**IODP Expedition 376: Brothers Arc Flux**

**Week 1 Report (5–12 May 2018)**

The first week of the International Ocean Discovery Program (IODP) Brothers Arc Flux Expedition (376) comprised the port call activities in Auckland, New Zealand, the transit to Site U1527 (proposed Site NWC-1A), rotary core barrel (RCB) coring to 101 m in Hole U1527A, and initial preparations of a reentry and casing system that we will drill into the seafloor at Hole U1527B. All times in this report are in ship local time (UTC + 12 h) throughout the expedition.

## Operations

The Brothers Arc Flux Expedition 376 started at 0652 h on 5 May with the first line ashore at the Freyberg Wharf B in Auckland. The Co-Chief Scientists, IODP JRSO technical staff, and two CDEX technical engineers moved onto the ship at 0900 h. The IODP JRSO technical staff conducted crossover with their Expedition 375 counterparts. Expedition 375 and 376 Co-Chief Scientists' interviews with Radio New Zealand and a ship tour took place as scheduled. Initial loading of incoming freight began. The Expedition 376 scientists boarded the vessel in the morning of 6 May, got settled in their rooms, and were given a short introductory talk and presentation on information technology aboard the *JOIDES Resolution*. They started to connect their computers to the shipboard network and had their photos taken. The science party then convened for presentations about life at sea and general safety that were followed by a ship safety tour. Seven public relations tours of the vessel took place as scheduled. Loading and discharge of freight continued throughout the day. This included completion of loading 83 joints of casing (10¾ inch and 13⅜ inch), 40 joints of 5½ inch drill pipe, and 97.5 short tons of sepiolite.

On 7 May, the day began with introductions of the Expedition 376 scientists and IODP JRSO technical staff, followed by a presentation of the expedition scientific objectives by the Co-Chief Scientists and a presentation of the expedition work plan by the Expedition Project Manager (EPM). In the afternoon, after the Captain's introduction and safety orientation, scientists presented their individual research goals. The day was concluded with an introduction to the descriptive information system, given by IODP JRSO technical staff to the core describers. Initial laboratory team meetings took place. The loading of hardware and supplies continued all day, including reentry hardware and catering supplies.

On 8 May, the Expedition 376 Curator gave a talk on curation, followed by an introduction to core sampling on the core deck. Half of the science party was given a core flow tour by the EPM. All laboratory groups convened for meetings with the technical staff to learn their laboratories and start preparing associated instruments. The loading of supplies and hardware was completed,

including the CDEX turbine-driven coring system. A news team of the New Zealand nationwide TV channel "Three" visited the vessel and was given a tour and interview by the Co-Chief Scientists and EPM. Upon completion of final loading operations, the ship shifted to Wynyard Wharf for fueling with the first line ashore at 1930 h on 8 May. Fueling was completed at 0400 h on 9 May and the pilot boarded the vessel at 0758 h on 9 May. The vessel departed Wynyard Wharf with the last line away at 0821 h and, releasing the pilot at 0924 h, we began our sea passage. The rest of 9 May was spent in transit to Site U1527 (proposed Site NWC-1A). During the transit, the science party was given a tour to the helideck by the Schlumberger logging engineers where they received an introduction to the downhole logging tools and their preparation for high-temperature downhole measurements at Brothers volcano. The Education and Outreach Officers provided the scientists an overview of their plans for the expedition. In the afternoon of 9 May, the captain held the first fire and boat safety drill, the EPM gave a talk on downhole measurements, the IODP JRSO Operations Superintendent and CDEX technical engineers introduced drilling and coring operations, the Publications Specialist introduced the science party to IODP publications, as well as their obligations during the expedition and afterwards, and the second half of the science party was given a core flow tour by the EPM.

After a 246 nmi transit from Auckland with an average speed of 10.6 kt, we arrived at Site U1527 at 0800 h on 10 May. We put together the RCB bottom-hole assembly and started lowering it to the seafloor in preparation for coring. We attached an advanced piston corer temperature tool (APCT-3) shoe to the subsea camera system and deployed it to conduct a visual survey of the seafloor; we located the precruise site survey seafloor marker at 1745 h on 10 May. After completing the survey of six potential hole locations, we retrieved the camera system, picked up the top drive, and reassembled the rig floor. We began coring in Hole U1527A from a water depth of 1464 m at 2240 h on 10 May. We pumped tracer material and measured downhole temperatures through readings of temperature strips contained in a housing tool attached to the RCB core barrel head. Cores 1R to 15R penetrated to 101.4 m and recovered only 1.27 m (1.6%) in the unconsolidated volcanic deposits. The drill string occasionally became stuck, which required frequent pumping of mud sweeps. We stopped coring at 0515 h on 12 May, pulled the drill string out of the hole (the bit cleared the seafloor at 0635 h), and recovered the bit back on the rig floor at 1120 h on 12 May. We offset the ship 20 m to the east and started preparing the rig floor for assembling the Hole U1527B reentry cone and casing system that we will drill 94 m into the seafloor.

