IODP Expedition 327: Juan de Fuca Ridge-Flank Hydrogeology

Week 6 Report (9–15 August 2010)

16 August 2010

OPERATIONS

Hole U1362A Drilling and Conditioning

Further wiper trips were abandoned in favor of deepening the hole by ~30 m to provide a deeper "rat" hole for the L-CORK deployment. The rotary core barrel (RCB) assembly was switched to a 9-7/8 inch tri-cone drilling assembly. The tri-cone bit is equipped with bigger cutters and bearings better suited to handling rough drilling conditions and is also capable of handling the higher flow rates necessary for effective hole cleaning. At 0700 hr on 9 August, the pipe round trip began and at 1935 hr that same evening Hole U1362A was reentered for the ninth time. The bit was run to a depth of 476 m below seafloor (mbsf) without rotation or circulation. The hole was washed and reamed through 20 m of soft fill to total depth and a 50-barrel high-viscosity mud sweep was circulated. Another 17 hr were required to deepen the hole by 32 m to a final total depth of 528 mbsf. Two 75-barrel high-viscosity mud sweeps were pumped and at 1800 hr on 10 August a series of three wiper trips were initiated to clean up and condition the hole. This required 11 hr to complete including the requisite mud sweeps. After the third wiper trip the pipe was lowered without rotation or circulation to 515 mbsf. After some resistance at that depth, the pipe broke through the plug easily and the hole was clean to total depth. At 0500 hr on 11 August the pipe was tripped back to the casing shoe and 3-1/2 hr were spent on stand-by, waiting for the hole to equilibrate and to allow any remaining cuttings to fall to the bottom. During that time, general rig maintenance was conducted as well as a pressure test of the rig circulation system in preparation for the packer flow test. At 0930 hr on 11 August the drill string was lowered into the hole without rotation or circulation, reaching a depth of 512 mbsf. A 75-barrel high-viscosity mud sweep was circulated and the drill string was recovered back to the surface.

Hole U1362A Wireline Logging and Packer Flow Testing

The wireline logging/packer bottom-hole assembly (BHA) was assembled, the drill string was tripped to the seafloor once again, and at 0211 hr on 12 August Hole U1362A was reentered for the tenth time. The pipe was spaced out to a depth of 264 mbsf (still inside 10-3/4 inch casing) and preparations began for wireline logging. At 0545 hr on 12 August a single suite of logging tools was run in the hole (see Science Results for tool details). The logging string reached a depth of 507 mbsf without any resistance and this was considered deep enough for logging purposes. Two full passes were made from 508 mbsf to the casing shoe at 308 mbsf. A third partial pass was made from 508 to 373 mbsf across the area of interest for the lower packer setting. Wireline logging was completed and the tools were rigged down by 1615 hr on 12 August.

The drill string was then lowered to 519 mbsf without rotation or circulation for another depth check. The end of the pipe was raised to 436 mbsf, positioning the TAM packer assembly at the desired depth of 424.5 mbsf. After some difficulty in setting the packer in open hole, which was attributed to the >2 m of vessel heave, the first flow test was completed by 0430 hr on 13 August. The drill string was raised up into the 10-3/4 inch casing for the second and final flow test. This test was cancelled when after repeated attempts the packer failed to lock in pressure. The packer would set and pressure up but the pressure could not be locked in. At 1000 hr on 13 August the drill string was tripped to the surface and the end of the pipe cleared the rotary table at 1800 hr. Upon recovery, inspection of the packer showed evidence of damage and water was seen leaking from a bad gouge near the lower end, making it apparent why the packer failed to hold pressure.

