IODP Expedition 366: Mariana Convergent Margin

Week 1 Report (8–17 December 2016)

This week consisted of the Guam port call, a short transit to our first site, an attempt to recover the Site 1200 (MAF-4A) CORK, and coring in three holes at Site U1491C (proposed Site MAF-16A).

Operations

Guam Port Call

Expedition 366 Mariana Convergent Margin officially began with the first line ashore at Dock F-3 in Guam at 0648 h on 8 December. Pacing items for the port call were to complete the change out of the top drive motor, which failed on the last site of the previous expedition, and the replacement of the cryogenic magnetometer, which required JRSO technical staff with third party support from 2G Enterprises. Loading included 1000 metric tons of Marine Gas Oil (MGO), 20 metric tons of Barite and 20 metric tons of Sepiolite drilling mud via local P-trucks, 58 joints (3-flats) of 10¾ inch 40.5 lb/ft buttress casing, two Baker-Hughes-Inteq drilling motors, two HOC DTU950 underreamers, and three standard reentry cones. Refrigerated containers carrying nearly 7 km of Expedition 366 cores were dispatched to the Kochi Core Center in Japan, and returning surface freight was dispatched including the rental mud motor, an HOC DTU950 underreamer for refurbishment, and other miscellaneous freight. Originally, the *JOIDES Resolution* was scheduled to depart at 0700 h on Tuesday 13 December. However, due to military operations taking place in the area that morning, the decision was made with the pilot to depart at 0500 h.

Transit to Site 1200 (MAF-4A)

The last line was cast off at 0518 h on 13 December, and the transit proceeded without incident. The ship arrived at Site 1200 at 1624 h the same day.

CORK recovery operations at Site 1200

The planned operations at Site 1200, Hole 1200C, were to remove the currently installed CORK and ROV platform, install a new ROV platform, and recover a WSTP water sample from the inside of the cased/screened hole. This CORK was originally installed during ODP Leg 195 in 2001 and was one of the latched-in varieties in use at the time. The recovery attempt began at 0500 h on 14 December, and several near misses occurred when the tool appeared to go over the top of the CORK head but the pipe heaved off before the J-slots were fully engaged. After 5.25 h, the CORK head was engaged and the recovery tool J-slots were fully engaged. However, the CORK head parted while attempting to pull it free of the reentry structure. Less than 10klbs

of overpull was being applied and the CORK tried to shift; however, it failed at the latch assembly. Video of the reentry cone after removal showed a small diameter tube protruding from the center of the reentry cone. This was interpreted to be a piece of PVC tubing that had been previously installed in the CORK via ROV in 2009 after the original thermistor string was recovered in 2003. The high-resolution camera with the new upgraded pan, tilt, and zoom capability was critical for the CORK recovery and assessment.

At 1615 h, the recovery tool with the recovered portion of the CORK returned to the rig floor. Science party microbiologists and geochemists sampled macrofauna and precipitates from the CORK head. Since the original CORK platform was not recovered and because the lower portion of the CORK remained in the hole, replacement of the ROV landing platform replacement and the WSTP water sampling run could not take place, and preparations were made to transit to Site U1492 (MAF-16A).

Transit to Site U1491 (MAF-16A)

With the rig floor secured and all thrusters raised, the sea passage to Site U1491 was initiated at 2112 h on 14 December. The ship covered the 137 nmi distance to the site at an average speed of 9.8 kt, arriving at Site U1491 at 1048 h on 15 December.

