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Sr-Cr-Cd isotopes in carbonates of the Corumbá Group, Brazil: new insights into environmental changes linked to biological innovations in the Late Ediacaran

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The Late Ediacaran was a period of great environmental upheavals and biological innovations, including the rise of the first biomineralizing animals in the fossil record. Aiming to comprehend the paleoenvironmental conditions during the appearance of such fossils, we have analyzed shallow-water carbonate rocks from the Corumbá Group, Brazil, for Sr-Cr-Cd isotopes. Samples were collected from drill cores of the ICDP's GRIND project, encompassing dolomites from the Bocaina Formation (ca. 555 Ma) and fossil-bearing limestones from the overlying Tamengo Formation (ca. 550 – 540 Ma). $^{87}Sr/^{86}Sr$ values are consistently around 0.7100 in the Bocaina Formation, presenting a rapid drop to 0.7085 in the Tamengo Formation, which is ultimately related to increasing basin connection with global ocean after 550Ma, when the Sr isotopes reached Late Ediacaran global levels. $\delta^{53}Cr_{auth}$ values are in the range of Bulk Silicate Earth (BSE) in the Bocaina Formation, while in the Tamengo Formation they are positively fractionated around 0.5 ‰. Even under an oxidizing atmosphere and water column with positive $\delta^{53}Cr$, sediments can record BSE $\delta^{53}Cr$ values in stagnant, redox-stratified basins, where Fe-Mn oxyhydroxides incompletely uptake Cr, resulting in isotope fractionation back to BSE values, followed by Cr release below the chemocline. This Fe-Mn shuttle operated in the restricted, stagnant Bocaina Formation, while in the Tamengo Formation, increasing basin ventilation, turbulence, and water column mixing inhibited such mechanism, causing the $\delta^{53}Cr_{auth}$ record to preserve the positive values derived from oxidative weathering. These environmental changes are coincident with the appearance of the first Nama Assemblage biomineralizing macrofossils in the Corumbá Basin, suggesting that early animals preferred high-energy, turbulent, and ventilated waters, where oxygen availability in the water column was higher. Furthermore, cadmium isotopes are mostly negatively fractionated in both units, indicating that, even in shallow water settings, bioproductivity levels were low during the Late Ediacaran, comparable to present-day deep-waters.