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Upper Cretaceous Shallow Benthic Biozones (KSBZ): a Preliminary Report

INTRODUCTION

Oil exploration, industrial or academic subsurface geology and geological field work frequently need age determinations by means of paleontological methods. In the Cretaceous Shallow water deposits ammonoids and planktonic micro-organisms, like calcareous nanofossils and planktonic foraminifera used traditionally as biostratigraphical markers are absent, but the abundance, diversity, and the fact that most of them had high morphological change rates with time make the larger foraminifera as an extraordinary useful tool for age determination. Many sedimentary rocks deposited in shallow-water environments, particularly shallow water limestones, cannot be disaggregated and their fossil content has to be identified in thin slides or on fresh fractions with a hand lens in random sections. In the last case, larger foraminifera are the only important group of fossils having sufficiently diagnostic structures by which they can be identified, in non-oriented sections, to a taxonomic level of biostratigraphic significance.

The aim of this study is to establish a biostratigraphic scale using larger foraminifera to characterise in time the Upper Cretaceous neritic deposits. The study preteens to enlarge to the Cretaceous the work previously carried out successfully for Palaeocene and Eocene periods (Serra-Kiel et al. 1998), but the starting point of the Upper Cretaceous Shallow Benthic Biozones is not comparable to the early Tertiary ones; the Paleocene and Eocene Shallow Benthic Biozonation was largely based on previous classical biozonations (i.e. Hottinger, 1960; Hottinger and Schaub, 1964; Drobne, 1977; Hottinger and Drobne, 1980; Less, 1987), while the few larger foraminifera biozones described for the Upper Cretaceous are restricted to the interval of time late Santonian- Maastrichtian (see van Hinte, 1976, van Gorsel, 1978, Caus et al., 1996, for *Orbitoides*; van Gorsel, 1975 and 1978 for *Lepidorbitoides* and Wannier (1983) for the representatives of the subfamily *Siderolitinae*), and recently to the Cenomanian (Calonge et al., 2002).

THE PYRENEAN REALM: THE BACKBONE OF THE UPPER CRETACEOUS SHALLOW BENTHIC BIOZONATION

The Shallow Benthic Biozones from the Upper Cretaceous presented here cover the Cenomanian to Maastrichtian time span, and they are derived from numerous studies on neritic biostratigraphy carried out through the last twenty years in the Pyrenean Realm. This area has been chosen to be the backbone of the future trans-Tethyan biozonation due to the following raisons: 1) the Upper Cretaceous Pyrenean Basin was opened to the Atlantic Ocean and it is regarded as the best area to establish a biostratigraphical correlation between European and American Tethyan deposits. 2) In the last decades detailed mapping and correlation of many stratigraphic sections, based on lithological and paleontological evidence, showed the time relations between planktonic foraminifera zones and their biostratigraphic equivalents in shallow water deposits. Thus, the range in age of selected Upper Cretaceous larger foraminifera can be fixed in terms of plankton biozones. 3) The larger foraminifera are very abundant and diversified.

KSBZ (UPPER CRETACEOUS SHALLOW BENTHIC ZONES)

The proposed biozonation integrates many parallel index fossil groups corresponding to different habitats, from restricted very shallow environments to the lower limit of the photic zone. This zonation covers all the Upper Cretaceous sediments deposited in the euphotic zone in tropical to subtropical waters under oligotrophic to

mesotrophic conditions. Therefore, the proposed biozones are composite zones based on successive assemblages of index fossils with approximately synchronous ranges, that provide mutual control. Each biozone corresponds to the total range of some larger foraminifera taxa, and it is defined using integrated evidence of multiple first appearances (FA's) and last occurrences (LO's) of taxa (genera and species) from a complete set of facies types from littoral to the open platform coinciding with the lower limit of the photic zone (limit of the larger foraminifera having symbionts).

To name the Cretaceous biozones a numbered zonation is proposed. Following the Paleocene and Eocene nomenclature (Serra-Kiel *et al.*, 1998), the use of SB as a prefix for Shallow Benthics and K as a prefix for the Upper Cretaceous time interval is proposed. To employ a numbered zonation instead the names of fossil index for designating biozones in a zonation integrating many parallel index fossil groups (one for each group of fossils) is much more practical and more stable when taxonomic revisions occur.

LIMITS OF THE SHALLOW BENTHIC BIOZONATIONS

The proposed biozonation, that covers a wide range of habitats with a (theoretically) synchronous biozonation is not without dangers and contradictions. Due to the biostratigraphic range of the taxa used as index fossils is derived from their respective occurrences in a large number of sections from different habitats and the sea-level changes are synchronous, as it is postulated by sequence stratigraphy, all the distributions observed in each I sequence will be systematically biased by facies changes. On one hand, in a transgressive sedimentary sequence deepening upward, the shallow species appear earlier than the deeper ones, and on the other hand, in a regressive shallowing upward sequence, the deeper species will disappear earlier than the shallow ones. Therefore, the lithostratigraphic record of the successive shallow faunas will be systematically interrupted in the axis of a complete sequence during the sea-level high-stand and between two cycles if the base level falls below the point of observation in time and space, while the deeper faunas will have a comparatively longer record during high-stand and a longer interruption during low stand.

Moreover, between successive assemblages of larger foraminifera there are no clear-cut boundaries. It exists gaps in the record or periods in which the record can not be clearly assigned to one zone. The synchronous appearance and disappearance of many index taxa as shown in traditional range charts could be the effect of synchronous facies changes or synchronous gaps in the record, or to be inherent to the typological approach of the empirical methods used. As long as there is no method to measure time in much finer slices than the biozonations themselves there is no way to measure the true time range of an individual taxon within the assemblage.

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