**Science Results**

IODP Expedition 376 addresses the mechanisms of metal transport, volatile flux, and conditions for microbial life in intraoceanic arc-hosted magmatic-hydrothermal systems. Drilling at Brothers volcano on the Kermadec arc will thus provide the missing link (i.e., third dimension) in our understanding of mineral deposit formation along arcs, the subseafloor architecture of

these volcanoes and their related permeability, as well as the relationship between the discharge of magmatic fluids and the deep biosphere.

While in port and during the first day at sea, we had several meetings of the entire science party, introducing them to the shipboard facilities and laboratories, major scientific objectives and global scope of the expedition, education and outreach plans, and sample curation, as well as drilling and logging operations. We also convened for a group science meeting in which each participant provided a brief summary of their background and research interests in the expedition science. Upon arrival at Brothers volcano on 10 May, a Site U1527 kickoff meeting was held and the science party broke out into laboratory groups to continue preparing their laboratories and methods. An inspection of the third-party Petrospec spool-in thermocouple assembly was conducted, including a ship-to-shore videoconference meeting to familiarize the petrophysics group and IODP JRSO technical staff with the equipment. The science party started their shifts at 1200 h. On 12 May, the Co-Chief Scientists gave a short overview of the rock types and mineralization studies in the caldera wall proximal to Hole U1527B.

*Core Description*

The core describers (igneous, alteration, and sulfide petrologists; volcanologists; and structural geologists) spent most of the week familiarizing themselves with the instrumentation and methods to be used during core description. We underwent a number of training sessions carried out by the IODP JRSO technical staff, including an overview of DESClogik and Sample Master. Furthermore, we were introduced to the available imaging facilities (Section Half Imaging Logger [SHIL], polarization microscopy, and scanning electron microscopy), the Section Half Multisensor Logger (SHMSL), and handheld energy dispersive portable X-ray fluorescence spectrometer (pXRF). We began preparing the first draft of our Methods section for our IODP *Proceedings* volume, involving discussions on how to implement the core description.

Later this week, we started to describe cores from Hole U1527A using a combination of macroscopic core description and pXRF. The penetration of unconsolidated volcanic deposits led to an extremely poor core recovery of 1.3% in Hole U1527A. Cores U1527A-1R to 15R yielded a total of 1.27 m down to a final depth of 101.4 m. Cores 5R and 6R recovered fresh to slightly altered (zeolite, iron oxide coating/infilling), sparsely plagioclase phyric lava of gray to dark gray color that has andesitic or dacitic composition. This rock is moderately to highly vesicular and partially glassy. The core catchers of cores 4R and 9R yielded polymict pumiceous lapilli tephra, containing scoria fragments.

*Paleomagnetism*

After the initial familiarization with the instrumentation and software of the paleomagnetic laboratory, we carried out the first measurements on archive section halves 5R-1-A and 6R-1-A, respectively. Despite the high fragmentation of these sections, the superconducting cryogenic rock magnetometer (SRM) was useful to optimize the discrete sampling of paleomag cubes from

the working half, and we started alternating field (AF) demagnetization and isothermal remanent magnetization (IRM) experiments on the three paleomag cubes taken.

*Geochemistry*

The inorganic, organic, and fluid geochemists familiarized themselves with laboratory-based instrumentation, supplies, and protocols. We composed a draft of the shipboard Geochemistry Methods chapter that details sampling, processing, and analysis techniques for (1) headspace analysis of gases, (2) borehole fluid geochemistry, (3) interstitial water geochemistry, and (4) sediment and rock geochemistry. These methods will be updated following the analysis of calibration standards and our first samples. A master spreadsheet summarizing Kuster flow-through fluid sampler procedures was initialized. This master list served to organize the type and numbers of collection vessels needed, fixation, and storage conditions for each sample type. The extraction line for the Kuster flow-through fluid sampler was set up, the sampler was filled with deionized water, and the valve system was tested at ambient surface pressures. The clock timers that will trigger the valves were set and monitored to assess their function; precise closing times were recorded for each clock. As the Kuster tool will be reactive under the chemical and temperature conditions expected within the borehole, a series of contamination tests was proposed in the draft Geochemistry Methods chapter; these tests will be carried out in the next few days prior to the first sampling, and again at the end of the expedition, after the last sample is taken.

