IODP Expedition 378: South Pacific Paleogene Climate

Week 4 Report (26 January–1 February 2020)

Operations

This week we (1) cored one hole with the advanced piston corer/extended core barrel (APC/XCB) system; (2) transited to Timaru, New Zealand, for a transfer of fuel filters; and (3) began the transit to Papeete, Tahiti, French Polynesia.

Hole U1553E

XCB coring continued in Hole U1553E from 188.8 mbsf to a total depth of 237.6 mbsf with Core U1553E-27X. The drill string was recovered to the rig floor with the bit clearing the seafloor at 0830 h and the rig floor at 1130 h on 26 January 2020. The rig floor was secured for transit at 1215 h and the vessel switched from dynamic positioning to cruising mode at 1242 h, ending Hole U1553E and Site U1553.

A total of 27 cores were taken over a 237.6 m interval with 88.3% recovery. The total depth for Hole U1553E was 237.6 mbsf and total time on Hole U1553E was 33.25 h (1.4 d).

Transit to Timaru, New Zealand

The thrusters were raised and secured and the vessel was underway to the Timaru Pilot Station at 1300 h on 26 January. The vessel traveled the first day at reduced speed due to sea conditions. At 1306 h on 28 January, the vessel arrived at the Timaru Pilot Station, completing the 531 nmi transit in 48.3 h at an average speed of 11.0 kt. The vessel met the seagoing Tug *Hinewai* and completed the transfer of fuel filters by 1318 h.

Transit to Papeete, Tahiti

The vessel began the sea voyage to Papeete, Tahiti, at 1318 h on 28 January and continued the transit through midnight on 1 February. At midnight on 31 January, the ship's clocks were retarded 24 h as the ship crossed the International Date Line. The clocks were then advanced 1 h on 1 February to adjust the clocks to UTC – 10 h and place the vessel on the same time as Papeete. By midnight on 1 February, the vessel had traveled 1501.0 nmi in 129.7 h with an average speed of 11.6 kt (this does not include the transit to Timaru).

Science Results

Site U1553

Science activities during the week included the continued processing and measurement of Site U1553 core sections and shipboard samples, analysis of core data from Site U1553, and working on the Site U1553 chapter for the expedition *Proceedings* volume. The science party gave presentations on the results from Site U1553, began collaborative meetings to discuss postcruise research objectives, and the Expedition Project Manager (EPM) gave a presentation on the scientific and logistical tasks to accomplish during the last ~10 d of the expedition.

Lithostratigraphy

Descriptions of the sediments from Holes U1553C, U1553D, and U1553E continued during the week. It was discovered that the drying of siliciclastic sediment cores following splitting with the saw resulted in significant changes in color and visibility of sedimentary structures. Therefore, cores from these holes that were originally scanned immediately after splitting (following standard procedures) were allowed to dry on the surface and were rescanned. The siliciclastic unit of Holes U1553C and U1553D is characterized by high and variable bioturbation and the presence of glauconite, micas, and quartz grains, and abundant microcrystalline pyrite. Thin section analysis of this unit confirms the mineral assemblage and also reveals that sand-sized particles are usually dolomite crystals. This unit also includes fine lenses of upper bathyal foraminifers, variable preservation of siliceous microfossils, and preservation of organic matter. Sediments from Hole U1553E follow the same lithology as Holes U1553A and U1553B, where Oligocene nannofossil ooze with varying amounts of foraminifers transitions into nannofossil chalk. A packstone layer that was identified in Holes U1553A and U1553B is also present in Hole U1553E.

Biostratigraphy

The study of microfossil assemblages of Hole U1553E was completed. Calcareous nannofossil, foraminifer, and radiolarian assemblages are comparable to those recovered from Holes U1553A and U1553B and are of Pleistocene to middle-Late Eocene age with an unconformity between Pleistocene and Oligocene sediments. The biostratigraphy team prepared and revised their Methods and Site U1553 report text, figures, and tables. Along with the stratigraphic correlator and paleomagnetists, the biostratigraphers have synthesized microfossil and paleomagnetic datums from all holes and assisted in the creation of an age-depth model for Site U1553.

Paleomagnetism

All discrete samples from Site U1553 have been measured for anisotropy of magnetic susceptibility (AMS) and natural remanent magnetization (NRM) using the KLY-4 Kappabridge and the spinner magnetometer (AGICO JR-6A), respectively. The discrete samples show an initial increase in intensity at 3–6 mT. We suspect the initial intensity increase is caused by

removal of a drilling overprint that is imparted as the core is raised through the drill string over a long distance (~1222 m water depth).

The ~120 m preliminary magnetostratigraphy of Hole U1553A is composed of six pairs of normal and reversed polarity patterns (n1/r1 to n6/r6 downhole). As Hole U1553A is dominated by normal polarity, we correlate it to the middle–late Oligocene, which is consistent with the shipboard micropaleontology. However, whether n2 recovers the complete Chron C9n of the 2012 geomagnetic polarity timescale (GPTS) requires additional age constraints.

Recovery gaps in Holes U1553C and U1553D make it challenging to build a polarity pattern and to correlate it to the standard GPTS. However, two reversals were observed in Hole U1553C, one at ~290 mbsf between Cores U1553C-8R and 9R, and the other at ~442.8 mbsf in Core U1553C-29R. The deepest reversal observed in Hole U1553C may also be present at ~440 mbsf in Hole U1553D. Given that these successions are of Paleocene to Eocene age, we attempted to correlate the first reversal to the base of Chron C18n.2n, and the second (deepest) to the base of Chron C24n.3n, which agrees very well with the shipboard biostratigraphy.

