

IODP Expedition 366: Mariana Convergent Margin

Week 2 Report (18–24 December 2016)

This week was spent coring at Site U1492, located on the SW part of the circular plateau that forms the summit of Blue Moon Seamount (recently given the official name of Yinazao Seamount). The objective was to core a minitransect of holes away from the location of an active seep that had been previously identified by a dive of the ROV *Jason*. The hole spacing was ~100 m, with Hole U1492A furthest away from the seep, Hole U1492B in the middle, and Hole U1492C close to the seep itself. The week ended with preparations to install casing in Hole U1492D, also close to the seep, to enable an installation of a borehole monitoring system (CORK-lite) in the future.

Operations

Transit and Hole U1492A (38.3 m cored; 38.5 m recovered)

Week 2 began with operations at Site U1491 (proposed Site MAF-16A) coming to a close. The bottom-hole assembly (BHA) failed and we lost the bit, a non-magnetic drill collar, an advanced piston corer (APC)/extended core barrel (XCB) outer core barrel assembly, and an XCB core barrel assembly in the hole. At 0000 h on 18 December, the ship started the 9 km transit to Site U1492 (proposed Site MAF-15A) in dynamic positioning (DP) mode. Two replacement drill collars and a new APC/XCB outer core barrel assembly were made up. The rig mechanic worked on the blower motor in the top drive for 3 h before the remainder of the BHA was assembled. The pipe trip to the seafloor began at 1630 h on 18 December. The camera was deployed for a seafloor survey, but the target, a seep marked by a previous ROV survey, was found immediately, so no further survey was required. The ship was offset 200 m to the north and coring in Hole U1492A started at 0725 h on 19 December, establishing a seafloor depth of 3656.6 mbsl. After Core U1492A-2H, further coring was conducted using the half-length APC (HLAPC) for better recovery in the stiff serpentinite muds. While recovering Core U1492A-9F from 38.3 mbsf, the core line became snarled in the oil saver due to a kink above the rope socket, most likely caused by the high ship's heave. At this point we ceased coring in the hole, not far short of the 50 mbsf target depth. After slipping and cutting the drilling line, the oil saver was cleared of the tangled core line and the core line was reheaded.

Hole U1492B (51.4 m cored; 52.0 m recovered)

Hole U1492B, started at 0045 h on 20 December, was located 100 m south of Hole U1492A and formed the second in the minitransect of holes at this site. The seafloor depth was 3669.1 mbsl, 12.5 m deeper than at Hole U1492A. Coring continued using the HLAPC coring system through Core U1492B-13F to 51.4 mbsf, completing the objective at this hole.

Hole U1492C (138.4 m cored; 71.4 m recovered)

At 1100 h on 21 December, the ship was offset 120 m south to start Hole U1492C with a seafloor depth of 3666.5 mbsl. HLAPC coring continued through Core U1492C-23F to 98.7 mbsf. Formation temperature measurements (APCT3) were made during Cores 3F, 6F, 9F, 13F, 16F, 19F, and 22F (9.5, 23.5, 33.6, 51.7, 65.8, 73.9, and 94.0 mbsf respectively). Coring was suspended at this point to allow deployment of the temperature dual-pressure tool (T2P) on the motion decoupled hydraulic delivery system (MDHDS). The hole was swept with 20 barrels of high viscosity mud while the tools were being rigged up and prepared for deployment on the rig floor. The hole had been stable up to that point with no fill on connections or overpull coming off bottom. It took less than 1 h to rig up the MDHDS/T2P/Electrical Release System (ERS) tools, but while stabbing the logging line through the blocks (without rotation or circulation), the hole became unstable. The line was pulled quickly back out and the driller fought to maintain rotation, with top drive torque increasing from 200 to over 500 A. It was agreed that the T2P deployment should be abandoned for this site and retried at a shallower depth at the next summit drill site (MAF-11A). The hole was swept with 20 barrels of high viscosity drilling mud and a wiper trip was made to 70.6 mbsf to try and get some of the dense cuttings either out of the hole or below the bit so they could be ground up to a finer grain size and circulated out of the hole. Coring resumed at 0200 h in the morning of 23 December. HLAPC Cores U1492C-24F to 28G were cut to 117.5 mbsf before high torque and overpull necessitated a second wiper trip. The next 13.75 h were spent on hole conditioning before it was considered safe enough to install the sinker bars and recover the XCB wash barrel, which contained “ghost core” U1492C-28G. Coring then proceeded using the XCB coring system to recover Cores U1492C-29X through 30X to 129.4 mbsf. While cutting Core U1492C-31X at 139.1 mbsf, the driller once again lost rotation. The next 2.5 h were spent working to free the pipe; we then decided to abandon further attempts to core Hole U1492C, and the drill pipe was pulled up to the rig floor.

