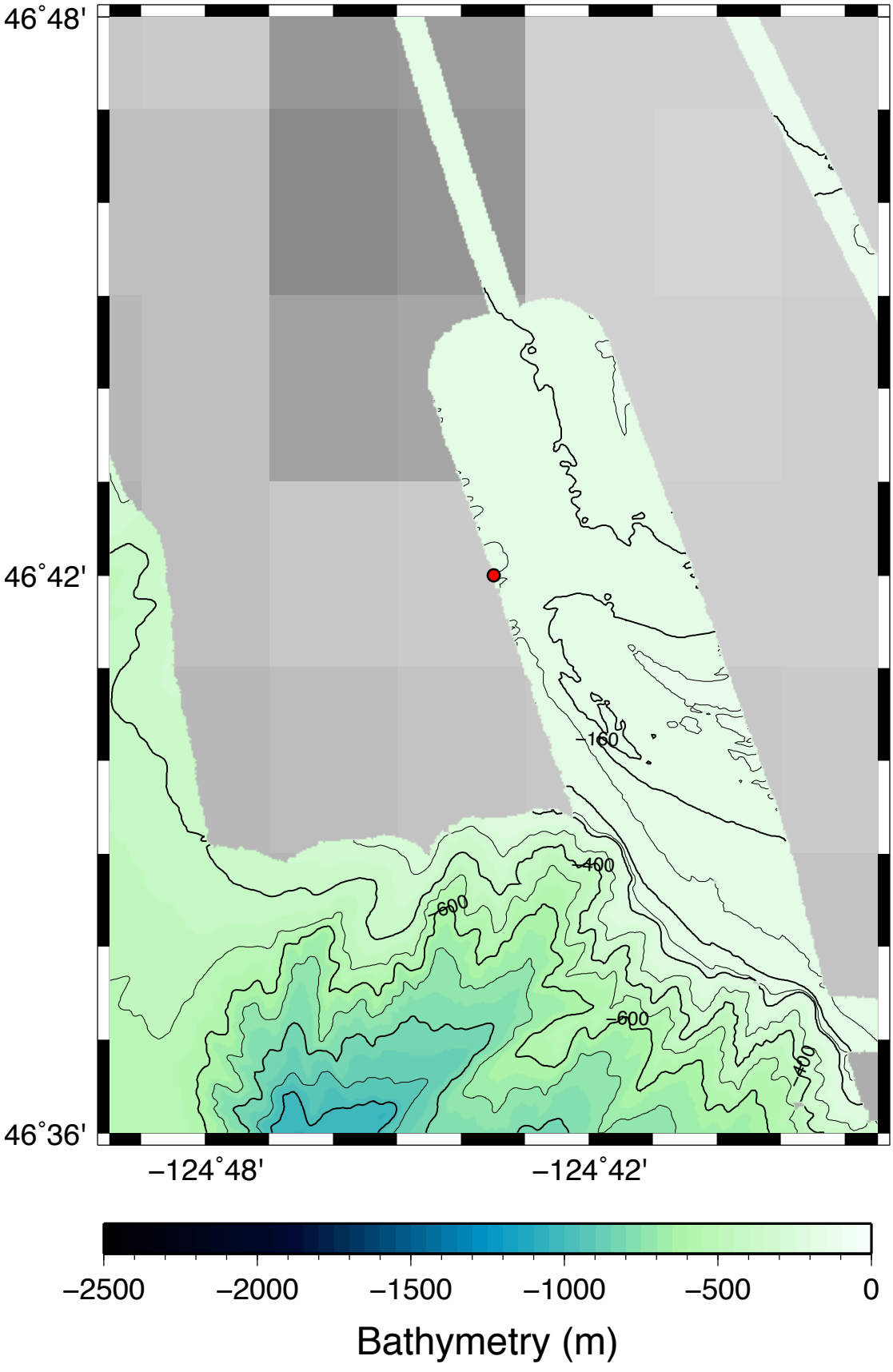
CFN12C


46˚54'
46˚48'
−125˚12'
−125˚06'
−1000
−1000
−1200
−800
−800
−800
−2500
−2000
−1500
−1000
−500
0
Bathymetry (m)

