

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

### **Week 8 Report (1-8 January 2012)**

#### **Operations**

Week 8 of Expedition 339 started while conditioning Hole U1389E in preparation for downhole logging. After concluding the wiper trip, the bit was released and the hole displaced with 375 barrels of 10.5 ppg logging mud. The end of pipe was positioned at 102.2 m. The first log was made with the Triple Combo, which was deployed shortly after midnight on 1 January 2012. The tool was not able to pass a bridge or ledge at 567 m. After logging the hole up from 567 m, the tool was recovered at 0610 hr. The second logging experiment was made with the FMS-Sonic tool string – it also was unable to penetrate deeper than 567 m. The FMS-sonic was recovered at 1425 hr after logging the upper portion of the hole.

The vertical seismic profile experiment had to be canceled. Shortly after arriving on Site U1389, maintenance was carried out in the vessel's sea chest and bilge spaces. As part of this routine, ultrasonic thickness readings were taken on the steel plating. Evaluation of the thickness readings indicated that some of the sea chest plating had wastage beyond acceptable limits and that several frames on the starboard side required immediate attention, and therefore repairs began. Although repairs were in progress, it was decided to not subject the deteriorated sea chest to the sound pressure generated by the air gun used for vertical seismic profiling. Therefore, the remaining VSP experiments planned for this expedition have been cancelled. The logging equipment was rigged down and the drillstring recovered and the beacon recalled. The vessel departed for the sixth site of the expedition at 1930 hr on 2 January 2012. The total time on Site U1389 was 12 days.

The 22 nmi transit to Site U1390 (proposed site GC-02B) was covered in just over two hours. The vessel was positioning on the new coordinates at 2145 hr on 2 January 2012. The APC/XCB bottom hole assembly and the drill string were deployed with the underwater camera. A survey of the seafloor was conducted using a 30-m grid pattern. Other than one large rock, no significant obstructions were observed. Hole U1390A was spudded with the APC at 0520 hr on 3 January. The seafloor depth was established at 1005.1 mbrf (993.4 mbsl); this is 3.1 m deeper than the corrected PDR value of 1002 mbrf. Piston coring was only able to advance to 76.7 m. The decision was made to switch to the XCB when the last APC core (U1390A-9H) required nearly three hours to extract from the core barrel. The recovery for the piston-cored interval was 102%. Cores were oriented starting with U1390A-4H. APCT3 temperature measurements were made at 32.1 m (U1390A-4H) and 60.6 m (U1390A -7H). XCB coring deepened the hole to the depth objective of 350 m by 1700 hr on 4 January. Recovery for the 273.3 m XCB cored interval was 91%. The overall recovery for Hole U1390A was 93%.

Instead of logging the third hole on site, it was decided to log Hole U1390A. The hole was subjected to the routine conditioning procedures including a wiper trip, mud flushes, and

displacement with 124 barrels of 10.5 ppg mud before the bit was placed at 96.6 m. The logging program consisted of the Triple Combo and FMS-sonic tool strings. The Triple Combo was deployed at midnight on 4 January and recovered at 0330 hr. The FMS-Sonic was run in at 0600 hr and recovered at 1000 hr on 5 January. Both tools successfully covered the open hole down to 350 m. After the FMS-Sonic was rigged down, the bit was pulled clear of the seafloor at 1155 hr on 5 January.

The vessel was offset 200 m north of Hole U1390A and the underwater camera monitored the seafloor during the movement of the vessel. Once the vessel was on position, Hole U1390B was spudded with the APC from 1002 mbrf at 1700 hr. The calculated seafloor depth was 1002.4 mbrf (990.7 mbsl). Piston coring advanced to 194.1 m where Core U1390B-21H could not be recovered with the coring line. When the orientation tool was retrieved to the surface by the coring line, it was discovered that the bulkhead lock pin between the male and female sections that connect the non-magnetic sinker bars to the core barrel had parted in two places (possible metal fatigue). After several fishing attempts failed to grasp the female section which remained downhole with the core barrel, the BHA was recovered and the core barrel extracted at the surface. The bit was at the rotary table at 2120 hr on 6 January. Piston coring recovered 189.9 m which represented 98% of the cored interval. Cores were oriented starting with Core U1390B-3H. APCT3 temperature measurements were obtained at 18.6 m (U1390B-2H), 47.1 m (U1390B-5H), and 75.6 m (U1390B-8H). All cores were obtained with non-magnetic core barrels.

