

IODP Expedition 334: Costa Rica Seismogenesis Project (CRISP)
Week 2 Report (21-27 March 2011)

OPERATIONS

Week 2 of Expedition 334, Costa Rica Seismogenesis Project (CRISP), began with the bit at 502.87 mbrf (365.9 mbsf) while LWD drilling. LWD drilling continued without issue until 1100 hours on 23 March when the bit reached a final depth of 1099.8 mbrf (962.8 mbsf). The hole was then displaced with 210 bbls of 10.5 ppg mud. The drilling assembly was tripped to surface and the rig floor was secured ending Hole U1379A at 2254 hr. The vessel returned to Puntarenas, Costa Rica to offload the LWD tools, arriving at 1006 hrs on 24 March. Port call activities began immediately after arrival. All LWD tools and LWD support equipment were loaded onto trucks and the LWD engineers departed the vessel. The vessel remained on standby until the next favorable tidal window occurred at 2030 hrs. The last line was released at 2035 hrs beginning the transit back to Site U1379, averaging 11.8 knots for the voyage. At 1001 hrs the vessel was placed into auto heading/position dynamic positioning mode and operations began.

The APC/XCB bottom hole assembly (BHA) was run to just above the seafloor. The bit was placed at 130 mbrf and Hole U1379B was spudded at 0950 hrs on 25 March, 20 meters west of Hole U1379A. A 1.0 m core was recovered, indicating the seafloor to be at 138.5 mbrf. A second core was taken for geochemistry and microbiology sampling ending Hole U1379B. While attempting last core, the forward core line parted at the crown. Examination of the line revealed severe internal corrosion. After the excess wireline was cut away, the core barrel was retrieved using T-Bars and an air winch. Prior to pulling the core barrel out, the pipe was pulled clear of the seafloor ending Hole U1379B at 1030 hrs on 25 March. Total cored depth of Hole U1379B was 10.5 mbsf with 8.72 m recovery, yielding a 83% recovery rate.

Hole U1379C was spudded at 1300 hrs on 25 March, 20 m north of Hole U1379B. The mudline core was shot from 136.0 mbrf and recovered 6.68 meters, indicating the seafloor is at 138.8 mbrf. APC coring continued from Core U1379C-1H through U1379C-17H to a depth of 91.2 mbsf. All cores after the second core were partial strokes of the APC and the hole was advanced by recovery. A total of 91.81 meters of core were recovered at a rate of 100.7% on the APC section. The coring system was changed over to the XCB system and coring continued at the end of week 2 with excellent recovery through Core U1379C-50X.

SCIENCE RESULTS

On 23 March during the second week of Expedition 334, LWD operations were successfully completed at total depth of 960 mbsf, clearly fulfilling some of the objectives of this cruise as well as of this site. Site U1379 is located on the upper slope of the Costa Rica margin, 28.2 km offshore Osa Peninsula and Caño Island. This site is located above the locked portion of the plate boundary as indicated by interplate earthquake relocation and geodetic measurements. The primary purpose of drilling Site U1379 was to determine the nature, composition and physical properties of the upper plate basement. This site is also designed as “pilot hole” in preparation for proposed deeper CRISP Program B drilling at this location. Additional objectives included (1) determination of the stress and strain regime of the locked portion of the margin (2) reconstruction of the stratigraphy of the slope sediments and documentation of the margin subsidence/uplift, (3) understanding of the fluid flow regime and the role of slope sediments, and (4) estimation of the quantity of tectonically eroded upper plate material.

According to seismic data, the margin at Site U1379 consists of an upper plate basement underlying slope sediments about 890 m thick. This seems to be supported by our preliminary LWD data showing two basic units: the sediment (0-893 mbsf) and the basement (893-963 mbsf). With a few exceptions the

sediments generally have constant physical properties (resistivity, density, porosity, natural gamma ray radiation). At ~65 mbsf, a ~5 m thick interval of low gamma ray and borehole enlargement is visible that could be caused by unconsolidated sand, which has little natural radioactivity and washes out easily. At 475 mbsf, a sharp 1 m-thick peak in natural gamma ray radioactivity, which could be a volcanic sand/tephra or a layer rich in organic matter (which may contain uranium) was encountered. From 600-893 mbsf, the base of the sediment sequence shows an enlarged and irregular borehole. Some of the largest hole washouts, centered at 620 and 645 mbsf, coincide with low gamma ray values and could correspond to sand-rich intervals. The basement interval shows a clear increase in density and resistivity, which is consistent with a decrease in porosity.

By the end of the week (408.12 mbsf at 0000 hrs 27 March) these findings are supported by the material being cored. The majority of the cored material consists of a very monotonous sequence of very compact, mainly greenish gray silty clay to clay, which is rarely interrupted by dm-sized sandy layers frequently containing shell fragments. One of the unconsolidated sand layers has been recovered at 61-63 mbsf in Core U1379C-10H. Between Core U1379C-15H (83.80 mbsf) and 21X (125.74 mbsf) a ~42 m thick sequence of clayey silt to silty clay can be observed that is alternating with abundant discontinuous beds consisting of carbonate mud and horizons of hardened carbonate mud clasts in mostly a clayey matrix. Below this interval, the sedimentation returns again to the monotonous sequence of sediments consisting of silty clay to clay that alternates with dm-sized sandy layers. Bedding is only rarely visible in this monotonous clay sequence. Measured dips range from 8-35° true dip.

To determine the ages of the sequences onboard a combination of biostratigraphic investigations from nannofossils and magnetic measurements of the cored material is being employed. All nannofossil assemblages described are characteristic of the late Pleistocene to early middle Pleistocene (NN21/NN20).

Shipboard paleomagnetic studies for Hole U1379C consist of continuous measurements and progressive demagnetization of archive half core sections. Core sections measured so far (up to Core U1379C-8H) show consistently normal polarity.

Analytics of the pore water squeezed from the sediments at regular intervals show a steady increase in alkalinity from seawater values to 18 mM in the upper 10 mbsf, and a decrease starting at 50 mbsf to a minimum of 4 mM at 70 mbsf. Values increased slightly with depth from 80 to 220 mbsf. Sulfate decreases from seawater values, and reaches nondetectable levels at 27 mbsf. According to preliminary headspace gas measurements the sulfate/methane transition zone (SMTZ) occurs around 25 mbsf, where CH₄ concentrations increase from 5.2 to 10.7 ppmv. At a depth of 60 to 90 mbsf, CH₄ concentrations increase to 11121.7 ppmv. At depth of 64.8 mbsf ethane was detected (0.3 ppmv) for the first time. The C₁/C₂ is 26380 for this sample, indicating a microbial source. At a depth of 137.32 mbsf, large gas voids were observed and sampled. Methane and ethane were both detected. Methane concentrations range from 13929.69 to 944118.9 ppmv, ethane concentrations range from 0.0–212.1 ppmv. C₁/C₂ ratios range from 3929 – 7177, still indicative of a microbial source.

TECHNICAL SUPPORT AND HSE ACTIVITIES

During LWD and related activities, the science party and technicians prepared and trained in their respective labs. On 25 March the ship was back on location and coring began. During the week, the new cryogenic cooler was installed on the magnetometer with good results. As the week came to a close, scientists and technicians were busy in the labs processing and sampling cores from the Site U1379. A fire and boat drill was held for the ship's complement on Monday March 21.