IODP Expedition 352: Izu-Bonin-Mariana Forearc

Week 2 Report (3–9 August 2014)

Operations

Week 2 of Expedition 352 (IBM Forearc) began in Yokohama, Japan, at Honmoku Berth B3. The last line was released at 1100 h (all times presented are ship local time, which is UTC + 9) on the morning of 4 August 2014, beginning the 457 nmi transit to proposed Site BON-2A. A pre-spud site meeting was held prior to arrival to review the operations plan. The *JOIDES Resolution* completed the transit at an average speed of 11.3 kt and arrived at Site U1439 (BON-2A) at 0324 h on 6 August 2014.

The advanced piston corer/extended core barrel (APC/XCB) bottom-hole assembly was assembled and lowered to a depth of 3134 m below rig floor (mbrf) before shooting the first core. When we were ready to spud Hole U1439A, the sinker bars got stuck and core line was spooled off the drum, requiring two hours to repair. After an initial unsuccessful attempt to obtain a mudline core, Hole U1439A was spudded at 2340 h. The mudline core recovered 6.8 m of sediment and the seafloor was calculated to be 3139 mbrf (3128 m below sea level). Non-magnetic core barrels were used for APC coring from Core U1439A-1H through Core 10H. Core orientation was performed using the FlexIt tool on Cores 2H-9H. Temperature measurements were taken with the APCT-3 temperature tool on Cores 4H, 6H, 8H, and 10H. After switching to the XCB coring system, coring continued through Core 18X. While making a connection on the rig floor, a hydraulic hose located in the top drive umbilical ruptured, requiring 4.5 h to repair. Hole U1439A was terminated with Core 23X at a total depth of 3338.1 mbrf (199.4 m below seafloor [mbsf]), which was decided to be a suitable depth for setting casing. At the conclusion of coring the drill string was pulled out of the hole, clearing the seafloor and ending Hole U1439A at 1520 h on 8 August. A total of 10 piston cores were taken over a 92.3 m interval with a recovery of 84.3 m. Thirteen cores were taken over a 107.1 m interval with a recovery of 86.4 m. Overall core recovery for Hole U1439A was 86%. The total time spent on Hole U1439A was 60 h.

The vessel was offset 20 m to the east and a jet-in test was conducted in Hole U1439B to establish the length of the first casing string we will have to install if we return to this site. Hole U1439B was spudded at 1545 h and the jet-in test reached a depth of 42.2 mbsf. The drill string was raised to ~100 m above the seafloor, and at 2030 h the ship started the 8.2 nmi transit to proposed Site BON-1A in dynamic positioning mode.

The vessel arrived at Site U1440 (BON-1A) and dropped an acoustic beacon. After the beacon landed on the seafloor, the vessel positioned itself off the beacon and moved 200 m at an azimuth of 261°. The drill string was extended to 4780 mbrf and Hole U1440A was spudded at 1255 h on 9 August 2014. Coring continued with non-magnetic core barrels and orientation through Core

U1440A-6H. The first two APCT-3 temperature measurements were taken on Cores 4H and 6H. At week's end the vessel was APC coring at Hole U1440A from a depth of 49.0 mbsf, with extreme heave conditions impacting core quality.

Science Results

Week 2 science activities started with the last two orientations scheduled for port call: (1) the reports that need to be created on board, the IODP depth scales that will apply to our data sets, and some of the database reporting tools available; and (2) the education and outreach activities being planned. Laboratory training and preparation continued until we arrived on site. APC coring operations began at Site U1439 (proposed Site BON-2A) on 6 August 2014.

Hole U1439A

Hole U1439A contains two major lithostratigraphic units: a sedimentary unit (0–178.5 mbsf; Cores 1H to 20X); and a basement unit (178.5–c.199.4 mbsf; Cores 20X to 23X). The boundary is marked by a "manganese crust" in Core 20X, which is inferred to represent the paleo-ocean floor.

