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Turnover and paleoenvironmental changes across the Cretaceous/Paleogene boundary at the Galanderud section (Northern Alborz, Iran) based on benthic foraminifera

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A high-resolution quantitative study of benthic foraminifera across the expanded and continuous Cretaceous/Paleogene (K/Pg) boundary at the Galanderud section in northern Iran provides an excellent record of the K/Pg event. The benthic foraminiferal assemblages, in contrast to the planktic foraminifers, did not suffer mass extinction at the K/Pg boundary. Uppermost Maastrichtian assemblages are well preserved and highly diverse. Only ∼3% of the benthic species became extinct, including Bolivinoides draco, Eouvigerina subsculptura, Neoflabellina sp. and Praebulimina reussi. Other species are temporarily absent for a short interval after the K/Pg boundary.

Benthic foraminifera indicate outer neritic-uppermost bathyal depths during the Plummerita hantkeninoides Zone until 70 cm below the K/Pg boundary. This interval contains abundant species of Bolivinoides draco, Gaudryina pyramidata, Cibicidoides hyphalus, P. reussi, and Sitella cushmani. The paleodepth decreased to outer neritic in the uppermost Maastrichtian based on the dominance of Stensioeina excolata, G. pyramidata, Cibicidoides pseudoacutus, and Coryphostoma incrassata forma gigantea. On the other hand, some species such as P. reussi and C. hyphalus, which are normally found at bathyal depths, decreased in their abundances. These data suggest a sea-level fall at the end of Maastrichtian. Additional evidence for sea-level fall is a decrease of planktic/benthic ratio from ∼60% to ∼40% in the uppermost Maastrichtian.

The K/Pg clay layer is characterized by a high abundance of opportunistic species such as Cibicidoides spp., C. pseudoacutus, and Tappanina selemensis. The drastic change of benthic foraminiferal assemblages coincides with a sharp drop in magnetic susceptibility and $\%CaCO_3$, mass extinction of planktic foraminifera, a sharp enrichment in Ir, and a 2.25‰ negative excursion in ∂13C at the K/Pg boundary, which is largely compatible with the catastrophic effects of an asteroid impact on Earth that briefly, but severely destabilized the oceanic phytoplankton food webs. Isothermal Remanent Magnetization (IRM) curves treated by the cumulative log-Gaussian function shows that hematite (or goethite) and magnetite are the main magnetic minerals in the K/Pg clay layer, whereas large and small magnetite characterize the Maastrichtian and the Danian sediments, respectively. The dominance of hematite over magnetite at the K/Pg boundary explains the lack of the characteristic positive magnetic susceptibility peak observed in other sections suggesting higher oxidation state of the Galanderud depositional environment during the impact.

The presence of three calcareous dinoflagellate chalk layers and large excursions in O- and C-isotopic compositions in basal Danian Zone P0 highlight the instability of the ecosystem immediately following the K/Pg boundary. In the Parvularugoglobigerina eugubina and Parasubbotina pseudobulloides Zones, there is an increase in both diversity and infaunal morphogroups, and a slight decrease of the epifaunal morphogroups; some deeper species increase in abundance including Gyroidinoides globosus and Marssonella oxycona. These changes might indicate a sea level rise and uppermost bathyal paleodepths in the early Danian, but it might also indicate improved conditions at the seafloor including greater flux of organic matter. These abrupt paleoenvironmental changes at the K/Pg boundary are correlated in age to the Chicxulub impact event and to the Deccan Phase 2; the contribution of each event is currently under study.