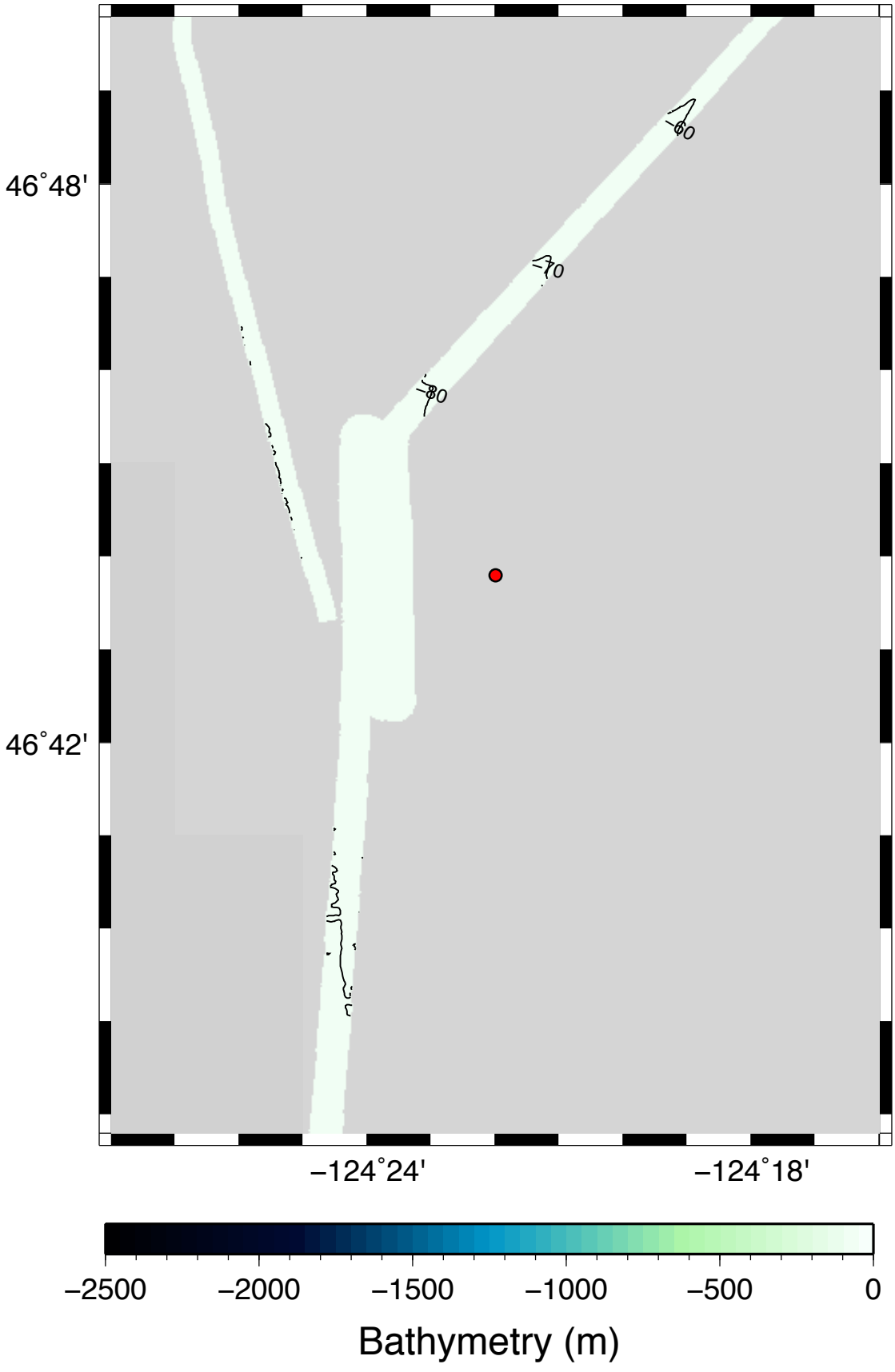
CFN14C



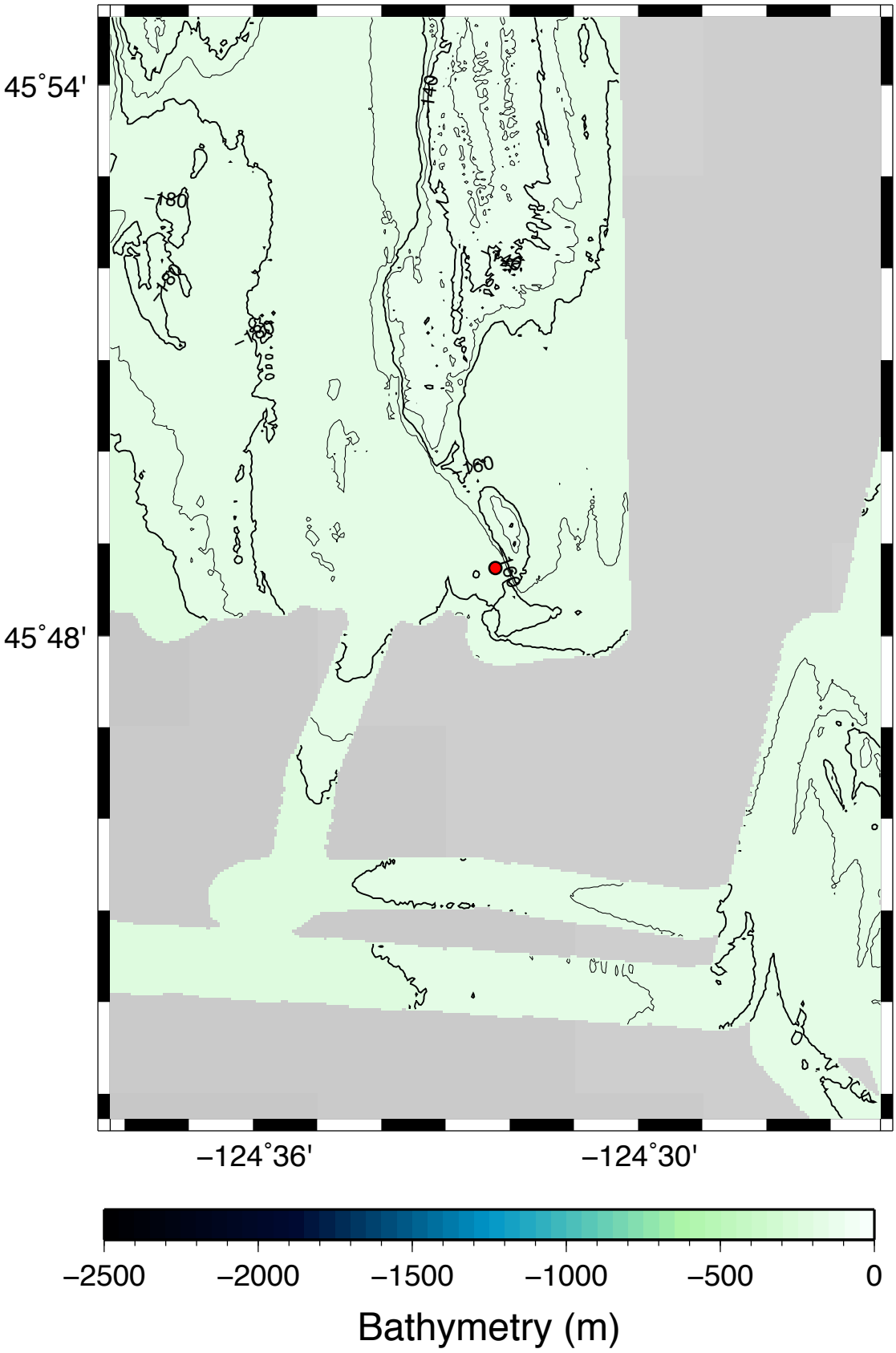
CFN18C


46˚48'
46˚42'
46˚36'
−124˚48'
−124˚42'
−160
−400
−600
−600
−400
−2500
−2000
−1500
−1000
−500
0
Bathymetry (m)

