Research Article
The Registration of the Mid-Paleocene Biotic Event (MPBE) in Tunisia

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1. Introduction

The mid-Paleocene biotic event (MPBE) has been described at the beginning, offshore in some studies of deep-sea sections, at Shatsky Rise (Ocean Drilling Program, central Pacific) and Walvis Ridge (south Atlantic) (e.g., [1–5]). In 2007, this event was first recognized onshore, in the Zumaia section (western Pyrenees) (e.g., [6]). This event is characterized by the existence of a remarkable dissolution level in the carbonate sediments and it was short lived and probably related to hyperthermal events (e.g., [1–3, 7]).

The aim of this paper is to show the micropaleontologic and geochemical analysis of the middle Paleocene series in the northwest of Tunisia (Tejerouine section), the evidence of the mid-Paleocene biotic event (MPBE) similar to the one described previously. We want to demonstrate that this event is also recorded in Tunisia and, therefore, is a worldwide event. It needs intensive work to get more information and to find far more interpretations.

2. Material and Methods

The Paleocene series are complete, well exposed, and easily accessible, in the Tejerouine section. In the field, the sampling was done particularly in marls and was tighter at the boundaries. In the laboratory, samples of marls were dipped in the tap water and then washed through sieves. The residues thus obtained were dried in the oven to at least 50°C and then sorted under a binocular microscope to extract the microfauna. The qualitative and quantitative analysis of the microfauna collected has concerned the fraction above 63 μm. The same samples have been the subject of a geochemical analysis.

3. Geology and Lithostratigraphy

The Tejerouine region is part of the northwest of Tunisia, the El Kef area, in the Tunisian Atlas (Figure 1). The section is
located on the geological map labeled, Tejerouine on the scale 1/50000, in the level of the lambert coordinate points: N35° 52' 44.06", E8° 37' 51.83".

The Paleocene was first recognized in the El Haria Formation (e.g., [8]) which overlies the upper Cretaceous Abiod Formation. When it is complete, the Paleocene is represented by Danian, Selandian, and Thanetian stages and it crops out only in some areas in western and north-central Tunisia. In terms of lithology, the Paleocene interval is represented by grey marls admitting the intercalation of decimetric slightly argillaceous limy beds.

4. Results and Discussion

The El Haria Formation is characterized by relatively deep-water deposits, which consist of marls and occasionally limestone. The marls, which generally show a low TOC content, are rich in planktonic foraminiferal assemblages. Planktonic foraminiferal assemblages are diverse and are composed of the genera *Morozovella*, *Acarinina*, *Igorina*, *Globanomalina*, *Pseudohastegerina*, and *Subbotina* (Figure 2). Benthic assemblages, which are characterized by Midway, mixed Midway, and Velasco-type faunas, are also diversified. The lower boundary of the middle Paleocene or the Danian/Selandian (D/S) boundary coincides with the bioturbated limy bed with variable thickness, rich in glauconitic grains and phosphates, which is recorded by a peak of P2O5 in Figure 4. In micropaleontological terms, the D/S boundary coincides with the first appearance of the species *Igorina albeari* (e.g., [9, 10]) (Figure 2). This bioturbated limy bed could be used as a good marker of the D/S boundary and reflects a global event well recorded on the biostratigraphic and lithological composition.

Selandian deposits are absent in most outcrops in Tunisia and Thanetian deposits are unconformably overlying Danian or Cretaceous deposits and are being clearly transgressive. When it is present, the Selandian is also located in the middle grey marl of El Haria Formation. The Selandian interval is rather rich in planktonic and benthonc foraminifera. It is remarkable that the species represented by the genera *Morozovella* and *Subbotina* are the most abundant (Figures 2 and 3). At the top of the Selandian, with the beginning of the Gl. pseudomenardii (P4) zone, it should be noted that the planktonic foraminifera become very poorly preserved and much less abundant than the Selandian (e.g., [11]).

They are represented by three species of the genus *Acarinina*, one species of *Igorina*, four species of *Morozovella*, three species of *Globanomalina*, four species of *Subbotina*, and one species of *Parasubbotina*. However, the extinction of *Woodringina* is worth mentioning. The upper part of the Selandian is represented by three species of *Morozovella*, three species of *Globanomalina*, three species of *Subbotina*, and two species of *Acarinina*, whereas both the genera of *Igorina* and *Parasubbotina* are extinct (Figure 3).

This assemblage is mostly represented by the species belonging to the group “*Subbotina*” having globular chambers. It becomes less abundant, much less diversified, and represented by small species. The number of the benthic foraminifera clearly exceeds that of the planktonic foraminifera. There has been a start of the microfauna’s tests dissolution and enrichment in iron oxides and gypsum crystals. The CaO content decreases substantially and reaches the lowest
value (7, 33%), while the content of the oxides of Fe, Al, Mg, and Na has the highest ratio. SiO$_2$ is the most abundant element and reaches the maximum value (49, 44%) in the sample T30, where the maximum dissolution of carbonates was recorded (Figure 4). The phenomenon of dissolution process of the tests is increasing more and more upwards. Many tests, which are dissolved and partly fragmented, are associated with gypsum crystals and oxides. A similar pulse of intense carbonate dissolution and richness in clays is noted at the same moment as the dissolution event, which is registered by the planktonic foraminiferal assemblages in the Zumaia section, western Pyrenees (e.g., [1, 2, 5]).

However, some small benthic foraminifera belonging to the genera *Lenticulina* and *Anomalina* escape the dissolution and very few planktonic foraminifera belonging to the genus *Subbotina* persist.

More than ten meters from the base of P4, there has been an increase in the ratio of gypsum crystals and iron oxides, sometimes with the presence of glauconitic grains and phosphates (Figure 4). The dissolution affects most of the
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5. Conclusions

The quantitative and qualitative analysis of foraminifera at the top the Selandian reveals important changes in faunal composition. The major calcareous planktonic and benthonic foraminiferal changes indicated a disturbed environment due to the warming of the ocean.

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Conflict of Interests

The authors declare that there is no conflict of interests regarding the publication of this paper.

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