IODP Expedition 353: Indian Monsoon Rainfall

Week 7 Report (11–17 January 2015)

Operations

After a 97 nmi transit from Site U1445, the vessel arrived at Site U1446 at 1515 h on 10 January. As the thrusters were lowered, a fishing line was spotted. The ship maneuvered around the line and dynamic positioning assumed control at 1614 h.

An APC/XCB bottom-hole assembly was made up and Hole U1446A was spudded at 2225 h on 10 January. Cores U1446A-1H to 18H were retrieved using the APC system. The half-length APC (HLAPC) was then deployed for Cores U1446A-19F to 21F. After reaching a total depth of 180.0 mbsf, the drill string was pulled from the hole. The bit cleared the seafloor at 2105 h on 11 January, ending Hole U1446. Downhole temperature measurements using the APCT-3 tool were taken on Cores U1446A-4H, 7H, 10H, and 15H. The IceField tool was used to obtain orientation data for Cores U1446A-2H to 18H. A total of 18 APC cores were taken over a 165.8 m interval with a total recovery of 171.88 m of core (104%). Three HLAPC cores were taken over an interval of 14.2 m with 14.75 m recovered (104%). Total core recovery for Hole U1446A was 104%.

The vessel was offset 20 m west and Hole U1446B was spudded at 2150 h on 11 January. Hole U1446B was dedicated for high-resolution pore water sampling. Cores U1446B-1H to 3H were retrieved with 100% recovery. The bit was pulled from the hole and the bit cleared the seafloor at 2325 h, ending Hole U1446B. A total of three APC cores were taken over a 27.1 m interval with a total recovery of 27.2 m of core (100% core recovery).

The vessel was offset 20 m north and Hole U1446C was spudded at 0005 h on 12 January. The APC system was used for Cores U1446C-1H to 16H. Cores U1446C-13H and 15H had no recovery despite evidence that sediment had been in the core liner. Core U1446C-15H was re-shot from the same depth and a full core was recovered. The IceField tool was used to obtain orientation data for Cores U1446C-2H to 16H. Partial strokes were recorded for Cores U1446C-11H and 16H. The HLAPC was then deployed for Cores U1446C-17F to 23F. After reaching a total depth of 182.0 m, the bit was pulled from the hole, cleared the seafloor at 1930 h, and was back on the rig floor at 2355 h on 12 January, ending Hole U1446C and Site U1446. The vessel began the transit to Site U1447 at 2400 h on 12 January. A total of 16 APC cores were taken over a 149.4 m interval with a total recovery of 145.87 m of core (98%). The HLAPC system was used for seven cores over a cored interval of 32.6 m with 34.68 m recovered (106%). Total core recovery for Hole U1446C was 99%.

After a 709 nmi transit from Site U1446, the vessel arrived at Site U1447. The thrusters were lowered and dynamic positioning assumed control at 1430 h on 15 January. An APC/XCB

bottom-hole assembly was made up and deployed to a depth of 1396 mbrf. Hole U1447A was spudded at 2320 h on 15 January. Core U1447A-1H was used to estimate the seafloor depth at 1402.2 mbrf. The APC system was used for Cores U1447A-1H to 29H. The HLAPC was then used for Cores U1447A-30F to 44F. Cores U1447A-45X to 53X were cut with the XCB system. The target depth for Hole U1447A is 738 mbsf. Downhole temperature measurements using the APCT-3 tool were taken on Cores U1447A-4H, 7H, 10H, and 15H. The IceField tool was used to obtain orientation data for Cores U1447A-2H to 29H. A total of 29 APC cores were taken over a 261 m interval with a total recovery of 268.69 m of core (103% core recovery). The HLAPC system was used for 15 cores over a cored interval of 67.8 m with 69.12 m recovered (102%). Thus far, the XCB system has been used for nine cores over a 81.9 m interval with 72.78 m recovered (89%).