The sedimentary unit recovered in Hole U1439A records an excellent example of the deep-sea sedimentary cover of an assumed subduction initiation complex in a fore-arc setting. The entire succession exhibits a background of well-oxidized nannofossil ooze, which is typically silty and variably bioturbated. Types of clastic sedimentary intercalations interrupt the pelagic carbonate lithology. In the higher levels, tephra layers are abundant (18 in all), ranging in thickness up to several centimeters. These are normally graded and are typically felsic in composition. Downhole, there is a distinctive interval of dark, graded and planar-laminated siltstone to fine sandstone of volcaniclastic composition, which is rich in mineral grains (e.g., feldspar, pyroxene, and amphibole). The lower part of the succession includes centimeter- to decimeter-thick intercalations of pale-colored tuffs, variably reworked and mixed with pelagic ooze. The lower part of the succession also exhibits considerable diagenetic manganese oxide mobilization resulting in prominent local color variations. The base of the pelagic succession is marked by a thin, black layer of manganese oxide (manganese crust).

XRD analyses of Cores U1439A-1H to 4H show very homogeneous results. The top 40 m of sediment is mostly composed of carbonates with minor illite, muscovite, and quartz.

Cores U1439A-1H to 20X include nannofossil assemblages useful for biostratigraphic dating. Recovery was intermittent and revealed ages ranging from recent to the late Eocene in Core 20X, with a maximum age of ~38 m.y. A few continuous sections were recovered from the Pliocene and upper Miocene as well as in the lower Miocene and across the Oligocene boundary. Interestingly, all epoch boundaries are represented in the recovered material. This includes the Pliocene/Pleistocene, Miocene/Pliocene, Oligocene/Miocene, and Eocene/Oligocene (E/O)

boundaries. The E/O boundary is described on a tentative basis as marker taxa for this boundary are scarce or absent in equatorial Pacific waters.

In terms of structure, Cores U1439A-1H to 17X have sedimentary and pyroclastic layers with subhorizontal bedding (dip angles <11°). Pyroclastic flow structures (cross bedding, irregular folds) are apparent between 148.4 and 152.2 mbsf. The bedding plane attitude was measured in the least disturbed sections, preferentially along lithologic interfaces marked by sandy layers. Drilling-induced deformation is prominent below 107.9 mbsf and primarily takes three forms: (1) core flank deformation caused by the downward motion of the coring tool (this results in bedding planes that appear concave-down instead of horizontal and planar); (2) rotary shear deformation caused by tool rotation (this results in sedimentary beds being highly disturbed and exhibiting plastic deformation); and (3) core expansion that continues to occur along the core axis several hours after the core has arrived in the laboratory (this results in spontaneous shear fractures [thrusts] as the core ends are constrained by the core liner). Subhorizontal stylolites, related to pressure-solution that occurs in chalky sediment, were observed between 159.2 and 160 mbsf. Subvertical injection veins, related to dewatering of the sediment, occur between 152.2 and 164 mbsf. Tectonic deformation structures become common from 165 mbsf to the igneous basement interface. Subvertical shear fractures and extensional fractures were observed between 165 mbsf and just below the interface at 180 mbsf. The shear fractures show a normal sense of shear with a maximum displacement of 5 cm. From 155 mbsf to the contact with igneous basement, bedding dip angles continuously increase from subhorizontal to ~20°.

The basement unit comprises hyaloclastite breccia with volcanic clasts, volcaniclastic sand and silty sand, and granule conglomerate. The matrix of the hyaloclastite breccias is, in general, highly altered rock fragments and mud, but fragments of fresh glass are common in some sections. Volcanic rock fragments are generally fresh, perhaps representing pillow interiors, with minor oxidative alteration in the outer rinds and fresh glass preserved in at least one fragment. Preliminary examination indicates that these rocks are boninite. Igneous rock samples in Cores U1439A-20X to 23X were described and entered into the database using a slightly reconfigured DESClogik template.

In terms of alteration, the matrix comprises a completely altered, low-temperature assemblage of fine-grained clays, carbonates, and zeolites. Some have a distinctive blue-green color due, probably, to the presence of smectite. In the large clasts that have experienced significant alteration, the groundmass and primary minerals have been transformed mainly to clays but the primary igneous texture is preserved. They are sometimes crosscut by whitish to greenish veins filled with zeolite and associated minor carbonates.