Hole U1492D

At 0935 h on 24 December, preparations began for deploying the reentry cone/drill-in casing system for Hole U1492D. The previously assembled standard reentry cone was moved over well center on the moonpool doors. The casing shoe joint and four 39 ft screened casing joints were assembled, followed by 13 additional 10¾ inch casing joints. The casing string was lowered and latched into the reentry cone. The stinger assembly was made up, including a tri-cone bit, Baker-Hughes Inteq high torque mud motor, a set of HOC underreamers, and the Dril-Quip (DQ) running tool. The motor/underreamer combo was tested in the moonpool for proper operation. At 0630 h on 25 December the driller began running in with the reentry cone/casing assembly. Several QA/QC issues were identified during the making up of the casing and drilling assembly, including: (1) an improperly machined thread on a casing joint; (2) a ~0.020 inch under gauge 16 inch casing hanger which prevented connection to the Dril-Quip running tool until 3 h of grinding work enabled them to fit together; (3) one of the other 16 inch casing hangers was also found to be out of specification; and (4) the first set of HOC DTU950 underreamers failed to

open and close properly during the predeployment test at the usual 30–35 strokes/min, requiring instead 80 strokes/min to open and a pressure in excess of 700 psi. This set of underreamers was set aside and another set was picked-up. This set performed normally.

Science Results

Core Description

Core descriptions and sampling for Hole U1491C were wrapping up at the start of the week. Hole U1491C contains two units: an upper red-brown clay-rich mud with scattered lithic and carbonate clasts, and a lower unit of greenish-grey to pale green serpentinite mud with about 10% lithic clasts of serpentinized ultramafic rock. Fall-in deposits are common in the tops of many cores. The three holes cored at Site U1492 all have the thin uppermost unit of red-brown pelagic mud with lithic clasts overlying a lower unit of blue-grey serpentinite mud containing 5%–10% lithic clasts of serpentinized ultramafic rock. Some sections of core are clast-poor and contain blue-black serpentine mud; other sections contain a white microcrystalline mineral tentatively identified as brucite but pending pXRF analysis. The serpentine mud is extremely stiff and fall-in deposits occur mostly after wiper trips to clean and maintain hole conditions.

Geochemistry

Activities in the Geochemistry Laboratory focused on the extraction and analysis of interstitial water (IW) samples from serpentinite mud cores recovered at Site U1492. Twenty-five headspace gas samples were extracted and analyzed for volatile hydrocarbons and H₂. Fifty-seven interstitial water samples were extracted and split for both shipboard and shore-based analysis. The shipboard IW splits from Sites U1491 and U1492 were analyzed for key anions (PO₄, SO₄, NH₃, Br, Cl), pH, alkalinity, and selected major and minor elements (Ca, Mg, K, Na, Si, Fe, Mn, B, Li, Sr, Ba). The two sites show marked chemical differences, with the flank site (Site U1491) reflecting the signature of infiltrating seawater, while the summit site (Site U1492) records the signature of the high pH (10.7–11.2), low B, high Ca upwelling fluids that have modified the shallow upper mantle, resulting in serpentine mud volcanism at Yinazao Seamount. At Site U1492, many of the species show marked depletions relative to seawater, including the halogens Cl and Br, which are not commonly leveraged by mineral/fluid exchanges, while Sr and NH₃ are notably elevated. Mixing with seawater occurs only within the upper 10–20 m, to a greater depth at Hole U1492A (furthest from the seep) than at Hole U1492C (at the seep). At greater depths the interstitial waters are 100% dominated by upwelling fluids, with no evidence for seawater involvement except for some samples that show drilling-related contamination. Rock samples from Site U1492 are being prepared for inductively coupled plasma–optical emission spectrometry (ICP-OES) analysis during the lull in core recovery during casing operations at Hole U1492D.

Microbiology

At Site U1492, the microbiologists continued subsampling, preserving, and storing samples under controlled conditions. The break in coring activities will allow time for samples to be prepared for light microscopy and qPCR analysis.

Physical Properties

Physical properties measurements were performed on cores partly from Site U1492. Gamma ray attenuation (GRA)-density and magnetic susceptibility (MS) measurements using the Whole-Round Multisensor Logger (WRMSL) are mostly of good quality; however, *P*-wave velocity measurements using both the WRMSL and the gantry were generally of poor quality and unreliable. Some of the tops of core sections were difficult and fluidized, resulting in incompletely filled core liners and anomalously low GRA density, with values less than 1.5 g/cm³ locally. Moisture and density (MAD) analyses of discrete samples taken from undisturbed material show rather homogeneous bulk density values with depth, of about 1.5 to 2 g/cm³. These near-constant values tend to confirm the effect of coring disturbance at the top of core sections, as also demonstrated by vane shear measurements. As at Site U1491, the ~5–10 m thick top pelagic sediment unit is clearly highlighted by contrasting WRMSL measurements compared to the underlying serpentinite mud units. In serpentinite mud units, low natural gamma radiation (NGR) values (<1 count/s) and homogeneous thermal conductivity (~1.4–1.6 W/m·K) and bulk density (~1.5–2.0 g/cm³) are measured, without clear relationships with depth. Several significant variations of magnetic susceptibility are observed in the different holes. These variations have no obvious correlation to any lithostratigraphic change described in the homogeneous serpentinite mud.