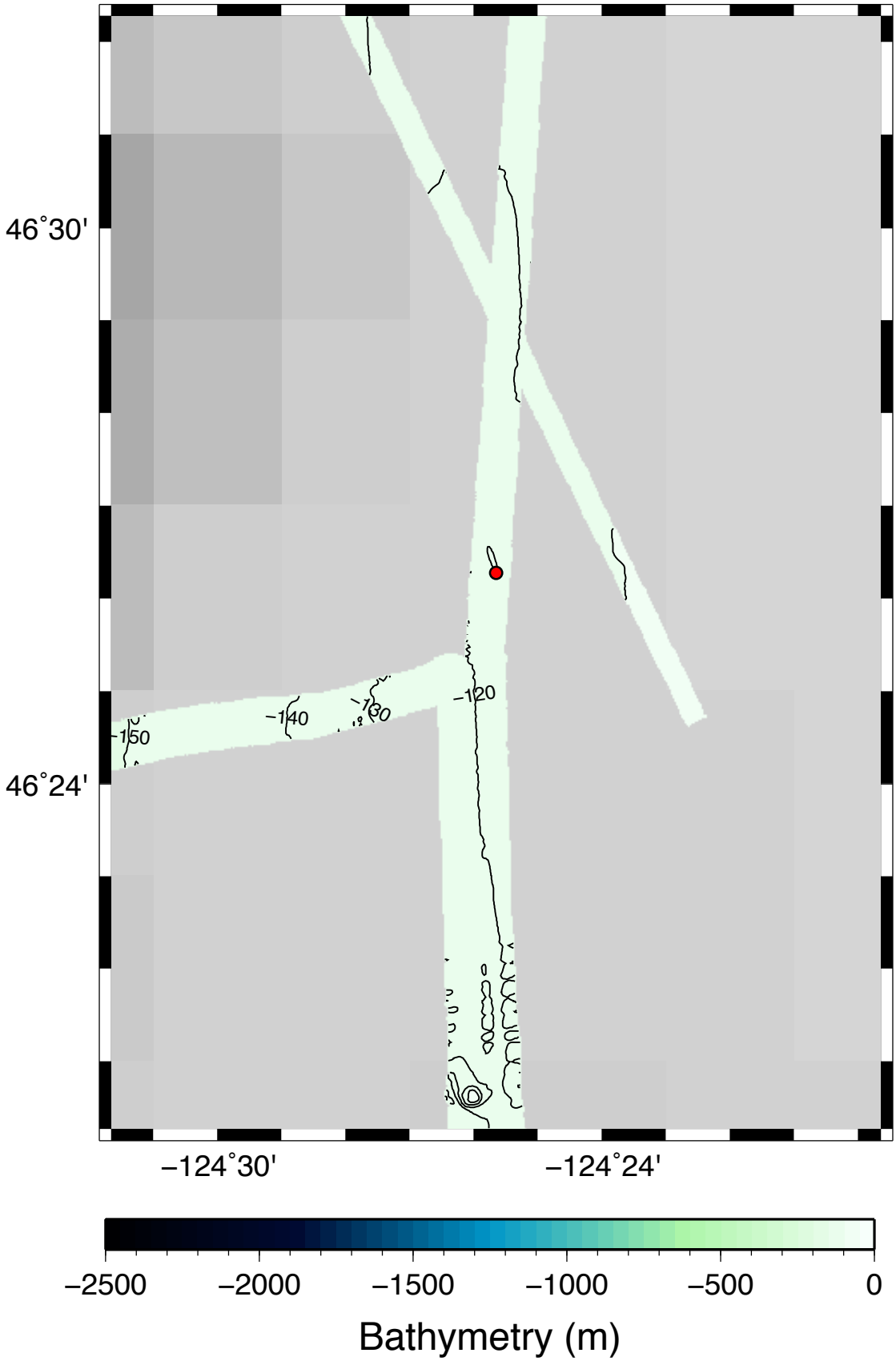
CFN19B


46˚48'
46˚42'
−124˚24'
−124˚18'
−80
−70
−60
−2500
−2000
−1500
−1000
−500
0
Bathymetry (m)

J41B


45˚54'
45˚48'
140
160
180
−124˚36'
−124˚30'
−2500
−2000
−1500
−1000
−500
0
Bathymetry (m)

J49B


46˚30'
46˚24'
−124˚30'
−124˚24'
−120
−130
−140
−150
−2500
−2000
−1500
−1000
−500
0
Bathymetry (m)

Appendix 2:

4 and 12 kHz data:

Digital 4 and 12 kHz acoustic profiling data were acquired during most of the cruise. Data were saved both as Knudsen format .keb and .kea files and in segy format. Keb files can be read by a free reader provided by Knudsen Engineering Limited. Files are time-stamped and contain both 4 and 12 kHz data. Kea files are ascii files that contain relevant metadata. For reasons that have not been determined, recording of segy data for the 12 kHz channel stopped partway into the cruise, so only 4 kHz data are available in segy format for the entire cruise. However, it is possible to export keb-format data as segy files. Data are available via R2R (http://www.rvdata.us/)

Line numbers were automatically incremented by 1 for each file. File names also contain year, day and hour/minute of the first sample. After line 178, the acquisition system was restarted and line numbers were restarted at 200. Generally lines were stopped and then restarted at each station. For the acoustic vent surveys described below, lines were stopped and started at the beginning and end of each survey line.

While the OBSIP staff slept, the night watch conducted acoustic surveys of a vent site located at a depth of 150 m within the OBS array. Prior studies of this vent (Salmi et al., in press) have shown that the seafloor here is characterized by a large pockmark containing slabs of carbonate and active bubble emissions. A upward-looking 200 kHz acoustic transponder was mounted on the bottom for 33 hrs in 200x and showed temporal variability in the methane expulsion rate and a correlation with biological activity.

To characterize temporal variability, we conducted repeat surveys of this site using the shipboard 4 and 12 kHz echo sounders. Three survey patterns were run (Table 1). The first was a reconnaissance survey to determine whether this vent was currently active. The second was a set of 6 short NS profiles that was shot in a race-track pattern and repeated a total of 9 times over 3 nights. The third was a series of 8 EW lines shot 3 times over 2 nights. Acquisition parameters were kept fixed during all of the surveys (Table 2). Table 3 is a matrix of line numbers showing the spatial and temporal distribution of lines for surveys 2 and 3. Data were shot at a ship speed of 2-3 kts and will processed similarly to Kannberg et al. (in review), who summed the backscatter along the track within various time windows to obtain a relative quantification of vent intensity. Unlike prior studies on Hydrate Ridge, vents were visible in the 4 kHz as well as the 12 kHz data. Figure 1 shows an example of the data.

Figure 1. Screengrabs of the Knudsen playback program showing 4 and 12 kHz data for Line 16.