The drillstring was re-deployed and the vessel offset 20 m east of Hole U1390B. Hole U1390C was spudded with the APC at 0240 hr on 7 January and established the seafloor depth at 1004.1 mbrf (992.4 mbsl). Piston coring proceeded to the depth objective of 174.5 m by 2200 hr 7 January. There were stuck core barrels on Cores U1390C-2H, -3H, and -4H that required an extra coring line round trip to pull the orientation tool before it was possible to recover the core barrel. Cores were oriented starting with Core U1390C-4H and then followed by Cores U1390C-9H to -19H (last core). APCT3 temperature measurements were obtained at 23.4 m (U1390C-3H), 51.9 m (U1390C-6H), 80.4 m (U1390C-9H), and 108.9 m (U1390C-12H). Non-magnetic core barrels were used to obtain all cores. The bit was pulled free of the seafloor at 2300 hr and cleared the rotary table at 0115 hr on 8 January. The vessel departed Site U1390 for the last site of the expedition at 0230 hr on 8 January. The total time on site was 5.2 days.

The 115 nmi voyage to Site U1391 (proposed site WI-01B) was made at an average speed of 11.5 knots. The vessel was positioning on the new site at 1230 hr on 8 January.

## **Science Results**

This week we completed measuring, splitting and describing all cores and samples taken at Sites U1389 and U1390. Geochemical analyses of sediment and interstitial water samples from Site U1390 are still ongoing. Expedition scientists completed the reports from Site U1389 and

presented the results at the science meeting. Later in the week, the Chief Scientists summarized and presented the scientific highlights achieved so far by Expedition 339.

The sediment recovered at Site U1390 is classified generally as mud (calcareous mud, mud with biogenic carbonate and biogenic mud), silty mud (calcareous silty mud, and silty mud with biogenic carbonate), sandy mud (sandy mud, and sandy mud with biogenic carbonate), and silty sand (silty sand with biogenic carbonate and calcareous silty sand). In the top 300 m, relative proportions of mud, silty mud, sandy mud and silty sand vary widely, showing a pattern of 20-30 m of coarser sediment, consisting of interbedded mud and coarser beds each about 1.5 m thick, followed by an interval of about 10 m of calcareous mud. From 300 m to 350 m (in Hole U1390A), the interval is characterized by a relatively high proportion of coarser sediments in thick beds, among them at least two sandy contourite beds each exceeding 4 m in thickness. Overall the number of sandy beds (sandy mud and silty sand) varies between 0 and 10 per core at all holes. As is observed at the previous sites, contourite bedding shows both typical bigradational grading and normal grading patterns with sharp bottom contacts, but a high number of inverse graded beds (top-cut-out contourites) are observed at Site U1390.

Core catcher samples from all holes cored at Site U1390 were prepared for nannofossil, planktonic and benthic foraminifer, and ostracod analyses. Pollen content was also examined in seven samples from Hole U1390A. Preliminary results based on various nannofossil biostratigraphic events indicate that the sedimentary section recovered at Site U1390 spans 1.2-1.56 Ma.

Standard gas analysis from headspace samples have been completed for Site U1390. Methane, ethane, and propane were the only hydrocarbons detected. Bulk sediment analysis of  $\text{CaCO}_3$ , total and organic carbon, and total nitrogen have also been completed. Weight percent  $\text{CaCO}_3$  varies from 21.1 to 34.5 wt% with no discernible trends downhole. Organic carbon is low, generally under 1 wt%, and varies between 0.4 and 1.12 wt%.

