

IODP Expedition 362: Sumatra Seismogenic Zone

Week 2 Report (14–20 August 2016)

OPERATIONS

Week 2 of Expedition 362 (Sumatra Seismogenic Zone) began with preparations to deploy the temperature dual-pressure tool (T2P) with the motion decoupled hydraulic delivery system (MDHDS) and the Electrical Release System (ERS) system in Hole U1480E. The MDHDS/T2P assembly was run to the bottom of the drill string on the Schlumberger wireline and was released using the ERS. The MDHDS then released the T2P tool, which was pumped into the formation. After waiting for 30 min for the measurement to be completed, we made several unsuccessful attempts with the wireline and the coring line to grab the MDHDS. Finally, a fishing spear was successful in grabbing the outer core barrel and the MDHDS/T2P assembly was brought to the surface. As part of the process of recovering the T2P tool, we pulled the drill string out of the hole with the bit clearing the seafloor at 1540 h on 14 August.

After offsetting the ship 20 m to the north, Hole U1480F was started at 1910 h on 14 August 2016 and was drilled without coring from the seafloor to 98.0 mbsf. Piston coring began with Core U1480F-2H and continued through Core 8H to 146.5 mbsf. Cores 1H–8H were oriented with the IceField tool. Because all attempts at full-length piston coring were partial strokes, coring continued with the half-length advanced piston corer (HLAPC) system from Core 9F to 29F to 245.2 mbsf. Formation temperature measurements (APCT-3) were taken successfully at four depths in Hole U1480F. Since all cores with the HLAPC system were also partial strokes, we began alternating 5 m drilled intervals with HLAPC cores to achieve penetration while still complying with safety guidelines. Cores 31F to 51F penetrated from 250.2 to 357.7 mbsf. Within that interval, the nature of the formation required using the extended core barrel (XCB) system for Cores 34X, 35X, and 37X. Continuous XCB coring resumed from Core 52X to 98X at a final depth of 815.0 mbsf. The week ended with the drill string being pulled out of the hole in preparation for installing a reentry system at Hole U1480G.

SCIENCE RESULTS

Sedimentology and Petrology

In Holes U1480E and U1480F, thick to thin, very fine-grained sand beds are common from ~25 to ~345 mbsf and are intercalated with mottled gray silty muds. Below ~345 mbsf, there is a decrease in bulk mean grain size to thin and very thin silt beds intercalated with mottled gray-

green muds. In the upper ~25 m of the hole, carbonate content is higher (0%–60%) than in the underlying sediments. Total clay in the upper ~25 m is notably high, ranging from 60% to 70% in the muds. Below ~25 mbsf, the bulk composition of the sediment shows strong variation between different lithologies but only subtle trends within the same lithology.

Structural Geology

Observed structural features in Holes U1480E and U1480F include natural normal faults, synsedimentary faults, clastic intrusions, and drilling-induced faults. All faults are minor with apparent offsets of 2–10 mm. Deformed burrows were used to record downhole changes in mudstone fabric. We also described the intensity and style of drilling disturbance in all cores. Based on structural geology core descriptions, we developed a qualitative strength profile that reflects increasing strength with depth evolving from weak, ductile materials at the top to intermediate ductile and some brittle intervals at the base of the hole. Some localized deviations from this strength profile warrant further investigation.

Biostratigraphy

Diatoms and poorly preserved radiolarians are present sporadically in the upper 25 m. Below that, samples are barren down to 815 mbsf. Rare planktonic foraminifers occur sporadically but provide a few useful age constraints. Rare to few calcareous nannofossils occur sporadically throughout the entire cored section, and more consistently below ~500 mbsf. Biostratigraphic and magnetostratigraphic data reveal a ~5 m thick, condensed interval in the Pleistocene section that encompasses ~1.5 m.y. High sedimentation rates characterize the rest of the Pleistocene. Sedimentation rates decrease to ~100 m/m.y. close to the Pliocene/Pleistocene boundary and are fairly uniform throughout the Pliocene. Hole U1480F ends in sediments of late Miocene age.

Paleomagnetism

We continued to measure the natural remanent magnetization of archive-half core sections and 18 discrete samples taken from the working halves were analyzed. We subjected archive-half sections to alternating-field (AF) demagnetization up to 20 mT to isolate the characteristic remanent magnetization and measured them with the pass-through superconducting rock magnetometer at 2.5 cm intervals. Discrete samples were subjected to stepwise AF demagnetization up to 80 mT. In general, we find that the magnetic properties of the recovered sediments are relatively uniform with insignificant variations downhole. Data from oriented cores

in the upper intervals of Holes U1480E and U1480F provide some useful magnetostratigraphic information.

