IODP Expedition 362: Sumatra Seismogenic Zone
Week 3 Report (21–27 August 2016)

OPERATIONS

Week 3 of Expedition 362 (Sumatra Seismogenic Zone) began with the recovery of the drill string and the APC/XCB bottom-hole assembly (BHA). Our next operation was to install a reentry system at Hole U1480G so that we could reach our deeper coring and logging objectives. Deploying the reentry system involved the following steps. First, we assembled 755.9 m of 10¾ inch casing and suspended it from the mud skirt, which was resting on the moonpool doors. Second, we assembled and tested a drilling assembly with a drill bit, an underreamer, and a mud motor; this was lowered through the casing hung off in the moonpool. Third, ~687 m of 5 inch drill pipe was attached to the drilling assembly, followed by a Hydraulic Release Tool (HRT) that was secured on the casing hanger. Next, the casing with the drilling assembly and drill pipe within were lowered to ~150 m below the rig floor so that a free-fall funnel (FFF) could be dropped onto the HRT. Finally, the entire reentry system and drilling assembly was lowered to the seafloor and the subsea camera was deployed so that we could observe the reentry system while it was drilled into the seafloor. Hole U1480G was started at 0105 h on 23 August, and drilling continued until the reentry system landed on the seafloor at 1330 h on 24 August. The depth of the hole was calculated at 759.6 mbsf, with the end of the casing at ~754 mbsf. The HRT was released from the casing, and the subsea camera and drill string were brought back to the rig floor. We assembled a rotary core barrel (RCB) BHA, lowered it to the seafloor, deployed the subsea camera, and reentered Hole U1480G at 2005 h on 25 August. As we were lowering the drill bit through the casing, it encountered fill at ~573 mbsf (~180 m from the bottom of the 10¾ inch casing) that had to be washed out before coring could resume. At 0700 h on 26 August, we started RCB coring at 759.6 mbsf. Coring continued for the rest of the week through Core 17R at 909.3 mbsf.

SCIENCE RESULTS

Sedimentology and Petrology

Hole U1480B

Core U1480B-1H (split and described out of sequence) is dominated by moderately-bioturbated, brownish to beige clay with variable amounts of calcareous microfossils, vitric ash, and gray silty clay. A single, intact ash layer is present in Section U1480B-1H-5 and two large ash pods layer are present in Section 1H-3.

Hole U1480F

Cores U1480F-69X to 98X (523.3–815.0 mbsf) consist of normally graded, cross- and parallel-laminated silty to sandy beds, surrounded by moderately-bioturbated, dark greenish-gray clay. In Cores 85X–90X (~686.5–730.0 mbsf), the lithology becomes somewhat coarser and is dominated by silty clay with intercalated thin to medium beds of fine sand. Minor amounts of biogenic carbonate are present, and a few fine sand and mud beds are partly cemented by carbonate.

Hole U1480G

Cores U1480G-2R to 10R contain primarily bioturbated, very dark gray to black clay with thin beds and laminae of parallel-laminated silt. Cores 11R–12R contain debris-flow deposits with structureless medium to fine sand with cm-scale rounded to angular clay and silty clay clasts, and intervals of deformed silty clay beds. Core 13R contains bioturbated intervals of alternating reddish-brown and greenish-gray silty clay.

Structural Geology

A major effort this week involved the interpretation of data collected in Holes U1480E and U1480F and updating data in the database and the visual core descriptions. Cores in Hole U1480G contain few natural deformation structures. Minor fault structures were observed in Core U1480G-4R, including one interval of scaly fabric that was also seen in Core U1480F-94X. Bedding dips remain subhorizontal. Slump folds are identified in close association with possible debris-flow deposits.

The drilling process has caused a wide range of drilling disturbance intensities from highly fragmented core rotated in a matrix of injected drilling mud and cuttings to sections of intact core up to 50 cm and longer. We are attempting to correlate drilling disturbance intensity to penetration rate and other drilling parameters to qualitatively assess any changes in sediment strength.

Biostratigraphy

Poorly preserved planktonic foraminifers are observed in a few samples, indicating a late Miocene or younger age. Benthic foraminifers were observed in several samples. Nannofossils occur infrequently although more frequently than planktonic foraminifer, and indicate a late Miocene age for the oldest sediment in Hole U1480G. Diatoms and radiolarians are not observed in this interval.