Operations at Site U1491

Hole U1491A

A precision depth recorder (PDR) seafloor depth measurement was taken once the ship was settled in over the site coordinates; it was surprisingly 222 m shallower than the prospectus water depth. Initially, the discrepancy was thought to be an artifact from being on the steep-sided flank (approximately 10° slope) of the mud volcano; however, ultimately it was confirmed that the operations summary being used had an erroneous position coordinate. The plan showed a latitude of 15°42.12′N when it should have been 15°47.12′N, a 5 nmi error. With the drill string at a depth of 1855 mbrf, we could continue tripping the drill string while moving in dynamic positioning (DP) mode to the corrected location coordinates. The deployed positioning beacon was recovered, and at 2148 h the DP move was initiated. At 0500 h in the morning of 16 December the top drive was picked up and the drill string was spaced out for spudding Hole U1491 (proposed Site MAF-16A). A new PDR seafloor depth measurement at the corrected drill site was 4453.4 mbrf, still considerably different (57.6 m shallower) than the corrected prospectus depth of 4511.0 mbrf. To be certain about the seafloor depth, it was decided to tag seafloor with the core bit. At 0645 h the bit took weight at 4504.6 mbrf. The bit was raised to a shooting depth of 4500.0 mbrf. The advanced piston corer (APC) core barrel was deployed ~1 h later; however, the driller could not pressure up the drill string, implying that there was material inside the bit/bottom-hole assembly (BHA) preventing the APC barrel from properly seating/sealing in the BHA. The bit was pulled above seafloor at 0700 h, officially ending Hole U1491A. The core barrel was recovered at 0800 h with 1.32 m of recovery including three

distinct mudlines, likely resulting from ship heave causing the BHA to hop and tag the seafloor multiple times.

Hole U1491B

After removing the sinker bars the pipe was thoroughly circulated to flush out any remnant material. Another APC core barrel was deployed, and at 1015 h Hole U1491B was spudded, recovering 3.69 m of core and establishing a seafloor depth for the hole at 4503.4 mbrf. Oriented APC coring continued using the advance by recovery method through Core 5H to 19.4 mbsf (4522.8 mbrf) where coring was halted due to the continued presence of coarse gravel. All cores were incomplete strokes with no pressure bleed-off. Temperature measurements using the APCT3 were attempted at 13.2 and 19.4 mbsf. The drill string was pulled out of the hole, clearing the seafloor at 2323 h on 16 December, ending Hole U1491B.

Hole U1491C

We offset the ship 200 m NW (downslope) of Hole U1491B, spaced out the drill string, and started coring in Hole U1491C at 0025 h, establishing a seafloor depth of 4529.8 mbrf. Oriented APC coring continued through Core 2H to 9.6 mbsf (4539.4 mbrf), where the decision was made to switch the coring system to the half-length APC (HLAPC) and advance-by-recovery. Six HLAPC cores were cut before the decision was made to switch to the extended core barrel (XCB) coring system. HLAPC Cores 3F through 8F were cut and recovered to 24.3 mbsf (4554.1 mbrf). At no time did the barrel fully stroke and recovery varied from 1 to 4.7 m. The APC coring system was set aside and the XCB coring system was implemented. XCB Core 9X was cut to 34.2 mbsf (4564.0 mbrf) requiring 70 min of rotating time to cut the core as well as substantial effort to clean out the 5 m of coarse gravel fill on bottom prior to cutting the core. When Core 9X was recovered, a jammed piece of core in the barrel resulted in only 0.27 m recovery. A second XCB core barrel was deployed and the bit was advanced to 43.9 mbsf (4573.7 mbrf) when the driller noticed a loss of torque and pump pressure. Two unsuccessful attempts were made to recover the core barrel; however, the overshot did not engage the pulling neck on the barrel. Upon recovery of the sinker bar string the overshot was found to have all shear pins intact; however, the core line was damaged on both runs. Recognizing that something was wrong with the drill assembly (and fearing a BHA failure) the drill string was recovered back to the ship. The seafloor was cleared at 2350 h on 17 December, the top drive was set back, and the remaining drill string was pulled back to the ship.

Science Results

Two sites were visited during the first week of the expedition, Site 1200 on South Chamorro Seamount, where the CORK was to be removed, and Site U1491, on the NW flank of Blue Moon Seamount, where expedition coring started.

