

## **IODP Expedition 339: Mediterranean Outflow**

### **Week 5 Report (12-18 December 2011)**

#### **Operations**

The fifth week of Expedition 339 started while deploying the RCB coring assembly and the underwater camera system down to the seafloor. Once the video images provided by the underwater camera confirmed that the seafloor was clear of obstructions, the driller tagged the seabed with the bit at 569.8 mbsf (558.4 mbsl) at 1640 hr on 11 December. Following the retrieval of the underwater camera, Hole U1387C was spudded with the RCB at 1850 hr. The hole was drilled with a wash barrel in place to 290 mbsf where continuous RCB coring was initiated.

Rotary coring proceeded to a final depth of 870 mbsf by 0930 hr on 16 December. The results of the hole were 580 m cored with a recovery of 71%. The average rate of penetration for the cored interval was ~12 m/hr. The drilled portion of the hole was 290 m and the total penetration (cored plus drilled) was 870 m. While penetrating the cored interval, the drillers pumped 11 each 20-barrel and 2 each 30-barrel high viscosity mud flushes to keep the hole clean of cuttings.

Near the end of the week we carried out downhole logging operations in Hole U1387C. Following a wiper trip and a hole conditioning exercise, Hole U1387C was displaced with 290 barrels of 10.5 ppg mud to prepare the hole for downhole logging. The open end of the pipe was placed at a logging depth of 104 mbsf. The Triple Combo tool string descended through the seafloor at 0310 hr on 17 December and was run down to 1220 mbrf (651 mbsf) where it was blocked from further downhole progress by an obstruction in the hole. At this depth, a bridge or ledge had already been noted during the hole preparation from 649 to 653 mbsf. Logging started at 0539 hr and the tool string was back on deck by 0830 hr.

The Versatile Seismic Imager (VSI) tool was run as a second tool string during daylight. Marine mammal watch for conducting the vertical seismic profile experiment (VSP) started at ~1000 hr. The airguns (2-gun cluster, 7 m below sea level on the port side) had been ramped up in a soft start procedure initiated at 1115 hr. The VSI tool started its descent down Hole U1387C at 1120 hr and reached an obstruction at 824 mbrf (255 mbsf) at 1205 hr. The shallow penetration for this tool run indicated that the hole was closing quickly with time. Despite the large diameter of the borehole and the soft formation, good first arrival times were obtained for five stations. The last log was made with the FMS-sonic, which was deployed at 1610 hr and could not go deeper than 334 mbsf. The FMS-sonic was recovered and disassembled by 2300 hr. The drilling equipment was secured and the vessel departed for Site U1388 (proposed site GC-04D) at 0230 hr on 18 December. The total time on site was 9.3 days.

## Science Results

The sedimentary sequence in Hole U1387B is essentially the same as that cored in Hole U1387A. It is dominated by the three lithofacies described previously as Lithologic Unit I at Site U1386: (1) nannofossil mud, (2) silty mud with biogenic carbonate, and (3) silty sand with biogenic carbonate. Although the overall abundance of the coarser lithologies is less in the upper ~350 m of Holes U1387A and U1387B than at Site U1386, variations in the relative abundances of the nannofossil mud vs. the coarser lithologies are similar to the pattern of relative abundance variations in Lithologic Unit I at Site 1386. That is an upper zone with relatively higher abundances of sands and silts, an intermediate zone with fewer sands and silts, and a lower zone with higher abundances of sands and silts.

The deeper interval cored in Hole U1387C included lithofacies and lithofacies sequences not encountered previously at this site; these include:

- 1) A 59 cm-thick bed of dolomitic mud in Core U1387C-19R and another one 12 cm-thick in Core U1387C-20R. These are massive beds composed of fine-grained dolomite. Their origin is still being discussed; in particular, whether they are detrital, represent hardgrounds, or are diagenetic.
- 2) A recurrent stacking pattern of the three lithofacies observed in the upper part of Site U1387, with shell-rich silty sand to sand grading up into silty mud, relatively lighter nannofossil mud, and relatively dark nannofossil mud, with a distinctive pattern of bioturbation in the upper 10-20 cm of each cycle. The lighter color lithofacies are interpreted as turbidites, whereas the darker muds are potentially contourites. This pattern is well-developed in Cores ~U1387C-19R through -33R.
- 3) Contorted/convolute bedding in several intervals from Core U1387C-34R (~600 mbsf) to Core U1387C-43R (~685 mbsf). These intervals are interpreted as recording submarine slumping events.
- 4) Partially cemented to heavily cemented sandstones in an interval of low recovery, from Core U1387C-43R (~685 mbsf) to Core -47R (~722 mbsf), and from Core U1387C-49R-CC (~748 mbsf) to Core -50R-1 (~751 mbsf). These include a gray, strongly cemented, well sorted sandstone with abundant subrounded quartz grains, shell fragments, and dissolution molds of shell fragments and a dark greenish gray weakly cemented, poorly sorted silty/muddy sandstone. Additional information about these sandstones will be derived from thin sections presently being prepared.

