

November 2, 2004

## IODP EXPEDITION 303: NORTH ATLANTIC CLIMATE I SITE 1305 SUMMARY

1305A Latitude: 57°28.507'N Longitude: 48°31.842'W

1305B Latitude: 57°28.507'N Longitude: 48°31.813'W

1305C Latitude: 57°28.509'N Longitude: 48°31.783'W

Water depth: 3459 mbsl

Site 1305 is located close to the southwest extremity of the Eirik Drift, 82.2 km south of ODP Site 646. The thickness of the sediments above the mid-Late Pliocene seismic reflector R1 (about 540 m) is almost twice that at ODP Site 646. The water depth (3459 m) means that the seafloor at Site 1305 lies below the main axis of the Western Boundary Under Current (WBUC) and hence the site preserves expanded interglacial intervals, and relatively condensed glacial intervals. The high mean sedimentation rate, over 17 cm/ky for the Quaternary, promises a high-resolution record of ice sheet instability and changes in surface and deepwater masses.

Three holes were cored at Site 1305 with the APC system to a maximum depth of 287.1 mbsf with an average recovery of 104%. Six cores had to be obtained by drill over in Hole 1305A, two in Hole 1305B, and none in Hole 1305C. After completing coring operations, Hole 1305C was prepared for logging, and the Triple-Combo tool string was deployed to ~258 mbsf, (~29 m from the bottom of the hole). The hole was logged successfully on the first pass, but the tool became stuck when attempting to retrieve it into the drill pipe after a short second pass. The tool was eventually freed, and upon retrieval we discovered that one of the caliper arms had broken off and the logging line had been damaged. Because of heave state (up to 4 m), the hole condition, tool safety, and operational constraints, we decided to forgo the deployment of the FMS-sonic tool string, concluding operations at Site 1305.

The sediments at Site 1305 are designated as a single unit dominated by varying mixtures of terrigenous components and biogenic material, primarily clay minerals, quartz, detrital carbonate, and nannofossils. Total carbonate content ranges from 1 to 49%. The most common lithologies are dark gray to very dark gray silty clay, silty clay with nannofossils, nannofossil silty clay, silty clay nannofossil ooze, and nannofossil ooze with silty clay. In addition, olive gray sandy silt laminae and centimeter- to decimeter-scale intervals of silty clay with detrital carbonate are present at Site 1305. The sediments are gradationally interbedded at scales of a few meters or less.

Calcareous, siliceous, and organic-walled microfossils show generally good preservation and abundance in the upper ~200 mcd. However, the abundance of microfossil assemblages is variable below this depth with generally poorer preservation. All microfossil groups investigated are dominated by subpolar to polar assemblages. Planktonic foraminifers show a biomodal test size distribution. The small test-sized planktonic foraminifers, which are cold-water species, coexist with increased abundance of benthic foraminifers, possibly indicating transport by bottom currents.

The sediments at Site 1305 carry well-defined magnetization components and appear to provide useful records of geomagnetic transitions. Natural remanent magnetization (NRM) intensities are strong both before and after demagnetization and show variability at both the meter scale and throughout the sequence. NRM intensities decrease by about one half below 166 mcd. Directional magnetization data allow identification of the Brunhes and part of the

Matuyama Chronozone, including the Jaramillo, Cobb and Olduvai Subchronozones. The Cobb Mountain Subchronozone and the top of the Olduvai Subchronozone are less clearly identified because of the incomplete removal of the normal polarity drill string magnetic overprint.

A continuous stratigraphic composite section was constructed to ~295 mcd with a single problematic interval between 197.2 and 206 mcd. The mean sedimentation rate calculated using biostratigraphic and magnetostatigraphic datums is 17.3 cm/ky for the entire section cored at Site 1305. Using only paleomagnetic datums results in sedimentation rates that are still relatively uniform with the exception of a greater mean sedimentation rate between 1.07 and 1.19 Ma (from the base of the Jaramillo to the top of the Cobb Mountain Subchronozones) that averages 29.3 cm/ky.

Despite the low organic carbon content (mean < 0.4 wt%), organic matter diagenesis dominates the pore water chemistry. Sulfate decreases linearly downcore and is completely reduced by 58 mbsf. Methane increases immediately below the sulfate reduction zone reaching a maximum of 46,000 ppmv at 228 mbsf. Ethane fluctuates between 2-14 ppmv within the methanogenic zone, but no higher hydrocarbons were detected. Alkalinity increases downcore reaching a maximum of 18.9 mM at the sulfate-methane interface (SMI). Calcium reaches a minimum of 2.58 mM at the same depth, suggesting carbonate precipitation associated with anaerobic methane oxidation at the SMI. Similar to previous Expedition 303 locations, dissolved strontium at Site 1305 is at or below seawater values indicating little or no carbonate dissolution or recrystallization.

Physical property records at Site 1305, in particular magnetic susceptibility and density, are highly variable, recording lithologic and mineralogic changes. Low magnetic susceptibility and density values usually coincide with the presence of silt-sized detrital carbonate. Natural gamma radiation increases towards the transition between detrital carbonate and terrigenous-dominated layers, suggesting a relative increase in the clay component. Site 1305 sediments are also characterized by an overall downcore increase in density (from 1.3 to ~1.9 g/cm<sup>3</sup>), decreasing porosity (from 80 to 62%) and low velocities (1500-1600 m/s).

Wireline logging data from Hole 1305C span the interval 95.3 to 265.9 mbsf. The "Triple-combo" tool string was successfully deployed, yielding downhole records of density, porosity, natural gamma radiation, electrical resistivity and photo-electric factor. Density and porosity are generally inversely related to each other with density increasing downhole and porosity decreasing. Density and porosity data are, in some places, affected by the large diameter of the hole (up to ~18 in), although these intervals most likely correspond to softer, more easily washed away sediments. Density and gamma-ray logging data show similar downhole trends to those observed in core data, suggesting that it will be possible to correlate core and log data. The logging data also exhibit stratigraphic trends that appear to be cyclic, possibly caused by temporal changes in lithology. Successful core-log integration will permit an assessment of the origin and significance of the trends in the logging data.

The initial analysis of MST, AMST, biostratigraphic and paleomagnetic data indicates that a complete and continuous high-resolution record (mean sedimentation rate of 17.3 cm/ky) covering the uppermost Pliocene and Quaternary has been recovered at Site 1305. The record represents a rich archive of environmental change that will document episodes of instability in the surrounding (Laurentide, Greenland and Inuitian) ice sheets, the history of surface currents and deep-water currents, and hence the strength of the Western Boundary Under Current that contributes to North Atlantic Deep Water. Good preservation of both planktonic and benthic foraminifers for isotopic analysis, and a high fidelity paleomagnetic record, indicate that the environmental record has the necessary attributes for construction of a paleointensity-assisted chronostratigraphy.