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Iron and molybdenum isotopic systematics of continental red beds

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Continental red beds (CRB) represent peculiar rock formations with time-specific occurrence in the Earth`s history (e.g., Devonian, Permian or Triassic). The CRB are traditionally considered as an intriguing paleoenvironmental archives that can provide essential information about extent of atmosphere oxygenation and climatic as well as depositional conditions in the past. Overall, the CRB are composed by variably colored red siliciclastic sedimentary rocks that tend to alternate with non-red facies with the color boundaries commonly developed along surfaces associated with the changes in redox conditions. Because Fe and Mo are essential redox-sensitive elements that are predominantly bound to color-carriers (Fe-Mn-oxyhydroxides), elemental and isotopic compositions of the CRB red to gray successions can provide important constrains on Fe–Mo cycling and, by inference, processes responsible for the red or black coloration of the rock as well as paleo-redox conditions. We focus on four different types of the CRB of late Silurian-Devonian (Wales, UK), Permian (Czech Republic), Triassic (Utah, USA) and Quaternary (Czech Republic) age originated at variable depositional conditions (fluvial, lacustrine, eolian and glaciofluvial). Here, we present results obtained so far for the Quaternary and late Silurian-Devonian lithologies. In glaciofluvial sediments, Mo–Fe isotopic fractionation towards largely negative d^{98}Mo and d^{56}Fe values, respectively, is controlled by the presence of the color coatings of detrital grains containing a mixture of Fe- and Mn-oxyhydroxide precipitates that developed along former subsurface redox gradients due to changes in groundwater flow. In fluvial CRB from Wales, the red color is largely pedogenic in origin and carried predominantly by hematite alteration of primary biotite. The Mo isotopic fractionation appears to be controlled by lithology rather than the red-grey color, which can be best explained by different porosity and permeability of the rocks whereby the sandstone was more susceptible to percolation of Mo-enriched reducing fluids with positive d^{98}Mo signatures than the associated mudstone. On the other hand, overlapping and positive d^{56}Fe values (up to +0.43 ‰) without any relationship to color, grain size or extent of hematite enrichment indicate partial oxidation of Fe at mildly oxidizing conditions at syn-depositional conditions.

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