

IODP Expedition 353: Indian Monsoon Rainfall

Week 4 Report (21–27 December 2014)

Operations

The *JOIDES Resolution* began the week stationed ~36 nmi outside of Visakhapatnam, India, waiting for the necessary clearance permits to occupy the remaining primary Expedition 353 drill sites that are all in Indian waters. After waiting on standby for 5 d, the decision was made to begin coring operations at alternative sites on the Bengal Fan. After learning that Indian customs would not allow any additional passengers, including Indian scientists, to board until the ship docked and port formalities were conducted, the vessel began the transit to site BoB-11A.

The vessel arrived at alternative site BoB-11A (U1444) at 0715 h on 24 December, after a 191 nmi transit. A beacon was deployed, an APC/XCB bottom-hole assembly (BHA) was made up, and the drill string assembled. The water depth was estimated to be 3143.4 mbrf, based on the precision depth recorder (PDR). The first attempt at a mud line core resulted in a broken and bent core barrel. The vessel was offset 10 m north to avoid core barrel debris and a second mud line core was attempted. Hole U1444A was spudded at 2035 h on 24 December. APC coring continued to a depth of 112.5 mbsf. The liner for Core U1444A-13H was crushed and the core was pumped out of the core barrel. The XCB coring system was then deployed. Core recovery dropped significantly between Cores U1444A-20X to 30X (15%). The half-length APC (HLAPC) was deployed for Core U1444A-24F in an attempt to recover more sediment. This core returned 3.94 m of watery, unconsolidated sand. When Core U1444A-37X was retrieved from a depth of 330.9 mbsf, it was noted that the cutting shoe had failed and part of it was left in the hole. Coring was terminated in Hole U1444A. The drill string was pulled out of the hole and cleared the seafloor at 0600 h on 27 December, ending Hole U1444A.

The vessel was offset 20 m to the south and Hole U1444B was spudded from a depth of 3142.5 mbrf. A full core was retrieved and the seafloor was estimated at 3142.5 mbrf. The APC system was deployed for Cores U1444B-1H to 5H, which reached a depth of 47.5 mbsf. The hole was then drilled to a depth of 95 mbsf and the XCB system was deployed for Cores U1444B-7X to 10X. Hole U1444B was terminated at a total depth of 128.6 mbsf. The drill string was recovered and the bit cleared the seafloor at 2220 h on 27 December. The bit cleared the rotary table at 0445 h on 28 December and the beacon was recovered at 0600 h. The thrusters were raised at 0630 h and the sea voyage back to Visakhapatnam began at 0645 h.

Science Results

The sedimentologists described cores from Holes U1444A and U1444B. The sediments are siliciclastic, dominated by silty sands and clays, with the majority being turbiditic in origin.

Many of the sands are dominated by quartz, with significant mica content throughout and variable amounts of feldspar. The lithostratigraphy is provisionally divided into 4 units: Unit I (0–103 m CSF-A) is characterized by silty sands and silty clays, with low carbonate content, very little biosilica, and wood-rich intervals; Unit II (103–166 m CSF-A) is dominated by nannofossil-rich clays with silt, and a persistent foraminiferal component, and much less sand than Unit I; Unit III (166–273 m CSF-A) is a poorly recovered unit apparently dominated by silty fine-medium sand, with little biogenic material; Unit 4 (273–324 m CSF-A) is characterized by nannofossil-rich silty clays and clayey silts, with interbedded fine sand beds.

Calcareous nannofossils are absent to abundant (>50% of particles) at Site U1444, and where present they are well to moderately preserved. Calcareous nannofossils are absent to common in the upper 108 m CSF-A (Cores U1444A-1H to 12H), which contain frequent turbidite deposits, and the assemblages suggest a Late Pleistocene age (<0.44 Ma). A number of Pliocene–Pleistocene marker species are identified between Cores U1444A-13H and 19X, where nannofossils are common to abundant, suggesting a relatively condensed early Pleistocene/late Pliocene interval in these sediments. Cores U1444A-18X to 30X contain very few calcareous nannofossils. Cores U1444A-31X to 37X are early Pliocene/late Miocene age, and the basal age of Hole U1444A (Sample 37X-CC; 320.95 m) is estimated to be between 5.59–7.53 Ma (late Miocene).

