**IODP Expedition 366: Mariana Convergent Margin**

**Week 3 Report (25–31 December 2016)**

This week was spent installing casing in Hole U1492D to 211 mbsf for the future installation of a borehole monitoring system. Site U1492 is located at an active fluid seep on the southwest part of the circular plateau that forms the summit of Blue Moon Seamount (recently given the official name of Yinazao Seamount). The lower part of the casing includes four screened casing joints (about 46 m long in total) that will allow formation fluids into the cased borehole for analysis by monitoring instruments in a "CORK-Lite" package to be deployed by a future non-IODP research cruise.

## Operations

*Hole U1492D*

Hole U1492D was started at 1620 h on 25 December at a tagged seafloor depth of 3666 mbsl, the same depth as for Hole U1492C. The drill-in casing method was employed here, using a mud motor to power rotation of the bit and underreamer bit assembly, which projects ~3 m below the bottom of the casing. The casing is 10.75 inch in diameter, the screened casing joints are 12.5 inch in diameter, and the underreamer arms were set to create a 14.75 inch diameter hole. Drilling proceeded smoothly until a harder layer was encountered at ~84 mbsf, a similar depth to a hard (but unrecovered) layer encountered while coring in Hole U1492C. The layer was catching on to the bit, causing the drill pipe to torque up and then detorque in the opposite direction when the bit was freed. On one such detorque, the pipe rotated enough to activate the casing running tool and release the reentry cone, and the reentry cone fell down the casing string and onto the seafloor over the hole. Shortly after this, at 0230 h on 26 December, the 211 m long casing string also disengaged from the casing running tool and dropped about 3 m. We could still drill ahead, and we were able to reengage the casing and penetrate to 93 mbsf. However, hole conditions remained poor and it was decided to pull the casing back to the ship and inspect the casing and drilling assemblies. On recovery, one cone was missing from the underreamer, but other parts of the assemblies were in working order. The casing string was hung off in the moonpool forward of well center.

Given the difficulties drilling into serpentinite mud containing rock clasts in this hole, we decided on a different approach. We decided first to drill the hole without coring to 225 mbsf using a 14.75 inch bit, then reenter this hole to drill in the casing using the mud motor and underreamer bit. At 1415 h on 27 December, Hole U1492D was reentered and reamed down to the previous total depth of 93 mbsf. From that point it took 17 h to advance the hole to the target depth of 225 mbsf (11 m deeper than casing to provide an adequate amount of rathole). The drill

bit was raised to 67 mbsf then run back down to 225 mbsf, and the hole was swept three times with high-viscosity mud to clean out cuttings prior to pulling this bit out of the hole to prepare for the second attempt at casing.

At 0930 h on 29 December, the rig crew moved the already-assembled casing string back to the center of the moonpool, reassembled the mud motor and underreamer, then lowered the casing and drilling assembly to the seafloor. Hole U1492D was reentered for the second time at 2300 h. The casing was lowered to 54 mbsf before taking weight, then drilling/washing with the underreamer continued slowly to 144 mbsf where the casing became stuck. Six hours were required to free the casing. After further slow progress was halted at 184 mbsf by poor hole conditions, the bit was pulled back to 96 mbsf to free the casing. We resumed drilling it in and we were able finally to drill the casing all the way to the total target depth of 214 mbsf at an average rate of 10 m/h; the casing shoe is at 211 mbsf. The casing running tool was released at 2240 h. It was not possible to confirm that the latch ring on the casing hanger had fully engaged the reentry cone because clouds of cuttings and drilling mud obscured our camera images; however, this was not considered to be a significant problem for the installation. As of midnight on 31 December 2016 the top drive had been set back, the camera was being recovered, and the drill string was being tripped back to the ship.

## Science Results

### *Core Description*

Hole U1492C consists of an uppermost unit of red-brown pelagic mud with lithic clasts, overlying a lower unit of blue-grey serpentinite mud containing 5%–10% lithic clasts of serpentinized ultramafic rock. Near the base of the hole, a 30 cm section of white soft material, initially thought to be brucite, is now inferred to be a mix of carbonate veins and gypsum(?) based on the high Ca and S counts in pXRF analyses. XRD analyses are needed to confirm this preliminary identification. Petrographic analysis of thin sections from Sites U1491 and U1492 continued during the week, mostly of variably-serpentinized ultramafic rocks, but one clast was revealed to be a volcanic rock in thin section. Systematic pXRF analyses of harzburgite clasts revealed a high S content. This is supported by petrographic thin section analysis of harzburgite clasts, many of which appear in reflected light to have significant sulfide mineralization (pyrite or pyrrhotite).

### *Geochemistry*

The bulk of the basic analyses of the high pH (10.7–11.2) pore fluids from Site U1492 were completed the previous week, and new analyses were conducted to answer questions raised by our initial data. High downhole concentrations of calcium and sulfate in Site U1492 pore fluids confirm the thermodynamic stability of sulfate minerals, consistent with the possible presence of

gypsum in the core. Total inorganic carbon (TIC) concentrations average from 3 to 11 ppm at depth, and total organic carbon (TOC) ranges from 1 to 4 ppm. Silica concentrations, which were for the most part too low to be determined by ICP-AES, were quantified by spectrophotometry. An attempt to quantify dissolved sulfides in Site U1492 pore fluids was unsuccessful, as the samples had equilibrated with the atmosphere, resulting in pH decrease and associated $H_2S$ loss. This procedure will be conducted on future pore fluid aliquots using a fixing agent (either Zn acetate or $CdNO_3$) to ensure quantitative results. Analysis of overlapping major element datasets (Ca, Na, K, Mg, and Cl) indicated good agreement between ICP-AES and ion chromatography results for Mg and K, good agreement between data for ICP-AES Ca wavelength and ion chromatography results for Ca, and poor agreement between ICP and IC Na data, as well as for IC and titration-based Cl data. Na concentrations in the major cation dilutions for ICP-AES were too high for reliable quantitative measurement, a problem also evident in two of the three spectral lines used for ICP Ca determinations. As regards Cl measurement, both instruments were documented as producing precise and accurate data on standards, so it appears that other anions (possibly sulfide) may be complicating the titration measurements done immediately upon pore fluid collection.

