



FK190612 30-day Post Cruise Report

1. **Ship name:** Falkor
2. **Cruise Dates - Day Departed:** 6/12/2019
3. **Cruise Dates - Day Returned:** 7/3/2019
4. **Cruise Number:** FK190612
5. **Departure Port:** Astoria, OR
6. **Arrival Port:** Astoria, OR
7. **Mid-Cruise Port Call (if any):** N/A
8. **Mid-Cruise Port Call (if any):** N/A
9. **Participating Organizations, Institutions, Foundations, Government Agencies, etc.:**
USGS, Geomar, BGS, PMEL, UNC-Chapel Hill
10. **Funding Sources:** US Geological Survey Coastal/Marine Hazards and Resources Program:
Enhanced Funding (no grant number) to C Ruppel and N Prouty
U.S. Dept. of Energy: "DOE-USGS Interagency Agreement for Methane Hydrates Research" DE-FE0023495 to C. Ruppel
11. **Describe all of the geographical area(s) where the science occurred:** Landward of Cascadia subduction zone deformation front offshore Washington (state) and Oregon.
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13. Cruise Objectives:

This cruise examined Cascadia margin seep dynamics and processes at different locations and on several timescales during the June 2019 cruise. The interdisciplinary cruise objectives were as follows: (1) establish a temporary mini-observatory at a single seep site close to the landward limit of gas hydrate stability on the Cascadia margin upper slope and (2) conduct detailed scientific investigations of seep sites along depth transects (from shallower than the updip limit of gas hydrate stability to deep water and well within the hydrate stability zone). The cruise collected physical measurements of methane bubble emission rates and sizes; chemical measurements of dissolved gas concentrations in the water column, water column pH, sediment pore water compositions, and various isotopes; and biological measurements to constrain the rate of methane oxidation at the seafloor in seep settings. In addition, the cruise conducted mapping, quantitative surveying, and sampling of seafloor benthic communities, associated sediment infauna, and motile organisms near seeps; characterization of the physics and chemistry of sediments at seep locations and in the farfield; and geochronologic studies of authigenic carbonates to constrain the timing of methane seepage events.

Additional Principal investigators included Chris Martens (UNC-Chapel Hill), Tamara Baumberger (NOAA PMEL and OSU CIMRS), and Diana Sahy (British Geological Survey).

14. Cruise Summary:

This cruise was 22 days, completing 24 dives at 4 primary locations: Astoria Canyon and environs, Grays Canyon, Heceta, and Coquille. We deployed a suite of instruments that enabled in situ measurements of methane concentrations (METS sensors), methane oxidation rates (UNC mini landers), bubble imagery enabling characterization and flux estimates (Bubble Box and GasQuant landers), seafloor characterization (Imaginex MBES and ROV imagery), plus the use of the ROV Subastian to collect samples of the benthos (sediments and megafaunal invertebrates), authigenic carbonate, and water. Throughout the cruise, operations went well overall and we consider the cruise a great success. There were issues with the EK60 calibration likely due to the antifouling paint on transducer head. Comparisons of previous MBES data with surveys acquired during the cruise indicate there is some reduction in the data quality from the ship's EM system. While the CTD rosette wasn't ready to sail, the marine techs worked tirelessly to make sure it was ready to go. Also, the CTD on Subastian was having issues, so they placed another instrument (Midas) on deck to serve as a back-up datalogger. The ROV biobox dividers do not keep the individual sections isolated from sediment and water movement, which is not ideal if one wants to make sure there isn't cross contamination of smaller organisms. Also, we recommend that following calibration, ROV optode data should be corrected for seawater rather than using factory settings (which is calibrated for fresh water). Daily summaries are included below:

12 June

We departed Astoria, OR at approximately 1500 local time and transited to our target location for the EK60 calibration over previously detected seeps. Plumes were observed on the MB and EK systems. After completing the shallow seep transect using the shipboard acoustic systems, we transited to the dive target for S-0256 because the ship wasn't quite ready for EK60 calibration. Arrival on station occurred at 2100 local, and we initiated EK60 calibration, with the plan to complete the calibration, remap the dive area, and launch on 13 June at 0700.