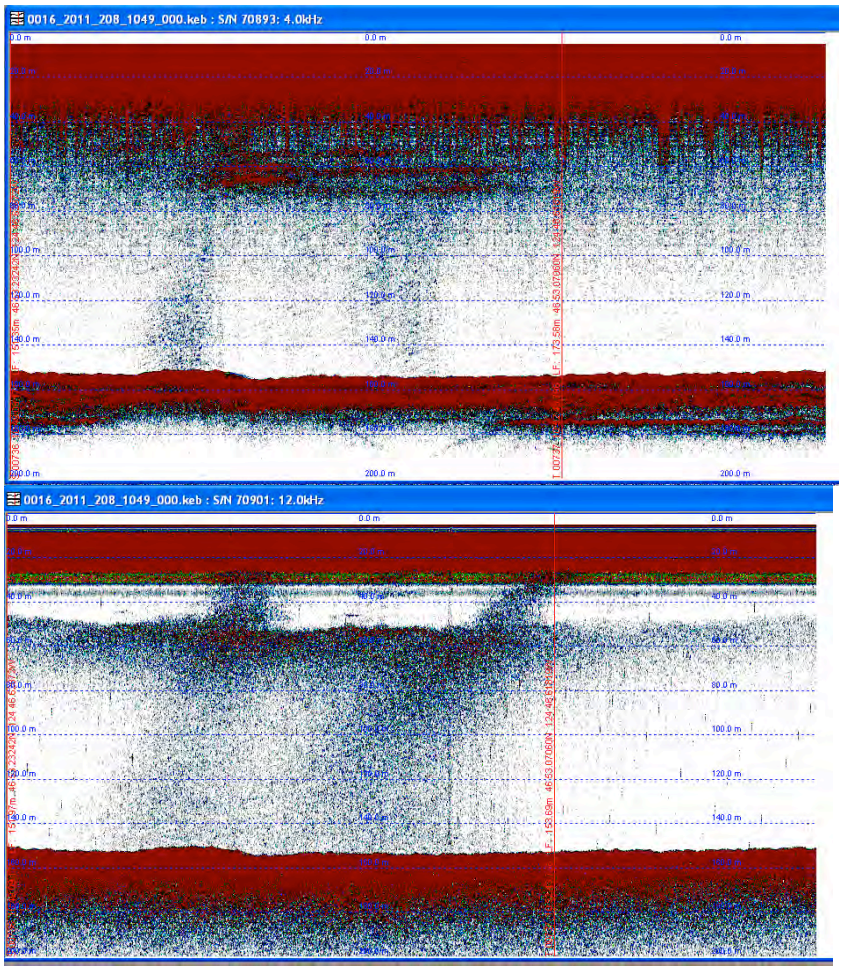


Table 1. Waypoints for bubble surveys.

Survey 2 (repeated 9 times; first 2 surveys extended north to 46° 53.50):

Line 1		Line 4	
46° 53.00’	124° 46.50’	46° 53.25’	124° 46.66’
46° 53.25’	124° 46.50’	46° 53.00’	124° 46.66’
Line 2		Line 5	
46° 53.25’	124° 46.62’	46° 53.00’	124° 46.58’
46° 53.00’	124° 46.62’	46° 53.25’	124° 46.58’
Line 3		Line 6	
46° 53.00’	124° 46.54’	46° 53.25’	124° 46.70’
46° 53.25’	124° 46.54’	46° 53.00’	124° 46.70’

Survey 3 (repeated 3 times):

Line 1		Line 5	
46° 53.053’	124° 46.80’	46° 53.100’	124° 46.80’
46° 53.053’	124° 46.40’	46° 53.100’	124° 46.40’
Line 2		Line 6	
46° 53.145’	124° 46.40’	46° 53.190’	124° 46.40’
46° 53.145’	124° 46.80’	46° 53.190’	124° 46.80’
Line 3		Line 7	
46° 53.076’	124° 46.80’	46° 53.121’	124° 46.80’
46° 53.076’	124° 46.40’	46° 53.121’	124° 46.40’
Line 4		Line 8	
46° 53.167’	124° 46.40’	46° 53.212’	124° 46.40’
46° 53.167’	124° 46.80’	46° 53.212’	124° 46.80

Table 2. Acquisition parameters for the Knudsen 320B/R 4 and 12 kHz echosounder during bubble surveys:

Parameter	4 kHz	12 kHz
Pulse length	0.25 ms	0.25 ms
Power	1	2
Gain	30 dB	50 dB
Recording window	0-200 m	0-200 m

Table 3. Matrix of line numbers in surveys 2 and 3. Keb and segy file names start with the line numbers in the table. The first 2 lines of the table give the approximate starting and ending time of each survey. A particular survey appears as a column. The first column gives (line numbers in space)/(line number in time). In space, lines are numbered from east to west (survey 2) or south to north (survey 3). In time, they are numbered in the order in which they were shot.

Survey 2:

Time start	7/27 101914^	7/27 121641	7/27 134834	7/27 144156	7/28 072438	7/28 085646	7/28 102004	7/28 112816	7/30 124335
Time end	121114	133414	143635	160246	084640	101245	112248	122647	134129
1/1	15	26	38	50	65	77	89	101	168**
2/3	18	30	42	54	69	81	93	105	172
3/5	22	34	46	57	73	85	97	109	176
4/2	16	28	40	52	67	79	91	103	170
5/4	20	32	44	55*	71	83	95	107	174
6/6	24	36	48	59	75	87	99	111	166

* This file contains the turn preceding the line as well as the line.

** This survey was shot out of order, with the western line shot first and that the normal order was picked up.

^ These times are from the hand-written log. They should be updated from start and end times in the kea files.

