

IODP Expedition 385: Guaymas Basin Tectonics and Biosphere

Week 2 Report (22–28 September 2019)

The second week of International Ocean Discovery Program (IODP) Expedition 385, Guaymas Basin Tectonics and Biosphere, comprised the transit to Site U1545 (proposed Site GUAYM-01B) in the Gulf of California and APC/HLAPC/XCB coring to 372 m in Hole U1545A. All times in this report are in ship local time (UTC – 7 h).

Operations

This week began while we were securing the ship for transit to the Gulf of California. The pilot boarded the vessel at 0642 h on 22 September 2019. The *JOIDES Resolution* departed the B-Street Pier Terminal in San Diego at 0742 h, starting the 1152 nmi sea voyage to Site U1545 (proposed Site GUAYM-01B). The passage began with a transit to Ensenada, Mexico, to clear customs and pick up the final member of the science party. During the transit, the Captain held the first weekly fire and life boat safety drill. The vessel arrived in Ensenada at 1442 h on 22 September and anchored at 1515 h, completing the 81 nmi transit in 7 h at an average speed of 11.6 kt. The port agent and final member of the science party boarded the ship at 1515 h, and all clearance formalities were completed by 1555 h. The anchor was secured at 1632 h, and we resumed our sea voyage to Site U1545 at 1636 h.

We arrived at Site U1545 at 1342 h on 26 September 2019, completing the entire 1152 nmi transit in 92.4 h at an average speed of 12.5 kt. All thrusters were lowered and the vessel was switched to dynamic positioning mode. Rig floor operations commenced at 1345 h. The advanced piston corer/extended core barrel (APC/XCB) bottom-hole assembly was made up with an 11.44 inch (29.05 cm) C-3 drill bit. After the drill string was lowered to 1558.1 m below sea level (mbsl), we pumped a “pig” (pipe cleaning device) through the drill string to remove some of the rust. By 2300 h, the drill bit was lowered to 1588.1 mbsl. We then installed the sinker bars and the Icefield core orientation tool, picked up the top drive, and positioned the bit to take the first core. Hole U1545A was spudded at 2322 h on 26 September. Mudline Core U1545A-1H arrived on deck at 2335 h, recovering 4.4 m. This determined a seafloor depth of 1593.5 mbsl.

On 27 September, APC coring continued through Core 16H at a depth of 138.5 meters below seafloor (mbsf). After encountering hard layers, we recorded partial strokes and 50 klb (222.4 kN) overpull force was needed to retrieve Cores 14H–16H. To improve core quality, we switched to the half-length APC (HLAPC) tool for Cores 17F to 31F (138.5 to 202.9 mbsf), where conditions indicated that the APC tool might be viable again. Upon switching back to APC and recovering Core 32H, we encountered strong overpull of 100 klb (444.8 kN) and we

had to drill over the core barrel in order to retrieve it. We thus made the decision to resume HLAPC coring.

On 28 September, coring alternated between the HLAPC and XCB systems. The HLAPC was deployed from Core 33F at a depth of 217.1 mbsf to Core 50F at a depth of 284.6 mbsf. The XCB coring tool was used for Cores 40X and 49X to break through hard carbonate layers after recording partial strokes and damaged HLAPC cutting shoes. Following Core 50F, we decided to use XCB coring continuously due to the infrequent occurrence of hard carbonate interbeds. Hole U1545A was deepened to 372.1 mbsf by midnight.

From 26 to 28 September, Cores 1H to 59X penetrated from the seafloor to 372.1 mbsf and recovered 312.6 m (84%). Nonmagnetic core barrels were used on all APC and HLAPC cores and orientation measurements were taken on all full-length APC cores using the Icefield orientation tool except Core 32H. Formation temperature measurements were made with the APC temperature tool (APCT-3) on Cores 4H, 7H, 10H, 13H, 18H, 24F, 30F, 36F, 43F, and 47F.

