

October 10, 2005

**IODP EXPEDITION 311:
CASCADIA MARGIN GAS HYDRATES
WEEK 6 REPORT**

OPERATIONS

HOLE U1327B: After concluding coring and logging operations at Site U1329, the drill string was tripped to the rig floor and we transited 9.2 nmi to Site U1327, arriving at 04:15 hr on 2 October. We spudded Hole U1327B, retrieving a full core, which indicated we did not recover the mudline. Therefore, we terminated operations in Hole U1327B to obtain a mudline core from a new hole, which is important for shallow geochemical and microbiological studies.

HOLE U1327C: The bit was picked up 5 m and Hole U1327C was spudded returning a 6.1 m mudline core, providing an estimated seafloor depth of 1304.5 mbsl (1315.4 mbrf). With the APC system, the hole was advanced to 92.9 mbsf (104% recovery), below which the hole was cored to 300 mbsf with the XCB (81% recovery). Four APC temperature measurements were made with the APCT. Additional temperature measurements were made using the DVTPP probe at 170.4, 218.5, and 300.0 mbsf. Three PCSs were deployed at 44.1, 121.8 mbsf, and 197.3 mbsf; the shallowest was returned without pressure. After reaching total depth, the hole was displaced with weighted mud, and the bit was pulled clear of the seafloor at 15:45 hr on 4 October, ending Hole U1327C.

HOLE U1327D: After completing operations in Hole U1327C, we offset 15 m to the northeast to spud a dedicated tool hole, which focused on pressure coring and wireline logging. Additional conventional APC and XCB spot coring was conducted in targeted zones of specific interest. Zones between pressure cores that were not targeted for spot coring were washed or drilled. The coring phase of Hole U1327D was interrupted for 20 hr on 5 October by adverse heave conditions (>4.5 m), which made it impossible to keep pressure core systems on the bottom of the hole. Ultimately, seven total pressure core deployments were conducted in Hole U1327D with five containing cores under pressure (2 PCS, 2 HRC, 1 FPC). The two cores that returned without pressure were the PCS at 83.0 mbsf and the FPC at 132.0 mbsf. The HRC at 126.3 mbsf was recovered under pressure, but during the transfer for core logging measurements, the transfer system lost pressure.

Two APC cores were taken to 16.4 mbsf for ultra-high resolution sampling for geochemical and microbiological analyses. Seven XCB spot cores also were taken within the presumed gas hydrate stability zone: one core at 126.0 mbsf; three from 133.0-155.1 mbsf, one at 157.1 mbsf, and two in an interval (218.7-237.9 mbsf) with equivalent depths across the BSR. At 16:15 hr on 7 October, Hole U1327E had been drilled to a total depth of 300 mbsf, but adverse ship heave conditions, > 3.0 m, were not conducive to logging so the hole was conditioned with a wiper trip and the bottom 20 m was reamed out, which was followed by a mud sweep. By 23:30 hr, the heave conditions had improved so the pipe was pulled up to logging depth and the triple combo was rigged up and lowered to 295.4 mbsf. The hole was logged without incident until near the top of the log run. The combination of a ship heave event (>3.0 m) and the oversized borehole apparently caught and tore off the density tool caliper arm. The damaged triple-combo tool string was returned to the ship without further incident. The VSP logging program in Hole U1327D began at 07:20 hr on 8 October with the pre-shooting, one-hour marine mammal observation period, followed by ramping up the firing pressure for the GI gun. The WST was lowered to 276.4 mbsf and the VSP program began. We moved in 5 m increments up the hole and had completed sixteen positions at

~11:00 hr. Around 136 mbsf the WST was unable to clamp although the caliper log from the triple-combo run showed that the hole should have been suitable for clamping. It was decided to pull the WST back to the ship for inspection. Unfortunately the tool could not be pulled back into the drill pipe. Attempts to clamp the logging wireline with two Kinley crimpers were unsuccessful; however, the WST was finally worked back into the drill pipe and pulled to the surface by 23:00 hr on October 8.

