IODP Expedition 362: Sumatra Seismogenic Zone
Week 1 Report (6–13 August 2016)

OPERATIONS

Week 1 of Expedition 362 (Sumatra Seismogenic Zone) began while docked at the Passenger Terminal in Colombo, Sri Lanka, performing port call activities. Expedition 362 officially began at 0800 h on 6 August 2016. The Co-Chief Scientists, IODP technical staff, and Expedition Project Manager/Staff Scientist boarded the ship on the first day of port call. The remainder of the science party and the Siem Offshore crew boarded the ship on the second day of the port call. Because most of the scheduled port call logistics had been completed before the start of Expedition 362, the vessel was able to depart almost two days early at 1018 h on 9 August 2016. The 842 nmi transit to Site U1480 (proposed site SUMA-11C) was completed in 65.8 h at an average speed of 12.8 kt.

After arriving at Site U1480 at 0615 h on 12 August 2016, the APC/XCB bottom-hole assembly was assembled and the drill string was lowered to the seafloor. Holes U1480A, U1480B, U1480C, and U1480D were spudded at 0050 h, 0235 h, 0400 h, and 0535 h, respectively. In each case, a full core was recovered and the hole was terminated because the mudline was missed. The drillers found a calculation error in their drill pipe tally that caused all depth measurements to be off by ~28.5 m. The drill bit was repositioned at 4157 m DRF and Hole U1480E was spudded at 0710 h on 13 August. Core 1H recovered 7.76 m of sediment and the seafloor was calculated to be at 4158.7 m DRF (4147.5 m below sea level). Nonmagnetic core barrels were used for all cores in Hole U1480E. Orientation with the IceField tool began with Core 1H, but we stopped using the orientation tool after Core 8H because of sandy layers. APC coring continued through Core 12H, and APCT-3 formation temperature measurements were attempted with Cores 6H, 8H, and 12H. Coring was suspended after Core 12H so that the T2P instrument could be deployed.

SCIENCE RESULTS

Introduction

The 2004 Mw 9.2 earthquake and tsunami that struck North Sumatra and the Andaman-Nicobar Islands devastated coastal communities around the Indian Ocean. This 2004 earthquake and the Tohoku-Oki Mw 9.0 earthquake in 2011 showed unexpectedly shallow plate boundary slip. In the case of North Sumatra, this shallow slip was focused beneath a distinctive plateau of the accretionary prism. This intriguing seismogenic behavior and forearc structure are not well

explained by existing models. The aim of Expedition 362 is to understand the nature of seismogenesis in North Sumatra through sampling the input materials to the subduction zone at two primary sites (proposed Sites SUMA-11C and SUMA-12A) where the input section is ~1.45–1.6 km thick and composed primarily of Bengal-Nicobar Fan-related sediments. Near the trench, the input materials reach a thickness of 4–5 km. This input sequence shows strong indirect evidence for induration and dewatering from geophysical data and has probably reached the temperatures required for sediment-strengthening diagenetic reactions prior to accretion. Expedition 362 will use coring, wireline logging, and in situ pressure and temperature measurements to constrain lithology, sediment deposition rates, diagenesis, thermal and physical properties, and fluid composition of the input section. Based on the observations and the regional geological context, postexpedition experimental analyses and numerical models will be developed and employed to investigate the evolution of mechanical and frictional behavior of the input section sediments/sedimentary rocks as they thicken, accrete, and become involved in plate boundary slip system and prism development. This work will thus advance our understanding of how thick input sediments control décollement position and properties, and how they may facilitate to shallow coseismic slip. The expedition will also investigate the depositional history of the sedimentary section, including Nicobar submarine fan deposition linked to Himalayan uplift and monsoon development, and the in situ stress conditions of the complexly deforming Indian oceanic plate.

The first three days of Expedition 362 included orientations and safety training. During the transit, the scientists became familiar with the core flow, sampling, and laboratory procedures used on the ship. The science party also discussed their research plans and formulated a comprehensive sampling plan. Laboratory teams worked on their methods, which will be documented in the IODP *Proceedings* volume.

The vessel arrived at Site U1480 on 12 August 2016 and coring started on 13 August. Cores from Holes U1480A through U1480E were measured on the whole-round loggers, whereas only cores from Holes U1480A, U1480C, and U1480E were measured on the section-half loggers and partially described. Preliminary science results from the first day of coring are presented below.

Sedimentology and Petrology

Hole U1480A

Core U1480A-1H down to Section 1H-3 is dominated by a clayey ooze with normally graded to structureless fine-grained sandstone of varying thickness, containing rare mollusk fragments. The

lower part of the core consists of pale yellowish nannofossil ooze with varying admixtures of clay minerals and siliceous allochems.

Hole U1480E

The major lithology is pale yellowish nannofossil ooze with intervals of alternating clayey silts and normally graded, parallel-laminated fine to silty sands. Ash layers occur in Sections 1H-2 (5–57 cm) and 1H-CC. Bioturbation is dominated by *Thalassinoides* burrows.

