May 15, 2005

IODP EXPEDITION 307: SITE U1318 SUMMARY
MODERN CARBONATE MOUNDS: PORCUPINE DRILLING

U1318A	51°26.162'N	11°33.018'W	409.3 mbsl
U1318B	51°26.148'N	11°33.019'W	408.8 mbsl
U1318C	51°26.150'N	11°33.040'W	409.9 mbsl

Site U1318 (Proposal Site PORC-2A) is located in on the eastern slope of the Porcupine Seabight on the southwest continental margin of Ireland and is upslope from the Belgica Mound Province, including Challenger Mound. The principal objective at Site U1318 was to recover the sediments from the three seismic units (P1-3) of the southern Belgica mound province. Complete data from the seismically low amplitude layer (P2) would refine the paleoenvironmental history growth of the Challenger Mound began.

Sediments from the up-slope Site U1318 were divided into three units based on sediment colors, erosional surfaces, and biostratigraphy. The uppermost Unit 1 consists of brown-colored silty clay with black motted structure, which is partly laminated and bioturbated. Dropstones are common in this unit. Unit 2, 4-6 m thick, underlies a distinct erosional surface. This unit mainly consists of olive-gray, medium-fine sand interbedded with dark yellowish-brown silty clay. The sand beds are normal graded with sharp lower and upper boundaries. Dropstones, up to 3 cm in diameter, are found in both sand and clay horizons. The base of this unit is a conglomerate resting on a distinct erosional surface, which is 5-10 cm thick, and associated with black-colored apatite nodules. Unit 3, 155 m thick (Hole U1318B), consists of dark green siltstone, which frequently intercalates with sandstone layers in the upper and lower horizons. The siltstone tends to become calcareous to downward.

Unit 1 is younger than 0.26 Ma as indicated by abundant occurrence of *Emiliani huxleyi*, and corresponds to Unit 1 at Site 1318. Nannofossils from Unit 2 indicate the early Pleistocene small *Gephyrocapsa* Zone (0.96-1.22 Ma), which was also found in the upper part of Unit 1 (mound section) at Site 1317. The interval of the hiatus between Unit 1 and 2 was estimated to be more than 0.7 m.y.. Age of Unit 3 ranges from Pliocene to Miocene. Nannofossil data indicate a clear hiatus between Units 2 and 3.

Archive halves were measured for their magnetization after 0, 15, and 20 mT demagnetization steps. Inclinations for Unit 1 are close to the expected inclination (68°) at the site latitude (51.4° N), therefore Unit 1 is assigned to the Brunhes Chron (0-0.78 Ma). The normal polarity of Unit 1 is truncated by a hiatus, identified by lithostratigraphy and biostratigraphy, so the base of the Brunhes is not represented. Below the hiatus in Unit 3, magnetic susceptibilities and intensities are weaker and inclination data more scattered, and so could not be interpreted in terms of magnetic polarity stratigraphy. It is noteworthy that, although the silty clay sediments are calcareous, the carbonate content is not high enough to dilute the magnetic susceptibility to the extent observed. Therefore either Unit 3 has a much lower siliciclastic content than is supposed, or the principal magnetic mineral in the unit (probably magnetite) has been dissolved.

Major changes in physical properties were observed at unit boundaries that can be directly related to reflectors in the seismic section. The sand layers, silty clays, dropstones and oyster bed of Unit 2 create a high amplitude reflector in the seismic profiles, and this erosive reflector has been tentatively identified as the upslope continuation of the

moundbase reflector. The enigmatic low amplitude seismic package, whose identification was one of the main aims of drilling this site, corresponds to homogeneous calcareous silty clays. Subunit 3C, below 192 mbsf, is characterized by a slight general increase in density in combination with some high density thin beds, and corresponds with high amplitude, high frequency parallel reflectors which can be traced along the seismic profile to the sigmoid unit at Site U1316.

Triple Combo and FMS sonic downhole logs were acquired between 70 and 240 mbsf in Hole U1318B. The downhole logs are characterized by low amplitude variations in Subunits 3A and 3B (92-192 mbsf), and by increased velocity and thin lithified layers in Subunit 3C (below 192 mbsf). The hiatus represented by the oyster bed at the base of Unit 2 is rich in uranium (as seen in the natural gamma radiation logs), which tends to accumulate at hiatuses and condensed intervals.

Periods of rapid sedimentation overlying hiatuses have profoundly affected the chemistry and microbial activity of Site U1318 sediments. The dominance of burial over diffusion within the upper Unit 1 sediments is strikingly shown by the nearly non-changing, near seawater concentrations of Li and Sr in the upper 50 m of drift sediments. Below 50 mbsf both linearly increase with depth indicating a source for both elements that was deeper than our maximum sampling depth. Chlorinity exhibits a constant concentration of 570 mM in Unit 1. However, we observed a broad excursion in the chloride concentration between 100 and 160 mbsf of up to 580 mM (at 140 mbsf). This excursion may be correlated to a major oceanographic low water stand, e.g., the Messinian Salt Crises in the Late Miocene. Buried and repeating trends in the sequence of terminal electon acceptors is also seen in the interstitial Mn, Fe and sulfate profiles. We observe a peak of dissolved Mn, underlain by dissolved peaks in Fe, and a decrease in sulfate concentration. This indicates the classic sequence of Mn reduction, Fe reduction, followed last by sulfate reduction. This sequence occurs at the surface and then repeats itself at 80 mbsf, and then again at 180 mbsf. These represent buried redox fronts. Prokarote abundances are greater than predicted from the global depth-abundance curve in the sediments of Subunits 1b and 1c, but drop precipitously below the hiatus in Unit 2. Some deep dolomitization must be occurring base on the decrease in Mg at depths below 200 mbsf. This is consistent with microscopic and XRD identification of dolomite in these sediments. Si concentrations exhibit striking change in the interstitial water concentration between the Unit 1 (200 M) and Unit 3 (900 M) sediments. This probably reflects a change in siliceous facies occurring over the hiatus at 82 mbsf. Total carbonate concentrations also change dramatically at this boundary, increasing from 10 wt% in Unit 1 to a peak of 40 wt% throughout Subunit 3A.