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Climate control of silicate weathering intensity through the Smithian/Spathian boundary in the western USA basin

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The aftermath of the end-Permian mass extinction is marked by large and recurrent perturbations of the environment and of the biosphere, which are thought to have delayed the recovery of marine ecosystems. A potential widespread loss of vegetation cover linked to destabilization of terrestrial ecosystems along with the climate warming that persisted for several million years after the Permian-Triassic boundary likely contributed to the markedly enhanced soil erosion and intensified continental chemical weathering recorded in the Early Triassic (Algeo and Twitchett, 2010). As continental weathering delivers nutrients to the oceans, this process could have played a major role in the repeated development of anoxic conditions by sustaining primary productivity and export of organic matter to the seafloor (Algeo and Twitchett, 2010; Sun et al., 2018). Yet our knowledge of the importance of this process in triggering anoxic conditions is currently hampered by the lack of proxies providing chemical weathering records at a local scale. In this study, we tested a novel proxy of chemical weathering intensity at the local scale, based on the coupled isotopic composition of hafnium and neodymium in clay minerals, to explore the links between chemical weathering, climate fluctuations, and anoxia in the western USA basin during the Early Triassic. This proxy has been recently calibrated in modern environments (Bayon et al., 2016) but has only been scarcely applied to deep-time environments.

We analyzed clay sediments for their Hf and Nd isotope composition from 5 sections within the western USA basin (that encompasses the Smithian-Spathian boundary (SSB). The well -stablished bio-chemo-stratigraphical frame of this basin allows the exploration of the respective timing of anoxia establishment and variations in chemical weathering of the continental masses adjacent to the basin at a high temporal resolution. Our new dataset highlights the existence of a decrease in chemical weathering of the continents surrounding the Basin at the Smithian-Spathian boundary, during the development of anoxic conditions marked by enhanced organic matter burial in the sediments. Our new data therefore bring new light on the links between nutrient inputs linked to modifications in continental weathering and the establishment of anoxic conditions in the western USA basin. The decrease in continental chemical weathering depicted in our data set occurs during the global cooling event identified by conodont $d^{18}O$ records in other regions of the word (Goudemand et al., 2019). This cooling may have promoted a decrease in the intensity of the hydrological cycle and the establishment of more arid conditions in the western USA basin, impeding chemical weathering in the studied area.

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