Downhole Measurements

In Hole U1492C, seven APCT-3 measurements were attempted, of which three yielded high quality temperature equilibration data, two had medium quality data, and two had low quality data. The temperature data are consistent with upward fluid flow rates exceeding 1 m/y.

Paleomagnetism

Measurements were conducted on archive section halves of the cores of Holes U1492A, U1492B, and U1492C, with stepwise alternating field (AF) demagnetization from 5–20 mT using the superconducting rock magnetometer (SRM). Bulk magnetic susceptibility of 21 samples were measured with a Kappabridge KLY-4, with average values of 5.1–5.5 × 10⁻³ SI units for samples from each of the three holes.

Education and Outreach

The Education and Outreach officers continued to produce videos, tweets (<https://twitter.com/TheJR>), Facebook posts (<https://www.facebook.com/joidesresolution>), and joidesresolution.org blog items (<http://joidesresolution.org>). There were three ship-to-shore videoconferences; videoconference activity will pick up once schools return from the holiday break.

Technical Support and HSE Activities

Laboratory Activities

- Icefield core orientation tool: We fixed the spring that was damaged last week on one of the units. Due to the nature of the material being cored, and the loss of one of the non-magnetic BHA subs in Hole U1491C, orientation measurements have been suspended for the rest of Expedition 366.
- The new *P*-wave logger (PWL) system has been assembled and bench tested with no issues to report.
- The Special Task Multisensor Logger (STMSL) track has been disassembled in preparation for installing the new rail system and new PWL.
- The new 2G liquid-helium-free superconducting rock magnetometer (SRM) is now fully operational and collecting data for this expedition. Work has begun on the chill water manifold, which will allow us to switch from the ship supplied to chill water to the emergency chiller.
- X-ray diffraction: Numerous issues have caused the shutdown of the XRD. We will continue consulting with Bruker after the holidays but it looks like a service call will be needed.
- New QEPro Spectrophotometer: Work has begun developing a labview driver. Successful communication and control has been established using raw USB protocols.

Application Support Activities

- The handheld X-ray fluorescence (XRF) uploader has been deployed. Report updates are nearly completed.
- Created new variant “PMAG Cube” label format (called “Personal PMAG Cube”) for SampleMaster that puts the request code (usually the first few letters of a scientist’s last name) on the label rather than the test list.
- Work continues on the PanelBuilder for LIMSpeak II (a.k.a. DQView).
- Work started on “controller” prototype for L-DAQ project.

- Updated TCON uploader to always upload both the measured and calculated values. Also modified the reports to show both values. Retroactively altered TCON data gathered on this expedition to match the new paradigm.
- Fixed a minor defect in SampleMaster's parameter search screen related to how records are sorted.
- Worked on creation of a new database table for storing IMS errors.

IT Support Activities

- The scanning electron microscope (SEM) instrument in the Microscope Laboratory was not usable for part of a day after it was discovered that the TM3000 application running on the instrument host threw an error when launched. Troubleshooting revealed that application is dependent upon monitor screen resolution and steps were taken to document this.
- Forty-four Mac workstations and Mac Video Distribution Units (VDU) were updated with the latest version of the NAC Agent. The previous versions of the NAC Agent periodically hung or crashed, causing the NAC Manager to drop the workstation's or VDU's connection. As of this writing, the new NAC Agent has been stable and no NAC-related disconnection has been reported.
- We're still working to demo the video encoder unit that may replace the existing VBrick units displaying camera feeds aboard the vessel. No video feed has been affected, but we plan to switch one video feed to the new encoder in the coming week.
- The task to deploy 27 inch monitors is ongoing. We have four monitors on the Fo'c'sle deck and one in the Downhole Measurements Laboratory remaining to deploy. Eleven monitors will need mounting arms that will have to be replaced during subsequent expeditions, as the mounting arms are not yet available on the ship.
- In the coming week, we plan to engage select users to convert them to using Microsoft Outlook with Exchange. They will be part of the pilot program for Exchange email service.

HSE Activities

- Held the weekly fire and boat drill as scheduled on 24 December at 1030 h.