

Planktic foraminiferal biostratigraphy, paleoecology and chronostratigraphy across the Eocene/Oligocene boundary in northern Tunisia



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ABSTRACT

The biostratigraphic analysis of the Eocene-Oligocene transition of the Menzel Bou Zelfa and Jhaff sections in northeastern Tunisia (Cap Bon peninsula) allows us to identify a continuous planktic foraminiferal biozonation. The following biozones were recognized: *Globigerinatheka semiinvoluta* Zone (E14), *Globigerinatheka index* Zone (E15), (*Hantkenina alabamensis* Zone (E16) of the upper Eocene and *Pseudohastigerina naguewichiensis* Zone (O1) of the lower Oligocene. A rapid mass extinction event in planktic foraminifera occurred at the Eocene-Oligocene transition, including the extinction of the turborotalids (*Turborotalia cerroazulensis*, *Turborotalia coccaensis* and *Turborotalia cunialensis*) followed by a significant size reduction of the genus *Pseudohastigerina* and the extinction of the hantkeninids (*Hantkenina alabamensis*, *Hantkenina brevispina*, *Hantkenina nanggulanensis* and *Cribohantkenina lazzarii*), which mark the Eocene/Oligocene boundary. These species were tropical and subtropical surface and intermediate dwellers, with distinctive morphologies (carinate turborotalids and spinose hantkeninids), which were well adapted species of k-strategy. The surviving planktic foraminifera species were quite similar in morphology with globular chambers (globigerinids) and small planispiral (pseudohastigerinids), which were opportunistic species of r-strategy. The recognition of a 4 m thick interval, between the extinction of turborotalids and hantkeninids, indicates that the section is continuous and one of the most expanded throughout the Eocene-Oligocene transition. This section could serve as an auxiliary section (hypostratotype) for the complete definition of the Global Stratotype Section and Point for the Eocene/Oligocene boundary, which mark the base of the Rupelian Stage.

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1. Introduction

The Eocene-Oligocene (E-O) transition was an epoch of great turnover, in both terrestrial and marine environments. Mammals were highly affected by an extinction event called *grande coupure* of Stehlin, which has been very well documented in Europe and Asia (Hartenberger, 1998). In America the tropical molluscs underwent a significant extinction event at the beginning of the Oi-1 glaciation in the Oligocene (Hickman, 2003). This drop in temperature was caused by the opening of the Drake Strait, thereby giving rise to the circum Antarctic current, the formation of ice caps on the poles and

the development of the psychrosphere in the deep ocean (Shackleton and Kennett, 1975; Kennett and Shackleton, 1976; Barker and Thomas, 2004; Livermore et al., 2005). Evidence and causes of the Eocene/Oligocene event, based on extinction and survival patterns of foraminifera, were reviewed by Molina (2015, see other references herein).

In order to establish the precise chronology of the turnover at the E-O transition, as the Priabonian and Rupelian stage stratotypes duration was imprecise, the International Commission on Stratigraphy organized a working group in 1980 to define the Eocene/Oligocene (E/O) boundary, which officially corresponded to the base of the Rupelian Stage. This task was undertaken by the International Geological Correlation Programme, Project 174 led by Charles Pomerol and Isabella Premoli Silva (Premoli Silva and Jenkins, 1993). The working group searched worldwide for

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suitable sections, mainly in Spain and Italy. Several sections were visited, sampled and studied in the Betic Cordillera, southern Spain and the proposed candidates were the Fuente Caldera section (Molina, 1980, 1986; Comas et al., 1985), the Torre Cardela section (Martínez-Gallego and Molina, 1975) and the Molino de Cobo section (Molina et al., 1988). These three sections showed an expanded stratigraphic interval based on planktic foraminifera, between the extinction of the turborotalids and the hantkeninids, spanning about 1 m in thickness, never previously found in other sections, but also found in the Massignano section in Italy (Molina et al., 1986, 1993; Nocchi et al., 1988; Gonzalvo and Molina, 1992). In the Massignano section this critical stratigraphic interval was less expanded, but when the section was multidisciplinary studied (Premoli Silva et al., 1988), other interesting data were found. Consequently, the Global Stratotype Section and Point (GSSP) for the base of the Oligocene (Rupelian) was defined at meter 19 of the Massignano section, coinciding with the extinction of the hantkeninids (Premoli Silva and Jenkins, 1993).

Since then the E/O boundary has been recognized worldwide and the biostratigraphy of the E-O interval has been improved. A revised geochronology and chronostratigraphy was proposed by Berggren et al. (1995) and a revised tropical and subtropical Paleogene planktic foraminiferal zonation was proposed by Berggren and Pearson (2005), Pearson et al. Eds. (2006) and Wade et al. (2011). The upper Paleogene deposits attracted the interest of

some researchers in Tunisia, who were able to find the Eocene and lowermost Oligocene in north eastern and central Tunisia (Ben Ismail-Lattrache, 1981, 2000; Boukhalfa et al., 2009; Amami Hamdi, 2014; Ben Ismail-Lattrache et al., 2014), in Jordan (Farouk et al., 2013, 2015) and in Egypt (Orabi et al., 2015). However, they were never able to find the critical expanded interval of the E/O boundary.

