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Isotopic and geochemical characterization of the K-Pg boundary sections from Central Sakarya Region, Turkey; a discussion on possible double impact

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The Cretaceous-Paleogene (K-Pg) boundary is one of the widely discussed events in the earth's history. Although most of the authors agree on a single large meteorite impact, the possibility of the second impact is still under debate. In this study we characterize two new K-Pg sections from Central Sakarya Region on isotopic, geochemical (including Ir and the other PGE) and paleontological data.

The study area locates paleogeographically in the northern branch of NeoTethys. The Campanian – Maastrichtian interval is represented by thick, complete, deep marine, mainly siliciclastic succession. The Early Paleocene, consist of a rhythmically bedded, echinoid bearing lime-mudstone and marl alternations with organic rich clay intervals. Two 4.7 m and 3.5 m thick sections across the K-Pg boundary (Okcular and Goynuk sections respectively) were measured and investigated in detail.

The Okcular section starts with 2 meter thick hemi-pelagic mudstones with intercalated turbidites. Section continues with 2.2 meter thick mudstone and ends with 50 cm thick limestone/marl alternation. Detailed field investigations demonstrated that the 2.2 meter thick turbidite-free muddy part contains two thin (ca. 2 mm thick), continuous, reddish, iron rich, clay levels with sharp bottom and top boundaries separated by 17 cm of brownish mudstone. According to paleontological studies (nannofossils, planktic foraminifera, organic-walled dinoflagellate cysts) levels below the first reddish layer belong to Maastrichtian. The first truly Danian species were detected just below the second layer. The Goynuk section has a similar stratigraphy, but contains only one rusty ejecta layer. However, about 17 cm above the ejecta layer, where the second layer would be expected, the mudstones change in colour and texture.

The δ13C curve of the Okcular section shows a gradual increase from bottom of the section to lower reddish clay, while δ18O remains constant. At the lower reddish clay layer both δ13C and δ18O show abrupt negative shifts. Afterwards, both proxies stay at negative values in between the two reddish layers. Above the upper reddish layer, δ13C and δ18O curves gradually return to the values recorded before the K-Pg boundary. The Ir content of the first layers is significantly higher compared to local background and average continental crustal values ($\sim$8 ppb) and slightly enriched in the second layer ($\sim$1 ppb) although PGE do not entirely go down to background levels in the samples between the two layers. A similar distribution profile can also be observed for other trace elements, including Cr, Ni, Pt, Rb, Nd, Yb, Pb. It is clear that the two layers are not exactly the same, thus it is not just a repetition of the first layer due to faulting or slumping. Sharp bottom boundaries of both layers, continuity of bedding and constant grain size in between the layers exclude the possibility of the sedimentary reworking. Therefore, we believe that geochemical remobilization and re-precipitation or record of a second impact are the most realistic explanations for the presence of the second rusty layer. However, the absence of the second layer in the Goynuk section still remains unanswered and needs further investigation and discussion.