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Enhanced continental weathering in the NW Tethys during the end-Triassic mass extinction

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The end-Triassic mass extinction (ETE) is thought to have been triggered by widespread eruption of the Central Atlantic Magmatic Province (CAMP) flood basalts. Although palynological studies of shallow marine deposits in the basins of Denmark and Germany suggest that deforestation and catastrophic soil loss occurred during the CAMP volcanism and ETE interval, the intensity and timing of continental weathering in the northwestern Tethys Ocean remain unclear. We present Sr, C, and O isotope data, as well as principal component analysis (PCA) of major element contents, for a Rhaetian limestone succession (~100 m thick) in Slovakia, to develop a continental weathering record in the NW Tethys during the ETE event. The studied section consists of a shallow marine carbonate sequence of the Rhaetian Fatra Formation and overlying Hettangian Kopieniec Formation.

Two negative carbon isotope excursions (NCIEs) occur in the uppermost Fatra Formation. These two NCIEs can be correlated with the “precursor” and “initial” NCIEs reported for the NW Tethys during the latest Rhaetian. Strontium isotope analysis of the limestones revealed an abrupt increase in Sr isotope ratios between the precursor and initial NCIEs, which indicates that continental weathering of the Bohemian Massif increased rapidly in the latest Rhaetian. PCA of the major element compositions of limestone samples also revealed that intense chemical weathering of the hinterland was accelerated after the precursor NCIE, the timing of which overlaps with the emplacement of the CAMP. The release of volcanic and contact metamorphism-related thermogenic C (CO_2) and/or volcanic SO_2 emissions from the CAMP may have triggered the extreme continental weathering between the precursor and initial NCIEs. Our geochemical data and PCA also suggest that the marine environments in European basins may have developed an oxygen minimum zone during the increase in continental weathering during the latest Rhaetian, and these environmental changes may have had an important role in the marine ETE event.