IODP Expedition 366: Mariana Convergent Margin

Week 4 Report (1–7 January 2017)

The week began with continued operations at Hole U1492 (proposed site MAF-15A), which had been successfully cased to 211 mbsf the previous week. Unfortunately, on 2 January the cased hole was blocked at 37 m by the accidental premature deployment of the mechanical bridge plug that should have been deployed at the base of casing. Plans are being made to return to Hole U1492D later in the expedition for remediation operations. To continue coring operations, we moved from Blue Moon (Yinazao) Seamount 136 nmi north to Big Blue (Asùt Tesoru) Seamount and cored three shallow sites on its southern flank (Sites U1493, U1494, and U1495). These sites form an age transect of serpentinite mud flows, from older at the foot of the seamount (Site U1493) to younger near the summit (Site U1495).

Operations

Hole U1492D (15°42.57'N, 147°10.60'E, water depth 3666 mbsl; proposed Site MAF-15A)

After casing Hole U1492D to 211 mbsf the previous week, the drill string was raised back to the ship and was on the rig floor by 0915 h on 1 January. The underreamer was serviced and cleaned of rocks and mud, and 115 ft of drilling line was slipped and cut as part of regular maintenance. Three tasks remained to make the cased hole ready for a future deployment of borehole monitoring equipment: clean the hole of any accumulated debris; install a bridge plug at its base; and install an ROV landing platform. A drilling bottom-hole assembly (BHA) was lowered to the seafloor and reentered Hole U1492D to clean out any material that may have built up in the base of the casing. No obstructions were found down to 211 mbsf, and a 30 barrel high-viscosity mud sweep made sure the hole was clear. The BHA was raised back to the ship and the bottom part was exchanged to include the bridge plug deployment apparatus. The bridge plug was to be set near the base of the casing to prevent formation muds from coming up into the casing. However, at 2300 h on 2 January, while the pipe was hung off at the rotary for a pipe connection, the drill string jolted, suggesting that the drill string had become attached to the casing. After completing the pipe connection it was confirmed that the mechanical bridge plug had set prematurely at a depth of 37 mbsf. After an unsuccessful attempt to unseat the bridge plug, the drill pipe was detached from it and the drill pipe was raised back to the ship, where the bridge plug release tool was inspected. Nothing was found to be wrong with the running tool. The prevailing theory is that during the pipe trip through the water column, the running tool setting ring rotated the 10 required turns. Then, after reentry, when the pipe was hung off on the elevator stool, the ship took a large heave and the slips on the bridge plug hung up in the gap between casing joints (opposite the coupling), which allowed the appropriate amount of force to be applied, causing the slips on the bridge plug to set.

The options for casing at Site U1492 were to drill out the bridge plug, or to drill in a second, shorter casing in a new hole at Site U1492. Since either option would have required some preparation time, we decided to move on to Site U1493 (proposed Site MAF-14A) at the foot of Big Blue Seamount, and return to Site U1492 later in the expedition. The drill string and positioning beacon were recovered and the 136 nmi sea passage to Site U1493 began by 1430 h on 3 January.

Hole U1493A (17°59.1668'N, 147°6.0057'E, water depth 3359 mbsl; proposed Site MAF-14A; penetration depth 0.1 m, recovery 0.09 m)

We arrived at Site U1493 (proposed Site MAF-14A) at 0400 h on 4 January following a 13 h transit. A reentry cone was set up in the moonpool in advance of its use at Site U1496 (proposed Site MAF-11A) at the summit of Big Blue Seamount, and the drill pipe was lowered through it. Sites U1493 to U1496 (proposed Sites MAF-14A, 13A, 12B, and 11A) form a ~14 km south to north transect, and are close enough for transit between them in dynamic positioning (DP) mode, allowing the same drill string to be used without being raised back up to the ship. The plan was to drill a single 50 m advanced piston corer (APC)/extended core barrel (XCB) hole at each of the three sites on the southern flank of Big Blue Seamount, Sites U1493, U1494 and U1495. On Core U1493A-1H, the APC core barrel bent in two places and recovered 9 cm of mud with microfossils.

