IODP Expedition 355: Arabian Sea Monsoon

Week 4 Report (19–25 April 2015)

Operations

Hole U1456C (IND-03C)

We completed the pipe trip out of Hole U1456C, racked the drill collars back in the derrick, and laid out the seal bore and nonmagnetic collars to the forward pipe rack. The bit cleared the rig floor at 0220 h (UTC + 5.5 h) on 19 April 2015, officially ending Hole U1456C and beginning Hole U1456D.

Hole U1456D (IND-03C)

The vessel was offset 15 m south of the original site coordinates and the seafloor tag depth of 3648.0 m below rig floor (mbrf) used as the official seafloor depth for the hole. After laying out the upper guide horn, preparations began for installing the reentry cone and 10¾″ casing string. The 16″ casing hanger assembly was made up and racked back in the derrick. We then assembled and tested the 458.83 m long drilling assembly, which consisted of the 9⅞″ tricone drilling bit, 8″ mud motor, and underreamer with arms set to 12¾″. The pre-assembled standard reentry cone was positioned over the moonpool doors. We began to run casing at 1200 h on 19 April. The casing string, made-up of a Texas pattern casing shoe, shoe joint, 33 joints of 10¾″ casing, a 16″ × 10¾″ casing crossover (swage), 16″ casing pup joint, and a 16″ casing hanger, totaled 455.11 m in length. This assembly was lowered into the reentry cone using the casing running tool. At 2045 h on 19 April, the driller lowered the drilling assembly into the reentry cone and latch-in was completed at 0035 h on 20 April. At 0100 h we began tripping the assembly toward the seafloor. During the pipe trip, the subsea camera was deployed and the drill pipe filled with seawater every 15 stands.

After picking up the top drive, Hole U1456D was spudded at 1035 h on 20 April. It required a total of 20.75 h to drill-in the 455 m of casing. The reentry cone base landed on the seafloor at 0710 h on 21 April, positioning the casing shoe at a depth of 455.1 m below seafloor (mbsf). The driller rotated the drill string 3½ turns to the right to release the casing running tool; however, the drilling assembly was unable to pull free of the reentry cone and casing. We attempted to free the assembly over the next 4.25 h by offsetting the ship in a grid pattern away from the hole location. After this did not free the assembly, it became clear that the running tool was released, but the underreamer arms had not fully retracted. At 1135 h on 21 April, the drilling assembly was pulled free with 15,000 lb of overpull. While pulling the drill string, the underreamer continued to drag intermittently inside the casing, predominantly when passing through casing couplings. The top drive was set back, the subsea camera retrieved to the ship, and the bit pulled clear of the seafloor at 1540 h. After tripping the assembly back to the ship, the running tool was de-torqued,

the drill collars racked back in the derrick, the mud motor and underreamer assemblies flushed with fresh water, and at 0140 h on 22 April, the bit cleared the rotary table. From start to finish, using a mud motor and underreamer assembly, we required only a total of 3 d to make-up and install a standard reentry cone with 455 m of 10¾″ casing in 3648 m water depth using the drill-in casing approach.

With the reentry cone and casing installed, the drill crew requested time to investigate a noise they had heard on multiple occasions that emanated from the drilling package. During operations they were unable to determine whether the source of the noise was the top drive itself or the swivel assembly. A total of 9 h of "downtime" were taken to separate the swivel from the top drive and thoroughly investigate the issue. Ultimately the gear was all reassembled without identifying the original source of the noise. Once everything was reassembled, the noise was no longer heard.

We then made up the rotary core barrel (RCB) bottom-hole assembly and, after slipping and cutting the drilling line, began tripping toward the seafloor. The subsea camera was deployed during the pipe trip; however, after there was a problem with the video feed, the camera was brought back aboard, repaired, and redeployed. At 0245 h on 23 April we reentered Hole U1456D after maneuvering the ship for only 20 min. The drill string was lowered into the casing string to a depth of 416.0 mbsf (39.1 m above the casing shoe) when soft fill was tagged. We picked up the top drive, deployed a wash barrel, and began to slowly circulate. The fill was cleared by 0800 h on 23 April. A 40-barrel sea gel mud sweep was circulated out and the wash barrel recovered. At 1000 h on 23 April, a core barrel was deployed and continuous RCB coring using nonmagnetic core barrels initiated. RCB coring continued with 30-barrel sea gel mud sweeps pumped every third core. Although we encountered no fill on bottom between cores, rapid penetration rates, low recovery, and evidence of sand in the recovered core material indicated there was still some sand in the formation. We therefore initiated preventative measures in order to preserve the integrity of the hole as much as possible. As of midnight on 25 April, 32 RCB cores had been taken in Hole U1456D with a recovery of 46%.

