

## **IODP Expedition 362: Sumatra Seismogenic Zone**

### **Week 5 Report (4–10 September 2016)**

#### **OPERATIONS**

Week 5 of Expedition 362 (Sumatra Seismogenic Zone) continued with coring in Hole U1480G. Cores 71R to 73R advanced from 1412.1 to 1431.6 m below seafloor (mbsf). Coring was halted at 0930 h on 4 September 2016 when penetration and high torque indicated a possible bit failure, which was confirmed by the tapered end of the last core. In preparation for logging, the drill bit was released at the bottom of the hole and the hole was displaced with 300 barrels of heavy mud. The drill string was pulled out of the hole but encountered significant drag at 1025.3 mbsf. After offsetting the vessel 210 m to be able to work with the top drive and then trying to free the drill string with 150 klb overpull for several hours, the drill pipe came free at 0155 h on 5 September. We resumed pulling the drill pipe out of the hole until it reached 63.3 mbsf, within the casing, the depth set for logging.

The rig floor was prepared for logging and an abbreviated tool string was run into the hole, where it encountered an obstruction at 4967.6 m below rig floor (mbrf) or 809 mbsf, ~52 m below the casing shoe. Logging data were collected from 4967.6 to 4140.0 mbrf (809 mbsf to ~19 m above seafloor) and the tools were pulled to the surface and stored. Logging activities were completed at 1730 h on 5 September. The drill string was pulled out of the hole and operations at Hole U1480G ended at 0510 h.

An APC/XCB bottom-hole assembly was made up and the drill string was lowered to the seafloor. Hole U1480H was spudded at 1545 h on 6 September 2016. APC coring continued through Core 17H to 129.4 mbsf, the base of the hole. Nonmagnetic core barrels were used, the cores were oriented with the FlexIt orientation tool, and formation temperature measurements were taken with Cores 4H, 7H, 10H, 12H, and 17H. The drill string was pulled out of the hole, and the vessel was prepared for transit. Site U1480 activities concluded at 0212 h on 8 September, and the total time spent on Site U1480 was 26.8 d.

The 19.3 nmi transit to Site U1481 (proposed site SUMA-12A) was completed in 2.4 h at an average speed of 8.0 kt. The vessel arrived at Site U1481 at 0436 h on 8 September, and the thrusters and hydrophones were lowered. The upper guide horn was removed, and the mud skirt was moved to the moonpool beneath the rotary table. A 730.5 m long 10<sup>3</sup>/<sub>4</sub> inch casing string was

assembled and suspended from the mud skirt. A tricone bit, underreamer, and mud motor assembly was put together, and the mud motor and underreamer were tested in the moonpool. The drilling assembly and ~658.9 m of 5 inch drill pipe were connected to the Hydraulic Release Tool (HRT) tool, and the HRT was bolted onto the casing in the moon pool. The mud skirt, casing and drill string were lowered to ~4180 mbrf, and a free-fall funnel was assembled in the moonpool and dropped to land on the reentry system. The subsea camera was deployed to observe the drilling operation. Hole U1481A was spudded at 1500 h on 9 September, and the reentry system landed on the seafloor at 1910 h on 10 September. The depth of the hole was calculated at 734.1 mbsf. The HRT was released from the casing at ~2000 h, and the subsea camera was recovered. On 10 September we were pulling the drill string to surface, with the bit at 3830.3 mbrf (3818.6 m below sea level).

## **SCIENCE RESULTS**

### **Sedimentology and Petrology**

Core U1480G-61R comprises bioturbated tuffaceous silty clay with calcareous ooze and laminae of ash and tuffaceous silt. Core 62R contains igneous rocks, tuffaceous sandstones, and conglomerates. Core 65R contains tuffaceous and calcareous ooze and igneous rocks. Cores 65R–69R contain partially-altered porphyritic igneous rocks with calcite veins. Calcareous ooze and clay with silt occur in Cores 69R–71R. The lower part of Core 71R consists of discrete layers of basalt separated by recrystallized calcareous ooze. Cores 72R–73R consist entirely of basalt.

### **Structural Geology**

A variety of structures were described from the top of the pelagic sequence beneath the Nicobar Fan to the bottom of the hole in Core 73R (1431.6 mbsf) in basaltic ocean crust. In lithologic Subunit IIIB, and in particular Cores 61R and 62R, we found an abundance of small-scale normal faults, many of which appear in a conjugate geometry with a bisecting angle of ~115°. A number of early diagenetic fabrics, such as flattened oxidized reduction spots, as well as the low angle dip of the observed faults suggest that these faults formed early in the burial history. The extrusive and intrusive basement of lithologic Units IV and V contain mineral-filled veins dominated by calcite, quartz, and Fe-oxide phases.