Geochemistry

We continued processing Hole U1480F whole-round (WR) core samples for pore fluid analyses and integrating with results from Hole U1480E. Recovery of pore fluid has been limited due to low core recovery in the deeper portion of Hole U1480F, but we collected 20 cm WRs when sufficient core material was recovered. Each WR yielded between 8 and 59 mL of water, with the amount of water generally decreasing with increasing depth. The chemical data from the upper 200 m are indicative of organic matter diagenesis, with alkalinity reaching a maximum of 9 mM at 90 mbsf. Sulfate decreases from the seafloor to the sulfate/methane transition zone, which occurs at ~110 mbsf. Below this depth, methane concentrations increase to values of 10^3 ppmv and return to background levels below 320 mbsf. Concentrations of K and Mg decrease with depth, possibly reflecting diagenetic alteration of ash.

Physical Properties

Natural gamma ray, bulk density, and grain density values remain fairly constant from 100 mbsf to the bottom of Hole U1480F at 815 mbsf. *P*-wave velocity values show a similar trend but the interval from ~730 to 815 mbsf shows an increase in velocity values to ~1700 m/s. Magnetic susceptibility shows a shift to higher values at ~360 mbsf, below which the values remain almost constant with increasing depth. Thermal conductivity values increase slightly, from ~1.0 to ~2.0 W/(m·K), with increasing depth. Finally, porosity values determined from moisture and density analyses have a decreasing trend with depth, from ~46% at 100 mbsf to ~40% at 620 mbsf. Moisture and density measurements for the bottom of Hole U1480F are in progress.

Downhole Measurements

The T2P was deployed in Hole U1480E to measure formation pressure and temperature, however the tool did not collect any data in the formation. Four deployments of the APCT-3 temperature tool were made between 125.8 and 212.3 mbsf in Hole U1480F and the temperature data correspond to a temperature gradient of 42°C/km. Combined with the thermal conductivity values obtained from the cores, this yields an estimate of the vertical conductive heat flow of 67 mW/m². As a result of the abundance of sand layers in Hole U1480F and the high risk of the logging tools getting stuck, the science party decided to defer logging of the shallow section at Site U1480.

Core-Log-Seismic Integration

Because Holes U1480A–U1480D did not sample the mudline, there was some uncertainty on the starting depth of each hole. To clarify these depths, physical property data and core photos from Holes U1480A–U1480D were correlated to similar data sets from Hole U1480E. This enabled us to correlate ash layers in Holes U1480C and U1480E. In the upper part of Hole U1480E, there is an excellent correlation between the physical properties measured on the Whole-Round Multisensor Logger (WRMSL), the seismic data collected pre-cruise, and the lithology. There is a regionally correlatable unconformity at the base of seismic Unit 1 that corresponds to the downhole appearance of high-impedance sands in Hole U1480E.

EDUCATION AND OUTREACH

The Education and Outreach Officers made daily posts to Twitter (<https://twitter.com/thejr>) and Facebook (<https://www.facebook.com/joidesresolution>) and wrote several blogs about science on board and life at sea. The E/O Officers continued to discuss the scientific background and goals of the expedition with the scientists onboard so that they can communicate this information via their blogs and upcoming videoconferences. So far, 35 videoconferences have been scheduled for the expedition, with the first set planned for the upcoming week.

TECHNICAL SUPPORT AND HSE ACTIVITIES

Technical staff are fully engaged supporting the science at Site U1480. Minor issues continue with applications accessing web services.

Laboratory Activities

Mechanical wear of the WRMSL *P*-wave logger (PWL) logger prevented the caliper from closing for a good percentage of the measurements. The design and purchase requirements for a replacement system have been sent to shore. We continued to fine-tune the new SRM software that runs to cryogenic magnetometer, which has been working well for core section measurements. Changes were made to the penetrometer program, the chemistry worklist generator, DESClogik, and the value list management service. Changes were also made to the thermal conductivity, moisture and density, and drilling coring summary reports. A ceiling light was relocated over the sampling table to provide more light for structural geology measurements. Finally, a problem that was causing server crashes has been identified and fixed, and the connectivity of the shared Zoom station was improved.

HSE Activities

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