Extensive oxidative weathering following a Late Neoproterozoic glaciation – evidence from trace element and chromium isotope records in the Moro do Urucum and Puga iron formation (Mato Grosso do Sul, Brazil)

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The gigantic Late Neoproterozoic Fe and Mn deposits of Moro do Urucum and the iron formations from Puga Hills (Jacadigo Group, Brazil) are associated with glacigenic deposits and represent the youngest and one of the largest sedimentary iron and associated manganese formation (IF) deposits of Cryogenian age in the world. Redox trace element signatures and Rare Earth Element+Yttrium patterns suggest deposition in shallow oxic basin seawater, influenced by significant fresh water input most probably directly derived from glacial meltdown. The lack of Eu anomalies, the presence of negative Ce anomalies, the peculiar occurrence of negative Y anomalies, together with positively fractionated $\delta^{53}Cr$ values, indicate that that long-distance transport of Eu was inhibited and high-temperature hydrothermally sourced Fe in the Urucum IF was not important, and that the Urucum and Puga basins were sufficiently oxygenated which enabled effective reductive scavenging of Cr(IV) through co-precipitation with Fe-(oxy)hydroxide phases. Samples in which the proportion of Cr from detrital components relative to total Cr is less than 50% by mass define an authigenic (i.e., dissolved) $\delta^{53}Cr$ signature of +1.11 ± 0.44‰ (n=14; 2σ) which we interpret as the average signature of the shallow seawater from which these ironstones were deposited. These stronlgy positively fractionated signatures support the intriguing view that an increase in atmospheric O_2 levels following the Late Neoproterozoic glaciations was correlated with the evolution of macroscopic multicellular lifeforms.