The Late Lutetian Thermal Maximum in the Tasman Sea (IODP Site U1508, Southwest Pacific)

Irene Peñalver-Clavel*†[1], Joyeeta Bhattacharya[2], Claudia Agnini[3], Edoardo Dallanave[4], Thomas Westerhold[5], Gerald Dickens[6], Rupert Sutherland[7], and Laia Alegret[1]

[1]University of Zaragoza - Universidad de Zaragoza [Zaragoza] – Spain
[2]Picarro Inc. Headquarters – United States
[3]Università degli Studi di Padova = University of Padua – Italy
[4]University of Bremen – Germany
[5]Center for Marine Environmental Sciences [Bremen] – Germany
[6]Trinity College [Cambridge] – United Kingdom
[7]Victoria University of Wellington – New Zealand

Abstract

The middle Eocene is marked by a gradual cooling trend punctuated by transient and geologically brief hyperthermals. These events are characterized by negative excursions in carbon and oxygen stable isotopes (measured in bulk sediment and benthic foraminifera), increased pCO2 levels and/or marine carbonate dissolution. The study of these perturbations of the global carbon cycle is essential to understand their consequences on Earth's climate and biota. Here we present a unique record of the Late Lutetian Thermal Maximum (LLTM), also called the "C19r event", in the Reinga Basin (Tasman Sea). This short-lived event (30 kyr of estimated duration from Atlantic Ocean records) is found to be difficult to identify in deep-sea sediments, and so far only three studies have described its paleoecological consequences in the deep sea in the Atlantic Ocean.
This study is the first record of deep-sea benthic foraminiferal response to the LLTM in the Southwest Pacific (International Ocean Discovery Program Site U1508). We refined the shipboard age model based on GPTS2012 using published magnetostratigraphy and improved biostratigraphic data, and assuming linear sedimentation rates between tie points. The study interval spans from the upper part of Chron C19r to the lower part of Chron C19n, and calcareous nannofossil zones CNE13 and CNE14. The LLTM event is located in the upper part of Chron C19r, at 41.38 Ma in the new age model.

Quantitative analyses of benthic foraminifera reveal a decrease in diversity of the assemblages and changes in the relative abundance of species during the LLTM. The CaCO3 % decreases from 80% to 68% across the LLTM, but calcareous taxa make up ≥85% of the assemblages and the foraminiferal tests do not present any evidence of carbonate dissolution. Decreased diversity of the assemblages points to environmental stress at the seafloor during the LLTM, possibly linked to oxygen deficiency as suggested by the dominance of dysoxic taxa and species of the Superfamily Buliminacea, which in the modern oceans tolerate low oxygen conditions and/or a high nutrient supply to the seafloor. A scenario characterized by

*Speaker
†Corresponding author: irenepc@posta.unizar.es

oxygen deficiency associated with eutrophic conditions is supported by the decrease in the relative abundance of the oxic indicator Globocassidulina subglobosa, and the high relative abundance or infaunal, bi-triserial agglutinated forms.

Our preliminary results indicate enhanced export productivity in the Tasman Sea during the short-lived LLTM. These conclusions will contribute to better understand the relative role of changes in carbon flux vs. warming during rapid hyperthermal events, and to evaluate how global changes affect marine ecosystems.
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