Science Results

The sedimentologists described Cores U1456D-2R through 30R (458.8–739.69 mbsf) using a combination of visual core description, microscopic investigation of smear slides, core imaging, spectral color scanning, and magnetic susceptibility. The dominant lithology of Cores 2R through 6R (458.8–497.91 mbsf) is dark greenish gray silty sand and clay, with rare bioturbation and pyrite nodules. Normally graded silty sand typically overlies parallel laminated clay with an erosive contact. Drilling disturbance is often severe and fractures are common. The dominant lithologies change in Cores 7R through 29R (507.3–726.6 mbsf) to dark gray nannofossil-rich claystone, dark gray claystone, and light gray nannofossil chalk with some pyrite nodules and dark gray silty sand and sandstone. Bioturbation is generally light to moderate, and the cores are

affected by slight to moderate, but occasionally severe, drilling disturbance. Another downhole change in lithology occurs in Core 30R, with a shift from sandstone to claystone that is marked by a sharp color shift from light to dark greenish gray. Smear slide analysis supports the lithologies identified through macroscopic core description and verifies the occurrence of nannofossils throughout the recovered interval, especially in Cores 8R through 23R. Detrital minerals include abundant quartz, feldspar, and micas, and rare to common heavy minerals.

The biostratigraphers examined core catcher samples from Cores U1456D-2R through 31R (458.8–759.8 mbsf) for calcareous nannofossil, planktonic foraminifer, radiolarian, and diatom biostratigraphy. Calcareous nannofossils are generally common and are well preserved, although their abundance decreases in coarser grained intervals. Planktonic foraminifers are generally common in Cores 2R through 17R; however, below Core 17R, planktonic foraminifers are mainly absent in the core catcher samples examined. When present, planktonic foraminifers are moderately to well preserved. Radiolaria are low in abundance and poorly preserved. Diatoms are absent in all samples examined. The 458.8–759.8 mbsf interval is assigned a late Miocene to Pliocene age, based primarily on nannofossil biostratigraphy. Two radiolarian species also support this interpretation. Significant reworking of Cretaceous and Paleogene forms hampers biostratigraphic interpretation, particularly within the calcareous nannofossil assemblages.

After completion of downhole logging in Hole U1456C, the stratigraphic correlators compared whole-round natural gamma radiation (NGR) data from Holes U1456A and U1456C with the processed spectral gamma ray downhole log. Excellent correlation exists between the base of pipe (at 81 m drilling depth below seafloor [DSF]) and the base of the spliced section at 136 m wireline matched depth below seafloor (WMSF). Between 136 and ~210 m WMSF, it was possible to make a fair to good correlation between the Whole-Round Multisensor Logger (WRMSL) data and the logs. Correlation was difficult in the interval between ~210–380 m WMSF, where we only have core data from Hole U1456A because we drilled through this interval without coring in Hole U1456C. Correlation was again possible below 380 m WMSF, where the lithology changes from coarser grained material to clay and claystone.

The geochemists collected samples for shipboard analysis of headspace gas, interstitial water chemistry, and bulk sediment geochemistry analyses in Hole U1456D. Headspace gas was measured in Cores U1456D-2R through 32R. Methane values are low (<2000 ppmv), and C_2 and C_3 gas values are below the detection limit. Sediment from interstitial water (IW) squeeze cakes and moisture and density (MAD) samples from Holes U1456C and U1456D are currently being prepared for carbonate and CHNS analysis. Whole rounds (10 cm in length) for interstitial water extraction were collected from Hole U1456D when the recovery was greater than 40%. Below Core 18R (614.0 mbsf), we increased the length of the IW whole round to 15 cm to extract an adequate volume of water. We measured the salinity, pH, and alkalinity of the interstitial water samples. The pH is slightly alkaline and salinity is near 32. Alkalinity declines with depth.