Science Results

The sedimentologists have completed the description of the cores from Site U1446. The sediments recovered from this site are Holocene to middle Pleistocene in age, and are typical of continental margin settings, falling within the hemipelagic classification as a mixture of a dominant lithogenic fraction diluting a minor biogenic fraction. They are primarily composed of dark gray to gray clay with nannofossils, nannofossil-rich clay, clay with foraminifers, clay, clay with biosilica, and biosilica-rich clay. Due to the homogeneous clayey nature of the sediments, only one lithostratigraphic unit (Unit I) is recognized at this site. Visual core description and smear slide observations were used with supporting information from physical properties and geochemical data to evaluate the varying abundances of the siliciclastic fraction versus the biogenic fraction. Turbidites are rare at Site U1446, with only occasional thin quartz-rich or shallow water carbonate-rich intervals indicative of the presence of reworked sediments. All cores were retrieved using the APC system, so the drilling disturbance is generally slight to moderate and is characterized by voids and gas expansion cracks. After the transit from Site U1446, the sedimentology team has started to describe the cores from Site U1447 in the Andaman Sea. The upper 130 m CSF-A of the sediments recovered from Hole U1447A mainly consist of foraminifer-rich nannofossil ooze with varying clay content. Deeper than 130 m CSF-A, distinct turbidites start to occur. Both thickness and frequency of turbidites increase down hole with a maximum at ~210 m CSF-A, then decrease to down to 320 m CSF-A.

Calcareous microfossils are continuously present in the sediments of Hole U1446A, whereas siliceous microfossils are sporadically present. Calcareous nannofossils show abundances ranging from few to abundant in the smear slides studied, and their preservation is generally very good to good, and occasionally moderate. Foraminifers are dominant to abundant at Site U1446A in 19 of 21 core catcher samples. Preservation is good to moderate in all foraminifer samples. Diatoms are present in the lower and upper part of the Hole U1446A record. Valve preservation ranges from good to poor, and tends to be better whenever abundance is higher. All

Late Pleistocene calcareous nannofossil events are identified. Late to Middle Pleistocene assemblages are typical of tropical/subtropical paleoenvironments. All core catcher samples from Hole U1446A contain Pleistocene planktonic foraminifer assemblages. Planktonic assemblages are dominated by tropical to warm-subtropical species. The diatom community is highly diverse and resembles that of Site U1445. The diatom assemblage consists of species typical of warm to temperate, low-to-mid latitude ocean waters. The age model for Site U1446 was established by combining nannofossil, planktonic foraminifer, and diatom datums with paleomagnetic reversal datums. The combined biostratigraphy/magnetostratigraphy age model indicates a mean sedimentation rate of ~16 cm/k.y. from 0 Ma to just over 1 Ma. The oldest planktonic foraminifer datum encountered is the last occurrence of *Globorotalia tosaensis* (0.61 Ma) in Sample U1446A-12H-CC, while the combination of nannofossils and diatoms datums constrains the basal age of Hole U1446A to between 0.90–1.0 Ma and 1.26 Ma.

In Hole U1447A, we cored an apparently continuous Pleistocene to middle Pliocene section. In Samples U1447A-1H-CC to 56X-CC, calcareous nannofossils are generally common to abundant, and usually well preserved, with the exception of some intervals with high authigenic carbonate content where nannofossils are overgrown. Almost all Pleistocene and late Pliocene marker species are identified. Reworked nannofossils (Miocene and Pliocene species in Pleistocene sediments) are present throughout and are rare to common; however these usually represent <2% of total nannofossils. Planktonic foraminifers are abundant and well-preserved in Samples U1447A-1H-CC to 39H-CC with the exception of samples where authigenic calcite overgrowths impede species identification. All Pleistocene and late Pliocene planktonic foraminifer zones and most species events are identified due to high species diversity.

The chemistry laboratory spent the week preparing the reports for Sites U1445 and U1446 and analyzing samples. The group completed analyses of interstitial water and carbonate samples from Holes U1446A and U1446B this week, and samples from Hole U1447A are underway. The organic carbon content of Site U1446 ranges from 0.8% to 1.6% (average 1.2%) and the geochemistry of Site U1446 mainly reflects the anaerobic processes of sulfate reduction and methanogenesis associated with microbial degradation of organic matter. Sulfate declines rapidly from 28 mM at the sediment-water interface to the detection limit at ~20 m CSF-A. Alkalinity peaks at 20 m CSF-A, consistent with the production of bicarbonate during the sulfate reduction. Dissolved barium concentrations increase with depth, suggesting ongoing barite dissolution and release of sulfate. Changes in the concentration of other cations and anions (iron, manganese, calcium, boron, ammonia, strontium) in interstitial water can be readily explained by the microbial induced chemical reactions and their effects on pH, alkalinity, and mineral dissolution and precipitation. Overall, methane concentrations in sediments of Hole U1446A are generally low shallower than 30 m CSF-A, but rise between 30–70 m CSF-A, peaking at ~50 m CSF-A, with a moderate concentration of 1000 ppm. High methane/ethane ratios suggest that the methane is mostly of biogenic origin (methanogenesis). Carbonate content varies significantly between 2% to 20% within the scale of a few meters, with the low content intervals corresponding to high natural gamma radiation (NGR) (terrestrial, clay-rich materials).

