

## **IODP Expedition 353: Indian Monsoon Rainfall**

### **Week 5 Report (28 December 2014–3 January 2015)**

#### **Operations**

The *JOIDES Resolution* began the week in transit to Visakhapatnam, India, for an inspection by the Indian Navy and to gain permission to core the remaining primary sites for Expedition 353. After a 235 nmi transit, the vessel was tied up at the Fertilizer Pier in Port Visakhapatnam with the first line ashore at 0720 h on 29 December. The naval inspection took place on 30 December and was completed by 1630 h. Three scientists from Indian institutions boarded the vessel at 2130 h on 30 December. A diplomatic note from the Indian Ministry of External Affairs granting clearance to operate within the Indian exclusive economic zone was received at 2145 h.

The vessel departed Visakhapatnam for primary site BB-5 (U1445) on 31 December with the last line ashore at 0306 h. After an 87 nmi transit, the ship arrived at Site U1445. The thrusters were lowered and dynamic positioning assumed control of the vessel at 1942 h.

Winds of 35 kt and heave up to 4.5 m forced operations to wait on weather until 0245 h on 1 January 2015. At that time an APC/XCB bottom-hole assembly was made and deployed to the seafloor by 1015 h. High heave conditions caused the spudding of Hole U1445A to be delayed until 1715 h.

Hole U1445A was spudded at 1900 h on 1 January. The seafloor was estimated at 2502 mbsl. Cores U1445A-1H to 24H (0–225.1 mbsf) were retrieved using the APC coring system. Temperature measurements were taken on Cores U1445A-4H, 7H, 10H, and 13H. Core orientation data was obtained using the Ice Field tool from Cores U1445A-3H to 24H. The XCB system was deployed for Cores U1445A-25X to 50X (225.1–447.4 mbsf).

#### **Science Results**

The sedimentology team has described Cores U1445A-1H to 33X. Cores U1445A-1H to 18H consist primarily of nannofossil-rich clay or clay with nannofossils. Foraminifers, biosiliceous fragments, and plant debris were commonly observed. Thin silt-to-sand sized beds (1–5 cm) occur as a minor component (several per core) and contain foraminifers, quartz, mica, and/or glauconite. An ash layer was observed in Section U1445A-2H-5. Clasts of reworked nannofossil ooze were observed in Sections U1445A-5H-5 and 8H-3. Cores U1445A-19H through 33X are composed primarily of diatom-rich clay with glauconite, biosilica-rich clay with glauconite, and silty clay with biosilica. Nannofossils and foraminifers exist in a low but persistent abundance in this interval. Gas expansion cracks were common in Cores U1445A-3H to 33X. Mousse-like and soupy textures were observed in Sections U1445A-7H-2, 19H-5, and 21H-1 that suggest the

presence of gas hydrate. Cores recovered using the XCB system (U1445A-27X to 33X) show severe biscuiting.

Biostratigraphic results suggest that sedimentation rates at Site U1445 are high. Calcareous nannofossils are continuously present in Hole U1445A core-catcher samples, with abundances varying from rare to abundant. Nannofossils are generally well preserved. Most Pleistocene bio-events have been identified, and Sample U1445A-45X-CC (408.395 m CSF-A) has a late Pliocene age of around 3.54 Ma. The sequence of nannofossil marker species suggests that sedimentation has been continuous at this site. Reworked specimens of Miocene or older age were identified in many samples, however these are generally rare and only seldom common.

Foraminifers are present in all core catcher samples studied thus far (U1445A-1H-CC to 30X-CC). Abundances drop from dominant or abundant to common or few beginning with Sample U1445A-20H-CC. Preservation ranges from good to moderate until Sample U1445A-29X-CC where it drops to poor. Planktonic to benthic foraminifer ratios range widely with increased numbers of benthic foraminifera occurring in samples where diatom blooms are identified. No reworking is evident. Planktonic foraminifer age datums consistently lead calcareous nannofossil and diatom age datums as well as paleomagnetic age estimates suggesting that established planktonic foraminifer biostratigraphy requires revision for application in the Bay of Bengal.