Hole U1362A L-CORK Head Assembly and Deployment

Assembly of the L-CORK began at 1845 hr on 13 August. The CORK running tool was made-up to a 2 m drill collar joint and laid out on the rig floor for later use. The bull nose was then made up with three perforated and coated 8-1/4 inch drill collars. A single joint of perforated and coated 5-1/2 inch casing along with the required crossover subs was then made up and lowered into the moonpool area. A microbiology miniscreen was installed on the lower end of the 5-1/2 inch casing joint and its umbilical was attached. A chemistry miniscreen was attached in the upper third of the 5-1/2 inch casing joint along with its umbilical. At 2130 hr the first inflatable packer was installed, followed by a landing collar and the first swellable packer assembly. A pressure miniscreen was installed on the 4-1/2 inch casing mandrel below the inflatable packer along with the umbilical connection. It was at this point that concerns were raised about the swellable packer diameter because the swellable element was >9-3/4 inches in places. This packer was designed with four separate packer halves that had molded channels on the inside to accommodate the umbilical lines. The halves can be bolted together over the umbilicals and the design is such that the packer will swell into and heal any remaining gaps over time. This process is supposed to take on the order of several weeks to complete once the element is submerged in sea water. Because there were concerns over getting a 9-3/4 inch plus diameter into the open hole it was decided that the packer elements should be machined down to 8-1/2 inches. While time consuming (~8 hr for each pair of packer halves) this was considered the more prudent approach. The first pair of swellable packer elements was ready for installation at 1100 hr on 14 August, allowing work to proceed in the moonpool with umbilical connections and miniscreen installations. Installation of the second swellable packer pair began at 1830 hr that evening. By 2200 hr, eight additional joints of 4-1/2 inch casing were run and then the second set of inflatable and swellable packers were installed. This also included additional chemistry and pressure miniscreens. Another 22 joints of 4-1/2 inch casing were run by 0845 hr on 15 August. At that point, the L-CORK head was picked up, the CORK running tool was made-up to the L-CORK head, and the head was made up to the top 4-1/2 inch casing joint, all within 30 min. The final umbilical terminations were made including all strapping and securing. Only a few casing centralizers were installed on the CORK stinger to minimize the potential for getting stuck in the open hole during deployment. A single 5-1/2 inch centralizer was used to protect the lowermost chemistry miniscreen. A 4-1/2 inch centralizer was used next to the lowermost pressure screen, above the first swellable packer, and below the second inflatable packer. This was followed by a pair of 4-1/2 inch centralizers installed on all 4-1/2 inch casing joints that would remain inside the 10-3/4 inch casing. The packer inflation hose was installed between the running tool and the L-CORK head, the valves were opened, and after picking up a single stand of drill collars, the L-CORK was lowered into the water. The L-CORK was then pulled back up to close the valves and secure the valve handles with rubber bands. One final operation was to test fit the VIT/subsea TV frame over the L-CORK head. The pipe trip to the seafloor with the L-CORK assembly was initiated at 1300 hr on 15 August.

Hole U1362A L-CORK Instrument String Assembly and Deployment

At 1630 hr on 15 August the drill string was positioned just above the seafloor and preparations began for deployment of the instrument string. A 250 lb sinker bar was assembled with six discrete osmotic sampler sections. With the osmosamplers suspended in the pipe the deployment of the Spectra rope and temperature loggers began. The deployment proceeded faster than in the past because the string had lifting eyes pre-spliced into the Spectra rope at 25 m increments. It is estimated that this new technique saved hours of rig time in the deployment of the 464 m instrument string. The instrument string was slowly lowered to the bottom at 1815 hr and by 1945 hr the string had landed and latch-in had been verified with 400 lbs of overpull. Within minutes the weakened shear pin was sheared off and the wireline was recovered. By 2230 hr the drill

string was spaced out for reentry and the VIT/subsea TV arrived at the end of the pipe. The attempted reentry was suspended at this point when it became apparent that the instrument string was protruding beyond the end of the CORK bull nose by a significant amount. The wireline sinker bar and first osmosampler section were visible beyond the CORK stinger. It was not considered advisable to attempt reentry and deployment in the open hole as this would most likely result in damage to the instrument string and possibly loss of the hole. The remainder of the evening was spent discussing options and developing a mitigation plan.

SCIENCE RESULTS

Core description, shipboard sampling, and laboratory measurements continued throughout the week. A science meeting was held to discuss preliminary data from Site U1362, followed by a sampling party for postcruise analyses.