Geochemistry

Redox zones, organic matter, degradation zones, and potential soil-rock interactions were assessed within the sediments of Site U1553. Source rock analysis on 13 discrete bulk sediment samples from the deepest cores of Hole U1553C and U1553D revealed low maturity of the source rock. Replicates were measured whenever possible. Discussion and interpretation of the principal geochemical results integrated primary data from other laboratories such as lithostratigraphy and physical properties.

Physical Properties and Downhole Measurements

Physical properties data was collected for Hole U1553E. Measurements in Hole U1553E are consistent with Holes U1553A and U1553B, contributing to the stratigraphic and lithological framework for the site. Downhole density and the deconvolution of natural gamma ray (NGR) data to estimate K, U, and Th concentrations in the sediments were reassessed with a correction factor for Holes U1553C and U1553D. In addition to finalizing the datasets, we wrote the physical properties report.

Stratigraphic Correlation

The stratigraphic correlation team finalized a provisional set of ties (offsets) between Holes U1335A, U1553B, and U1553C. A set of ties were also developed for Cores U1553C-28R to 32R and U1553D-4R to 7R, spanning the possible Paleocene/Eocene Thermal Maximum (PETM) and the early Paleocene. No splices were attempted due to lack of resolution in the ties/offsets. Splicing will be completed following onshore X-ray fluorescence (XRF) scanning.

Underway Data Collection

While in transit through international waters, surface water samples were collected twice per day for shipboard measurements of alkalinity, pH, nutrients, and major/minor elements and shore-based postcruise studies. The Marine Magnetics Towfish Magnetometer was also deployed during transit through international waters.

Outreach

The following outreach activities took place during Week 4.

Social Media

Platform	Number of posts	Analytics	Notes
Facebook	10 posts	8.5k reach, 30 new followers; 2.86k engagements	1 Facebook Live event, 12 shares, 5.7k reach; 813 engagements
Instagram	31 posts	20.5k reach, 2.3k reach; +14 followers net	
Twitter	23 tweets	18 new followers; 435 engagements	

Ship-to-Shore Broadcasts

Group	Number of people	Notes
Aggieland Country School, Texas	25	
Facebook live	20	Uploaded video, 12 shares
COSI, Ohio	145	Videoconference
COSI, Ohio	370	Videoconference
IES Pintor Luis Saez, Spain	78	In Spanish with Blanca
Taylor Middle School, Ohio	33	
Hatea-a-Rangi, East Cape, NZ	27	
GNS, Wellington, NZ	28	
South Westland Area School, Harihari, NZ	18	
Japanese High School	26	In Japanese, with Erika
Te Kura, Invercargill/Dunedin	8	Science Journeys project
Fun Science, Dunedin	12	
Wellington School, Ohio	205	
North Harford MS, Maryland	~60	
University of Athens, Greece	80	With Eleni, in Greek

Website/Blogs

- A Chinese article entitled "Sailing Notes 3: Hey! What's your age Big Bro C? IODP378" was posted on IODP-China official website and Deep-sea Exploration WeChat account. http://www.iodp-china.org/show.aspx?info_lb=3&flag=3&info_id=669

Other

- Podcast promo on SoundCloud, sorting RSS issues with iTunes before posting episodes.
- Two blog posts sent to Otago Museum blog.
- Content sent to ANZIC-IODP for newsletter: https://us17.campaign-archive.com/?u=9cf3109dfd45d5d26c57f2add&id=9e7db67a99
- One report sent to IODP-China and Shanghai Natural History Museum.
- Published one original blog post and three from Debbie Thomas on *JOIDES Resolution* website (https://joidesresolution.org).

Technical Support and HSE Activities

The following technical support activities took place during Week 4.

Laboratory Activities

- Processed remaining cores and samples from Hole U1553E.
- Cleaned the laboratories.
- The capacitor on the Bead Maker failed while the instrument was used during transit. The capacitor was replaced and the Siem Offshore electricians enabled the Bead Maker to be run on regulated power. A new protocol was also established to keep the Bead Maker powered on for at least 30 min after the last bead is made to allow the internal fans to cool down the electronics before shutting it down.
- Technical staff assisted scientists with surface seawater collection in international waters.
- Deployed the towed magnetometer in international waters.
- Changes to the Kappabridge software were made and testing is in progress.

Application Support Activities

- Worked with technicians and Marine Computer Specialists on various laboratory issues including MUT uploader, X-ray diffraction (XRD) data upload issues, scanning electron microscope (SEM) image upload training, the Chem Work List and uploading of salinity data, and DESClogik depth issues.
- Modified and deployed MUT so that it can upload portable X-ray fluorescence spectrometer (pXRF) data.

- Finished LIMS2Excel upgrade, and deployed LIMS2Excel to Publications Office.

IT Support Activities

- Started rebuilding pXRF laptop.
- Assisted EPM and Co-Chief Scientists with content recovery in a Microsoft Word document.
- The new Thin Section Report Writer program built to work with the new launcher doesn't work correctly. We have reverted to the old Thin Section Report Writer that requires Java.

HSE Activities

- Conducted abandon ship drill.
- Safety shower and eye wash stations were tested.