Polyphyletism and parallel evolution in Foraminifera and their implications in biostratigraphy. Two new examples from the Priabonian of the Helvetic Alps

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Recurrent evolution of similar or equivalent forms through geologic time is common in Foraminifera. We show two examples from the Priabonian Sanetsch Fm in the Helvetic Nappes of the Swiss Alps: one dealing with polyphyletism and the other with parallel evolution.

1-*Rotorbinella*, a polyphyletic genus

Rotorbinella is a small hyaline foraminiferal genus with the simplest rotalid architecture: a simple umbilical plate delimiting a spiral canal around an umbilical plug. It appears in the Cenomanian and has a discontinuous stratigraphical range with species known from the Cenomanian, Coniacian-Santonian, Paleocene-Ilerdian and Miocene-Recent time intervals.

We identified a new species from the Sanetsch Fm, *Rotorbinella* sp. 1. The differences with other *Rotorbinella* species are subtle and refer to quantitative characters. These differences, together with the hiatuses in the stratigraphical record of *Rotorbinella,* point to a polyphyletic origin of *Rotorbinella*. This simplest rotalid architectural model would have originated recurrently, first in the Cenomanian, and latter during the upper Turonian, the Paleocene and also in the lower Priabonian. Most Miocene to Recent species are known only from external characters and need a revision including structural studies.

2-Diachronous parallel evolution in Caribbean and Tethyan *Asterocyclina*

Orthophragminids are a group of orbitoidiform larger foraminifera that thrived during the Eocene. They consist of several genera of two different families, Discocyclinidae and Orbitoclypeidae, both originated in the Caribbean. In the Thanetian (late Paleocene) the discocyclinid *Discocyclina* and the orbitoclypeid *Orbitoclypeus* reached the Tethys. During the Eocene both groups evolved separately in the two bioprovinces. *Orbitoclypeus* gave rise to equivalent stellar ribbed forms, assigned to the genus *Asterocyclina*, which has the same stratigraphical range in the two bioprovinces. However, from the data available, it is not possible to ascertain if *Asterocyclina* evolved in parallel in the two bioprovinces or migrated from one to the other.

In the Caribbean, some species of *Asterocyclina* developed a new character, which we have named *rods*: radial thickenings of imperforate calcite along the ribs. This was a feature known only in middle-upper Eocene Caribbean species. Now we have found this character in a late Eocene Tethyan species, *A. ferrandezi*. Furthermore, rods are found in two new subspecies (=phylogenetic chronospecies), which occur in Shallow Benthic Zones 19 and 20 respectively. A revision of own samples and of the literature showed that they occur in different basins of the western Tethys.

Apart of their interest as new biostratigraphical markers for the Priabonian, these two new subspecies are relevant because they demonstrate the occurrence of parallel evolution in larger foraminifera. While in the Caribbean species of *Asterocyclina* with rods appeared yet at the early middle Eocene, in the Tethyan realm they originated during the late Eocene. In this case, parallel evolution is made evident because it is diachronous, but this is rather the exception. Biochronostratigraphical correlation based on equivalent species from different bioprovinces should have to be considered with the utmost caution. It can easily lead to either erroneous biostratigraphical correlations between different bioprovinces or to misinterpretations of the timing or direction of migration.