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A Cr isotope fingerprint of submarine LIP volcanism

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Cr and other metals of basaltic affinity are variously enriched in shallow marine carbonates deposited in the proto-North Atlantic Ocean during OAE 2. These enrichments are attributed to increased magmatic activity associated with emplacement of the Caribbean LIP (Large Igneous Province), which is the proposed trigger of OAE 2. Consistent with the addition of LIP-sourced Cr (–0.1‰) to the oceans during OAE 2, two marine sections in the proto-North Atlantic region record large negative shifts in sedimentary $\delta^{53}Cr$ values, reaching –0.1‰ in the Portland core in the Western Interior Seaway and –0.3‰ in a core from Demerara Rise. These results show that $\delta^{53}Cr$ can reveal links between marine anoxia and submarine LIP eruptions in the geological past. To realize this potential, more information is needed to determine whether lowering of seawater $\delta^{53}Cr$ during LIP events represents a regional or global signal. The answer depends whether hydrothermally sourced Cr(III), which is relatively insoluble in oxygenated seawater, can spread to oceanic regions beyond the reach of anoxic hydrothermal plumes. For this to happen, Cr(III) must be oxidized to Cr(VI), which is highly soluble in oxygenated seawater. This oxidation reaction commonly occurs in continental weathering environments, where Mn(III/IV) oxides are abundant. The reaction has received less study in the oceans, although submarine LIPs also provide large quantities of Mn to seawater. This talk will present new Cr isotope data for marine sections located far away from direct influence of the Caribbean LIP. If a decrease in $\delta^{53}Cr$ values is found, then hydrothermally-sourced Cr(III) was oxidized to Cr(VI) during OAE 2, and the resulting fingerprint of a global-scale negative excursion in seawater $\delta^{53}Cr$ values may be used to evaluate the role of oceanic LIPs as drivers of climate change and extinction in the rock record since the rise of O_2.

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