Survey 3:

Time start	7/28 124239	7/28 142455	7/30 105902
Time end	141830	155328	123251
1/1	113	129	150
2/3	117	133	154
3/5	121	137	158
4/7	125	141	162
5/2	115	131	152
6/4	119	135	156
7/6	123	139	160
8/8	127	143	164

Appendix 3:

CTDs:

Several CTDs (physical data only; no water samples) were taken. Most were taken when the CTD winch was being used to pressure test OBS housings. In addition, a ToYo transect of CTD profiles and two stationary CTDs were acquired across the vent site.

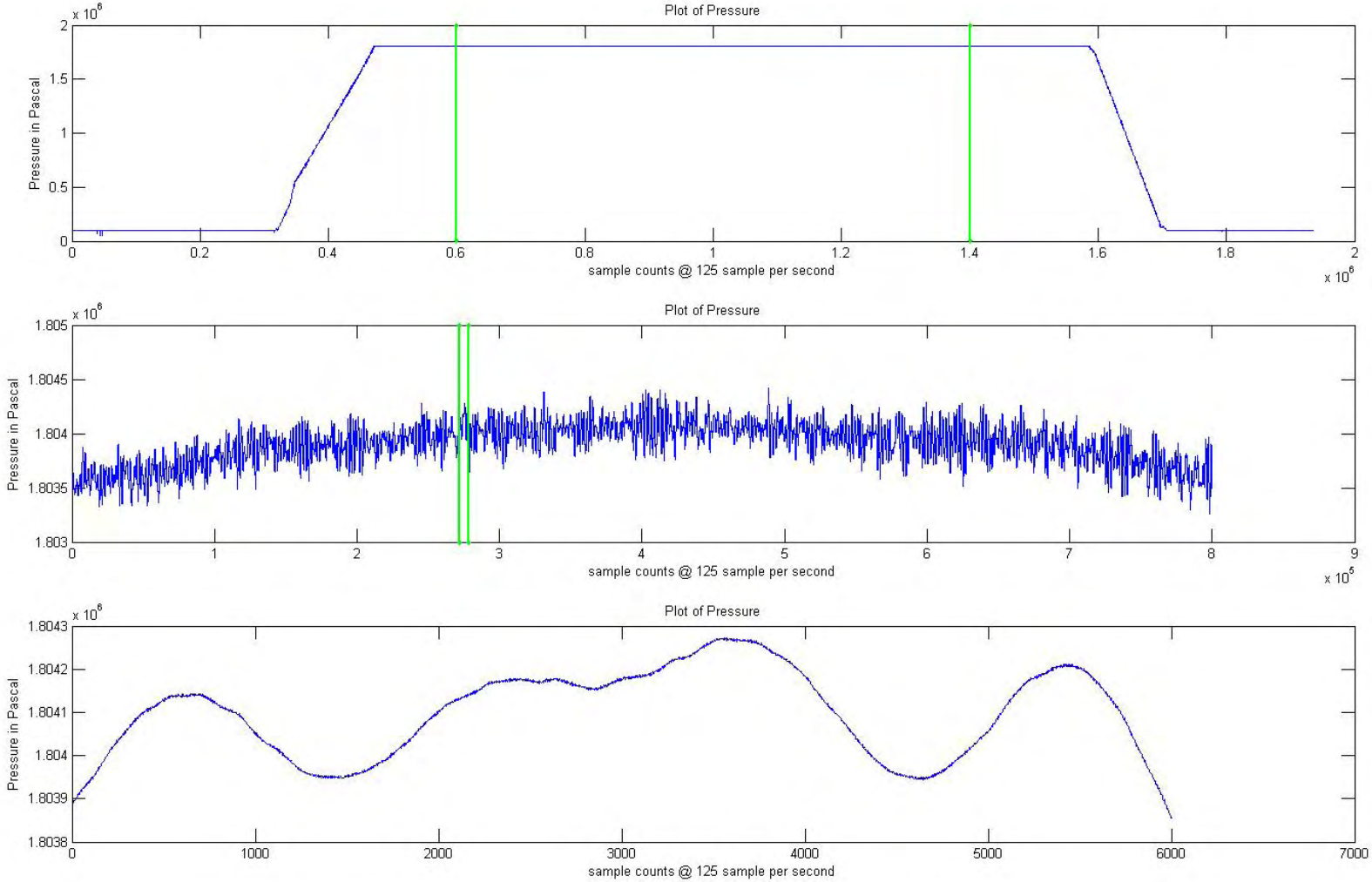
CTDs acquired during W1107A:

