

IODP Expedition 372: Creeping Gas Hydrate Slides and Hikurangi LWD

Week 5 Report (25–31 December 2017)

Operations

The week began with continuing logging-while-drilling (LWD) operations at Hole U1519A (proposed Site HSM-01A). After reaching the total depth of 650 m, the hole was cleaned with mud, and the LWD tools and drill string were pulled out of the hole with the bit clearing the seafloor at 0425 h and the rig floor at 0855 h on 26 December. The vessel began the 28 nmi transit to Site U1520 at 0910 h on 26 December.

The vessel arrived at Site U1520 (proposed Site HSM-05A) at 1302 h on 26 December. The 210.39 m long LWD bottom-hole assembly (BHA) was assembled, including the geoVISION, SonicScope, NeoScope, TeleScope, proVISION, and StethoScope tools. The BHA was deployed to 390 mbsl and flow tested to determine the appropriate flow rates. The proVISION tool was not sending real time data and the drill string was recovered so that the spare proVISION tool could be deployed. The tools and drill string were set at 390 mbsl for a second LWD tool test. Again, the proVISION tool failed to send real time information. The tool string was deployed to the seafloor (3527.4 mbsl) and Hole U1520A began at 0845 h on 27 December. This time the proVISION tool began sending real time data as soon as the tools were turned on. The weather and sea conditions began to deteriorate and the drill string had to be pulled out of Hole U1520A after reaching only 97.9 m. Hole U1520A ended when the bit cleared the seafloor at 1410 h on 27 December.

The vessel had to wait for the weather to clear for nearly 2 d (45.75 h). During this time the ship was offset 20 m to the northwest of Hole U1520A, and eventually LWD drilling in Hole U1520B began at 1245 h on 29 December. The hole was washed down to a depth of 80 m and LWD measurements were taken from 80 to 750 m. After reaching the total depth of 750 m at 0430 h on 31 December, the hole was cleaned with mud and the drill string was pulled out of the hole. The bit cleared the seafloor at 0715 h and the rig floor at 1930 h. The LWD tools were broken down and the vessel departed for Site U1517 at 1954 h. After a 32 nmi transit, the ship arrived back at Site U1517 at 2300 h and preparations began for temperature dual-pressure tool (T2P) formation pressure measurements.

Science Results

Preliminary smear slide analysis of Hole U1517C sediments shows distinct differences in constituent grain size for the five identified lithological units, confirming the unit assignments based on macroscopic descriptions. Hole U1517C core lithologies are being integrated with the LWD logs and seismic reflection data.

Over the past week, the LWD group has been involved in safety monitoring, downhole data quality control, and initial data analysis for Sites U1518–U1520. The initial recorded mode data files for Holes U1518A, U1518B, and U1519A were received along with processed data files for Site U1518. The team worked on initial interpretations of the thrust fault zone at Site U1518, where high quality logging data was acquired to help us understand physical and geotechnical properties in the hanging wall, footwall, and fault zone. The logging teams have also been interpreting bedding and fracture orientations to compare to the seismic data. At both Site U1518 and U1519, indications of natural gas hydrate were observed in what is interpreted as thin centimeter-thick turbidite sands. Thick (over 100 m) sand sequences were also interpreted to be present at both sites. Real time data from Site U1520 suggest an upper sequence consisting of soft sandy sediment overlying the Ruatoria avalanche deposit. These in turn overlie an apparently muddy sequence that becomes sandier with depth. Towards the base of the borehole the sediment appears more consolidated, with logging signatures indicating a change in lithology to higher velocity and denser material. The lower sequence is inferred to be predominantly pelagic sediments overlying the subducting Pacific Plate.

Dissolved chloride measurements indicate the presence of discrete gas hydrate occurrences between ~135 to 165 m, with gas saturation (S_h) values reaching up to ~65%. This distribution is consistent with inferences on gas hydrate saturation based on resistivity data obtained by LWD. The sulfate–methane transition (SMT) is well defined at 16.6 m by depletion of dissolved sulfate and a marked increase in methane concentration in headspace samples. Alkalinity, calcium, and magnesium show distributions that are typical for reactions occurring at the SMT. Pore water profiles in the methanogenic zone suggest a combination of reactions that may include silicate weathering and the formation of authigenic minerals that remove iron, manganese, calcium, and potassium from the pore water. Analyses of the solid phase yielded CaCO_3 values ranging from 4.63% to 8.99 wt%. Total organic carbon (TOC) concentrations are generally <1%. The C/N ratios ranged from 3.78 to 31.34.

All of the science teams turned in reports for Site U1517, and the LWD team continues to work on reports for Sites U1518 and U1519.

Education and Outreach

Education and outreach activities consisted of video broadcasts, blog posts, and social media posts. Video broadcasts included a school in China and several “Friends and Family” broadcasts for members of the science party, technical staff, and crew.

Eight original posts were made to Twitter (<https://twitter.com/TheJR>), five posts to Instagram (http://instagram.com/joides_resolution), and 15 posts to Facebook (<https://www.facebook.com/joidesresolution>). Ten blog posts were made and posted to the <http://joidesresolution.org> web

page. Blog topics included interviews with individuals on the ship and topics related to activities at sea.

Technical Support and HSE Activities

IODP JRSO technical staff engaged in various maintenance projects, laboratory technical cross-training, as well as preparing for coring operations.

Laboratory Activities

- Continued to work on the Underway Geophysics Laboratory manuals.
- Completed updates to the X-ray fluorescence (pXRF) and X-ray diffraction (XRD) manuals.
- A quick start guide was created for the new Velocity application at the gantry station.
- The Core Description Laboratory manuals were updated.
- The IMS 10 version of the superconducting rock magnetometer (SRM) software was tested.
- Currently updating the Kappabridge software.
- Shipping papers were created for the offgoing expedition shipments.

Application Support and I.T. Activities

- The gas elements report in LORE was updated so that gas ratios are labeled as a ratio rather than as a percentage.
- A service visit is scheduled from HP Enterprise and Sharp New Zealand to repair the tape library and copier during port call in Lyttelton.

HSE Activities

- The technical staff completed the weekly check of the safety showers and eyewash stations.
- The weekly fire and boat drill was held on 1 January.