Whole-rounds for pore-water analyses were taken (1 per core) and squeezed to a depth of 350 m in Hole U1390A. Elemental analyses were made on 35 samples including alkalinity, chloride, ammonia, sulfate, and major and minor seawater elements. Chloride and sodium are especially noteworthy in that they steadily increase downhole from bottom water values to a maximum of 1800 and 1300 mM, respectively, at 328 m. Sodium/chloride ratios are all below the modern seawater value of 0.86, except at 81.1 m. All the alkali earth elements (Ca, Mg, Sr, Ba) have very similar downhole pattern, suggesting that the same process controls their concentrations. Pore-water isotopic measurements are underway for Site U1390.

Measurements of physical properties (magnetic susceptibility, natural gamma radiation, Gamma Ray density, color reflectance spectrometry, thermal conductivity as well as moisture and density determinations on discrete samples) continued at Hole U1389E and Holes U1390A, U1390B and U1390C. At Site U1389 a coherent pattern of high magnetic susceptibility, GRA density, and a\*

(i.e. reddish color) has been observed in the upper part of the section in sand layers interpreted as contourite deposits. This relation changes in the deeper sandy intervals believed to be influenced more by gravity flows (i.e. turbidites), suggesting that different sedimentary processes are controlling the sediment composition over time. Porosity data from Site U1389 also reveals coherence with a marked positive chlorinity anomaly observed in the pore water chemistry indicating changes in permeability of the strata in relation to lateral fluid migration.

We measured the remanent magnetization of archive-half sections of APC and XCB cores from Holes U1390A and U1390B before and after 20 mT alternating field demagnetization. Measurements of cores from Hole U1390C are currently in progress. Paleomagnetic data from Site U1390 document an outstanding record of Brunhes Chron (C1n) variability at high resolution. The interpretation of negative polarity intervals near the bottom of Hole U1390A will require guidance by biostratigraphic data and pending results from discrete sample demagnetizations and associated analyses.

The three holes cored at Site U1390 provide enough material to produce a composite stratigraphic section that is complete with no gaps from the seafloor down to the base of Core U1390A-21X at 188.8 m, which corresponds to ~202 meters composite depth (mcd). The lower section at Site U1390 was cored only in Hole U1390A down to a total depth of 350 m, with short gaps inevitably occurring between cores and larger gaps occurring whenever core recovery was low.

Downhole logging measurements were made in Hole U1389E after completion of XCB coring terminated at 989.9 m (DSF). The Triple Combo and the FMS-Sonic tool strings were deployed. The Triple Combo measured resistivity, density, porosity and natural gamma radiation of the borehole from 567 m up. The lower 423 m of Hole U1389E remain unlogged. Only one pass was performed because Hole U1389A was already logged. The Formation MicroScanner-sonic tool recorded resistivity images of the borehole, sonic velocities, and natural gamma data over the same depth interval during the first pass, but only from 525 m in the second pass due to another bridge encountered when lowering the tool string in the hole for the second run.

This week downhole logging was also conducted in Hole U1390A. Both the Triple Combo and FMS-sonic tool strings successfully collected data to the total depth of the hole (350 m).

### **Education and Outreach**

This week education and outreach events have continued through diverse activities. Blogs posted on the JOIDES Resolution site (<http://joidesresolution.org/blog>) include life at sea, day to day operations, and scientific research ongoing aboard the JR written in several languages (English, Portuguese, French, Spanish, Dutch and Japanese) by our international bloggers.

Three live ship-to-shore interactive video conference programs were conducted with 7th, 8th, 10th and 11th graders from Escola Secundária Miguel Torga (Monte Abraão, Portugal), 7th to

10th graders from Fernie Secondary School (Canada), and 7th to 9th graders from Escola D. Manuel I (Tavira, Portugal). Twelve more videoconferences are scheduled for next week.

In addition, the expedition's Education Officer continued to post daily updates on the JR Facebook page and Twitter account. Updates included links to the blog or other pages on the JR website and photos. Our Education Officer continues to dedicate significant time to his own students developing mathematical problem sets that will be delivered to them in the classroom by his fellow teachers.

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

The USIO technical staff was engaged in core processing at Site U1390. Other activities included assistance with laboratory and instrument support, as well as minor software upgrades to various applications.

An Abandon Ship drill was held for all hands on 3 January.