*Microbiology*

No new cores were collected this week, so no new microbiology samples were taken. Testing continued on different sample preparation methods for qPCR analyses.

*Physical Properties*

Effort during this week was focused on final plotting of all the data relative to whole-round loggers and half-round discrete measurements, and integrating data with those from other laboratory groups.

*Downhole Measurements*

Downhole temperature results from Hole U1492C were compared to results from Conical and South Chamorro Seamounts drilled on ODP Legs 125 and 195. At all three summits there is evidence for flow rates varying either over short spatial distances or with depth in the same hole.

*Paleomagnetism*

Measurements of 50 discrete samples from Sites U1491 and U1492 were conducted on the superconducting rock magnetometer (SRM) with stepwise alternating field (AF) demagnetization from 0–30 mT. Principal component analyses of the demagnetization curves were calculated, to be compared with archive section results, concentrating on the pelagic/volcanigenic sediments in Unit 1 at Site U1491. Paleomagnetic directions had no clear downhole pattern, and many retained steeply dipping directions inconsistent with the site location.

## Education and Outreach

The educators made regular daily social media posts to Facebook (https://www.facebook.com/joidesresolution) and Twitter (https://twitter.com/TheJR). Blogs on http://joidesresolution.org featured the work of crew members and members of the science party, about the broader significance of the research being conducted on Expedition 366. Videos featuring interviews with several members of the science party are being edited, and a video about ship's Christmas activities was posted. No videoconferences were scheduled with schools this week because of the holidays.

## Technical Support and HSE Activities

*Laboratory Activities*

- Special Task Multisensor Logger (STMSL): The rebuild of the STMSL's track and installation of the new *P*-Wave Logger (PWL) hardware is completed. Staff are currently building an instrument shelf and installing support electronics and wiring.
- Superconducting Rock Magnetometer (SRM):
    - We installed the chill water manifold and secured the emergency Haskris chiller. During the 20 min that the chill water was off, we did not lose superconduction in the superconducting quantum interference devices (SQUIDs).
    - Installed the NI-USB oscilloscope to monitor the SQUIDs.
- Section Half Multisensor Logger (SHMSL):
    - Installed the new QEPro spectrophotometer (replaced the USB4000). The new unit provides superior spectral resolution and better sensitivity to dark-colored rocks.
    - Installed the new AR700 laser displacement sensor (replaced AR200).
    - Developed new IMS software modules for the above hardware.
- M-Drives (stepper motors used on all IMS track systems): Rebuilding cable assemblies and mounting plates for all M-Drive installations.
- Navigation: The aft GPS receiver became disconnected by a network switch in the Underway Laboratory. At the same time, an IP conflict with the gyroscope blocked its input to the WinFROG navigation software. Both issues where discovered while getting the site location for Hole U1492D and were fixed. The "lost heading" alarms in WinFROG were re-enabled so that we will be alerted if this happens again.

*Application Support Activities*

- Built Database Table IMS_ERROR_CODE to be used to store and inquire about the errors that are known to occur in the IMS System for the various tracks.

- Built the Webservices used for retrieving the error code information from the error code database table.
- Continued work on the PanelBuilder application for the LIMSpeak II/DQView application.
- Work on new LDAQ Controller framework. Work will continue on this project for some time.
- New Report (PXRF) for Handheld X-Ray continues. Report is nearly finished. Few minor steps to clean up final design and then submit for approval and testing.
- Updates to pXRF (Handheld X-Ray) uploader. Changed to properly capitalize the element names to standards.
- Created new panels for LIMSpeak II/DQVIEW for use by SRM technician to assist in testing the new SRM hardware and software.
- Create new MS point Panel for LIMSpeak II/DQVIEW for testing of new application.
- Downhole Temperature TP-FIT report changed to show the accurate depth information. It was not reporting any depth information but now reports top-depth. Discussion continues about longer-term solution for new instruments that will report similar data.
- New SHMSL, IMS instruments modules for the QEPro spectrophotometer and AR700 laser displacement sensor were developed and deployed. To support the new hardware, the SHMSL DAQ module was updated to change process steps.

*IT Support Activities*

- The JR experienced no major network, Internet, or computer system issues during the week beginning 24 December 2016.
- The fan unit in the AC unit inside the bow VSAT radome developed a squeaking noise. Cooling is normal, and the bow antenna is operational. We have contacted SIEM's First Engineer to seek remediation. We've provided him with manuals to the AC unit. At our current and planned positions the aft antenna will have line of sight to the satellite in the case we needed to shut the bow antenna off. The risk to Internet connectivity is low.
- Computer monitor replacement continues with only two planned deployments remaining. Both are in the Microscopy area of the Chemistry Laboratory.
- Distribution groups on the Exchange server have been updated in preparation for piloting a few Outlook email users on Expedition 366.
- Testing of a new video encoder is ongoing. No video streams were affected.

*HSE Activities*

- Held the weekly fire and boat drill as scheduled.