

IODP Expedition 361: Southern African Climates

Week 6 Report (29 February–6 March 2016)

Operations

After completing operations at Hole U1475F, the drill string was pulled from the hole with the bit clearing the seafloor at 0235 h on 29 February. The positioning beacon was recovered at 0451 h and the rig was secured for transit at 0930 h, ending Site U1475.

The vessel initially transited toward proposed Site ZAM-05B. However, after not receiving clearance to operate within the Mozambique exclusive economic zone (EEZ) at the end of the day on 2 March, the decision was made at 1730 h to halt the transit to ZAM-05B and abandon the Mozambique sites. Rather, an alternative operations plan consisting of proposed Site CAPE-01C and alternate Site SubSAT-01D (redrill of ODP Site 1089) would be carried out.

Site SubSAT-01D is located in ~4620 m of water, which requires more drill pipe than was already assembled in stands in the pipe racker. The decision was made to take advantage of the good weather conditions and remove 153 joints of drill pipe from the riser hold and make up 51 stands of pipe. This operation was completed the morning of 3 March and the vessel started the transit to Site CAPE-01C at 0936 h.

At 1313 h on 3 March, we received news that the clearance documents had been signed by Mozambique officials and the diplomatic note would be sent to the vessel and JRSO when it was received by the embassy. Once the diplomatic note is received, the vessel will be cleared to begin science operations in the Mozambique EEZ. The decision was made to transit to the northernmost site (proposed site MZC-01C) so that coring operations could be attempted at all of the primary proposed sites. The vessel changed course and was underway to Site MZC-01C at 1318 h on 3 March and is estimated to arrive on site at 0100 h on 8 March. At the end of this week, the JRSO had not yet received the diplomatic note providing permission to operate in Mozambique waters.

Science Results

Cores from Holes U1475D, U1475E, and U1475F were described. Two major lithological units were identified. Unit I (0–5 m CSF-A) is composed of pale brown, light greenish or olive gray, and white gray nannofossil-rich foraminifera ooze. Unit II (5–277 m CSF-A) is composed of light greenish or pale gray to white gray nannofossil ooze. Alternations between foraminifera-bearing or foraminifera-rich nannofossil ooze and nannofossil ooze with fine sand (foraminifera, quartz, and occasionally diatoms) are observed. Sediments in both units include dark gray molting that we interpret as bioturbation. Thin darker bands commonly surround burrows and

macroscopic pyritized burrows are also common. Dropstones (displaying coarse sand to granule grain sizes) were observed in three different cores, which we interpret to represent ice rafted debris. Sediments in both units also include green layers that predominantly consist of pyrite and glauconite, representing diagenetic alteration.

Whole-Round Multisensor Loggers (WRMSL) were used to measure density, *P*-wave velocity, magnetic susceptibility, and natural gamma radiation (NGR) at 2.5 cm resolution in Holes U1475D and U1475F. Cyclic changes in NGR are observed throughout the section. These variations decrease in amplitude below 100 m CSF-A. At 108 m CSF-A density and *P*-wave velocity exhibit stepwise increases. Light reflectance and RGB values show characteristic variations in sediment color that are useful for stratigraphic correlation and likely represent orbital time scale variations. Prominent changes in *P*-wave velocity at Site U1475 can be clearly linked to seismic reflectors present in the site survey profiles.

Analysis of calcareous nannofossils, planktonic foraminifers, and diatoms from core catchers and core samples of Holes U1475B, U1475C, and U1475E reveals that the ~277 m CSF-A section recovered at Site U1475 spans the latest Miocene (~6.91 Ma) to Recent. Calcareous nannofossils show moderate to good preservation in all the sequences with the consistent presence of well-preserved Eocene to middle Miocene species. The nannofossil chronostratigraphy of Site U1475 spans from Biozones NN21 and CN15 to Biozone NN11 and the CN9d/CN9c boundary. The calcareous nannofossil assemblages are characterized by species typical of tropical to subtropical and temperate environments. Planktonic foraminifer biota in Site U1475 is moderately to well-preserved and is mostly composed of subtropical convergence species mixed with polar species. Diatoms show poor to moderate preservation and have a mixed assemblage of subtropical and Southern Ocean taxa. Diatom markers from both environmental settings are used to define datums and the diatom chronostratigraphy spans from Zone NTD 17 to NTD 12.

