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CAMPing by the sea: Evidence for synchrony of volcanism and the end-Triassic extinction and carbon isotope anomaly from a marine Triassic-Jurassic boundary section

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The end-Triassic extinction (ETE) is one of the five largest Phanerozoic mass extinctions, associated with and likely triggered by rapid and severe environmental change. Volcanism in the Central Atlantic Magmatic Province (CAMP) has been proposed as the main trigger, but direct evidence for this linkage is scarce. To help constrain scenarios for the Triassic-Jurassic boundary (TJB) events, we obtained a temporally highly resolved, multidisciplinary dataset from the Kendlbachgraben section in the Northern Calcareous Alps in Austria. The section belongs to the same paleogeographic unit (Eiberg Basin) and share similar stratigraphies with the newly selected base Jurassic GSSP at Kuhjoch.

The topmost beds of the Rhaetian Kössen Formation yielded an REE pattern that differs from all other levels in an enrichment of heavy REEs, hinting at some minor contribution from mantle-derived magmatic material to the sedimentary basin. Micromineralogy of the same bed revealed pseudomorphs of altered, euhedral pyroxene and amphibole crystals. Their well-faceted morphology excludes any terrestrial weathering and transport, but is consistent with their origin from air-fallen distal mafic volcanic ash. Peculiar spherical or rounded grains, altered to illite/aluminoceladonite were also observed, likely representing altered volcanic glass. The dominant clay mineral of this bed is low- to medium-charged smectite, accompanied by vermiculite, both typical alteration products of mafic rocks. These features from a bed deposited very near to the TJB are interpreted as direct evidence of CAMP volcanism, immediately preceding the main extinction event and the initial negative carbon isotope anomaly. Clay mineralogy of the Rhaetian–Hettangian Kendlbach Formation (overlying the Kössen Formation) reveals a kaolinite-dominated interval at the base of the formation, followed by an illite-dominated interval. Thus a hot and humid period may have characterized the TJB, in agreement with a previously suggested super-greenhouse episode, which was likely connected to degassing during CAMP volcanism.

On the other hand, our study of pyrite, and the stratigraphic distribution of abundance of Ce and other redox sensitive elements provide little support for widespread anoxia, which was also cited previously as a possible cause for the marine TJB extinction.