Hole U1493B (17°59.1665'N, 147°6.0060'E, water depth 3359 mbsl; proposed Site MAF-14A; penetration depth 32.6 m, recovery 19.0 m)

The ship was offset 10 m to the east and we started Hole U1493B at 1800 h on 4 January. An advanced piston corer temperature tool (APCT-3) measurement was made on Core U1493B-5F at 24.5 mbsf, obtaining a satisfactory temperature equilibration curve. Because of slow coring due to difficult APC/XCB drilling conditions and because we had sufficient samples for lithological, geochemical, and microbiological assessment of the site, we decided to stop after Core U1493B-9X and move 4 nmi upslope to Site U1494. The transit was made in DP mode at a speed of about 1 kt.

Hole U1494A (18°3.0900'N, 147°6.0000'E, water depth 2200 mbsl; proposed Site MAF-13A; penetration depth 39.0 m, recovery 28.0 m)

The first core at Hole U1494A was taken at 2325 h on 5 January. The serpentinite mud at Site U1494 was very firm and had relatively low water content compared to muds at equivalent depths at preceding Expedition 366 sites. There was pervasive deformation of Cores U1494A-6F to 10F, with muds and rock clasts sucked-in and sheared along the length of core sections. Coring by half-length APC (HLAPC) and by XCB became progressively more difficult with depth, and after Core U1494-11X took 2 h to drill, we decided to move on to Site U1495. The 2.6 nmi transit took 4 h in DP mode.

Hole U1495A (18°5.6693'N, 147°6.0004'E, water depth 1406 mbsl; proposed Site MAF-12B; penetration depth 10.7 m, recovery 4.8 m)

The ship arrived at Site U1495 at 0115 h on 7 January. The hole was unstable for drilling, and after each half-length APC core an XCB barrel was run while drilling down to the depth of the previous HLAPC core, resulting in two "ghost cores" containing mostly rock clasts. Elevated levels of hydrogen were found Core U1495A-2F, so we decided to core a second hole at this site to increase the number of microbiological and interstitial water samples.

Hole U1495B (18°5.6788'N, 147°5.9901'E, water depth 1403 mbsl; proposed Site MAF-12B; penetration depth 10.8 m, recovery 10.2 m)

The vessel was offset 25 m to the northwest and Hole U1495B was started at 1320 h. Coring continued with the HLAPC coring system to a total depth of 10.8 mbsf. Once again hole cleaning and slow rate of penetration drilling out the HLAPC rat hole led to a cessation of coring in the hole. The bit was pulled clear of the seafloor and the move to Site U1496 began at 2100 h on 7 January.

Science Results

Core Description

Sites U1493 and U1494 are lithostratigraphically similar, with thin covers (1–2 m) of red-brown fossiliferous pelagic silts and muds overlying the serpentinite mud flows. At Site U1493, the uppermost meter of serpentinite mud is oxidized to pale orange and sits on pebbly serpentinite muds that vary from pale gray-green to greenish blue or blue-gray in color. Most of the serpentinite pebbly mud flow units have 5%–10% clasts of serpentinized ultramafic rock. The lowermost units at both sites are breccias of harzburgite that ended drilling. The larger harzburgite clasts appear to be relatively fresh and preserve significant fractions of relic mineral phases; however, most clasts are highly altered. The serpentinite muds are extremely firm, especially in the darker blue regions, and flow-in drilling deformation plastically deforms both the clasts and matrix.

At Site U1495, an upper pale red-brown fossiliferous silty-sand to clayey silt layer with abundant foraminifera overlies serpentinite pebbly muds with fine sand that are pale grey-green at the top, and grade quickly downward into dense dark blue-gray pebbly muds and breccias. A 22 cm thick dunite boulder, found at 5 m depth, appears to be largely unserpentinized.

