STABLE CARBON AND NITROGEN ISOTOPES OF PERMIAN-TRIASSIC BOUNDARY SECTIONS IN THE REGIONS OF JULFA (NW IRAN) AND ABADEH (CENTRAL IRAN)

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The Permian-Triassic (P-Tr) boundary sections in the regions of Julfa (NW Iran) and Abadeh (Central Iran) have high potential for the study of the most dramatic extinction event in Earth's history. As part of a multidisciplinary project, we have conducted high-resolution carbon isotope analysis of bulk carbonate rocks ($\delta^{13}C_{carb}$), coupled with preliminary carbon isotope analysis of bulk organic matter ($\delta^{13}C_{org}$), and nitrogen isotope study of bulk sediment ($\delta^{15}N_{bulk}$), for three fossil-rich, pelagic P-Tr boundary sections in NW Iran (Ali Bashi, Aras Valley, and Zal) and one in the Baghuk Mountain area in Central Iran.

The Permian-Triassic boundary sections in Iran display three characteristic rock units: (1) the *Paratirolites* Limestone (4 m thick) with the mass extinction horizon (P-Tr extinction event) at the top surface, (2) the Boundary Clay (0.5–2 m thick), and (3) the Elikah or Shahreza formations with the conodont P-Tr boundary near the base. The well-known negative $\delta^{13}C_{carb}$ excursion begins in the middle of the *Paratirolites* Limestone and culminates at the base of the Elikah and Shahreza formations; it is interrupted by a weak positive $\delta^{13}C_{carb}$ excursion within the Boundary Clay. The bulk $\delta^{13}C_{org}$ values and time-equivalent bulk $\delta^{13}C_{carb}$ values show different trends. The $\delta^{13}C_{org}$ curve reveals highly oscillating values throughout the entire section. A negative $\delta^{15}N_{bulk}$ trend begins in the topmost part of the *Paratirolites* Limestone and culminates at the base of the Boundary Clay.

The $\delta^{13}C_{carb}$, $\delta^{13}C_{org}$, and $\delta^{15}N_{bulk}$ isotope data, together with TOC and TN concentrations as well as C_{org}/N_{tot} ratios, provide evidence for significant environmental changes around the P-Tr boundary. The beginning of the negative $\delta^{13}C_{carb}$ excursion correlates well with the largely explosive Siberian Trap volcanism, and the $\delta^{13}C_{carb}$ peak at the top of the *Paratirolites* Limestone corresponds to the strong explosive felsic volcanism in southern China. The oscillation of the $\delta^{13}C_{org}$ curve is attributed to a varying prominence of the input of marine and terrestrial organic matter, and/or the preservation mode of the organic matter. C_{org}/N_{tot} values and the $\delta^{15}N_{bulk}$ signatures of the entire *Paratirolites* Limestone and of the base of the Elikah Formation reflect normal marine conditions controlled by biotic factors. In contrast, a dominance of abiotic factors appears to be recorded within the Boundary Clay, where the low TOC and C_{org}/N_{tot} ratios, the negative $\delta^{15}N$ excursion, and the enhanced concentration of total nitrogen are observed. The low $\delta^{15}N$ values within the Boundary Clay reflect the terrestrial origin of nitrogen and speak for an introduction of atmospheric nitrogen into the marine nitrogen cycle. We conclude that low C_{org}/N_{tot} ratios within the Boundary Clay reflect the low organic matter accumulation ratios, coupled with a high content of inorganic nitrogen fixed within clay minerals. The enhanced TOC concentration and high C_{org}/N_{tot} ratios in the aftermath of the P-Tr mass extinction in the Elikah

Formation may reflect a time of high primary organic productivity with elevated proportions of land-derived organic matter.

The stable isotopes show that the environmental changes started in the Late Permian *Paratirolites* Limestone, below the actual P-Tr extinction event, and before the conodont P-Tr boundary.