Site 1200

South Chamorro Seamount is one of 14 large (up to 50 km in diameter and 2 km high) active serpentine and blueschist mud volcanoes on the Mariana Forearc; it is located about 78 km from the trench. It was cored during ODP Leg 195 and is primarily composed of unconsolidated flows of serpentine mud with clasts consisting dominantly of serpentinized mantle peridotite, but also includes clasts that contain blueschist fragments. The summit of the seamount shows active fluid seepage of slab-derived fluids, and a CORK was emplaced in Hole 1200C to study them. The plan for IODP Expedition 366 was to remove the CORK body and leave the hole open for a future ROV deployment of a CORK-lite. A CORK-lite allows for a modular design including multiple ports for experiments and sensors outside of the CORK body.

Site U1491

Site U1491 is located on the lower northwest flank of Blue Moon Seamount (recently given the official name of Yinazao Seamount; the informal name Blue Moon Seamount was used in the prospectus and in previous publications), a serpentinite mud volcano that lies on the eastern edge of a forearc graben about 55 km from the Mariana Trench axis. Of the three mud volcanoes being cored during the expedition, it is the closest to the trench. This site was chosen to potentially intersect a series of mudflows that could provide a time sequence of evolving rock and mud geochemistry of flows from the summit. Three holes were planned, the deepest to 250 mbsf, but drilling conditions were difficult due to the presence of unconsolidated gravels in the formation, and a maximum depth of 34.2 mbsf was achieved. Despite the shallow penetration, the cores contain valuable information on downslope processes, petrology of rock clasts at Blue Moon Seamount, pore water geochemistry and microbiology.

Core Description

Hole U1491A comprises only one section composed of clayey brown mud with lithic and carbonate components. Hole U1491B consists of three units. Unit I consists of red-brown clay-rich pelagic mud with lithic clasts. Unit II is grey-green serpentinite pebbly mud with ultramafic clasts. Unit III consists of a lower unit of normally graded well-sorted turbidites with coarse pebbly bases and fine sand tops. Hole U1491C consists of similar sediments, but has a slightly different stratigraphy, which is unsurprising given that the two holes are 200 m apart and are located on a ~10% slope of a seamount. In Hole U1491C, the top unit of red-brown clay-rich pelagic mud is the same as in U1491, while below that there are intervals of breccia-conglomerate with a clay-silt matrix and carbonate clasts, matrix-supported conglomerate with carbonate and serpentinized ultramafic clasts, and grey-green serpentinite pebbly mud with ultramafic clasts.

Geochemistry

Geochemistry laboratory set-up included preparation of glove bag and fume hood workspaces for the preparation and splitting of interstitial water (IW) samples. A workflow for the preparation of IW splits for shipboard measurements and personal samples was developed, with specific instructions for fixation (e.g., HNO_3, $CdNO_3$, $HgCl_2$, etc.) and preservation (freezing, refrigeration) of each sample. The geochemists were trained in procedures for IW squeezing and sample preservation. A subset of the geochemistry and core description groups were trained in the use of the portable XRF (pXRF) system, and set up working curves for Mg, Al, Fe, Ca, Mn, Ti, Cu, Zn, Sr, Zr, Y, Cr, and Ni.

Geochemistry analyses completed thus far for Site U1491 included pH, alkalinity, chloride (Cl), and headspace gas. Interstitial waters were collected from five sections each in Holes U1491B and U1491C. The pH of IW samples ranged from 7.71 to 8.53 in Hole U1491B and from 7.70 to 7.95 in Hole U1491C, both increasing with depth. Alkalinity ranged from from 1.11 to 2.41 mM in Hole U1491B, and from 1.51 to 2.38 mM in Hole U1491C, decreasing with depth. Chloride ranged from 550.63 to 560.71 mM in Hole U1491B, and from 551.21 to 563.24 mM in Hole U1491C, more or less within typical seawater ranges. Chloride generally increased downhole, albeit more consistently in Hole U1491C. Analyses for headspace gases were conducted on all Site U1491 core sections. Only methane was detected, ranging from 1.46 to 2.23 ppmv. However, these values are considered background.