13 June

In the early morning hours, the EK60 calibration was aborted because it was not performing. We continued with the plan to dive at Astoria Canyon, 843 m (AC-850), S-0256, at a site that has been visited before on previous Nautilus expeditions. The GasQuant (GQ) lander, 16 pushcores, 4 niskins, the slurp chambers, bioboxes, markers, and a scoop were included on the basket. The dive was aborted due to issues with vehicle control. The ROV was turned around on deck quickly, then deployed at the same location for dive S-0257. On bottom time was 1600 UTC. During descent, we observed dense marine snow. Once on the seafloor, we encountered a variety of fish, including flatfish, hagfish, rockfish, and eelpouts. Also, several seastars and sea cucumbers. At ~1624 UTC, we found the marker 273 (old PMEL) and saw hydrate and active bubbling.

GQ lander was deployed and oriented to 182o (1647UTC). Push cores were collected at an active venting area with microbial mats nearby. Cores were also collected in a mat area. There were issues with the cores on the port side because the stoppers were not installed prior to launch. Mats observed included white, orange, and pink colors. We also saw *Acarax* shells during the seafloor image transects. Toward the end of the dive, we found a large, hummocky area with active bubbles and gas hydrate. Time off bottom was 0136UTC. Biological collections included seastars, seacumbers, shells, clams, gastropods, and water for POM.

Following ROV recovery, the 2 UNC Landers were deployed, and each were queried before deploying the next one.

14 June

Our 2nd science dive (S-0258) at same location as 257, this time included the Bubble Box (BB) on deck. On bottom time was 1448 UTC. Two landers were placed east and west of the BB and the valves were left open in observation/not incubation mode. We observed multiple seastars (sun star and other types), sea cucumbers, holothurians, thornyhead "rock fish", and flounders. There were also a few sea pens. Core samples were collected within a microbial mat environment. Once we completed the GQ placement and BB measurements, the ship/ROV transited to another bubble location to the north end of the canyon. Bubbles and mats were observed at the new site. 2 gas tight samples and BB measurements were collected here. Hydrate was observed forming on the inside of the BB (838 m, 21:03UTC). Cores were collected within a clam habitat. Deployed the marker #3 at a heading of 251o (837m, 2356UTC) where gas tight samples were collected. Off bottom time was 0027 UTC. Biological collections included seastars. Note that the CTD was not working midway through the dive.

During the dive, we hosted the 1st ship to shore event with school in Oregon.

Following the dive, we transit mapped to Grays Canyon and ran a survey over previously detected seeps.

15 June

Dive 0259 was at a shallow site (~500m) near Grays Canyon. Before the dive, we noticed that there was a time difference of 1min28sec between the ROV overlay and the large UTC display. Once on bottom (14:31UTC) we searched for seep targets and found octocorals and many dead clams (shells). While transiting along the seafloor, we collected a brown rock that resembled a dropstone and then carbonates with gastropod egg cases, then came upon a live clam patch. We deployed the BB at active bubbling areas and placed marker #5 near one of the bubble measuring sites. CTD was not working. 1 gas tight was collected along with push cores in active bubbling area. We returned to the clam patch for coring then clam collections. Toward the end of the dive after carbonate collections we observed an octopus. Off bottom time was 0122 UTC. Additional biological collections included several clam samples and octocorals.

CTD01 was conducted after the ROV was on deck.
Overnight mapping and transit to determine next dive site.

16 June

Dive S-0260 was at newly detected seep site in Grays Canyon at 1012 m. On bottom time: 14:51UTC. Lots of bubbles were observed early in the dive. Gas tights were collected and marker 7 was deployed at edge of large crater/depression. We collected several push cores (adjacent to mats and bubbles) and carbonate samples. We conducted an image survey of the main crater site before heading northwest for more exploration. While transiting, we observed several live clam patches, large gastropods, and mats. Notably, we observed a few tubeworms at this site, first time on this expedition so far. An extremely long tubeworm was collected (at least 2 m) along with at least one more individual. Push cores were collected by clam beds and in mats. We deployed the BB. Off bottom time was at 0133UTC. Other collections included clams and carbonates.