No samples for microbiology have been taken so far in Hole U1456D; however, the microbiologist continues to examine samples from Holes U1456A and U1456B. Samples from approximately 11.5 mbsf in Hole U1456B contain fungal mycelium, which will be used to explore the metabolic activity of subsurface fungi.

Paleomagnetic and magnetic susceptibility anisotropy analyses have been completed for Hole U1456C. This work is ongoing in Hole U1456D. We have a preliminary magnetic polarity stratigraphy for Site U1456 that includes the Brunhes Chron (C1n) and the Jaramillo subchron (C1r.1n). The Olduvai appears to be missing, but the Gauss (C2An) is well expressed. We have resumed analysis of archive-half sections in Hole U1456D because of the more favorable lithology. These data agree well with discrete sample results. Interestingly, the drill string overprint that was prevalent in Holes U1456A and U1456C has mostly disappeared in Hole U1456D.

Physical properties measurements were completed for U1456C and are ongoing for Hole U1456D. Measurement of compressional wave (*P*-wave) velocity was discontinued on whole-round cores from Hole U1456D because of the gap between the core liner and sediment when coring with the RCB system. We applied a correction factor of 1.138 to the density measurements from the WRMSL due to the reduced diameter of the cores (66 mm/58 mm = 1.138). Thermal conductivity measurements were conducted on split sections when possible, with values varying between 1 and 2 W/(m·K). No downhole trend is apparent in those data. Porosity is generally low (~40%) in Hole U1456D, similar to the deeper section of Hole U1456A. Discrete *P*-wave measurements were made on the working half of split cores on the Section Half Measurement Gantry (SHMG). Higher *P*-wave velocities occur in the sandstones (>2000 m/s) compared to claystones. The *P*-wave velocities measured on the SHMG in both Holes U1456A and U1456C are offset to lower values compared to sonic velocities from downhole logging. Magnetic susceptibility shows variations that correlate with the alternation between coarser graded beds, interpreted as turbidites, and nannofossil-rich hemipelagic sediment. Variations in NGR and density also correlate well with lithologic changes.

Education and Outreach

We conducted five ship-to-shore video events during the week. We held our first connections with India, introducing the expedition objectives and shipboard laboratories to ~200 high school students in Bhagwanpur (Varanasi) and ~250 high school students in Assandh (Haryana). We also held an event with high school science teachers in France who are interested in preparing curriculum material about scientific ocean drilling for their classrooms. Finally, we connected with two groups of ~50 students at a magnet school in Los Angeles, California (USA).

Technical Support and HSE Activities

The following technical support activities took place during Week 3.

Laboratory

- Conducted Protected Species Watch training for all involved staff.
- Continued processing cores from Hole U1456D.
- Troubleshot the Special Task Multisensor Logger (STMSL) for data dropping event. Replaced Startc communication card with NI 2-port card. No addition dropped data noted thus far; however, monitoring continues. And old Startec communication card was found, is now replaced with NI 2-port card.
- RGB data on Section Half Imaging Logger (SHIL) are offset by 4–5 cm. This offset has now been traced backed to Expedition 353. Investigation into what caused it is ongoing.
- The paleomagnetists reported that the new orientation tool, Icefield, yielded irregular data in Hole U1456C when compared to discrete samples taken from the same cores. We conducted tests to compare the two Icefield instruments used during coring; however, both yielded reliable data. Investigation continues into what is causing the problem.
- The D-Tech is now running okay under reduced amperage and given ample time to rest between runs.
- Rigwatch is now fully functional.
- Air conditioning unit #2 in the core reefer is leaking refrigerant. Ship engineers are looking more closely to determine what needs to be replaced.
- Chemistry Laboratory continues to troubleshoot the Source Rock Analyzer (SRA) and is communicating with the vendor.

HSE Activities

- Tested safety shower and eye wash stations.
- An abandon ship drill was held on 22 April.