Physical properties measurements were performed on the ~180 m of sedimentary record recovered in Hole U1439A to obtain values of density, porosity, thermal conductivity, magnetic susceptibility, natural gamma radiation (NGR), *P*-wave velocity, and color reflectance. Preliminary analysis indicates that *P*-wave velocity is ~1540 m/s from 0 to 138 mbsf and

increases locally up to 2000 m/s to the bottom of the hole. This trend correlates with magnetic susceptibility and bulk density. Bulk density decreases gradually from 0 to ~130 mbsf, and then has scattered values to the bottom. NGR has a significant shift between ~100 and ~130 mbsf, where the bulk density has its minimum value.

Core section halves from Hole U1439A were demagnetized in an alternating field (AF) and measured on the superconducting cryogenic magnetometer. In total, ~10,800 measurements were made on APC cores and selected intervals of XCB cores with larger, intact pieces. In addition, 100 discrete samples were measured using mainly AF demagnetization. Thermal demagnetization was applied to ~20 samples, where we could cut cube samples from lithified sedimentary rock. Most samples seem to be unstable at higher demagnetization steps, perhaps indicating multi-domain grain behavior. However, preliminary data plots from the APC cores show that it may be possible to delineate a magnetic stratigraphy.

Headspace gas samples for hydrocarbon safety monitoring were analyzed from Cores U1439A-1H to 23X, except for Cores 21X and 22X that had insufficient sediment. Thirteen interstitial water (IW) samples were analyzed from Cores U1439A-1H to 19X for chlorine content, salinity, alkalinity, and pH. Finally, 18 sediment samples were sampled for shipboard carbonate and inductively coupled plasma–atomic emission spectrometry (ICP-AES) analyses from Cores U1439A-1H to 19X, and one igneous rock was sampled in Core 21X for ICP-AES analysis.

Cores U1439A-1H to 16X, 18X, and 19X were sampled for postcruise research projects.

Hole U1440A

Density, magnetic susceptibility, *P*-wave velocity, natural gamma radiation, and thermal conductivity measurements were completed on Cores U1440A-1H to 4H. Moisture and density measurements were completed on Cores 1H and 2H.

Cores U1440A-1H and 2H were split, imaged, and measured for color reflectance and point magnetic susceptibility. Cores U1440A-1H and 2H contain hemipelagic sediments with a terrigenous component and several ash layers. The sediments are undisturbed down to 12 mbsf.

Six headspace gas samples and six IW samples were analyzed from Cores U1440-1H to 6H for hydrocarbon safety monitoring and chlorine content, salinity, alkalinity, and pH.

Cores U1440A-1H and 2H were sampled for postcruise research projects.

Education and Outreach

The two education officers familiarized themselves with the labs and started documenting the coring process and scientific activities in various social media web sites (Facebook [https://www.facebook.com/joidesresolution], Twitter [https://twitter.com/TheJR], and Instagram

[http://instagram.com/joides_resolution]). Several blogs were posted on http://joidesresolution.org/; external blog sites in Europe, Japan, and the U.S.; and the National Geographic (see http://joidesresolution.org/ for links). The videoconference schedule was refined with ~50 events planned, most of them in September. A preliminary elementary curriculum was created and circulated to educators for feedback.

Technical Support and HSE Activities

Technical staff supported science operations at Sites U1439 and U1440.

Laboratories:

- Modifications were made to DESClogik templates.
- 0 kb TIFF files continue to plague the SHIL logger; writing of new code in progress.
- Completed installation of Laser Engraver door interlock system and airflow monitor.
- Spectrophotometer drivers were reinstalled to clear up communication issues.
- Scientists will conduct XRF tests with standards before deciding whether to use it.
- DTech amplifier issue under investigation.

HSE activities:

- Staff received training on the new Laser Engraver safety features.
- A fire and abandon ship drill took place on 4 August.