The aim of this study was to search for an expanded continuous marine section crossing the E/O boundary in northern Tunisia. A composite section has been found in the Cap Bon peninsula: Menzel Bou Zelfa and Jhaff sections. The planktic foraminiferal biostratigraphy indicates that this composite section includes a very expanded critical interval between the extinction of the turborotalids and hantkeninids. Consequently, this section is suitable and could be a potential auxiliary section (hypostratotype) to complement the definition of the E/O boundary that was defined in the Massignano section, Italy.

2. Material and methods

2.1. Geological and geographical location

The Menzel Bou Zelfa section is located in the Cap Bon peninsula, north-eastern Tunisia, 36°43'30.22"N and 10°42'15.57"E. The section was sampled in the NE flank of the Jebel Abderrahman

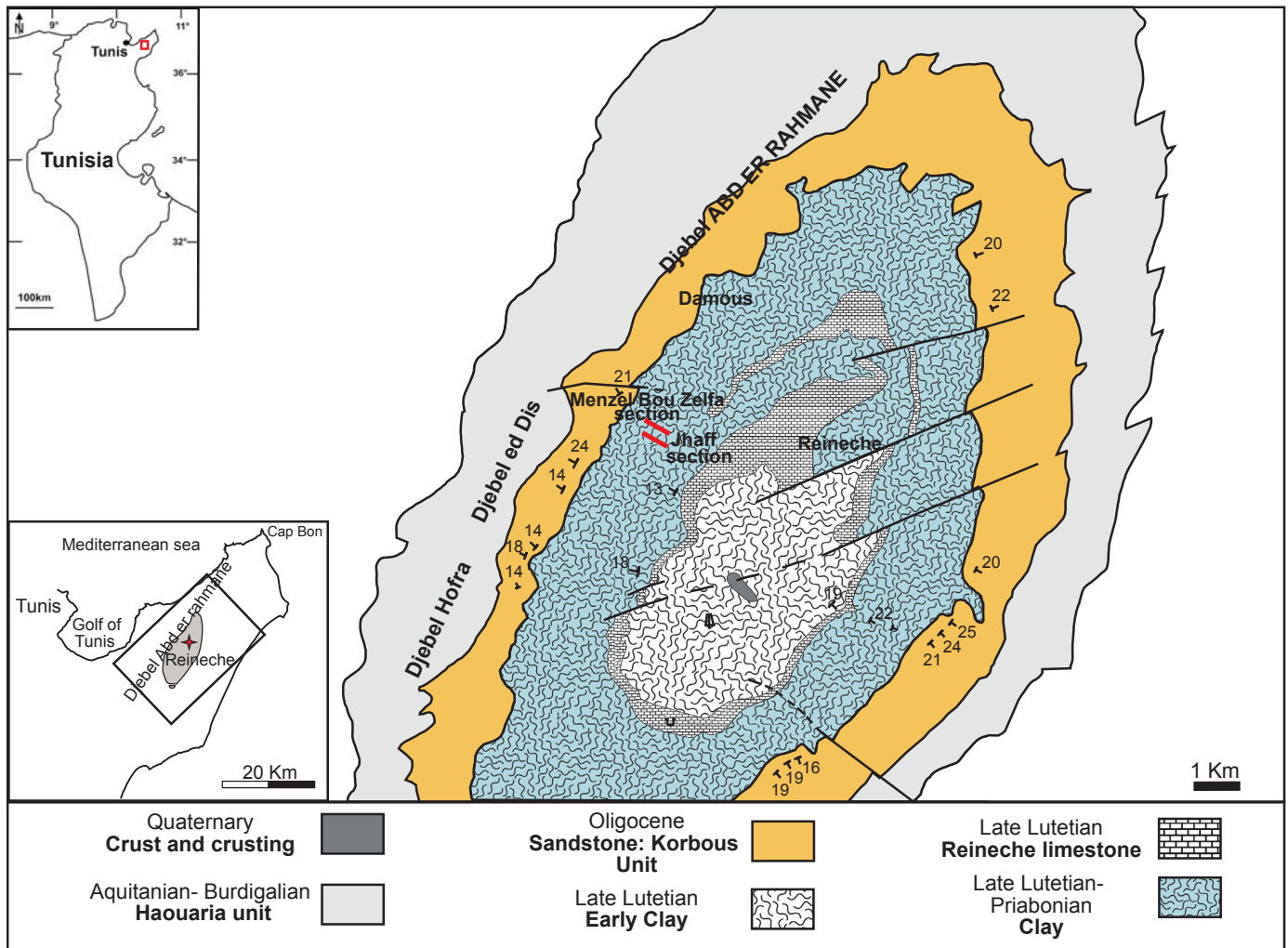


Fig. 1. Geographical and geological location of the Menzel Boy Zelfa and Jhaff sections.

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