**IODP Expedition 372: Creeping Gas Hydrate Slides and Hikurangi LWD**

**Week 1 Report (26 November–3 December 2017)**

## Operations

IODP Expedition 372 began with first line ashore at Berth D, Victoria Quay, Fremantle, Australia, at 0742 h (UTC + 8 h) on 26 November 2017. Once the vessel cleared customs, the IODP JRSO technical staff and Co-Chief Scientists for Expedition 372 moved onto the ship at 0900 h. The Expedition 369 science party disembarked at 1130 h, followed by the offgoing technical staff at 1530 h. The Expedition 372 science party boarded the vessel on 27 November at 1030 h, and the ship crew change took place that morning.

Offloading of Expedition 369 shipments was completed by the ship crew and the IODP JRSO technical staff. Schlumberger representatives visited the ship to review logging-while-drilling (LWD) requirements and operations with members of the science party and operations personnel. In addition to the routine loading of supplies, the LWD tools were loaded onto the ship and a new Schlumberger logging cabled was loaded and stowed. Three Schlumberger LWD engineers moved onto the vessel in support of the logging program.

After a video survey of the ship's hull, it was decided that the ship would move to anchorage outside of Fremantle to have the hull cleaned in order to comply with New Zealand biofoul (clean hull) regulations.

The vessel completed fueling at 0945 h on 1 December. The crew secured the vessel and prepared for departure. The pilot boarded at 1124 h and the five-day port call concluded with the last line away from Victoria Quay on 1 December at 1148 h. The vessel transited approximately 10 nmi and dropped anchor in the ORAN1 anchorage area in Cockburn Sound for hull cleaning at 1311 h. The cleaning barge arrived at 1400 h and the hull-cleaning activities began. Hull cleaning concluded at 1610 h on 3 December and the pilot came aboard the vessel at 1652 h. After pulling up the anchor at 1706 h, the vessel began the sea passage at 1830 h on 3 December. At the end of the week the ship had completed 58 nmi of the 3407 nmi transit to proposed Site TLC-04B.

## Science Results

The Expedition 372 science party includes individuals from 12 IODP member countries and 14 nationalities. In addition, two Education Officers from the USA and New Zealand are on board to conduct outreach activities. Our first week consisted of the science party moving onto the ship, ship and laboratory safety orientations, and several meetings that covered: an overview of Expedition science objectives, Expedition activities, information technology on the ship, IODP

publications, curation, research planning, and education and outreach activities. Additionally, the science party attended presentations on the results of MeBO drilling and an overview of logging-while-drilling measurements. The science teams had initial laboratory orientations and began setting up seismic data projects.

*Expedition Science Objectives*

Expedition 372 combines two research topics: slow slip events (SSEs) on subduction faults (IODP Proposal 781A-Full) and actively deforming gas hydrate-bearing landslides (IODP Proposal 841-APL).

Gas hydrates have long been suspected of being involved in seafloor failure; not much evidence, however, has been found to date for gas hydrate-related submarine landslides. Solid, ice-like gas hydrate in sediment pores is generally thought to increase seafloor strength, as confirmed by a number of laboratory measurements. Dissociation of gas hydrate to water and overpressured gas, on the other hand, may destabilize the seafloor, potentially causing submarine landslides.

The Tuaheni Landslide Complex on the Hikurangi margin shows evidence for active, creeping deformation. The landward edge of creeping coincides with the pinch-out of the base of gas hydrate stability (BGHS) on the seafloor. Gas hydrate may be linked to creeping by (1) repeated small-scale sliding at the BGHS, in a variation of the conventional model linking gas hydrates and seafloor failure; (2) overpressure at the BGHS due to a permeability reduction linked to gas hydrates, which may lead to hydrofracturing, weakening the seafloor and allowing transmission of pressure into the gas hydrate stability zone; or (3) ice-like viscous deformation of gas hydrates in sediment pores, similar to onshore rock glaciers. The latter two processes imply that gas hydrate itself is involved in creeping, constituting a paradigm shift in relating gas hydrates to submarine slope failure. Alternatively, creeping may not be related to gas hydrates but instead may be caused by repeated pressure pulses or linked to earthquake-related liquefaction.