Science Results

Scientists spent the first part of the week finalizing laboratory preparations and drafting their methods. All laboratory teams received training on core sampling by the Curatorial Specialist. The science party started moving to shifts at noon on 23 September. Upon arrival on site on 26 September, the Co-Chief Scientists gave a presentation on the science objectives of northwestern Guaymas Basin Sites U1545 (proposed Site GUAYM-01B) and U1546 (proposed Site GUAYM-02B) and what we anticipate to encounter. IODP JRSO technical staff then introduced the Chemistry and Microbiology Laboratory groups to the capabilities of the Kuster Flow Through Sampler (FTS) tool that is going to be deployed to recover borehole fluids. The science party described and analyzed the first cores recovered from Hole U1545A.

Core Description

During the transit to the first site, the core description team continued familiarizing itself with Core Laboratory instruments, the DESClogik software, and drafting the core description methods. Training was included on examining legacy smear slides with the petrographic microscope. The team also agreed on the methodology that will be used based on previous literature and specifically the results from DSDP Leg 64. A key component of the methods development was the choice of the lithologic classification that will be used during the expedition and establishing the templates for DESClogik. A first draft of the Methods chapter was completed.

Later in the week, the team started to describe cores from Hole U1545A using a combination of macroscopic and microscopic (smear slide) observations. By the end of the week, Cores U1545A-1H to 31F had been described. These cores span three different lithologies. Cores 1H to

8H are mainly composed of olive-gray laminated diatom ooze mixed with various proportions of clay and subordinate silt-sized nonbiogenic particles, nannofossils, silicoflagellates, and foraminifers. Evidence of soft sediment deformation (folding and tilting) was observed in Core 3H and across Cores 11H and 12H. Evidence of core deformation due to gas expansion upon core recovery was recorded starting at Core 8H. This core also showed the first occurrence of lighter colored bands that correspond to the presence of micrometer-sized authigenic carbonate particles. In Cores 9H through 26F, carbonate layers and nodules are common. These cores mainly consist of olive-gray diatom ooze with alternating intervals displaying laminated and homogenous textures. Starting with Core 27F, micrometer-sized authigenic carbonates are a main component of the sediment and the lithology ranges between light olive (more carbonate) to olive gray (more diatoms) micrite-rich diatom clay.

Biostratigraphy

The micropaleontologists continued familiarizing themselves with the core flow, laboratory preparations, and the polarization and scanning electron microscopes. The methods were drafted and both shifts agreed on the diatom and calcareous nannofossil biomarkers to be used. Once coring began, the biostratigraphers attempted to assign ages through Core 55X at 333.2 mbsf. A total of 28 samples were analyzed for biostratigraphic ages in Hole U1545A. Calcareous nannofossils occurred in most samples examined with various abundances. The only detected age-diagnostic calcareous nannofossil species yielded an age of 0.29 Ma in Core 15H at 134.8 mbsf. Though marine diatoms were abundant in most cores, no age-diagnostic species were found. This indicates a sediment age of less than 0.62 Ma. A few silicoflagellates occurred that are common in the Upper Pleistocene.

Paleomagnetism

Upon finishing instrument and methodology preparation, the paleomagnetism team received the first cores from Hole U1545A. Both archive-half sections and working-half discrete samples were demagnetized and measured from Cores 1H to 32H, using the superconducting rock magnetometer (SRM) and JR-6A spinner magnetometer, respectively. The average measured SRM inclination, following demagnetization at 20 mT, clusters around 45°, which is close to the inclination expected at the latitude of Site U1545 (the geocentric axial dipole inclination is ~53°). This assigns the cores to the normal Brunhes Chron (C1n; <0.78 Ma), in agreement with the biostratigraphic ages. A detailed analysis of the SRM results is underway to identify possible magnetic excursions. Detailed alternating field demagnetization of discrete samples (up to 60 mT) supports the archive-half data. Also, anisotropy of magnetic susceptibility (AMS) was measured on all samples.