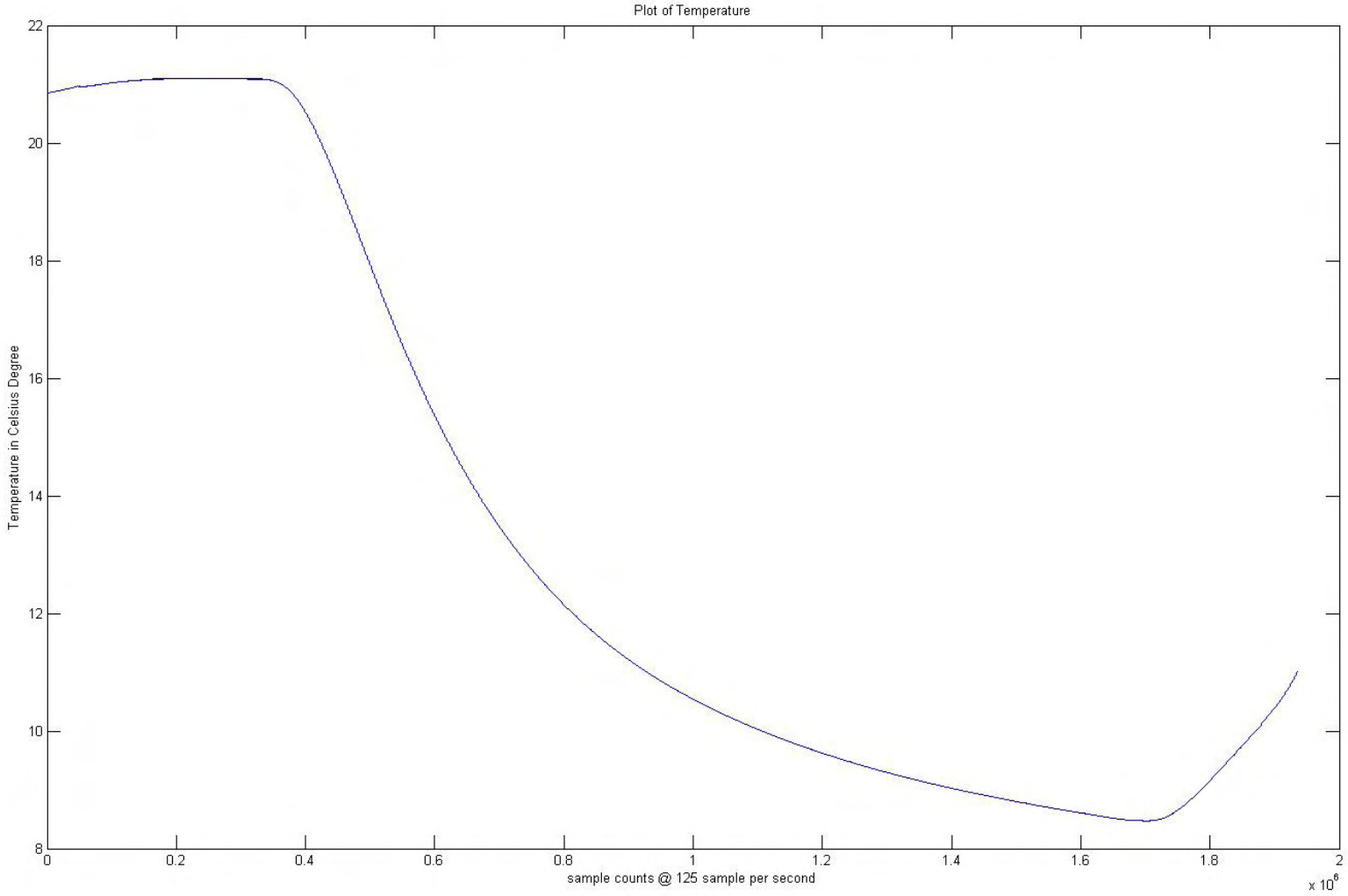
OBS site	Pump on time day hr/min	CTD station number	Latitude	Longitude	Water Depth (m)	Comments
J41B	206 0432	Cast01	45° 48.713	-124° 32.219	172	Pressure test. Hold at 140 m for 15 min.
PT2	207 0022	Cast02	46° 15.008	-124° 27.640	598	Pressure test. Hold at 200 m for 15 min.
CFN9C	207 2313	Cast03	46° 50.414	-124° 53.786	173	Pressure test.
CFN12C	208 0529	Cast04	46° 53.308	-125° 06.954	653	Pressure test.
ToYo1	209 2011	Cast05 – Cast08	46° 53.028	-124° 46.610	139	Temperatures differ ~1-4 °C. Check pumps and configuration files.
ToYo CTD1	209 2121	Cast09	46° 53.120	-124° 46.407	153	Stationary cast at vent site
ToYo CTD2	209 2139	Cast10	46° 53.184	-124° 46.410	156	Stationary cast
CFN7B	209 2247	Cast11	46° 51.336	-124° 47.172	155	Pressure test. Hold at 147 m for 15 min.
CRN19 B	210 0338	Cast12	46° 51.376	-124° 47.741	155	Pressure test. Hold at 147 m for 15 min.
CFN8B	210 1922	Cast13	46° 53.229	-124° 52.679	185	Pressure test. Hold at 170 m for 15 min.
CFN18C	211 1951	Cast14	46° 42.163	-124° 43.493	165	Pressure test. Hold at 155 m for 15 min.

