ICP 12 International Conference on Paleoceanography
UTRECHT the Netherlands 2016 August 29 – September 2

Onset and Progression of the Eocene-Oligocene Climate Transition: an Atlantic Ocean Perspective

Steve Bohaty, *Ocean and Earth Science, University of Southampton, United Kingdom (s.bohaty@noc.soton.ac.uk)*

The Eocene-Oligocene Climate Transition (EOT, ~34 Ma) marks a major step in the development of the modern 'Icehouse' climate state, characterized by abrupt high-latitude cooling and growth of large continental-scale ice-sheets on Antarctica. Although expansion of Antarctic ice sheets in the final phase of the transition occurred rapidly (~50 kyr), the EOT is rooted in much longer term global climate change through the Eocene. Compilation of benthic foraminiferal oxygen isotope (δ18O) records from multiple deep-sea sections reveals that Eocene cooling accelerated following the transient Middle Eocene Climatic Optimum warming event at ~40 Ma. This cooling trend culminated at ~37 Ma in a series of short-lived events that were likely associated with the appearance of small ice sheets on Antarctica. A highly dynamic "pre-Icehouse" climate state then prevailed through the Late Eocene until the onset of the EOT at ~34 Ma.

Long-term changes in atmospheric pCO2 most likely drove Eocene cooling, but the mechanisms that triggered Antarctic ice-sheet growth at the EOT are less clear. Further insight into these mechanisms requires precise correlation of an array of proxy datasets that document the timing, magnitude, and timescales of climate change around the globe. Many existing pelagic EOT sequences however suffer from incomplete core recovery and low (<1 cm/kyr) sedimentation rates, which limits the ability to resolve the sequence of events leading up to the EOT. Hemipelagic drift sediments recently drilled at Integrated Ocean Drilling Program Exp. 342 Site U1411 in the northwest Atlantic Ocean on the Newfoundland margin provide an extraordinary opportunity to overcome these problems. The rapidly accumulated clay-rich section recovered at Site U1411 (~3 cm/kyr sed. rates) is stratigraphically continuous and contains 'glassy' calcareous planktic and benthic microfossils, thus permitting reconstructions of both surface and deep-water environmental change across the EOT on astronomical timescales. Importantly, emerging records from Site U1411 can be correlated in detail to many existing marine records.

Construction of a cyclostratigraphic age model across the EOT interval of Site U1411 is possible using X-ray fluorescence core scanning, coulometric %CaCO3, and bulk carbonate stable isotope records, and bulk carbon isotope (δ13C) stratigraphy provides a means of precisely correlating Site U1411 to the Eocene-Oligocene boundary stratotype at Massignano, Italy, and key pelagic DSDP/ODP Sites 522, 523, 689, 929, 1090, and 1263 across the Atlantic basin. These integrated records show that a series of brief, negative δ13C excursions and pulsed carbonate compensation depth (CCD) shoaling preceded the first benthic δ18O step at the onset of the EOT. A stable, intermediate climate state was then sustained for ~300–400 kyr before major ice-sheet expansion and CCD deepening at the second benthic δ18O step (Oi-1). These results have important implications for our understanding of *interaction between the carbon cycle and ice-sheet growth across the EOT and shed new light on the chain of climate events leading up to and spanning the EOT. Site U1411 furthermore provides an unprecedented chronostratigraphic framework for multi-site correlation that allows development of higher resolution proxy CO2 records and model testing of different mechanisms for this fundamental change in Cenozoic climate state.*