Inorganic Geochemistry

The inorganic geochemistry team familiarized itself with the laboratory instruments and analyses, finalized the Methods draft, prepared all vials for interstitial water (IW) storage, and

started IW sampling in Hole U1545A. In total, we collected 20 IW samples for salinity, alkalinity, pH, and chlorinity analyses. Major cations and anions are being processed by ion chromatography. The method for $\Sigma\text{H}_2\text{S}$ analyses by colorimetry was revised. Salinity and chlorinity show a constant value from the seafloor to 200 mbsf (salinity: 34–36 g/kg, chlorinity: 554–570 mM). Alkalinity increased from the seafloor to 53 mbsf followed by a decreasing trend. The maximum alkalinity value is 60 mM at ~55 mbsf. We distributed IW liquid samples, squeeze cakes, and trimmed whole-round core samples for personal postcruise research plans. A plan for the sampling and splitting of IW liquids and squeeze cakes from Hole U1545B is being discussed based on the preliminary results from Hole U1545A.

Organic Geochemistry

The organic geochemists familiarized themselves with the laboratory instruments, sampling supplies, and protocols. We composed a draft of the Methods chapter that covers the protocols for void gas, methane headspace, and sediment sampling, as well as the shipboard analyses for these phases. We calibrated the gas chromatograph, source rock analyzer, and H_2/CO_2 analyzer. We refined our sampling plan for the upcoming microbiology-focused Hole U1545B and prepared a gas sampling station. Strategies were discussed for sampling borehole fluids at future sites as well as tests we would like to run to determine background contamination levels with the Kuster Flow Through Sampler tool. When coring operations commenced in Hole U1545A, we performed methane and hydrocarbon headspace gas measurements for the routine safety program through Core 58X. The methane concentration reached a maximum value of ~31,100 ppmv in Core 7H at 53 mbsf. Further data processing is ongoing. We practiced our method for void gas sampling on the catwalk, but did not retain these samples for analysis. Upon core splitting, sediments were sampled for solid-phase shipboard organic geochemistry, and these samples are currently being processed for measurements.

Microbiology

The microbiologists continued setting up the laboratory and preparing for the first samples that will be taken from Hole U1545B. This process involved sterilizing hundreds of vials, bottles, and tubes, as well as making growth media (solution that contains nutrients) to culture microorganisms and cutting numerous syringes for whole-round core sampling. Additionally, we set up the stable and radioactive isotope vans and two anaerobic chambers, testing the ability of the latter to maintain anoxic conditions. We also finalized protocols for catwalk sampling, established a core sampling plan, and created spreadsheets and diagrams with the intervals of personal samples within each core section for different coring tools (APC, HLAPC, partial recovery, etc.). We also worked out the tracer contamination control sampling routine, and we collected control samples of the drilling fluid (seawater) and the drilling muds used during the expedition.

Physical Properties

While on transit, we finalized instrument preparations and the first Methods draft. During coring operations in Hole U1545A, we measured the physical properties of whole-round core sections and discrete samples through Core 55X at a depth of 333.2 mbsf. The Whole-Round Multisensor Logger (WRMSL), Natural Gamma Ray Logger (NGRL), and Thermal Conductivity Meter (TK04) provided consistent data. The first remarkable interval appeared across Cores 25F and 26F where a large spike in NGR highlighted a consistent change in density and magnetic susceptibility (MS). This interval corresponds to clay-rich sediments. Overall, preliminary observations thus indicate that downhole changes in physical properties, including MS and NGR, are positively correlated with clay abundance and produce cycles ranging from a few centimeters to several meters. Two more NGR spikes were recorded on Cores 46F and 49X. These are anti-correlated with MS and are possibly related to ash layers. Discrete samples for measurements of moisture and density (MAD) analysis were taken from every core near intervals where headspace gas samples were collected from the whole-round cores.