Geochemistry

Preliminary examination of ICP-AES analyses of 70 rock and mud matrix samples shows all the samples to be very Mg-rich, consistent with serpentinite compostion. However, the data indicates some significant differences, in particular higher CaO, Al_2O_3, and markedly high Sr, which are not normally found in ultramafic or serpentine-rich rocks. Porewaters from fifteen samples from Sites U1493, U1494, and U1495 were extracted and analyzed.

Microbiology

Microbiological samples were taken from all three sites, and were prepared and stored for shorebased analysis.

Physical Properties

Compaction trends are evident in multisensor logger data at Sites U1493 and U1494, with increasing density and decreasing porosity with depth, although the values are locally disturbed by drilling effects. Moisture and density (MAD) analysis of discrete samples show a large range of bulk density values between 1.6 and 2.2 g/cm^3. Vane shear measurements present very high values, close to detection limits (200 kN/m^2), highlighting the degree of compaction or dewatering of the muds. Pelagic sediments show clear contrasts with serpentinite muds in the multisensor logger measurements. For example, moderate natural gamma radiation (NGR) values in the pelagic sediment enabled identification of a period of pelagic sedimentation separating two mud flow units at Hole U1494A. Magnetic susceptibility reaches as high as 6000 SI units. *P*-wave velocity in the deeper serpentine mud units reaches values of 2000 m/s.

Downhole Measurements

At Hole U1493B, a single APCT-3 deployment at 24.5 mbsf yielded a medium-quality temperature equilibration curve, from which a formation temperature of 2.51°C and a bottom water temperature of 1.76°C were derived. The resulting geothermal gradient of 32°C/km is comparable to the value of 29°C/km obtained during DSDP Leg 60 for Hole 459B, located just 26 km away.

Education and Outreach

Video Broadcasts with classrooms started back up this week after the holidays, with four broadcasts with USA classrooms ranging from 6th–12th grade and a broadcast with Masters students in Korea. The Education/Outreach Officers updated social media daily, interviewed JR crew members, and posted blogs on http://joidesresolution.org about expedition science and the history of the *JOIDES Resolution*. Videos are in production based on interviews with the science party and will be released in the coming weeks.

Technical Support and HSE Activities

Laboratory Activities

- Special Task Multisensor Logger (STMSL): Work continued on the new *P*-wave logger software module.
- Section Half Multisensor Logger (SHMSL): The benchmark and standard holder on track were rebuilt.
- X-ray diffraction (XRD): Bruker technical staff confirm that the XRD unit is down for the expedition. Parts are being ordered for Hong Kong.

Application Support Activities

- Made significant progress on the pXRF (hand-held XRF) uploader in MUT and corresponding report in LORE. This project is nearly finished now.
- Worked with developers on shore on the LIMSpeak II (a.k.a. DQview) project.
- Worked with developers from shore on LDAQ project.
- Finished error code webservice for the IMS application.

IT Support Activities

- The JR experienced no major network, Internet, or computer system issues during the week.
- We are working with the vendor to identify the replacement part for the fan unit inside the bow VSAT radome.
- Computer monitor replacement is completed. We have deployed thirty-three 27 inch monitors and will be shipping thirty-two 20 inch monitors to shore.
- The Microsoft Outlook pilot project is ongoing. We are awaiting licensing of the migration tool.
- Testing of a new video encoder is ongoing. The demo encoder has been deployed to display the Poop Deck camera feed. During the week, the Poop Deck camera video stream on the VDU's around the ship may have been disconnected for short periods. The Poop Deck video stream to the SIEM's radio room was unaffected. All Poop Deck video disruptions were localized to the IODP monitors around the ship. Users have a choice of video feeds on the IODP monitors, and the Poop Deck is one of the least watched cameras. The Poop Deck camera currently points to the port side at the water behind the ship.

HSE Activities

- Held the weekly fire and boat drill as scheduled.
- IODP lifting equipment inspected by ship's staff.