SSEs at subduction zones are an enigmatic form of creeping fault behavior. At the northern Hikurangi subduction margin (HSM), they are among the best-documented and shallowest on Earth. They recur about every 2 y and may extend close to the trench, where clastic and pelagic sediments about 1.0–1.5 km thick overlie the subducting, seamount-studded Hikurangi Plateau. The northern HSM thus provides an excellent setting to use IODP capabilities to discern the mechanisms behind slow slip fault behavior.

The SSE objectives will be implemented across Expeditions 372 and 375. Expedition 372 will undertake logging while drilling (LWD) at three sites targeting the upper plate, the frontal thrust, and the subducting section in the trench. Expedition 375 will undertake coring at the same sites, as well as an additional seamount site on the subducting plate, and install borehole observatories. Collectively, the LWD and coring data will be used (1) to characterize the compositional, structural, thermal, and diagenetic state of the incoming plate and the shallow plate boundary fault near the trench, which comprise the protolith and initial conditions for fault zone rock

associated with SSEs at greater depth, and (2) to characterize the material properties, thermal regime, and stress conditions in the upper plate above the SSE source region. Data obtained during Expedition 372 will be used to guide Expedition 375 operations and installation of CORK observatories at the frontal thrust and in the upper plate above the SSE source. These will monitor temporal variations in deformation, fluid flow, seismicity, and physical and chemical properties throughout the SSE cycle to test a suite of hypotheses about the fundamental mechanics and behavior of SSEs and their relationship to great earthquakes along the subduction interface.

**Education and Outreach**

Education and Outreach (E&O) activities included a presentation to the Expedition 372 science party, an interactive outreach event, as well as multiple posts on social media. During the presentation, the E&O Officers provided information on E&O activities that will be taking place during the cruise, as well as how the science party can be involved with the activities. One event took place during port call with an expedition scientist's undergraduate class at Ohio State University. This included a ship tour and Q&A session with the scientist. Ongoing live event scheduling has also been taking place, with multiple new events scheduled for the upcoming weeks.

Four posts were made to Twitter (https://twitter.com/TheJR) that included pictures showing the *JOIDES Resolution* (JR) in port, from its first day at sea, and to provide an announcement about a new blog and video that were posted. Three posts were made to Facebook (https://www.facebook.com/joidesresolution), including two short videos that were crossposted on the JR YouTube channel (https://www.youtube.com/user/theJOIDESResolution/) in the Expedition 372 playlist (https://www.youtube.com/playlist?list=PLroDmZEKRHPNv-Imwsdml38-D2rUoOLu6). Two blog posts were made and posted to the http://joidesresolution.org Expedition 372 page (http://joidesresolution.org/expedition/372/), outlining the basic objectives of the expedition and discussing the reason the JR has been delayed in leaving the Fremantle area.

Further E&O activities have focused on preparations for the upcoming weeks including: scheduling and preparing for future live interactive events; discussing participation of individual members of the science party in E&O activities and obtaining volunteers to participate; discussing individual scientists' E&O interests and how they fit in with other expedition E&O activities; and planning/working on individual E&O projects.

**Technical Support and HSE Activities**

IODP JRSO technical staff engaged in port call logistics, maintenance projects, safety training, and introduced the science party to the shipboard laboratories.

*Laboratory Activities*

- The microscopes were serviced in port.
- We have begun preparing for pressure coring system degassing in the core splitting room.
- The whole-round physical properties tracks have been dismantled and the counter tops were sanded and are being refinished. Once the counter tops are finished, the tracks will be reassembled and tested.
- The cold weather wall was assembled on the core receiving platform.

*Application Support and I.T. Activities*

- The Oracle database server was patched.
- The ship's internal webpages were updated.

*HSE Activities*

- The ship and laboratory safety meetings for the science party and new staff were conducted.
- The science party received a laboratory safety tour from the IODP JRSO technical staff.
- The technical staff completed the audit of hazardous storage areas and the weekly check of safety showers and eyewash stations.
- The weekly fire and boat drill was held.