Outreach

During the second week of Expedition 385, our expedition made headlines in both Mexico and the United States. We released six posts on Facebook (<https://www.facebook.com/joidesresolution>), resulting in 1,600 engagements and 14 new followers. On Twitter (<https://twitter.com/TheJR>), 13 tweets produced 33 new followers and 309 engagements. The *JOIDES Resolution* Instagram account (http://instagram.com/joides_resolution) made three posts that produced 274 engagements and 30 new followers. Two stories had 769 views. Our weekly takeover of the AGU Instagram account on 26–27 September included six posts that gained 975 engagements and seven new followers for AGU. We published two blog posts with 450 views combined. The expedition's website (<https://joidesresolution.org/expedition/385/>) had 216 new views.

An overview of media coverage during this week is provided below.

Mexico

- El Imparcial (Republished from El Universal): <https://www.elimparcial.com/mexico/Perforaran-Golfo-de-California-para-estudiar-la-historia-de-la-Tierra-20190927-0008.html>

USA

- Texas A&M University: <https://today.tamu.edu/2019/09/27/president-young-tours-joides-resolution-during-rare-iodp-stateside-port-call/>

- Think Geoenergy (From El Universal): <http://www.thinkgeoenergy.com/offshore-research-drilling-to-explore-geothermal-potential-gulf-of-california-mexico/>
- Mexico News Daily (from El Universal): <https://mexiconewsdaily.com/news/project-studying-ocean-floor-off-guaymas-sonora/>

Technical Support and HSE Activities

The first half of this week focused on continued laboratory orientations for the science party as well as helping set up the instruments and distributing all laboratory supplies. Later this week, we supported the science operations at Site U1545.

Laboratory Activities

- Preparation of Microbiology and Geochemistry Laboratories continued, including:
 - Prepared Chemistry Laboratory equipment and trained scientists for coring operations.
 - Distributing user-requested supplies.
 - Organizing space allocation for all participants sample processing.
 - Preparing the Coy polymer anaerobic chamber and the cold room.
 - Installing the Coy vinyl anaerobic chamber on the Upper Tween deck.
 - Setting up a flammable gas use station outside on the Fo'c's'le deck.
 - Setting up third-party equipment in the Paleontology Laboratory.
 - Finalized installation of third-party equipment in the Department of Energy (DOE) van and Radiation (RAD) van.
 - Troubleshooting an issue with the Liquid Scintillation Counter in the RAD van. The user cannot run samples using the standard Easy Count protocol provided in the standard software set-up; the instrument will encounter an error and stop running. Samples can be run using the protocol provided to measure the reference standards.
- Development of sampling strategies for the geochemistry/microbiology-dedicated hole at Site U1545.
- Preparation of the Core Laboratory and training of new technical staff for coring operations.
- Identified various issues with the core logger software. Issues were either resolved or do not impact core processing or data quality so will be addressed as time allows.
- One APCT-3 tool was modified to measure temperatures greater than 55°C.

IT Support Activities

- Discovered excessive internet traffic to Apple content delivery network (CDN) websites. Implemented firewall rules to block sites.

- Gas Chromatograph (GC) 2 instrument in the Chemistry Laboratory not able to print or printed very slowly, which affected the GC2 instrument software. Printer settings were reset.
- Tracer Pump LED light set up and functioning.
- Multiple Rigwatch (rig instrumentation system software) stations had issues that were corrected.

Application Support Activities

- Continued work on Catwalk sampling project.
- Assisted staff and scientists with Laboratory Information Management System (LIMS) account and software issues.
- New features and fixes deployed for testing for MUT XRD uploader.
- New versions of CahnBalance and Coulometer deployed.
- Several data alterations, especially to *P*-wave results. Working with shore to figure out why depths are not correctly reported after these alterations were made.
- New developer training.

HSE Activities

- Held weekly abandon ship and life boat safety drill.
- Safety showers and eye wash stations were tested.