Below ~722 mbsf, the section is dominated by nannofossil muds and silty muds with biogenic carbonate, with nannofossil muds becoming even more abundant in the last three to four cores, and tending toward muddy nannofossil ooze.

As was true in Holes U1387A and U1387B, the sediments in Hole U1387C are dominated by colors of gray to greenish gray to dark gray to very dark gray. Macrofossil debris is relatively common, especially as shell fragments. Bioturbation intensity ranges from sparse to slight, and recognizable ichnofauna are more common than at Site U1386.

Core catcher samples from Holes U1387B and U1387C were prepared for nannofossil, planktonic and benthic foraminifer, and ostracod analyses. Pollen content was also examined in some samples of Hole U1387C. Additional samples from the lower section of Hole U1387C were also analyzed to provide supplementary biostratigraphic control at Site U1387. Based on various calcareous nannofossil and foraminifer events, we estimate that the recovered section at Site U1387 spans from the Holocene to c. 5.8 Ma. The compilation of the final version of the biostratigraphy report of Site U1387 is still in progress.

All routine physical properties measurements have been completed on all cores from Holes U1387B and U1387C. These include magnetic susceptibility, natural gamma radiation, bulk density, colorimetry, thermal conductivity, sediment strength, moisture and density; as well as natural remanent magnetization and associated rock magnetic experiments. Physical property records show very complex patterns that reveal changes in sand composition and major variations in the detrital content of the sediments.

The remanent magnetization of archive-half sections of APC/XCB and RCB cores from all holes at Site U1387 was measured before and after 20 mT alternating field demagnetization. Detailed measurements of the demagnetization behavior of discrete samples are currently in progress. Below ~100 mbsf in Holes U1387A and U1387B and ~430 mbsf in Hole U1387C magnetic polarity is mostly obliterated by a strong normal overprint and by coring disturbances. With the exception of the top part of the Brunhes Chron, and the termination of Chron C2n (Olduvai, 1.778 Ma) at ~410 mbsf in Hole U1387C the magnetostratigraphy cannot be resolved without the pending results from discrete samples.

A nearly complete composite stratigraphic record was constructed down to about 350 mbsf from the three holes cored at Site U1387. This site is only 3.8 km from Site U1386. Correlation of the composite sections from Sites U1386 and U1387 aid in assessing the completeness of the records and provides an opportunity to examine differences in sedimentation rates and processes that occur between the sites.

Standard gas analysis from headspace samples were performed for Hole U1387A from 0 to 352 mbsf and Hole U1387C from 354 to 865 mbsf. Methane, ethane, ethane and propane were detected. Bulk sediment analysis of CaCO<sub>3</sub>, total and organic carbon, and total nitrogen have been completed for Holes U1387A and U1387B, and are ongoing for Hole U1387C.

Whole-round samples were taken one per core from Hole U1387A for interstitial water analysis to a depth of 350 mbsf. We did not take pore water samples below this level because of severe bisquiting caused by XCB coring disturbance and drill water contamination of the interstitial

whole rounds during RCB drilling. Interstitial water measurements of alkalinity, chloride, ammonia, sulfate, and major and minor seawater elements for Site U1387 were completed. We also completed high-resolution water isotopic analysis for Hole U1386B to a depth of 83 mbsf.

### **Education and Outreach**

Expedition participants continue to share their experience aboard the *JOIDES Resolution* on the JR's website (<http://joidesresolution.org/blog>) and other blogging sites. The expedition's Education Officer continued to post daily updates on the JR Facebook page and Twitter account.

Four live ship-to-shore interactive video conferences program were conducted: on Tuesday with 5<sup>th</sup> graders from the Agrupamento nº 1 de Escolas de Portalegre that were visiting the Centro Ciência Viva de Estremoz (Alentejo, Portugal); on Wednesday and Friday with the two 10<sup>th</sup> graders classes of our Education Officer from the Escola Secundária de Loulé (Algarve, Portugal); and on Thursday with Undergraduate 'Ocean Sciences' students from the Universidade do Algarve (Portugal). Three other videoconferences are scheduled for next week.

### **Technical Support and HSE Activities**

Activities of the USIO marine technical staff included laboratory and instrument support, catwalk core processing, curation and storage of core sections from Site U1387. They also carried out marine mammal watch during the vertical seismic profile (VSP) experiment conducted at Site U1386. A H<sub>2</sub>S Gas Alert and Boat Drill were held for all expedition participants on December 17.