Holes U1475D, U1475E, and U1475F were run in the superconducting rock magnetometer (SRM). The measured natural remanent magnetization (NRM) intensities after 25 mT demagnetization are on the order of 10^{-5} to 10^{-4} A/m. Inclination data obtained from stepwise NRM demagnetization (15, 25, 40, 60, and 80 mT) of discrete samples from Hole U1475D are consistent with the high-resolution SRM records. The boundaries of the Brunhes, Matuyama, Jaramillo, Olduvai, Gauss, Keana, and Mammoth paleomagnetic chrons and subchrons are identified and constrain the chronology of the sediments, and are in general agreement with the biostratigraphic data.

Interstitial water chemistry shows a moderate degree of early sediment diagenesis at Site U1475. The nitrate profile indicates suboxic conditions in the upper 0.25 m CSF-A. Sulfate concentration decreases throughout the sediment column and is never completely consumed. Methane concentrations remain at background levels. Carbonate is the dominant sedimentary component, ranging from 75–85 wt% with terrigenous material dominating the remaining fraction. Organic carbon contents range from 0.3% to 0.6%, decreasing slightly downhole.

Together, carbonate, organic carbon, and elemental biogenic indicator profiles suggest that export production increased into the Late Pleistocene.

Select sequences from Holes U1475B, U1475C, U1475E, and U1475F were spliced together to create the most complete and representative section possible using RGB blue, b* color reflectance, and NGR data. Sedimentological logs were consulted meticulously in the process of constructing the splice to avoid inclusion of any obviously disturbed sections or sections with completely unique features (relative to the other adjacent holes). The splice constitutes a continuous sequence with a total length of ~292 m CCSF. However, confidence in the splice is low surrounding certain problematic intervals.

Sedimentation rates are based on the shipboard biostratigraphy and magnetostratigraphy. Sedimentation rates in the Pleistocene and latest Pliocene are nearly linear at 2.8 cm/k.y. between 0 and ~3.9 Ma. A notable increase in sedimentation rates to 9.6 cm/k.y. occurs between ~3.9 Ma and 5.3 Ma. Finally, below 5.3 Ma, sedimentation rates decrease to 2.5 cm/k.y. Initial shipboard results indicate a complete, expanded Pliocene section was recovered that is unique to the region.

Education and Outreach

Ship to Shore Events

- Eleven live broadcasts to: eight classrooms in the USA, one aquarium in the USA, one classroom in Spain, and one classroom in Malta; 331 students were reached (147 elementary, 137 high school, 47 university, plus an unknown number of adults).

Social Media

- *JOIDES Resolution* blog (<http://joidesresolution.org/>): six posts, 935 reads so far.
- Facebook (<https://www.facebook.com/joidesresolution>): six posts, 4,750 people reached.
- Twitter (<https://twitter.com/TheJR>): six tweets, ~30–35 retweets, 2,700 followers, 3,370 impressions.
- Instagram (http://instagram.com/joides_resolution): six posts, hundreds of likes.

Media

- Working on Expedition videos with paleontologist Richard Norris.

Technical Support and HSE Activities

Technical Activities

- Towed Magnetometer: Two stabilizing fins that had been damaged while the magnetometer was being towed were replaced. It appears that they struck an object in the water.
- Cryomagnetometer: A motion control test of the new M-Drive motor was successfully completed during the transit.

Computing Activities

- DESClogik: Version 14.1 was installed on all of the workstations in the Core Laboratory.
- SCORS Downloader: Updates to the downloader were completed so that drilling-disturbance information can be downloaded.

HSE Activities

- The weekly lifeboat and fire drill was held on 6 March.