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THE CRETACEOUS/TERTIARY BOUNDARY AND THE "MASS EXTINCTION" PROBLEM AS COULD BE SEEN IN THE SECTIONS AROUND BJALA (EAST BULGARIA)

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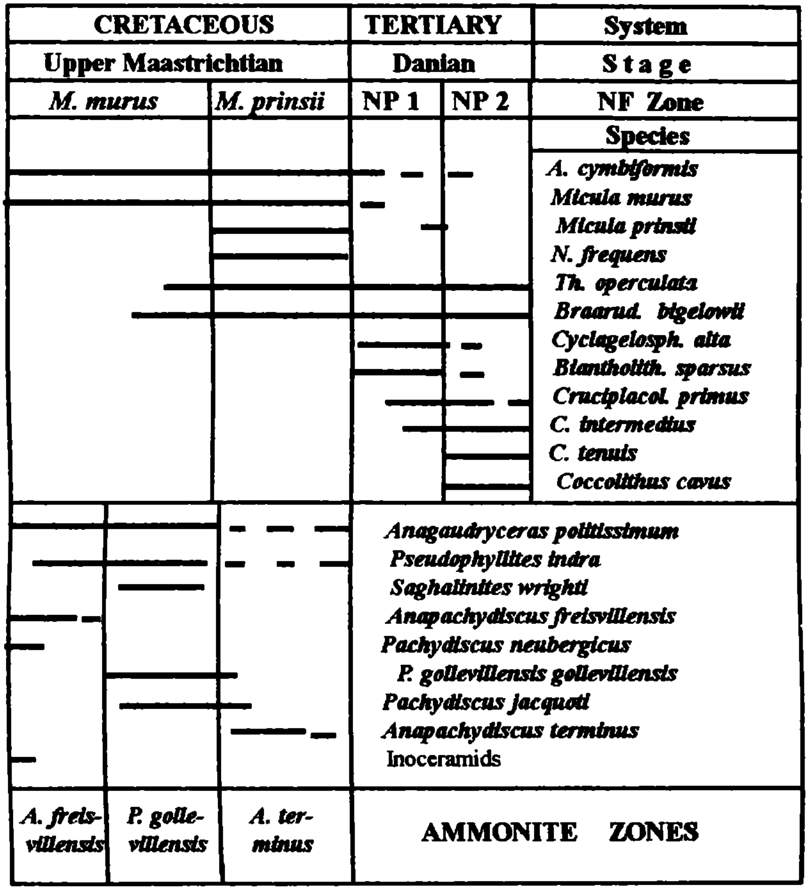
On the whole, three models of mass extinction have been advanced in theory. Catastrophic (sudden) extinction has been associated with impact events [1]; some authors think that it was a periodical phenomenon [8]. Stepwise extinction has been related to impulses in successive stages [2]. Gradual mass extinction is regarded as a final stage of degenerative evolutionary trend of the group of organisms without any relation to impact events [11]. The Cretaceous/Tertiary boundary is one of the typical examples of considerable change in the biosphere. Each of the three models has been "successfully" applied to explain extinction and turnover of groups of organisms at the boundary [3]. Yet it is worth noting that the models of mass extinction have been created for different sections with different fossil groups. In most of the sections of the Cretaceous/Tertiary boundary only the change of the surface ocean plankton (nannoflora and forams) has been investigated. The sections, where an abrupt, sudden extinction of marine macro–invertebrates has been recorded, at a closer study prove to be imperfect (incomplete or with significant interruptions) [12,10,5]. The marine sections of the K/T boundary should meet simultaneously the following requirements: completely represented Upper Maastrichtian with continuous sedimentation across the K/T boundary; simultaneous occurrence both of extinct and of survived group of organisms.

To determine the mechanisms of mass extinction at the K/T boundary, the examination of new sections is extremely important. The uninterrupted fossiliferous section Bjala 2b, recently discovered [9,7,4] is therefore, useful for such observations. In this section, a detailed studies on the occurrence of the calcareous nannofossils and the ammonites (and partly on inoceramids), have been carried out (Table 1). Here, at the base of the Upper Maastrichtian, 18 ammonite species belonging to 12 genera and seven families have been identified. In the middle part of the Upper Maastrichtian, the number of species gradually decreases down to nine or ten, related to eight genera. In the upper part, only six specimens of six species have been recorded (one representing each genus). In the topmost 1 m of the Maastrichtian nine specimens of three genera (3 species) have been identified: *Pseudophyllites indra*, *Anagaudryceras politissimum* and *Pachydiscus* sp. indet. The youngest ammonites found are at 40 cm below the K/T boundary. In our collection, the representatives of Phylloceratina, Lytoceratina and Ammonitina, as well as of heteromorphs are almost equally represented.

The data obtained from Bjala 2b section has shown that the ammonites recovered have similar generic and specific diversity, comparable to the ammonite records in the

Table 1



Biscay sections (Zumaya, Bidart) and Denmark (Stevns Klint, Kojlby Gard). The ammonite distribution in Bulgarian localities display an analogous extinction trend during the late Maastrichtian: gradual decreasing of the species diversity, well known from the above mentioned sections [12,10,5]. The "youngest" representatives of the ammonites almost reach the K/T boundary, becoming extinct at 40 cm below it. Their extinction occurs within the topmost part of the nannofossil zone *Micula prinsii*, 17 m thick in Bjala 2b. Inoceramids disappear in the late Maastrichtian, within the lower part of the nannofossil zone *Micula murus*.

The study on the calcareous nannoplankton across the K/T boundary has shown that nannofossil assemblages in the last centimetres of the uppermost Maastrichtian are characterized by relatively high diversity. The boundary clay bed is practically devoid of nannofossils. Here, only fragments of poorly preserved *Thoracosphaera, Micula, Braarudosphaera* occur rarely. Immediately above the boundary clay bed, in the lowermost part of the Danian, Cretaceous nannofossil species practically occur. We do not know whether these are reworked or if they survived the K/T boundary event(s). To solve this problem, it is necessary to undertake isotope investigations [6].

An explosive increase in the abundance of *Thoracosphaera operculata*, a calcareous dinoflagellate cyst, is observed immediately above the K/T boundary. Only a few new species appear in the first 10 cm above the boundary: *Biantholithus sparsus* (+1 cm), *Cyclagelosphaera alta* (+10 cm), *Neobiscutum romeinii, Neochiastozygus primitivus.* In the middle and upper part of the first Palaeocene nannofossil zone NP 1, the specification rate rises with the first representatives of *Cruciplacolithus* appearing (*C. primus* +1.80, followed by *C. intermedius*). By NP 2, the nannofossil assemblages have completely changed, comprising *Coccolithus cavus, Prinsius dimorphosus* and abundant *Cruciplacolithus.* The "Cretaceous" taxa, occurring in this zone are becoming less abundant.

In conclusion, the data obtained from the continuous K/T boundary section around Bjala shows that macro-invertebrates and calcareous nannoplankton differ in "behaviour" across the boundary. The extinction of the ammonites and inoceramids is a gradual (or may be stepwise) event. There is no relation between the impact event at the K/T boundary and the extinction of the macro-invertebrates. Calcareous nannoplankton assemblages are probably affected by a catastrophic K/T boundary event(s), changing considerably at the K/T boundary. A rapid turnover of taxa occurred within the limits of the first Palaeocene zone NP 1.

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