Microbiology

The microbiologists set up two clean benches in the laboratory and sterilized equipment in preparation for receiving core. At Site U1200, microbiologists sampled microbial mats from the CORK surface once it was recovered. The microbiology group received whole rounds from 10 cores at Site U1491, which were subsampled and preserved according to the sample flow plan.

Physical Properties

Physical properties measurements were performed on the ~19 m and ~23 m of sediment cores recovered respectively in Holes U1491B and U1491C. The transition between top pelagic sediments and serpentinite muds is clearly highlighted by step to higher GRA density values and a step to lower NGR values. GRA values of serpentinite muds are rather homogeneous, of about 1.5 to 2 g/cm^3, and are consistent with discrete sample MAD analyses. In comparison with core description, two types of serpentinite mud can be recognized from MS and NGR measurements. Muds with carbonate content (matrix, clasts) show higher NGR and lower MS values than muds without carbonates. This trend is observed on both Holes U1491B and U1491C. *P*-wave velocity values of serpentinite muds are highly variable, from 1500 m/s up to 3000 m/s with average values about 2000 m/s. This high variability is probably induced by the high water content within some of the partly filled sections and by the different hard rock clast size and density observed in the recovered sediments.

At Site 1491 two APCT-3 measurements were attempted while taking Cores U491B-2H and 5H at 9.5 and 19.4 mbsf, but recorded partly jumpy temperature equilibration curves. This combined with the small difference in temperature between the seafloor and these shallow depths meant that geothermal gradient and heat flow could not be determined.

Paleomagnetism

The new superconducting magnetometer was installed by the IODP JRSO technical staff and is functioning well, but we are waiting on confirmation from 2G Enterprises of the *x*-, *y*-, and *z*-axis correction factors before running any of our Expedition 366 half-round sections in the instrument. Measurements were made on cube samples on the spinner magnetometer.

Education and Outreach

The Education and Outreach officers familiarized themselves with the E/O facilities on board, and began producing videos, tweets (https://twitter.com/TheJR), Facebook posts (https://www.facebook.com/joidesresolution), and joidesresolution.org blog items (http://joidesresolution.org). They also prepared for the first ship-to-shore videoconference.

Technical Support and HSE Activities

The Guam port call and the transit to the first site had a full schedule of activities, including the offloading of four containers of core from the previous expedition, a full science resupply, laboratory preparation for microbiology studies, and installation of a new Superconducting Rock Magnetometer.

Laboratory Activities

- Underway Geophysics: Bathymetric data was collected on the transit to the first site. The magnetometer was not deployed.
- Microbiology Support:
    - Microbiology Container: Opened and cleaned the container to provide additional space for microbiology studies. Supplies stored in the van were moved to the core refrigerator. The thermostat that controls the refrigeration side of the container is broken. Electricians are trying to implement a workaround to get the system operational. In the early part of the expedition, the permanent laboratories are providing adequate space for the microbiologists and the M-Bio container is not being used.
    - Cold Laboratory: Removed a wall cabinet and setup the glove box on the starboard counter. The scientists elected not to use the temporary clean bench set-

