Anuário do Instituto de Geociências - UFRJ
ISSN 0101-9759 Vol. 29 - 1 / 2006 p. 500-501

FORAMS 2006

Correlation of the Thanetian-Ilerdian turnover of larger foraminifera and the Initial Eocene thermal maximum (IETM) confirming evidence from the Campo area (Pyrenees, Spain)

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It has long been known that a major larger foraminifera turnover (LFT) occurred at the boundary between the Thanetian and Ilerdian stages (Hottinger & Schaub, 1960. *Eclog. Geol. Helv.* 53). However, its possible correlation with the IETM was unsuspected until the re-study of the Campo section in the Spanish Pyrenees by Orue-Etxebarria *et al.* (2001. *Marine Micropaleontology, 41*). Orue-Etxebarria *et al.*'s correlation was later reinforced with data from additional sections in the Pyrenees (Urrobi, Mintxate, Ermua, Esplugafreda) and in the Galala Mountains of Egypt (Scheibner, 2005. *Geology 33*). However, although the combined evidence from all these sections is compelling, the information provided separately by any one of them is not without ambiguities: in deep-water settings, such as Ermua or the Galala Mountains Sections, the location of the Carbon Isotopic Excursion (CIE) that marks the IETM is well established, but the position of the LFT relies upon the record of re-sedimented larger foraminifera. Conversely, in shallow-water sections such as Urrobi or Campo, in which the LFT is well constrained, the isotopic signature is either obliterated or unclear. In point of fact, therefore, the proposed temporal concurrence of the LFT and the CIE hinges on a correlation between sections at different settings and, perhaps because of that, some specialists on larger foraminifera are still reluctant to accept it.

Here we present new information from two shallow-water sections that conclusively resolve the issue, Sections Campo and St Martin, situated less than 2km from each other in the Pyrenees. At St Martin, a ca. 7 meter-thick intercalation of continental deposits rich in pedogenic carbonate nodules is

sandwiched between shallow marine carbonates of late Thanetian and early Ilerdian age. Analysis of 35 of these nodules has shown that their s:$\delta^{13}C$ composition ranges between –11.4/-14.3‰ and averages –12.9‰, values that unquestionably record the CIE and, for the first time, are reported in a section where the LFT is clearly represented. That crucial evidence is coupled with new calcareous nannofossil and magnetostratigraphic data from Campo, that demonstrate that no sizeable break exists in the upper Thanetian/lower Ilerdian succession and, therefore, that the spatial coincidence of the LFT and the CIE at St Martin is not an artifact. Larger foraminifera were major rock builders in the extensive early Paleogene marginal seas of the Tethys Ocean. Our new data thus confirm that the ecological impact of the IETM was much greater than earlier thought, having also affected low- and mid-latitude shallow marine biota. The exact mechanisms bringing about the LFT, however, remain elusive.

Contribution to Projects CGL2005-02770/BTE, CGL2005-01721/BTE and 9/UPV00121.310-1455/2002.