CTD02 was conducted after the ROV was on deck.

17 June

0546 recovered both UNC landers, recovery went very well. Not an ideal site for methane concentrations.

Dive S-0261 – Short bounce dive at 862 m site, on bottom at 14:45 UTC, recovered GQ lander, off bottom at 15:12UTC.

Dive S-262 – Dive at shallow Astoria canyon site (494 m), on bottom at 17:05UTC. The BB was deployed and we collected multiple measurements. Two gas tight samples were collected. Bubbles, bacterial mats, and carbonates were observed early on in the dive. Several octocorals, including Primnoa and Isididae, were observed on the large chemoherm, or outcrop of carbonate, on the western edge of the feature. One of the Primnoa colonies was growing around the underside of a ledge. Bubble streams were particularly plentiful in the depression area between ridges. Large mats, clam beds and soft sediments were observed. On the western edge, we saw fishing line and a crab basket and some dead coral. There was an old marker observed at this site as well. Gastropod egg cases were attached to the carbonate rocks. Off bottom time: 0208. In addition to rocks, and water, several coral and clam samples were collected.

18 June

Dive S-263 was at same site as S-262. On bottom at 14:20UTC, this time the ROV had coral cutters attached to the starboard manipulator. Also, on deck was the GQ lander (did not record), mussel pots (2), and chess board for measuring. Push cores were collected in bubble area and adjacent to clams. Two gas tight samples were also collected. Two mussel pots were inserted into a clam patches for a quantitative community collection. We deployed marker 3 at a bubble stream area. At ~1821, the ship

indicated there was an issue with the cooling pump and that we had to recover the ROV, but it was resolved in 2 mins., so the dive continued. We conducted a photomosaic at a large chemoherm located at the western end of the seep area, where several parallel horizontal lines were run. Off bottom at 0114UTC. Several corals were collected, along with clams and a tube.

CTD03 was conducted after ROV recovery.

Deployed all 4 UNC landers at the AC500 site without issue. Queried each after they reached the seafloor.

19 June

Three of the four landers prematurely surfaced, starting around 0530 am (local). Decision was made to recover the remaining lander and determine the issue.

Dive S-264 was at Astoria Canyon, AC500. On bottom at 1556UTC. GQ and BB deployed, for a long deployment. GQ was deployed close to the location on dive S-0263. BB was deployed for 3 days in the "Bubble Alley", subsequently recovered on S-0266. Conducted visual surveys and collected a few additional coral specimens. Off bottom at 20:52.

During the dive, we hosted ship to shore event with Millhopper Montessori School Great Outdoors Camp.

Following ROV recovery, CTD04 targeted over primary plume area.

20 June

Dive S-265 at Astoria Canyon, deep ridge area, where previous dives had been conducted. We added sampling quivers to the front of the slide arms to facilitate collections of corals and other small organisms and to provide more real estate on the front porch for collections in general. On bottom at 1453UTC (1374 m). We had to use a bubble measuring device (a graduated funnel with a t-handle attachment) because BB was in shallow observatory site (AC500). Push cores were collected in a mat area. Gas tight sample was collected. We used the chessboard to calibrate the imaging field of view and the bubble stream. We encountered dense clusters of tube worms at several locations and found an old PMEL marker #221. Throughout the dive, we surveyed area to get an idea of the size of the site. Dive ended early because weather picked up (wind gusts 25kt with decent swell). Off bottom time was 2009UTC. ROV CTD has not been working since dive 256, but the aandara optode is functioning and records temperature and DO. For some locations we will have CTD data from the landers and casts. Collections included push cores, niskin samples, carbonates, tube worms, clam scoops, and 1 gas tight sample.

