

November 15, 2004

IODP EXPEDITION 303: NORTH ATLANTIC CLIMATE I SITE 1308 SUMMARY

Hole 1308A Latitude: 49°52.666'N, Longitude: 24°14.287'W
Hole 1308B Latitude: 49°52.667'N, Longitude: 24°14.313'W
Hole 1308C Latitude: 49°52.684'N, Longitude: 24°14.287'W
Hole 1308D Latitude: 49°52.700'N, Longitude: 24°14.287'W
Hole 1308E Latitude: 49°52.700'N, Longitude: 24°14.287'W
Hole 1308F Latitude: 49°52.700'N, Longitude: 24°14.312'W
Water depth: 3871 mbsl

Site 1308 constitutes a reoccupation of DSDP Site 609. Two principal holes (Hole 609 and Hole 609B) were drilled to 399 and 355 mbsf respectively with the Variable Length Piston Coring System (VLHPC) and XCB during DSDP Leg 94 (June-August, 1983). In addition, two cores were collected at Hole 609A to recover the mudline, and seven XCB cores were collected at Hole 609C to recover the 123-190 mbsf interval. Samples from DSDP Site 609 have played a major role in driving some of the most exciting developments in paleoceanographic research during the last 10-15 years such as the recognition and understanding of Heinrich Layers, the recognition of the 1500 yr cycles in hematite-stained grains and Icelandic glass, and the correlation of ice-core $\delta^{18}\text{O}$ to sea surface temperature proxies. The majority of the analyses from Site 609 have dealt with the record younger than MIS 6, partly because of the lack of a continuous pristine composite record. A primary objective at Site 1308, the re-occupation of Site 609, was to recover a demonstrably complete composite record, and hence considerably enhance the potential for Pliocene-Quaternary climatic records from this site.

Six holes were cored with the APC system at Site 1308: Hole 1308A to 341.mbsf, Hole 1308B to 198.3 mbsf, Hole 1308C to 279.9 mbsf, Hole 1308D to 6.7 mbsf, Hole 1304E to 193.0 mbsf and Hole 1308F to 227.0 mbsf. Average recovery was 95.4% for the cored intervals. Sea swell up to 6 m affected Hole 1308A core quality below ~ 170 mbsf. Therefore, we waited ~16 hr for the swell to abate before coring Hole 1308B. Coring in Hole 1308B was terminated after three successive poor recovery cores suggested accumulation of debris either in the hole or in the bottom-hole assembly. However, we could not spud Hole 1308C because of incomplete firing of the APC indicating the problem was bit obstruction. After clearing the bit, Holes 1308C, 1308D, and 1308E were cored, but core recovery was not optimal (<100%) due to loss of core from the base of core liners and, possibly related, crushed core liners. Before coring Hole 1308F, procedures to clear the bit were enacted again and Hole 1308F was cored with an average recovery of 100.7%, although crushed liners were still common.

The upper Miocene through Quaternary sedimentary succession at Site 1308, which is subdivided into two units, records variations in the input of terrigenous and biogenic sediments, primarily nannofossil ooze, nannofossil silty, and silty clay. Unit I (0-196.85 mcd) is composed of a Holocene to upper Pliocene sequence of interbedded biogenic and terrigenous sediments with dropstones. Subunit IIA (196.85-262.14 mcd) is upper Pliocene nannofossil ooze interbedded with terrigenous sediment-rich layers but at a lower frequency than Unit I. Subunit IIB (262.14-355.89 mcd) is entirely composed of lowermost upper Pliocene to uppermost Miocene nannofossil ooze.

Diverse assemblages of calcareous, siliceous, and organic-walled microfossils were recovered at Site 1308. Calcareous microfossils are abundant with good preservation in the upper ~180 mbsf, grading to moderate preservation below this depth. Siliceous microfossils are rare to

common and moderately preserved above ~255 mcd (upper Pliocene-Pleistocene), with radiolarians locally abundant only in the middle part of the cored sequence. Siliceous microfossils are absent below 255 mcd. The concentration of terrestrial palynomorphs is low. Dinocysts are common to abundant in the upper 200 mcd, but less common below. Microfossil flora changes observed at Site 1308 document the onset of Northern Hemisphere glaciation, as well as seasonal changes in bioproductivity and hydrographic fronts.

Paleomagnetic directional data document an apparently continuous sequence of polarity transitions. Identification of the Brunhes, Matuyama, and Gauss Chronozones are unambiguous. The Gilbert Chronozone is tentatively recognized in the lower part of Hole 1308A. The Jaramillo, Cobb Mountain, Olduvai, Reunion, Kaena, and Mammoth Subchronozones are also clearly identified.

Six holes were cored at Site 1308 to ensure the complete recovery of the stratigraphic section to 239 mcd. The unusually large number of holes was required because of poor recovery and core disturbance due to excessive heave and crushed core liners. There is one problematic interval between ~186 mcd and ~196 mcd where inclined bedding and sharp lithologic contacts suggest a possible break in continuity of sedimentation. The mean linear sedimentation rate calculated using magnetostatigraphic datums is ~8 cm/ky for the last ~3.5 Ma. Prior to that time the mean sedimentation rate was ~3.3 cm/ky based on biostratigraphic markers.

Interstitial water sulfate decreases downhole to 9 mM, but complete sulfate reduction is not achieved within the cored interval. Unlike all other Expedition 303 sites, strontium increases with depth to a maximum of 1592 μM at Site 1308. The nearly linear strontium increase and the corresponding increase in Sr/Ca ratios indicates that recrystallization (not dissolution) of biogenic carbonate is occurring. The approximately linear downhole decreases in magnesium and potassium and increase in calcium below ~100 mbsf are consistent with the alteration of volcanic material and/or basement below the cored interval.

Physical property records at Site 1308 document long-term changes in sediment composition, which likely reflect fundamental changes in North Atlantic climate. The natural gamma radiation (NGR) and Lightness (L^*) records from Lithologic Unit I (0-197 mcd) show a strong glacial-interglacial variability. In Subunit IIA (197-262 mcd), magnetic susceptibility (MS) and NGR values decrease both in absolute value and variability, and L^* increases. NGR shows a fairly abrupt change in absolute values and variability at the Unit II/I boundary at ~197 mcd (~2.74 Ma). In the white nannofossil ooze of Lithologic Subunit IIB (262-356 mcd), MS and NGR values are significantly lower and less variable than in Subunit IIA.

The six holes at Site 1308 have been pieced together to produce a complete composite section to ~250 mcd. The base of the composite section correlates to the middle part of the Gauss Chronozone at ~3.2 Ma. A discontinuous record was recovered below this level to 356 mcd in upper Miocene white nannofossil ooze. The upper Pliocene to Quaternary composite section will provide a means of studying the evolution of NADW, the extension of the Central Atlantic detrital layer (Heinrich-type) stratigraphy beyond the last glacial cycle, and the 1500 yr cycle in the petrologic characteristics of IRD. The mean sedimentation rate for the composite section (7.6 cm/ky) indicates that these studies can be carried out at moderately high resolution. Good preservation of benthic and planktonic calcareous and siliceous microfossils indicates that the site will yield high quality environmental and isotopic records. The pristine magnetostratigraphic record indicates that the site has good potential for the generation of a paleointensity-assisted chronology that will place the environmental record into a global millennial-scale stratigraphic framework.