### **Biostratigraphy**

We processed samples from the deepest part of Hole U1480G (Paleocene-Upper Cretaceous) and the shallow Hole U1480H (Pleistocene). Poor preservation and reworking make interpretation

difficult at the bottom of Hole U1480G, and it remains uncertain whether we recovered the Upper Cretaceous-lower Paleocene boundary at 66.0 Ma. A series of well-established biostratigraphic markers was observed in the Pleistocene interval of Hole U1480H. However, these markers do not show a typical age-depth progression and are partly in conflict with results from Hole U1480E, which also sampled the mudline. These conflicts are yet to be resolved. Biostratigraphic results from Holes U1480E and U1480G are consistently deeper than ~30 mbsf.

### **Paleomagnetism**

We conducted continuous measurements of archive-half core sections and progressive AF and thermal demagnetization measurements of discrete samples from Holes U1480G and U1480H. The intensities of natural remanent magnetization of the archive halves span more than two orders of magnitude, with the highest intensities observed in the basaltic rocks in lithologic Unit V. The unblocking temperatures of thermally-demagnetized discrete samples suggest that the magnetic carrier is fine-grained magnetite. Interpretation of orientation-corrected declination data is ongoing.

### **Geochemistry**

In Hole U1480H, we conducted high-resolution sampling in the upper 130 m of the section. Pore water was collected from 43 whole-round (WR) samples; a parallel set of samples was collected for postcruise microbiology studies. In addition, 41 rhizon samples were collected from WR core sections of Cores U1480H-9H, 10H, and 11H at a resolution of two rhizons per section. Preliminary results show excellent agreement between the geochemical profiles generated for Holes U1480E, U1480F, and U1480H.

### **Physical Properties**

We completed physical properties measurements for Holes U1480G and U1480H. Physical properties display large variations in the igneous rocks recovered at the base of Hole U1480G, resulting in definition of distinct physical properties units. The porosity values calculated below ~1300 mbsf deviate from the consolidation trend of lithologic Unit II, with subsets of both higher and lower porosity. These deviations are being investigated. Physical property data from Hole U1480H are similar to those from Hole U1480E.

### **Downhole Measurements**

Three logging runs were initially planned in Hole U1480G: triple combo with Ultrasonic Borehole Imager (UBI), Formation MicroScanner (FMS)-sonic, and vertical seismic profile (VSP). However, the drill string became trapped in the hole during pulling out of the hole following coring. After releasing the pipe from the unstable formation, it was clear that only a small portion of the hole remained open for logging. A tool string made of the HNGS and HRLA tools only (spectral gamma ray and resistivity, respectively) was lowered into the hole on 5 September 2016. The tools were unable to pass below 809.3 mbsf (52 m below the casing shoe), therefore resistivity and gamma ray logs were recorded from that depth to the seafloor, including an interval within the casing.

The APCT-3 temperature tool was deployed five times in Hole U1480H. Combined with the six successful deployments in Holes U1480E and U1480F, the measurements confirm a vertical temperature gradient of 42°C/km at this site.

### **Core-Log-Seismic Integration**

We revisited the correlation in the upper part of Site U1480, comparing Hole U1480H against Holes U1480A through U1480F. There is good agreement between the physical properties data in the top portion of these holes, allowing the development of a composite depth scale from the seafloor to 30 mbsf. The data deeper in the section are consistent and not sufficiently distinctive to allow generation of a deeper composite depth scale. The data from Hole U1480H are not sufficient to resolve the small offset between Holes U1480E and U1480F. Interpretation of the seismic data at Site U1480 was completed, with several horizons correlated between Sites U1480 and U1481 (proposed Site SUMA-12A) in support of our request to the Environmental Protection and Safety Panel (EPSP) and the TAMU safety panel to drill down to 1150 mbsf at Site U1481.

### **EDUCATION AND OUTREACH**

We conducted seven videoconferences with U.S. and French schools and posted several blogs, including an in-depth sedimentology blog. Tamara Jeppson was interviewed for a University of Wisconsin story.

### **TECHNICAL SUPPORT AND HSE ACTIVITIES**

Technical staff continued to support the science activities at Sites U1480 and U1481.

**Laboratory Activities**

Based on biostratigraphic data, we suspect that the section-half declination values obtained with the new SRM software are 180° off from what they should be. We are conducting tests to identify the source of the error. Upgrades are in progress for the discrete velocity software.

Sedimentologists, with the help of staff, have developed a method and Excel spreadsheet macros for quantitative XRD mineral analysis. We made minor changes and corrections to SampleMaster, MadMax, Alkalinity, Request Code Manager, and LORE reports. On 8 September, we had an interruption in ship-to-shore communications because the satellite connection was down from 0700 to 1100 h. The outage was traced to an incorrect configuration in the RigNet Cisco router.

**HSE Activities**

We held the weekly fire and abandon boat drill on 4 August.