During the dive, we hosted a Ship-to-shore event with the Smithsonian Museum.

CTD following recovery (CTD05). Targeted over clam and tubeworm location.

21 June

Dive S-266 was back at seep observatory site (AC500). Delayed launch due to software

glitch with the ROV. ROV tried to power up but there was no response. Assistance from the beach enabled a delayed launch ~ 1030 local. On bottom at 17:59 UTC. Coral samples were a priority for the beginning of the dive to wrap up sampling needs. BB was located and was not flickering, so the battery was probably dead. The area was still bubbling, however, so the spot appears to be continuously active. Partway through the dive the ROV experienced a relatively strong current to the north. After securing the BB and GQ, we came off bottom at 2040 UTC.

Transit south to Heceta.

22 June

Dive S-0267 dive was at Heceta (1236m), with Bubble measuring device (too deep for BB and CTD on GQ). During descent, we encountered lots of POM/marine snow in the water column. On bottom at 14:30UTC. We conducted several survey lines with the ROV to look for plume targets identified via MB. At PMEL marker 220, several clam patches were observed, where we collected mussel pots within and push cores adjacent to these patches. Tube worms were also observed and collected. Also, we collected push cores within mats in the same area close to marker 220. Following multiple collections, we headed to the west to constrain the seep field, then north after that transit was completed. When we transited SE, we observed hydrate with very few bubbles. We continued to survey the area and did not observe bubbles, so collected a background sediment core (outside of obvious visible seep influence). Several more patches of clams and mats were observed, but no active bubbling, despite clear signal on the EK60 profile. During the dive we crisscrossed and returned to marker 220 to obtain a thorough image survey of the area. We also lifted off bottom to see if we could detect the bubble streams using the ROV's scanning sonar with not much luck. At 0140UTC, we came off bottom for the end of the dive. No gas tights were sampled since active bubbling was not encountered. However, our basket was fully loaded with 2 mussel pot samples, several clam scoops, rocks, push cores, water samples, sponges, and anemone.

23 June

CTD06 was collected at Heceta 1300

Dive S-0268 occurred at Heceta-500, on bottom at 1439UTC. At marker 214, we observed active bubbling (yippee!). Collection of a gas tight sample was made. Following gas tight and rock collection, we slurped some clams, some of which got stuck in the hose so additional slurp collection of clams was combined with this one. Several BB measurements were taken during the dive in the active streams. Following these measurements, another gas tight sample was collected. We observed Acarax shells again, much like what we found on the previous dives. All Acarax shells on the surface with pronounced periostracum layer covering the outside of the shell. We collected some urchins while transiting south, some within the seep and several outside the area of active seepage. In addition, several clam scoops were collected. At 2243UTC, we started

the MB mapping grid at 10mab with the Imaginex MBES system attached to the ROV. Unfortunately, there was no way to check whether the MB was recording, since we didn't have that connection established prior to the dive, so no MB data were recorded. Off bottom time was 0117UTC. Several collections occurred during this dive, including 2 gas tights, 1 mussel pot (in clams), 6 push cores, corals and urchins, as well as several carbonate samples.

Transit to Coquille, MB en route.

24 June

CTD07 Heceta 500.

Dive S-0269 was at Coquille-500, and the ROV was on bottom at 1412 UTC. Dive was at cluster of previously detected seeps, reacquired through mapping efforts. We encountered seep environments fairly quickly on the dive and initiated sampling. Several BB measurements were made. Gas tight sample was collected in the slowly bubbling area (1hr to fill). During the transit south, we encountered lots of POM/marine snow, plus urchins and corals, and experienced rapid currents. Push cores were collected adjacent to clams. In addition to flounder, seastars, and clams, we observed rope or some type of cable. Several large and small patches and outcrops of carbonate were present and small carbonate samples were collected. MB lines were started at 0015 and completed at 0130. Off bottom time was at 0130UTC. Collections included one gas tight, a mussel pot, clam collections and mud next to clams, carbonate samples, urchins, sponge, and corals. Multibeam using the Imaginex did not record, again, but this was resolved before the next dive.

