

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

### **Week 9 Report (9-15 January 2012)**

#### **Operations**

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 last site of the expedition at 1230 hr on 8 January. The APC/XCB bottom hole assembly was made up and the routine survey of the sea floor was conducted using a 30-m grid pattern. No significant obstructions were observed. Hole U1391A was spudded with the APC with the bit at 1080.0 mbrf at 2035 hr on 8 January. The seafloor depth was established at 1085.4 mbrf (1073.7 mbsl). Piston coring advanced to final depth of 171.1 m with a recovery of 106%. Cores were oriented starting with -4H. There were temperature measurements made at 32.6 m (-4H), 61.1 m (-7H), 89.6 m (-10H), 118.1 m (-13H), and 146.6 m (-16H). Non-magnetic core barrels were used to obtain all piston cores. XCB coring deepened the hole to the depth objective of 353.1 m by 0345 hr on 10 January. The recovery for the 182 m XCB cored interval was 89%. Combined recovery for Hole U1391A was 97%. The drillstring was pulled out of the hole clearing the seafloor at 0520 hr on 10 January. The vessel was then offset 20 m south from Hole U1391A.

Hole U1391B was spudded with the APC from 1085 mbrf at 0815 hr on 10 January. Although the mudline core was 9.65 m, the desired vertical offset (5 m deeper) with the previous hole was maintained and piston coring continued to a final depth of 171 mbsf with a recovery of 104%. Cores were oriented starting with -3H. Temperature measurements were made at 19 m (-2H), 47.5 m (-5H), 76 m (-8H), 104.5 m (-11H), and 133 m (-14H). All cores were obtained with nonmagnetic core barrels. XCB coring deepened the hole to the depth objective of 353.5 m. The recovery for the XCB cored portion of 182.5 m was 93%. Combined recovery for Hole U1391B was 98%. The drillstring was recovered with the bit clearing the seafloor at 1350 hr and the rotary table at 1850 hr on 11 January. The trip out of the hole was suspended 1.5 hours for the routine maintenance procedure of slipping and cutting the drilling line.

A 4-stand RCB bottom hole assembly was made up with a new CC-4 bit and MBR and deployed. After the driller tagged the seafloor at 1085 mbrf (1073.3 mbsl), Hole U1391C was

spudded with the RCB at 2345 hr on 11 January. The hole was drilled with a wash barrel down to 340 m by 1400 hr on 12 January. The empty wash barrel was recovered and a fresh core barrel dropped at 1430 hr when rotary coring was initiated. Rotary coring advanced to a final depth of 671.5 m by 1645 hr on 14 January. Recovery for the 331.5 m cored interval at U1391C was 81%. The percentage was adversely affected by the zero recovery in Cores -26R, -29R, and -35R that was assumed to be formation related. The average ROP for the 331.5 m cored interval was 14.2 m/hr.

Following the wiper trip, the hole was flushed with sepiolite mud and the bit released at the bottom. The hole was displaced with 248 barrels of 10.5 ppg heavy mud and the end of pipe placed at the logging depth of 98.9 mbsf. The first log of the hole was made with the Triple Combo tool string, comprising natural gamma, density and resistivity tools. It was deployed at 0330 hr on 15 January and succeeded in reaching 668 mbsf. The tool suite was recovered and rigged down by 0815 hr. The second and final log was made with the FMS-sonic tool string reaching 666 mbsf. It recorded resistivity images of the borehole, sonic velocities, and natural gamma data. The hole contained many thin washouts. Logging equipment was rigged down by 1915 hr, concluding all science operations of the expedition. We plan to depart for Lisbon no later than 0400 hr on 16 January.

### **Science Results**

This week we completed all measurements and descriptions of all the cores and samples taken at Site U1391. Geochemical analyses of sediment and interstitial water samples from Sites U1390 and U1391 were finalized as well. Expedition scientists completed all reports from Sites U1390 and U1391 and will present the scientific results of the last site of the expedition on Monday 16 January before arriving in Lisbon, Portugal.

The sedimentology team completed the lithologic description of all cores from Holes U1391A, U1391B and U1391C. Recovered sediments are classified generally as calcareous mud (mud with biogenic carbonate, nannofossils mud and biosiliceous mud), calcareous silty mud, calcareous sandy mud, and calcareous silty sand. In the top 180-200 m, essentially typical bigradational contouritic sequences with bioturbated and gradational bottom and upper contacts

are observed, with maximum grain-size ranging in silty mud, sandy mud or silty sand. Some bigradational sequences are observed with a sharp to erosional contact in the middle of the sequence, at the base or at the top of the maximum grain size. A few sharp base and normal grading sequences, with maximum grain size in silty mud, sandy mud or silty sand, are also observed. This interval is also characterized by alternation of dark reddish/brownish and greenish gray sediments.

From 180-200 m in Holes U1391A and U1391B to 670 m at the bottom of Hole U1391C, contouritic sequences become rare and have a maximum silty mud grain size. This interval is also characterized by the alternation of thicker greenish gray sediments and somewhat thinner greenish beds. At 604 m in Hole U1391C, a potential debrite of at least 35 cm thick (missing the top) is observed. At 632 mbsf, there is a 56 cm-thick dolomitic mudstone barren of nannofossils and overlain by biosiliceous mud.