Paleomagnetism

We continued to measure the natural remanent magnetization (NRM) of core sections and discrete samples to document the magnetic properties of each lithostratigraphic unit. The sediment exhibits higher NRM intensities at 126–150 mbsf in Hole U1480F. Magnetic susceptibility and NRM intensity variations are closely correlated in each sedimentary unit. A few sharp increases in NRM intensity are present at ~147, 400–500, and 650–780 mbsf.

Discrete sample measurements made with the JR-6 Spinner magnetometer show stable characteristic remanent magnetizations, and the directions agree with those from corresponding superconducting rock magnetometer (SRM) pass-through measurements. This agreement between the two magnetometers confirms the validity of the data collected with the new SRM software, which was implemented at the beginning of this expedition. Core orientation data for Holes U1480E and U1480F using the relatively new IceField MI-5 tool are being reevaluated. The magnetic polarity intervals determined using the corrected declinations await additional testing.

Geochemistry

All analyses of pore water samples from Holes U1480E and U1480F were completed. The data show a pattern characteristic of ash alteration reactions, from hydrolysis of silicic ash layers that release silica and cations in the upper 20 m to formation of alteration products (smectites and zeolites) evidenced by consumption of silica and potassium below 100 mbsf. Deeper in Hole U1480E (to 600 mbsf), an increase in calcium and strontium concentrations and a concomitant decrease in magnesium are consistent with alteration reactions in underlying oceanic crust seen at other drill sites.

We took advantage of the casing operations to implement a modification of the ion chromatography method by including the use of nitrate as an internal standard. This modification of the procedure improves precision by ~50% and allows for the accurate measurement of major cations in the same run as sulfate, which saves time and uses smaller pore water volumes.

Headspace gas samples from Hole U1480G had increasing methane levels at the sulfate/methane transition zone, but methane remained between 20 and 400 ppmv through the deepest sample at 881 mbsf in Hole U1480G. Organic C/N ratios show a decreasing trend from ~43:1 at 50 mbsf to

an average of ~3:1 at 250 mbsf. These values are consistent with organic matter of a predominantly marine origin.

Physical Properties

Hole U1480F

MAD bulk density values increase with depth from ~2.0 g/cm^3 at 360 mbsf to ~2.15 g/cm^3 at 800 mbsf. Between 360 and 800 mbsf, the average porosity decreases from ~45% to ~35%.

Hole U1480G

MAD bulk density values are ~2.1 g/cm^3 from 760 to 777 mbsf. Porosity values decrease from 37% to 34% over the depth range of 760 to 777 mbsf. Magnetic susceptibility values are ~38 IU, with several peak values >100 IU. Discrete *P*-wave velocity measurements obtained in the *z*-direction increase with depth from ~1900 to ~2100 m/s. The *x*- and *y*-direction *P*-wave velocities are ~200 m/s higher than the *z*-direction values. Thermal conductivity values are 1.2–2.2 W/(m·K) and increase with depth.

Core-Log-Seismic Integration

The correlation between holes U1480A–U1480E was refined. Work continued on a time-depth model that will allow correlation of the seismic data with the core data. We are investigating whether detailed correlations between cores in Holes U1480F and U1480G can be established as part of generating a composite depth scale.

EDUCATION AND OUTREACH

This week we had our first set of videoconferences that reached over 300 students. We had 10 broadcasts with undergraduate students, high school students, and middle school girls in a science summer camp. Several blogs were added to Facebook (http://www.facebook.com/joidesresolution) and the *JOIDES Resolution* web page (http://joidesresolution.org); a tribute to oceanographer Marie Tharp on the tenth anniversary of her death ("Today in Geology History: In Memory of Marie Tharp, Pioneering Oceanographer") reached about 9,600 people. A New Scientist article about Expedition 362 was published on 25 August ("Floating lab drills 1.5km below sea floor to study megaquakes").

TECHNICAL SUPPORT AND HSE ACTIVITIES

Technical staff continue to focus on supporting the science activities at Site U1480. Minor issues continue with applications accessing web services.

Laboratory Activities

The bearings of the Whole-Round Multisensor Logger (WRMSL) *P*-wave logger (PWL) were replaced to address mechanical issues. The ability to measure discrete samples was added to the new SRM software. We made changes to several LORE reports including natural gamma ray (NGR) section trimming bug, summary headers, and shear strength units. We made a few minor changes to SampleMaster, and added a formula-calculation capability to DESClogik. We corrected a problem that did not allow the upload of close-up images.

HSE Activities

We checked the safety showers and eyewash stations, and held the weekly fire and abandon boat drill on 21 August.