Foraminifer preservation ranges from poor to good in Hole U1444A samples in which they occur. Sandy samples are barren (or nearly so) while mud-rich samples contain dominant to rare foraminifera. Though index species are missing from many samples, planktonic foraminifera indicate an unconformity between Samples U1444A-14X-CC and 16X-CC (119.42 and 137.41 m CSF-A) and provide a basal for Hole U1444A of 6.20–8.43 Ma (late Miocene; Sample U1444A-37X-CC).

A few Late Pleistocene diatoms were found in Sample U1444A-1H-1W, 40–41 cm. Other Site U1444 sediments are barren of siliceous microfossils.

The geochemistry laboratory focused primarily on initial sample processing from Hole U1444A, where pore water samples were obtained down to 322 m CSF-A with some gaps where insufficient material was available for squeezing. Limited pore water sampling was also conducted on Hole U1444B samples to a depth of 47.5 m DSF. Many analyses are currently underway, including sedimentary carbonate, pore water sulfate and other ions, nutrients (ammonium and phosphate), and major and minor elements. Total carbon samples are weighed and will be analyzed soon. Site U1444 sediments are very heterogeneous in nature and show evidence of organic matter remineralization downcore. Alkalinity increases to a peak >25 mM, and ammonium increases to over 3 mM. Chlorinity does not show a clear trend.

The natural remanent magnetism (NRM) and NRM after 10 mT AF-demagnetization was measured on the archive-half sections of Holes U1444A and U1444B. Sections dominated by sand were not measured because of their unstable texture, as well as the risk of contamination to

the cryogenic magnetometer. Sediments up to ~100 m CSF-A appear to be of normal polarity, suggesting that they are <0.78 Ma. In Hole U1444A, the Brunhes/Matuyama boundary (0.78 Ma) could be located around 107.5 m CSF-A, however the reliability/accuracy is unknown, in part due to the nature and orientation of Core U1444A-13H, which was highly disturbed. All XCB cores were severely affected by drilling related overprint and are difficult to interpret. The magnetic remanence component for a selection of discrete samples was also measured. Most of the discrete data from 0–100 m CSF-A are influenced by gyroremanent magnetization, likely due to the presence of greigite (a ferrimagnetic iron sulphide). Further measurements on discrete samples should be able to provide a low-resolution time series in order to construct a magnetochronological timescale. Rock magnetic experiments, which could also give some interesting insight into the mineralogical and palaeoenvironmental changes throughout Site U1444, are ongoing.

The physical properties laboratory team discussed sampling resolution for the Whole-Round Multisensor Logger (WRMSL), the Special Task Multisensor Logger (STMSL), and moisture and density (MAD) measurements at Site U1444. Core sections from Hole U1444A were each logged at 2.5 cm on the STMSL only. *P*-wave data from the WRMSL was found to be unreliable over the course of the first 17 cores, and thus, all WRMSL logging was abandoned from Cores U1444A-18X to 37X. MAD samples were taken from every other section and will be analyzed in the coming days.

The stratigraphic correlators helped the applications developers with debugging the correlation applications and the associated reporting utilities. Stratigraphic correlation was attempted at Site U1444; however, disturbance during drilling, especially in the turbidite-rich intervals, may ultimately render this effort unfruitful.

Technical Support and HSE Activities

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

Laboratory/Computing:

- Completed the processing and sampling of cores from Site U1444.
- The Wayne Kerr device, to measure the formation factor of sediment, will be used on cores from the Indian margin.
- A procedure was developed for sending the DESCLogik output and core images to shore on a daily basis.
- The developers continued to work with the stratigraphic correlators and shore personnel to resolve problems with the stratigraphic splice.

- The developers worked with the Imaging Specialist and physical properties technician to resolve minor issues on Section Half Imaging Logger (SHIL).
- The developers worked with technicians and the marine computer specialists to correct a problem with the natural gamma ray logger (NGR).

HSE activities:

- A Fire and Boat Drill was held on 27 December.
- The eyewash stations and safety showers were tested.