Paleomagnetic measurements were conducted on archive half sections for all three holes at Site U1446, with alternating field (AF) demagnetization up to 10 mT. Discrete samples taken from the working half sections of Holes U1446A ($N = 53$) and U1446C ($N = 9$) were also analyzed, with AF-demagnetization up to 40–80 mT. Characteristic remanent magnetizations (ChRMs) of these discrete samples were calculated using the principal component analysis (PCA) technique. The paleomagnetic signal was generally good down to ~120 m CSF-A, but poor below. A magnetostratigraphy is constructed from 0–1.173 Ma (~170 m CSF-A) in Hole U1446A with a certain degree of ambiguity for some of the chrons. In addition, anhysteretic remanent magnetization (ARM) was acquired and measured on a selection of Hole U1446A discrete samples. A significant decrease in ARM due to diagenetic reduction at 30 m CSF-A was observed for Hole U1446A. Below this depth, ARM intensity increases slightly from 40–60 m CSF-A, and decreases from 100–130 m CSF-A. Measurements are ongoing for Hole U1447A. Between Cores U1447A-1H to 16H, the paleomagnetic vector data is very reasonable, albeit with no apparent changes in polarity recorded. Deeper than Core U1447A-16H, declination and inclination data is noisier and it is difficult to assess any magnetozones. This holds true for the discrete samples, where only a few ChRMs are reliable deeper than Core U1447A-16H.

Standard shipboard physical property measurements were made on all cores from Site U1446 and several cores from Hole U1447A in the Andaman Sea. The physical properties data collected at Site U1446 were found to be in good agreement with the lithostratigraphic data. However, based on density and porosity changes with depth, Hole U1446A is divided into three subunits (Ia, Ib, and Ic). The changes in bulk density and porosity are possibly due to change in sediment composition. We observe similar trends in all physical properties data between Holes U1446A and U1446C. We observe cyclic variability in NGR values possibly due to changes in lithogenic input. Downhole temperature measurements were made while taking Cores U1447A-4H, 7H, 10H, and 15H. We received the processed downhole logging data from Hole U1445A and are starting to integrate these with the physical property data.

The stratigraphic correlators continued helping the applications developers with debugging the correlation applications and the associated reporting utilities. At Hole U1447A, magnetic susceptibility, bulk density, natural gamma, RGB, and color reflectance data were inspected to seek potential for correlation with future adjacent Holes U1447B and U1447C.

Education and Outreach

A total of 14 video broadcasts were held over the past week, which included schools in the United States, the United Kingdom, Germany, and India. Approximately 135 students participated in the broadcasts.

Technical Support and HSE Activities

The main technical support activities for the past week were processing core and supporting laboratory activities.

Laboratory/Computing:

- Readings from the magnetic susceptibility point source on the Section Half Multisensor Logger (SHMSL) are drifting. At low signal strength, there is a saw tooth pattern of an increase in the values. We are troubleshooting it now.
- Received the processed downhole logging data from shore, and it was uploaded onto computers for the scientists to work with.
- One of the transducers on the Whole-Round Multisensor Track (WRMST) failed. A transducer was removed from the Gantry to replace it. The spare set of transducers was located and put back into the Gantry and calibrated.
- The DESClogik output and core images are being sent to shore daily for the visual core descriptions to be produced.
- The Applications Developers continued to work to correct issues with the correlation software tools:
    - Perform tests using old version of *Correlator* (v1.695) to find out whether we can use old version to create usable affine tables and splices; test was negative, found that it suffers from the same bugs we are trying to correct in new version.
    - Work with correlation scientists to develop a strategy for using *Correlator* 2.0 to produce valid splices; found a workaround that is cumbersome for the stratigraphic correlators but will produce splices that do not result in gaps and overlaps in the splice.
    - Continued to work with personnel on shore to resolve problems in *Correlator* 2.0.
- The Applications Developers continued working on edits to the SampleMaster program.
- The Marine Computer Specialists are troubleshooting issues with the NAC Manager.

HSE activities:

- A fire and boat drill is scheduled for 20 January.
- The eyewash stations and safety showers were tested.