Structural Geology

The first few cores were used to calibrate the developed interpretive terms, which are subjective. The seismic reflection data through the site were reviewed and this reaffirmed the importance of identifying sense of slip on any small faults encountered in the core (normal or strike-slip, for example), intervals that might be prone to fault localization in the subduction zone, and the timing of faults. Drilling deformation in initial cores includes significant up-arched beds, some mingling and distortion of beds, and complete liquefaction of thick sand-rich intervals.

Biostratigraphy

The core catcher sample from Hole U1480A (Section U1480A-1H-CC) was barren and the three samples from Holes U1480A through U1480C carried variable amounts of biogenic carbonate of Pleistocene age. The first biosilica-rich samples occur in Core U1480E-3H. Sample U1480E-11H-CC suggests an age range between 1.93 and 2.39 Ma based on calcareous nannofossil data.

Paleomagnetism

Port call and transit activities included testing and improving the new Integrated Measurement System (IMS) SRM software version 9.1. At Site U1480, continuous measurements and progressive alternating-field (AF) demagnetization started on the archive-half core sections from Hole U1480E. As with previous ocean drilling expeditions, remagnetization imparted by the coring process is prevalent, with NRM inclinations strongly biased toward the vertical direction. Upon alternating field demagnetization to 20 mT, a significant decrease in intensity and a shift of the inclinations toward much shallower or negative values are observed. For oriented APC cores, several relatively well-defined polarity intervals have been identified in the declination records. Overall, the paleomagnetic data appear reasonably robust to provide age information and are also in good agreement with the biostratigraphic data.

Geochemistry

The geochemistry group processed 19 whole-round samples (Cores U1480E-1H to 4H and 10H to 12H) for shipboard and postcruise analyses. Cores U1480E-5H to 9H contain coarse-grained, unconsolidated sediment, so no interstitial water (IW) samples were collected from these cores. The main observation so far is a slight decrease in salinity with depth.

Physical Properties

Whole-round core physical properties measurements were performed on cores from Holes U1480A–U1480E. Thermal conductivity measurements were conducted on all cores. Discrete measurements were performed on Cores U1480E-1H to 3H, and moisture and density measurements are ongoing. Preliminary analysis indicates that the gamma ray bulk density varies downhole, with an abrupt increase from ~1.5 g/cm^3 at 16 m below seafloor (mbsf) to about 2.0 g/cm^3 at 30 mbsf. The magnetic susceptibility is lower at 15–30 mbsf and generally decreases below, with several peaks. *P*-wave velocity increases from ~1500 m/s to an average of 1580 m/s at ~100 mbsf, with a notable high velocity zone at 30–56 mbsf. Thermal conductivity increases downhole, with higher values of 2–2.5 W/(m·K) at 30–52 mbsf.

Downhole Measurements

The APCT-3 temperature tool was deployed with Cores U1480E-6H, 8H, and 12H. Two of the measurements were successful, providing a preliminary temperature gradient of 42°C/km.

EDUCATION AND OUTREACH

Two Education and Outreach Officers boarded the vessel with the science party and participated in all orientations. Coordination of the shipboard outreach activities began during the port call. So far, 20 requests for videoconferences have been received from children to senior citizen groups, from the USA, UK, France, Uruguay, and Australia. The first videoconference is scheduled for the week of 22 August. The Outreach Officers have started making connections with the onboard scientists, and two scientists have initiated blogs. In addition, the Outreach Officers have been blogging regularly and posting frequently on Twitter and Facebook. About 100–200 people read each post, and Facebook lists over 4000 people "reached" by several of the posts. A variety of materials are being gathered for shipboard videos that can complement the posts.

TECHNICAL SUPPORT AND HSE ACTIVITIES

No major issues to report. We have experienced numerous minor issues with applications that are related to the recent web services upgrade. None of the issues have impacted the expedition and have either been resolved or are in the process of being resolved. Technical staff is fully engaged supporting the science activities at Site U1480.

Port call

Nearly all of the on- and offgoing freight was handled by the previous expedition's technical staff. Staff crossover was conducted without issues. The science party was welcomed onboard and shown to their rooms, introductions were made, and safety talks and tours were given.

Laboratory Activities

Underway Geophysics

After clearing the shipping lanes south of Sri Lanka, the towed magnetometer was deployed. Both bathymetric and magnetic data were collected on the transit to the first site.

Track Systems

Almost all of the IMS tracks and SampleMaster have experienced numerous minor issues in accessing and processing LIMS database information via the new web service calls. We are working on WRMSL issues affecting PWL and GRA data quality. The new SRM software is in use for core section halves and we are working with the science party to improve the screen layout and data presentation.

IT Support

Scientists were given instructions on how to connect their personal computing devices to the network and to set up their shipboard accounts. A few minor issues arose that stem from the system changes made during the previous tie-up maintenance period.

HSE Activities

Conducted the Siem Offshore and IODP safety meetings for the science party and new staff. Conducted the IODP laboratory safety tours, an audit of hazardous storage areas, and the weekly check of safety showers and eyewash stations. Held the weekly fire and abandon boat drill on 9 August upon departing Colombo, Sri Lanka.