up on the port counter, as used on Expedition 360, because (1) the room cannot be chilled at the same time as the clean bench is in operation due to condensation (as established on Expedition 360 and reconfirmed on this expedition); and (2) the science party is using a third party KOACH clean bench (outside the cold room) supplied by a shipboard scientist. The cold room is also being used in parallel for microbiological sampling.
    - High Pressure Sampling: We setup IODP's HIP pump in the core refrigerator to pressurize microbiology samples to 10,000 psi.
    - –86°C Freezer: Replaced the broken freezer with a new unit and installed third party freezer in the Pallet Storage area.
- Paleo Prep: Scientist third party electrochemical sensors and gas chromatograph were set up in this space. No paleontological sample preparation is anticipated during this expedition.
- Handheld XRF Scanner: Set up the system on the STMSL bench. Modified the old XRF stand to accept the new XRF and fabricated a flexible shield system for section scanning.
- Microscope Laboratory: One station was retasked to support a portable gas analyzer.
- New Superconducting rock magnetometer (SRM) Installation: Preparations for removal of the old SRM were started on the previous expedition and completed on the first day of port call. The new system was moved into the laboratory but because critical parts were in the delayed airfreight, we were unable to start cool down until the third day. During this wait, we completed the installation the new foundation, aligned the sections of the SRM, connected the compressor to the ship's chill water, reconfigured electrical and network services, and competed installation of the SRM's electronics. By the fourth day of port call, the system had cooled to 4 K and became superconducting. 2G Enterprises technicians tested the SQUID and degaussing systems and confirmed them to be operational. We also confirmed that our IMS software was communicating with the SRM systems. By the end of the first day of transit, the sample handling hardware was installed and successfully tested. Several more days were needed to update the Degauss Controller software and to determine the locations of the SQUID coils and axial orientation. We are currently waiting on 2G to provide the X, Y, and Z coil response length values; otherwise, the system is ready for use.
- Vane Shear: Communications between the PC and instrument were lost and we do not have a clear understanding of the problem. We have currently moved the system to another computer and it is operational.
- Icefield Tool: Damaged the "shock" connector section on one tool (fired into gravel). The orientation tool appears to be fine.

Application Support Activities

- Work on PanelBuilder for LIMSpeak II (DQView). New version of application is also running at several workstations. Created new template designs per requests from staff and scientists. So far response to the new LIMSpeak has been mostly positive.
- Working on the MUTT Uploader and LORE report for the Handheld XRF.
- Changed the Education/Outreach JoidesResolution.org website to provide more accurate "Where is the Ship" view.
- MUTT for JR6 was not running because of corrupted settings in the XML configuration file.
- Web Service updates to provide more details for LIMSpeak II. LIMSM and Reference web service enhanced.
- PanelBuilder linked to DESClogik web services to be able to provide TAB and TEMPLATE names to users directly from DESC without manual intervention.

IT Support Activities

- For the week beginning 11 December 2016, we experienced some server and instrument host issues prior to core retrieval and processing.
- During the week we rebooted a Novell server and the GroupWise server to correct performance and access issues. We have experienced these symptoms in the past on rare occasions, and a reboot usually resolves the issues. The reboots happened early in the expedition prior to the first core on deck and outages lasted under 2 min each; therefore, the impact to users was very low.
- The Vane Shear application on the Gantry instrument host was found to be not operational. There appeared to have been a communication issue between the instrument and the Windows host. We deployed a new instrument host named AVS to run the Vane Shear application. The computer and applications were operational before first core on deck.
- The Engineering Office reported that they could not access the Engineering Catalog on Cumulus. We contacted the support company Torino and was advised of the configuration change needed to give access to the engineers. The change was carried out on 15 December.
- One of the AFN television channels has been lost due to lack of authorization. The two AFN channels were acquired by MCS Tom Wick while he worked at IODP. We are attempting to contact Mr. Wick to seek reauthorization, remediation, or explanation.
- We deployed 24 of the 48 27-inch computer monitors to the Science Office, Core Laboratory, and Chemistry Laboratory. The monitors replaced were identified by the Assistant Laboratory Officer. The replacement of monitors in the laboratories was done prior to the first core on deck to minimize impact to the science party.
- In the coming week we plan to engage in the following activities:

    - Deploy additional monitors to the Developer workstation, Downhole computer, ET Shop, Curator computer, Publication/Yeoperson Office, and Chemistry Laboratory non-instrument workstations.
    - Swap a video encoder on one of the live video feeds to demo a replacement unit.
    - Deploy the new NAC Agent on the Mac Minis to fix a problem with the disconnection issue.

HSE Activities

- Conducted both the SIEM and IODP safety meeting for the science party and new staff.
- Conducted a safety tour for the science party.
- Technical staff completed the audit of hazardous storage areas and the weekly check of safety showers and eyewash stations.
- Held the weekly fire and boat drill as scheduled.