Diatoms are abundant to rare and well to poorly preserved in several intervals. Diatoms are common to abundant between Samples U1445A-18H-CC and 21H-CC and between U1445A-31H-CC and 40H-CC. Marker species are present and allow for the establishment of biostratigraphic zonations. Beyond the biostratigraphic zones, the diatom assemblage provides insight into paleoclimatologic and paleoceanographic conditions of the low latitude Indian Ocean. In particular, the relative abundance of certain diatom taxa (e.g. *Thalassionema nitzschioides* var. *nitzschioides*; resting spores of *Chaetoceros*) allows for the identification of high productivity and strong upwelling intervals.

The chemistry laboratory has been processing and analyzing routine samples from Hole U1445A. Methane measurements were conducted on every core and the highest level was ~12,000 ppm at ~30 mbsf, where the  $C_1/C_2$  ratio of ~15,000 indicates the methane is of contemporary biological origin. Methane concentrations are relatively constant between Cores U1445A-5H and 16H at ~550 ppm, but rise to ~2500 ppm between Cores 17H and 28X. Here the  $C_1/C_2$  ratio is ~1500 to 2000, suggesting a partially thermal origin. From Core U1445A-30X, methane drops down to ~400 ppm. Void gas samples were also taken and are predominantly methane, with small amounts of  $H_2S$  (~70 ppm). Carbonate contents are being measured; the values show large variations from 0–140 m CSF-A, ranging from 1–50%. Pore waters are still being collected but preliminary results show a large peak (38 mM) in alkalinity at ~50 m CSF-A, decreasing to ~25 from 100 m CSF-A and below. Chloride decreases with depth from 555 to 495 mM, consistent with the increasing amount of gas hydrate dissociation (salt is excluded during the formation of gas hydrates), and then stabilizes at ~500 mM below 230 m CSF-A.

Other analyses are currently underway, including pore water sulfate and other ions and nutrients (ammonium and phosphate).

We completed measurements of natural remanent magnetism (NRM) and NRM after 10 mT AF-demagnetization on APC cores for Hole U1445A. In addition, we analyzed the ChRM up to at least 30 mT for discrete samples, which were used to constrain the archive-section demagnetization level and any preliminary polarity interpretations. The Brunhes/Matuyama (0.78 Ma) boundary is found at ~104–105 m CSF-A. Two further boundaries assigned to 1.78 and 2.58 Ma are likely found at ~189 and ~277 m CSF-A, respectively. Discrete samples from XCB cores show promising results and a magnetostratigraphy is likely possible for the entire hole.

Standard shipboard physical property measurements were taken at Hole U1445A for Cores 1H to 50X. On the catwalk, a FLIR infrared camera was used to detect cold spots from any gas hydrate dissociation occurring within the core. IR anomalies (cold spots) were found in many of the cores between U1445A-20H and 30H and were sampled for pore water analysis.

The stratigraphic correlators continued helping the applications developers with debugging the correlation applications and the associated reporting utilities. Magnetic susceptibility, bulk density, natural gamma, RGB, and reflectance data from Hole U1445A were inspected to seek potential properties that could be useful for correlation with Holes U1445B and U1445C.

## **Technical Support and HSE Activities**

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

Laboratory/Computing:

- Processing and sampling cores from Hole U1445A.
- Replaced the two port, StarTech serial card in the paleomagnetism desktop computer.
- The Ice Field orientation tool suffered an angular offset during the second run on Hole U1445A.
- The rebuilt hydraulic press was redeployed in the chemistry laboratory.
- Sent DESClogik output and core images to shore daily for the creation of Visual Core Descriptions (VCDs) due to the Publications Specialist leaving the ship.
- The applications developers continued work to correct issues with the correlation software tools:
  - Worked with the stratigraphic correlators to diagnose differences in depth values between Correlator and the LIMS database.

- Worked with program developers for Correlator to provide them with information regarding the behaviors observed.
- The applications developers worked with the description technician and scientists to diagnose a problem that causes DESClogik to crash.
- The marine computer specialists were troubleshooting communication issues with the D2000 Demagnetizer.

HSE activities:

- A Fire and Boat Drill was held on 3 January.
- The eyewash stations and safety showers were tested.