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Recent advances in the study of Eocene planktonic foraminifera

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We have recently completed a revision of the taxonomy, paleoecology, evolutionary relationships and stratigraphic distributions of planktonic foraminifera from the Eocene Epoch based on scanning electron micrographs of most of the type specimens and extensive illustration of exceptionally well-preserved material from around the world.

We recognize a total of 166 species in 36 genera, of which ten species and three genera are new. Analysis of wall structures forms the basis of our higher classification, dividing the group into microperforate, spinose and nonspinose groups. Revised biostratigraphic zonation for the Paleogene tropics/subtropics and high latitudes have been developed in parallel with this work.

Most of our studies have supported previous interpretations of the taxonomy and phylogeny of the group, thereby establishing them on a firmer basis. However the aspects of the taxonomy that are most novel are as follows:

- 1) Eocene *Globorotaloides* is revised following the assignment of *Globorotaloides suteri* Bolli to *Catapsydrax*. Two new species of *Globorotaloides* are described.
- 2) A new phylogeny for Eocene *Parasubbotina* is presented, in which the evolutionary relationship with *Paragloborotalia* is clarified.
- 3) The spinose genus *Globoturborotalita* is recorded from the Eocene.
- 4) The modern genus *Turborotalita* is recognized as having originated in the Eocene.

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- 5) The rapid evolution of *Hantkenina* from *Clavigerinella* was via a previously undescribed intermediate form.
- 6) The genus *Morozovella* is divided into two genera, whereby gracile middle Eocene species are included in a new genus.
- 7) *Dentoglobigerina* is nonspinose and may have descended from a nonspinose ancestor such as *Acarinina*.
- 8) The genus *Pseudohastigerina* is divided into two genera, with a new genus and species named for compressed planispiral forms that are believed to have arisen independently from *Globanomalina*.
- 9) The first species of *Turborotalia*, *T. frontosa* (Subbotina) is a nonspinose form that evolved from *Globanomalina*.
- 10) Observations of a monolamellar wall structure and stable isotope data from Eocene species of *Tenuitella* and *Jenkinsina* suggest that these genera may have evolved from a benthic ancestor.

The new data help clarify patterns of evolution and ecological diversification in the group in relation to Paleogene climatic change. Some implications for renewed study of Oligocene planktonic foraminifera are discussed.