Core catcher samples from Holes U1391A, B, and C were prepared for nannofossil, planktonic and benthic foraminifer, and ostracod analyses. Pollen content was also examined in six samples from Hole U1391A, and two of the Hole U1391C. Preliminary results based on various nannofossil and planktonic foraminifer events indicate that the cored section at Site U1391 spans between 3.31 and 3.5 Ma.

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) were completed at Holes U1390C, U1391A, U1391B and continue at Hole U1391C. At Site U1391, as has been observed at the other sites drilled, physical property data show relatively close tracking of magnetic susceptibility and bulk density in much but not all of the section. These may correlate or anti-correlate with NGR values, and with color reflectance ( $L^*$  and  $a^*$  values). Both larger-scale trends and smaller-scale cycles are evident, with some correlation at the small-scale with lithology. In lithostratigraphic Unit II below about 660 mbsf, there is much lower NGR variability and very low MS values.

The three holes cored at Site U1391 provide enough material to produce a composite stratigraphic section that is complete with no gaps to the base of the APC cored section at 196 mcd (171 mbsf). The section remains virtually complete, with only a few gaps all the way down 413 mcd (354 mbsf). The section below this is cored only in Hole U1391C down to a total depth of 671.5 mbsf, with short gaps inevitably occurring between cores and larger gaps occurring whenever core recovery is low.

The remanent magnetization of archive-half sections of APC/XCB and RCB cores from all holes at Site U1391 was measured in the paleomagnetism lab after 20 mT alternating field demagnetization. Measurements of the deepest parts of Hole U1391C are currently in progress. Above ~170 mbsf in Holes U1391A and U1391B an outstanding record of Brunhes Chron variability is preserved. In the XCB sections below that depth magnetic polarity is mostly obliterated by a strong normal overprint and by coring disturbances. Hole U1391C exhibits a well-preserved record of the Matuyama Chron and the onset and termination of the Olduvai Subchron (1.945 - 1.778 Ma) in Cores U1391C-15R through 17R. Initial analysis suggests that the lower part of Hole U1391C reaches the Gauss normal chron.

Standard gas analyses were completed for 34 headspace samples from Hole U1391A and 32 samples for Hole U1391C. Methane, ethane, and propane were the only hydrocarbons detected. Sediment samples were collected for analysis of solid-phase geochemistry (inorganic and organic carbon) at a resolution of approximately one sample per core in Holes U1391A. Weight percent CaCO<sub>3</sub> varies from 17.5 to 45.2 wt% and organic carbon between 0.5 and 1.8 wt%

Interstitial water samples were taken in every other section for the top 200 m in Hole U1391A except the bottom section where whole-round samples were taken (1 per core) and squeezed to a depth of ~350 mbsf. Elemental analyses were completed on 37 samples from Hole U1391A including alkalinity, chloride, ammonia, sulfate, and major and minor seawater elements. Whole-round samples were taken (1 per core) in Hole U1391C from 350 mbsf to the bottom of the hole (671 mbsf). Elemental analysis of these samples is underway. In addition, water isotopic measurements were completed for 34 samples at Site U1390 using the Picarro water isotope analyzer.

## **Education and Outreach**

Expedition participants continued to share their experience aboard the JOIDES Resolution on the JR's website (<http://joidesresolution.org/blog>) and other blogging sites. Thirteen live ship-to-shore interactive video conferences programs were conducted with 12th graders from Escola Secundária de Albufeira (Portugal), 8th and 9th graders from Escola Básica e Secundária de Albufeira (Portugal), 4th graders from Antonio Osuna State School (Spain), 10th graders from Escola Secundária de Loulé (Portugal), 10th graders that were visiting the Science Museum 'Centro Ciência Viva de Lagos' (Portugal), general public attending the 'Café Oceano' (Faro, Portugal), 10th graders from 'Ota Girls' High School (Japan), Escola Ciência Viva do Agr. Fernando Pessoa (Lisboa, Portugal), 10th graders from Arnold O Beckman High School (California, USA), 7th graders from Koganei Junior Highschool (Japan), 11th graders from 'Montes N.' Secondary School (Spain) and 11th graders from King Edward VI School (Southampton, United Kingdom).

During the last 8 weeks 31 video live broadcasts were conducted with audiences from 7 different countries (Canada, Japan, France, Portugal, Spain, United Kingdom and the United States) reaching around 1000 students and 200 adults with ages ranging from 3 to 82 years old.

The expedition's Education Officer continued to post daily updates on the JR Facebook page and Twitter account. Updates include links to the blog or other pages on the JR website (e.g. expedition page, glossary, ask a scientist answers page) and photos.

## **Technical Support and HSE Activities**

The USIO technical staff was engaged in core processing at Site U1391. Other activities included assistance with laboratory and instrument support, minor software upgrades to various applications, and laboratory cleaning in preparation for portcall activities.

The last Abandon Ship drill was held for all hands on 12 January.