October 25, 2004

IODP EXPEDITION 303: NORTH ATLANTIC CLIMATE I
SITE 1304 SUMMARY

Hole 1304A Latitude: 53° 3.401'N Longitude: 33° 31.781'W
Hole 1304B Latitude: 53° 3.393'N, Longitude: 33° 31.768'W
Hole 1304C Latitude: 53° 3.384'N, Longitude: 33° 31.751'W
Hole 1304D Latitude: 53° 3.378'N, Longitude: 33° 31.741'W
Water depth: 3064.5 mbsl

The objective at Site 1304 was to obtain a deep-water record from the southern edge of the Gardar Drift to compare with the intermediate depth site on the northern part of the Gardar Drift sampled during ODP Leg 162 (Site 983). The site lies in a partially enclosed basin to the north of the Charlie Gibbs Fracture Zone, 217 km WNW of DSDP Site 611. The sedimentation rates at Site 1304 are about six times those at DSDP Site 611, with excellent preservation of benthic and planktonic microfossils. The site will provide high resolution monitoring of North Atlantic Deep Water (NADW) and sea-surface temperatures, and a record of central Atlantic detrital-layer stratigraphy.

Four holes were cored with the APC coring system to a maximum depth of 243.8 mbsf at Site 1304. Overall recovery was 102.6%. Hole 1304C was limited to 69.6 m penetration when operations had to be terminated because of deteriorating weather conditions (heave in excess of 4 m at the rig floor). After waiting over 3 hours for the weather to abate, Hole 1304D was spudded and the interval 0-52 mbsf drilled before APC coring continued to total depth. The interval from 180.3-181.3 mbsf was also drilled in Hole 1304D (i.e., not cored) due to an apparent hard interval impeding APC penetration. The drill-over technique was utilized at Holes 1304A, 1304B and 1304D to extend APC coring past initial refusal depth.

Correlation of cores among holes at Site 1304, utilizing mainly magnetic susceptibility and natural gamma radiation, provides a continuous stratigraphic sequence to ~258.1 mcd with a single potential break within an 8-m thick diatom mat at ~199.3 mcd. The spliced composite section relies on sections from Holes 1304A and 1304B because good weather conditions during the early occupation of Site 1304 led to excellent recovery and good core quality.

The sediments at Site 1304 are predominantly interbedded diatom oozes and nannofossil oozes, with less common intervals of clay and silty clay, which also contain abundant nannofossils and/or diatoms. Calcium carbonate content ranges from 5-70 wt.% and organic carbon content is low (generally < 0.5 wt%). This sedimentary succession has been designated as a single unit because the various lithologies are generally interbedded on a scale of only centimeters to decimeters. Most contacts between nannofossil ooze and clay intervals are gradational, although sharp contacts are also observed. The contacts between diatom ooze beds and the other lithologies are generally sharp. Redeposited beds of silt and sand-sized particles are rare, as are disturbed units related to mass-transport processes (e.g., slumps, debris flows). Thus, the section cored at Site 1304 apparently represents a relatively continuous pelagic section, where the sediments record changes in productivity in response to oceanographic and climatic fluctuations.

Recurring laminated diatom sequences are the most prominent feature at Site 1304. Diatom assemblages are dominated by needle shaped species of the Thalassiothrix/Lioloma-complex. All other groups investigated, coccoliths, planktonic and benthic foraminifers,

radiolarians, and palynomorphs, are present in high to moderate abundance and well preserved. Biostratigraphic datums mainly derive from coccoliths, and are consistent with datums provided by diatoms, planktonic foraminifers, dinoflagellate cysts, and magnetostratigraphy. The composite sequence covers the uppermost Pliocene and the entire Quaternary. The microfossil assemblage indicates only minor redeposition.

Preliminary paleoceanographical and paleoclimatological interpretation of the microflora and microfauna reveals large amplitude changes in surface water temperature and trophic conditions. Diatom layers were formed during both cold and warm phases, according to the diatom and planktonic foraminiferal assemblages. The presence of the benthic foraminifer Epistominella exigua documents recurring pulses of fresh organic matter to the seafloor. A shift from dominance of autotrophic to dominance of heterotrophic dinocyst assemblages is recorded after 1.2 Ma, which may suggest a general change in trophic conditions of the surface ocean.

Site 1304 sediments document an almost continuous sequence including the Brunhes Chronozone and part of the Matuyama Chronozone including the Jaramillo Subchronozone, the Cobb Mountain Subchronozone and the top of the Olduvai Subchronozone. Short intervals of apparent normal polarity were recognized during the Matuyama Chron below the Cobb Mountain Subchronozone. Mean sedimentation rates of 17.8 cm/k.y. are estimated for the last 0.78 Ma, and 12.2 cm/k.y. for the interval from 0.78 to 1.77 Ma.

Site 1304 pore-water profiles indicate active sulfate reduction (minimum value of 2.8 mM reached at 214 mbsf) with corresponding increases in alkalinity and ammonium. Alkalinity values do not reach concentrations expected for the degree of sulfate reduction. Calcium concentrations decrease downcore to 2.7 mM, a ~75% reduction from standard seawater values. The decrease in calcium and consumption of alkalinity suggests active carbonate mineral precipitation. However, Sr concentrations remain at seawater values or lower indicating that carbonate dissolution and recrystallization reactions are not important processes in the cored interval.

The Quaternary sequence recovered at Site 1304 provides a high resolution, high sedimentation rate (average ~15 cm/k.y.), record of environmental change at a sensitive location close to the sub-arctic convergence between the surface Labrador Current and the North Atlantic Current. Good preservation of both calcareous and siliceous microfossils, abundant benthic foraminifers, and a high fidelity magnetostratigraphic record, indicate that the environmental record, including the monitoring of NADW, can be placed in a tight chronological framework.