EK60 calibration was attempted again but not optimal likely due to transducer head antifouling paint. Only one frequency (18 kHz) was calibrated.

25 June

CTD08 at Coquille-500

Dive S-0270 at Coquille-900. This area was a high priority due to the previous gas samples containing He3, which suggests some input from mantle-derived gases. Repeated measurements in a different area will help determine whether this is replicated at other seeps within the area. ROV team attached a gopro on the umbilical to provide another field of view and gain information about its behavior on the seafloor and trouble shoot any issues in the future. During descent, we encountered dense POM in the water column. On bottom at 1421 UTC. Imaginex MB confirmed to be logging and this is the 3rd survey using the system installed on the ROV brow, situated forward of the ROV to ensure no vehicle interference. Once on the seafloor, we saw lots of carbonate and shell material, plus multiple gastropod egg cases. We collected push cores and carbonates early in the dive, on or adjacent to a gassy mound. We also collected 2 gas tight samples in the area and deployed marker #2. At 2004UTC, we initiated the MB survey at 20mab, heading at 195o, towards where the bubble box was deployed. At 2054, MB line was

completed and the BB was deployed for multiple bubble measurements. Push cores were collected in clam patches and an active bubble site. A mussel pot was collected in the clam patch associated with the push cores. Tubeworms, sponges, and corals were observed in the later part of the dive. At 0015 UTC, another MB grid was initiated and was completed at 0119UTC. After retrieving the BB, we headed up at 0125UTC. Collections included mussel pot, push cores, 2 gas tights, mat slurp, several rocks, a tubeworm, and clams.

CTD09 at Coquille-1000

Transit north.

27 June

Upon arrival, landers were deployed at 1st light. No issues, all queried landers on bottom. One was quite a distance from target and may have slid downhill a bit after hitting bottom.

Dive S-0271, at surface at 1347, recovery started at 1357. The aborted dive at Astoria canyon observatory site. Dive aborted due to partial loss of vehicle comms, which was resolved quickly on deck.

Dive S-0272 at AC500: On bottom at 1545. Immediately, we tried to collect additional BB measurements within bubble alley. After deploying the BB, we moved to the lander locations so that we could place landers (allow at least 15min for each to flush), then toggle the lever closed. Swarms of plankton followed us. Between 1626 and 1853UTC, all landers were located and moved to our target sites, close to several bubble streams. Between 1900-1910, valves on landers 1 and 4 were toggled, then we commenced with collecting lander highlight imagery. Between 1919 and 1926, landers ML2 and 3 were closed, then the bubble box was readjusted. Following lander ops, we transited to collect additional coral samples. There was an issue with the ship's ability to maintain heading which resulted in a little slower operating speed on the seafloor. During the coral collections, we made sure to get nice imagery across the area for future highlights. Following coral collections, we commenced with a MB survey, sometime after 2029 UTC. This was the 4th survey using the Imaginex MBES on ROV, and it worked, mapping the entire extent of the seep area (~2hr run). At 0021, the MB survey was completed. The ML4 lander was a bit too close to the bubble stream, so we repositioned it slightly away from the bubbles. Then the valves were opened on ML4 to flush the system. At 0113, valves on ML4 were closed. Additional corals were collected prior to leaving bottom. Off bottom at 0152 UTC. Collections included water, corals, and urchins.

CTD10 at AC500

28 June

Between dives, the Imaginex was removed from the ROV and placed onto lander for deployment on S-0273.

S-0273 was a bounce dive at observatory site, AC500, on bottom at 1413UTC. GQ was

deployed at the beginning of the dive, adjacent to bubble alley, to be left on bottom for a few days, then we collected some corals, mussel pots, and push cores to wrap up sampling. Off bottom time was at 1658.

