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Cr isotope stratigraphy of Ediacaran cap dolostones, Doushantuo Formation, South China

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The Yangtze Platform in South China is considered a key site for studying Neoproterozoic ocean oxygenation. The chromium isotope composition (δ53Cr) of marine carbonates has shown to be a sensitive tracer of changing (paleo)redox conditions and was previously linked to photosynthetic activity (1). We applied this emerging proxy to cap dolostones of a deep water and a shallow marine carbonate section pertaining to the Doushantuo Formation that have previously been used to constrain the redox evolution of Ediacaran seawater (2,3). Postglacial detrital contamination and diagenetic alteration appear to have influenced the δ53Cr values of Doushantuo cap dolostones as evidenced by systematic changes in δ53Cr and Cr concentrations coupled with several geochemical tracers. We use Al concentrations as indicator of detrital contamination and to calculate the authigenic Cr isotope composition. Further, we hypothesis that post-depositional remobilization of Cr might have resulted in the loss of heavy Cr isotopes and the retention of light Cr isotopes during precipitation of secondary carbonates. This scenario is supported by a decrease in δ53Cr values that is correlated with a loss of Sr and increasingly light δ18Ocarb signals, which would indicate meteoric fluid/rock interaction and diagenetic alteration by continental basin fluids. However, some cap dolostones may still show pristine Ediacaran seawater signals with positively fractionated δ53Cr (relative to bulk silicate Earth; 4), 87Sr/86Sr close to Ediacaran seawater values and a pronounced negative Ce anomaly. These tracers reveal light pulses of enhanced postglacial oxidative weathering during cap dolostone deposition. The Cr isotope composition of Ediacaran cap dolostones pertaining to the Doushantuo Formation trace changes in past redox conditions, where fine-scale δ53Cr fluctuations are perhaps a result of detrital contamination and diagenetic alteration balanced against a signal of oxidative weathering. Although, a careful assessment of detrital contamination and diagenetic alteration is necessary, we propose that using the stable Cr isotope system can provide valuable information and further enhance our understanding of Neoproterozoic ocean oxygenation, past weathering regimes as well as past climate and environmental changes.

References: (1) Frei et al. (2011) EPSL 312, 114-125. (2) Guo et al. (2007) Palaeogeogr. Palaeoclimatol. Palaeoecol. 254, 140-157. (3) Hohl et al. (2015) GCA 163, 262-278. (4) Schoenberg et al. (2008) Chem. Geology 249, 294-306.