All Hole U1362A cores have now been described for igneous petrology. Vein logging is complete for Sections 2R-1 to 7R-1. After reviewing all cores, it was decided that adjacent units with similar flow morphology would be combined into a single unit with subunits used to identify minor differences. Eight units are now used to define the stratigraphy in Hole U1362A. Units 1, 3, and 5 have been classified as pillow lavas based on their igneous texture and abundant chilled margins that are often curved. Units 2 and 7 have been designated as thin flows or sheet flows. Units 4, 6 and 8 are classified as sheet flows that are meters thick with occasional chilled margins. Overall pillow lavas represent approximately half of the cored interval. Breccias are limited in this hole and are predominantly only present on a millimeter to centimeter scale along chilled margins. One example of a 50 mm hydrothermal breccia vein is present in Core 9R. The basalt throughout Hole U1362A is sparsely to moderately phyric with a range of secondary minerals including saponite, carbonate, Fe-oxides, celadonite and sulphides. Hydrothermal veins vary from microns to several millimeters in width and display a wide variety of compositions and orientations. Shipboard XRD results record the presence of clay, zeolites, and carbonate in veins. ICP-AES results are being analyzed. Thin section descriptions of each unit and alteration style are ongoing. Structural measurements are complete for Sections 2R-1 to 18R-5.

Whole round physical properties analyses have been completed for all remaining cores from Hole U1362A. Gamma ray attenuation density data continue to produce consistent peak bulk density values of ~2.5 g/cm^3, with slightly higher values in massive, high recovery sections. Magnetic susceptibility values are similar to previous results (1000 x 10^5 SI to 3000 x 10^5 SI). Total counts from the natural gamma ray logger were low (between 1 and 5 counts per second) for all cores. No further thermal conductivity measurements were taken, giving a total of three measurements in Hole U1362A, all in the upper sections.

P-wave velocity measurements of saturated samples have been completed with a verification step of using an acrylic standard every four measurements. Furthermore, since the estimated *P*-wave velocities are not stable, we measured the velocities four times for each axis of the cubic-shaped samples and obtained average values. Because *P*-wave velocities were still not satisfactory to us, we measured velocities of dry samples. *P*-wave velocities in saturated samples range from 4.7 to 6.3 km/s. In the next step, we are going to saturate all samples again, calculate *P*-wave velocities by manual picking and check the reliability of the estimated velocities. Bulk density and porosity analyses have been completed as well. Bulk densities range from 2.57 to 2.89 g/cm^3.

The microbiology group assembled two colonization experiments for the Hole U1362A CORK instrument string and assisted with the deployment of the microbiology umbilical.

Remanent magnetization measurements were completed for Hole U1362A and the data are being analyzed.

Hole U1362A was logged with a single wireline toolstring composed of a cablehead with a pseudo-SP (spontaneous potential) sensor, the HNGS gamma ray sonde, the HLDS density sonde, the LDEO MTT temperature tool, the GPIT orientation tool, and the UBI acoustic imaging tool. Both the HLDS mechanical caliper and UBI ultrasonic caliper provided the operations and science groups with the data needed to accurately place packers in the borehole, which was the primary objective of the logging program. Three passes of the toolstring indicated that acceptable packer seats exist at 419 and 450 mbsf.

Formation pressure data were recovered successfully from the packer flow test conducted at 424.5 mbsf.

Engineers, CORK specialists, and Transocean staff met to discuss safe working practices on the moonpool in preparation for the CORK deployment. Three umbilical reels were loaded onto stands and moved to the moon pool. Banana sheaves used to support the umbilicals were hung in the moonpool. The chemistry, microbiology, and pressure screens were prepared for deployment on the CORK. During the CORK deployment, staff assisted with securing the umbilicals to the casing, attaching screens, and the making the necessary umbilical terminations. Pressure testing and troubleshooting of the electronic RS (ERS) tool continued according to Stress Engineering's directions.

OUTREACH

Videoconferences were conducted with a science camp at the University of Southern California and students in Nouméa (New Caledonia). Other activities included a microbe culturing activity, a talk on seafloor and ocean crust bacteria, and deployment of the ROVs at night to test their lights. Individual projects are continuing on curriculum materials and experiments to be used in schools, art, and computer animation.

TECHNICAL SUPPORT AND HSE ACTIVITIES

HSE activities: Weekly fire and boat drills were held on Monday and Sunday.

Laboratory activities:

Processing of hard rock cores continues. Staff continues to provide support for various science, education and engineering projects. Laboratory projects in progress include the following: section half multisensor logger software upgrade completed and data validation testing in progress, whole core multisensor logger software upgrade in user testing, moisture and density/pycnometer software upgrade, and laboratory documentation updates. Minor updates were released for several LIMS applications.