S-0274 at Nehalem Bank, 180-200m. On bottom at 1943 UTC. Dive plan was to explore this area previously investigated by Wankel and others on the Falkor in 2018. This was a shallow dive in very murky water. Visibility was relatively poor throughout the dive until the last couple of hours. We observed corals, carbonate, and found marker 216. We collected a gas tight sample at a very slow bubble stream, sampling completed in slightly < 2 hrs. Cores were collected in a mat area. We saw large patches of carbonate and lots of shell debris, plus purple mat. Lots of fish were observed toward the end of the dive; not sure if they were aggregating due to the substrate or other behavioral reason. The ROV was off bottom at 0152 UTC. Collections included water samples, sponges, rocks, corals, gas tight, and push cores.

CTD11 at NB

29 June

S-0275 at Astoria Canyon ridge site, AC-1300. Our goal was to survey additional locations at this site, since our previous dive was cut short due to weather. We reached bottom at 1427 and immediately observed rocks with corals attached. For the first few hours, we focused on collected rocks, corals, and tubeworms, with co-located niskin water samples. We found marker 221 again and acquired a new position fix for that location. Push cores were collected adjacent to tubeworms and in mat environments. At 1749, we found marker 282 and collected coral attached to tubeworms. At 2107, we started collecting a gas tight sample. After taking several collections, we transited north and observed live clams more corals. At 2336, we started a grid for visual survey of the area. We continued to encounter carbonate blocks/outcrops, tubeworms and shell debris. The survey was completed at 0120 and we came off bottom at 0121. Collections included pushcores, octocoral samples, rocks, clams, tubeworms, water samples, and 1 gas tight.

CTD12 at AC1300

Map following ROV recovery.

30 June

Arrive on AC-500 site, query landers.

S-0276 dive at observatory site, on bottom at 1421. This was a short dive to toggle levers on 2 landers and recover GQ and BB. By 1514, both ML1 and 4 had been opened then closed. GQ and BB were on the porch by 15:40 and we were off bottom at 1541. No intentional collections, but the BB had a few urchins and a gastropod stowaway that were subsequently processed for various analyses.

Transit to McArthur ridge

S-0277 dive at McArthur ridge was the location of a previous dive. The bubble targets

were identified as intermittent but strong. At 1921UTC, the ROV was on bottom, and we commenced with a visual survey of the area, transiting in different directions to cover the site. The area was composed of a large carbonate ridge, with occasional bebbiata mats, and anemones. During the survey, we collected rocks and push cores (clams and mat environment), clams (scoops and mussel pot) and tripped niskins. During the survey, one of the gas tights was pretripped by the manipulator arm. We also saw a fire hose. At 2004UTC, we found marker M3 (Wankel marker). At 0002, the event logger stopped working, so data loggers used hard copy logging sheets for the remainder of the dive. Toward the end of the dive, we came upon a bubble site with very active venting that we had surveyed earlier in the dive, and we sampled the remaining gas tight. Unfortunately, the BB had been left at another spot and there was no time left to make measurements. At 0210 we left the seafloor. Collections included push cores, water, carbonate, clams, corals, and one gas tight sample.

1 July

S-0278 at Grays deep site. We hosted a ship-to-shore event with USGS in Reston, VA. This dive was located at the same spot as dive S-0260. During descent, we observed bubbles throughout the water column. We reached the seafloor at 1424 and deployed the GQ at the edge of the crater. Early in the dive we collected a gas tight sample and a piece of black coral. Several push core samples were collected, along with an additional gas tight sample. We conducted a visual survey of the area and found a large hydrate mound and active bubbling in several locations. There was a carbonate-gas fluid conduit that was collected. We made some measurements with the graduated bubble-funnel during the dive at the GQ deployment location. We conducted additional visual surveys, picked up the GQ, then left bottom at 0121 UTC. Very productive dive with several collections, including push cores, gas tight sample, rocks, clams, and water.

CTD13

2 July

Recovered landers using the small boat, one at a time.