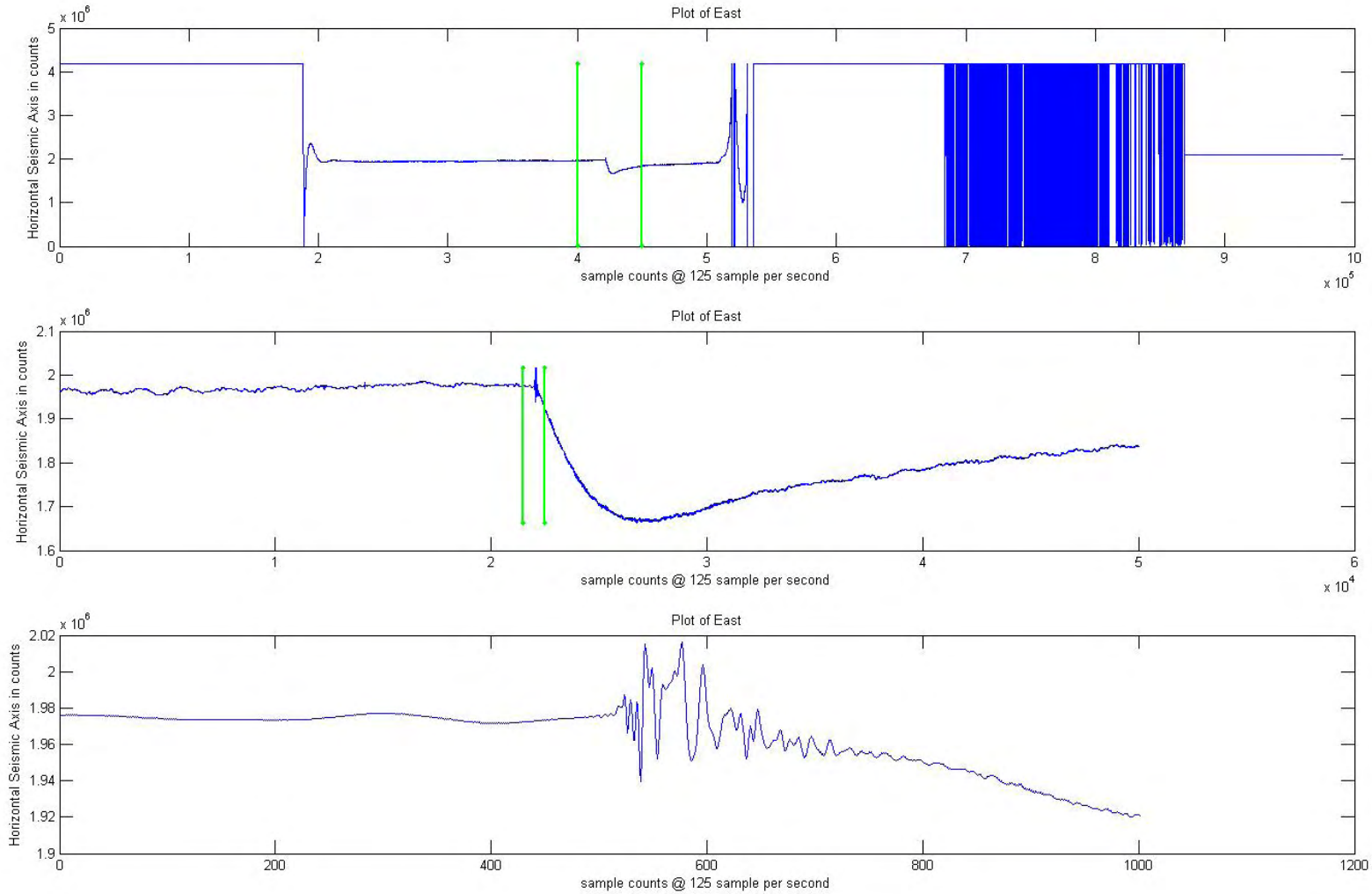
Appendix 4:

Data from OBS test deployment

The following pages contain the test data from the brief deployment on day 1. Plots are included of temperature and pressure from the Absolute Pressure Gauge and all three channels of the seismometers. Everything appeared to be working well, and the seismometer recorded a 'fish bump'.


Plot of Pressure
x 10^6
Pressure in Pascal
sample counts @ 125 sample per second
x 10^6
Plot of Pressure
x 10^6
Pressure in Pascal
sample counts @ 125 sample per second
x 10^5
Plot of Pressure
x 10^6
Pressure in Pascal
sample counts @ 125 sample per second


Plot of Temperature
Temperature in Celsius Degree
sample counts @ 125 sample per second
x 10^6
22
20
18
16
14
12
10
8
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2


Plot of East
x 10^6
Horizontal Seismic Axis in counts
sample counts @ 125 sample per second
x 10^5
Plot of East
x 10^6
Horizontal Seismic Axis in counts
sample counts @ 125 sample per second
x 10^4
Plot of East
x 10^6
Horizontal Seismic Axis in counts
sample counts @ 125 sample per second

References:

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