HOLE U1327E: Because of the critical nature of the downhole acoustic log data to achieve the goals of the expedition, it was decided to drill a dedicated wireline logging hole (Hole U1327E) and to acquire additional PCS, HRC, and FPC pressure cores from several critical intervals not successfully cored in the two previous holes at this site. Hole U1327E was started by drilling to 3.0 mbsf and then taking a single APC core for high resolution geochemical and microbiological sampling. An earlier attempt to sample across the sulfate-methane interface (SMI) in Hole U1327C was unsuccessful; Hole U1327E presented us with an opportunity to resample the SMI at this site. The hole was then advanced by drilling to 40.0 mbsf and the PCS was deployed to obtain a pressure core (Core 2P), which yielded a complete core but it was not pressurized. The hole was advanced by drilling to 80.0 mbsf and a second PCS core (Core 3P) was acquired, this time with a full core and at pressure. Core 3P was X-rayed and moved into the PCS van for degassing. The hole was drilled to 128.0 mbsf, the HRC was deployed, and Core 4E was recovered with sediment but the flapper valve failed to completely seal. A deployment of the FPC was planned at 134.0 mbsf, but was canceled because of growing ship heave conditions that had exceeded 3.5 m near the end of the HRC deployment. We decided to drill Hole U1327E to the target total depth of 300 mbsf and make ready for wireline logging.

SCIENCE

The 300 m sedimentary section cored at Site U1327 is Pleistocene very dark greenish gray silty clay and dark gray clay with varying diatom abundance. LWD/MWD logs from Hole U1327A, drilled on September 23-24, 2005, reveal a notable high resistivity interval, exceeding 10 ohm-m, within the depth section from about 123 -139 mbsf. The LWD/MWD acquired resistivity logs also revealed other less prominent high resistivity intervals to about 230 mbsf, which is near the predicted depth of the seismically inferred BSR at 220 mbsf. It is important to note that gas-hydrate-bearing sediments are often characterized by elevated electrical resistivities. Numerous recovered cores exhibited notable IR thermal anomalies (inferred gas hydrate), up to 3 m thick, in Holes U1327C and U1327D in the approximate depth interval 107-220 mbsf. One of the most notable IR thermal anomalies was found near a depth of 132 mbsf, which correlates with the lower part of the high resistivity interval as logged in the Hole U1327A. Also, the IR-scan of Core U1327E-15X revealed a 3-m-thick low temperature anomaly at the core depth of the seismically inferred BSR. Visible evidence of gas hydrate was seen in Cores U1327C-19X (small flakes) and U1327C-22X, where larger nodules several mm in diameter were observed. IR cold spots were subsampled for interstitial water analysis and microbiology characterization or were preserved in liquid nitrogen if they were believed to contain gas hydrate. Additional evidence for gas hydrate occurrence is provided by the interstitial water Cl profile. Superimposed on a generally decreasing trend downhole is a zone (~125-220 mbsf) with numerous pronounced negative Cl excursions, reaching a minimum value of 68 mM. The bottom of the zone with Cl excursions and IR anomalies is coincident with the depth of the seismically inferred BSR. The void gas C_1/C_2 ratio decreases steadily from >15,000 at 25 mbsf to 3200 at ~128 mbsf. Below 128 mbsf, the C_1/C_2 ratio decreases gradually to a broad minimum of ~1000 centered around 220 mbsf, then gradually increases with depth. The increase in C_2 relative to C_1 at 128 mbsf to below the depth of the BSR, which appears to correlate with the Cl excursions and IR anomalies indicative of gas hydrate, suggests that the gas chemistry in this interval may be effected by the occurrence of gas hydrate.

TECHNICAL ACTIVITIES

Week six saw coring and runs of various downhole tools, and the labs were in normal operation. The Canadian Marine Mammal Observer, Scott Toews, and an IODP technician, Rachel Culberson, arrived onboard via helicopter September 7 along with some needed lab supplies and spare parts. A VSP was run on September 8.

HSE Activities: There was a fire and boat drill on October 9. The METs team did not respond, as they were busy handling core. The rest of the technicians and scientists reported to their lifeboat stations. New arrivals on the ship, Scott Toews and Rachel Culberson, watched a presentation on the dangers of H₂S.