CTD14

The last dive for the expedition, S-0279, was at exploratory site in Astoria Canyon, north rim, 550 m. The dive included investigating previously detected and newly acquired bubble streams through overnight MB efforts. The ROV reached the seafloor at 1554 and we encountered active bubbling shortly thereafter. We filled two gas tight samples and deployed marker 10. Additional sampling within the bubble zone included a mussel pot collection at clams and push cores. There were lots of sablefish following us around and one made its way into the thruster. Following collections, we continued to survey the area to the west where we continued to encounter seep environments (e.g., clams and mats). Urchins were collected in the seep area and in a background environment.

Following collections, we continued to survey to the south and collected a carbonate sample. At 2129 we left bottom. Collections included water samples, clams (mussel pot), push cores, gas tights, urchins and rocks.

CTD15 at AC550

After the CTD was on deck, we continued mapping operations for the remainder of the cruise.

15. Did you collect Measurements or Samples, including biological specimens? Yes

16. Did you deploy and/or recover any Moorings, Bottom Mounted Gear, or Drifting Systems? Yes

17. Equipment Used: The GasQuant II is a lander provided by GEOMAR (Dr. Jens Greinert). It relies on a rotating sonar to record the spatiotemporal pattern of bubble emissions and can be kept at the seafloor for hours to days. The cruise provided the first repeated testing for this instrument over a series of many dives.

The BubbleBox is a lander provided by GEOMAR (Dr. Jens Greinert). It uses high-speed cameras to quantify bubble size and bubble emission rate at seeps. The cruise extensively used this technology to study emissions at methane seeps.

The University of North Carolina—Chapel Hill (Dr. Chris Martens) provided landers to measure aerobic methane oxidation (MOx) rates in situ near seep sites. This was the first test of such in situ MOx experiments, which were monitored by a suite of sophisticated chemical sensors. The landers could be remotely interrogated from the sea surface, meaning that the progress of MOx processes could be monitored without retrieving the landers.

Gas tight sampling was provided by NOAA PMEL (Dr. Tamara Baumberger). Gas tight sampling has previously been conducted on this margin during ROV dives off the E/V Nautilus and the R/V Falkor, and the new sampling was designed to confirm earlier results and obtain new results about gas sourcing for the seafloor seeps.

Mussel pots that Dr. Amanda Demopoulos borrowed from Dr. Erik Cordes were deployed for the first time on the R/V Falkor and were used to sample sediment and the entire infaunal community associated with chemosynthetic clams.

18. Total number of CTD casts completed during the cruise: 15

19. Total number of AUV dives completed during the cruise: 0

20. Total number of ROV dives completed during the cruise: 24

21. Total number of ROV samples collected during the cruise: 436

22. Total number of Unmanned Aerial Vehicle (UAV) or other vehicle deployments during the cruise: 0

23. Total amount (TBs) of data collected during the cruise: 11 TB

24. Other interesting facts: This multidisciplinary expedition studied the physics, chemistry, biology, and geology of seafloor methane seeps landward of the deformation front along the active plate margin offshore Washington state and Oregon. The expedition not only acquired samples at the seafloor, but also monitored the destruction of methane in the water column via aerobic methane oxidation and the size, rate, and frequency of bubble emissions at seep sites. Unique aspects of the expedition include the first test of landers capable of hosting in situ aerobic methane oxidation experiments monitored by advanced chemical sensors; the most rigorous test to date of the GasQuant II lander to track the spatiotemporal pattern of methane emissions; the first collections at these seeps of methane-derived authigenic carbonates for extensive geochronologic studies focused on determining the timing of methane emissions; the first deployment of a mussel pot from the ROV SuBastian to collect the entire community and associated sediment around chemosynthetic clams; and acquisition of many gas samples to expand PMEL studies that have already provided provocative evidence for the involvement of deep subduction zone fluids in gas emissions on this margin. By deploying multiple instruments on the seafloor to quantify gas flux, methane oxidation, with imagery and collections of seafloor organisms, sediments, and rocks at several sites along the Cascadia margin, we can develop an understanding of how methane influences seep environments along extensive spatial and temporal scales.