*Petrophysics*

The petrophysics group familiarized themselves with the equipment in the Physical Properties Laboratory and reviewed the various methodologies. Based on this, we created a workflow plan to enable efficient processing of cores and to maximize the data obtained from analyzed samples. This plan has proven effective in the processing of the first recovered cores. Successful analyses, including thermal conductivity and *P*-wave velocity, yielded results consistent with vesicular volcanic material in the uppermost crust, and comparable to similar material recovered during ODP Leg 193. Meanwhile, a range of equipment has been prepared by the downhole measurements team. The Kuster flow-through fluid sampler has been assembled and is ready for calibration by the geochemistry group. Moreover, we have reviewed the assembly of the Petrospec thermocouple setup and held a videoconference meeting with Petrospec to discuss tool assembly and operations procedure. A system of monitoring temperature via thermal indicator strips situated on the core barrel is being tested and refined. The temperature strips were inserted into a housing tool attached to the top of the core barrel, run every second core in Hole U1527A. The cores returned wet strips until the tool pusher decided to use Teflon to further seal the plugs. All strips were dry from Cores 7R to 15R. Temperatures within the chamber are apparently <37°C. The low temperatures are consistent with geological and geophysical precruise surveys of Site U1527 (proposed Site NWC-1A), but changes to the configuration of the housing tool are under discussion as initial shipboard experiments have revealed that the temperature

equilibration inside the housing tool is much slower (5°C/h) than expected. We have set up the fluid inclusion system laboratory, and a newly designed system for sampling fluids as inclusions in specially prepared mineral crystals. A test run of a thermometer made of glass capillary tubes designed prior to the expedition will be lowered to the seafloor with the subsea camera system following the installation of the reentry system in Hole U1527B. We have also advanced the writing of the draft Methods section.

*Microbiology*

The microbiologists made themselves familiar with the Chemistry/Microbiology Laboratory and determined the configuration of the shipboard microbiology sampling and workflow. We learned about the shipboard gas chromatography (GC) and sample preparation for contamination tests using perfluoromethyl decaline (PFMD) tracers. They were pumped down during coring in Hole U1527A, but no retrieved core material was suitable to sample. We also set up the third-party GC-HID for shipboard porewater gas analysis. In addition, we completed the first draft of the microbiology Methods section.

**Education and Outreach**

We have two Education and Outreach Officers sailing on this expedition; one is an educator from the United States and the other is a museum tour host and ranger from New Zealand. They both presented their E&O plans for the expedition to the science party. They spent the week preparing for upcoming live outreach events, including setting up the videoconferencing equipment, maintaining and establishing contacts with schools, arranging scientists for next week's ship-to-shore events, and collecting images for social media and educational activities. They posted initial blogs at http://joidesresolution.org and successfully started engaging scientists with blogging. Overall, there have been 20 social media (Facebook [https://www.facebook.com/joidesresolution], Twitter [https://twitter.com/TheJR], and Instagram [http://instagram.com/joides_resolution]) posts this week. Facebook parameters to measure reach of posts increased across the board throughout the week with more than 22,200 users reached, including the most popular post being a NZ Herald article (6,900 reached). On Twitter, the top tweet garnered almost 4,000 impressions. The U.S. educator has begun working on lesson plans relating to the expedition objectives. These lessons include topics such as diversity of hydrothermal vent communities and precipitation of minerals out of solution. Our New Zealand museum guide has been preparing for the Museum of New Zealand Te Papa Tongarewa live stream broadcasts, starting next week (a series of four events over the next six weeks), and started planning ship-to-shore events with Maori tribes and groups of the Hinātōre after-school club.

**Technical Support and HSE Activities**

The first half of the week focused on loading and discharge of freight, conducting laboratory crossover with the offgoing technical staff, and providing safety and laboratory orientations for the expedition scientists. Since then, the focus has been on supporting the science operations at Site U1527.

*Laboratory Activities*

- Laboratories were prepared for coring.
- The science party was given safety training tours, and laboratory groups were introduced to their associated laboratories and assigned marine laboratory specialists.
- Bathymetric data was collected on the transit to Site U1527.
- Software issues related to the Olympus handheld XRF spectrometer have been solved, but the system will be continuously monitored.
- The Bruker XRD system has been brought back online by a Bruker service call during the Auckland port call.
- First-time measurement of a water column temperature profile by deploying the APCT-3 temperature tool attached to the subsea camera system during survey of Site U1527.
- Processing of Hole 1527A cores.

*Miscellaneous Activities*

- Held Site U1527 prespud meeting.

*IT Support Activities*

- Completed crossover activities.
- Assisted scientists with personal laptop integration.
- Established laboratory data management accounts for participants and new staff.
- Continued with routine setup and preparations for onset of the expedition.
- Working on applying new catalogs and on fixing user account issues related to Cumulus.

*Application Support Activities*

- Work on Data Publishing web service is currently in progress.
- *P*-wave data unit issue fixed on the whole-round tracks and the Velocity applications.
- Added new applications to ship servers.
- Certain software updates distributed.
- Created user IDs for scientists and new technicians.

*HSE Activities*

- Conducted both the SIEM Offshore and IODP safety meeting for the science party and new staff.
- Conducted the safety tour for science party.
- Technical staff completed the audit of hazardous storage areas, and the weekly check of safety showers and eyewash stations.
- Held the weekly fire and boat drill as scheduled.