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Post-Snowball Earth oxygenated waters and quick recovering of primary productivity levels tracked by Cr-Cd isotope systematics of early Ediacaran cap carbonates from the Araras platform, Paraguay Belt, western Brazil

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The Ediacaran was a key period in Earth's story, comprising important unidirectional changes in the biosphere, lithosphere, atmosphere and global climate. To understand how all of these changes might have been interlinked, proxies that can track changes in key factors such as oxygenation and nutrient availability in ancient sedimentary basins are of utmost importance. The Araras carbonate-siliciclastic platform bordered the southern Amazon paleocontinental border during the Cryogenian and early Ediacaran, preserving sedimentary units that recorded both the pan-glacial Snowball Earth state (Puga Fm. diamictite) and the post-glacial cap carbonate succession of the Araras Group. To track the paleoenvironmental conditions in the Araras platform, we combine two carbonate-based avant-garde isotopic techniques, to elucidate redox (Cr) and nutrient (Cd) conditions on the aftermath of the Marinoan glaciation, along with new trace element, C, O and Sr isotope data, in two distinct sections: Terconi Quarry and Tangará da Serra. In both sections, carbon isotopes show typical negatively fractionated $\delta^{13}C$ around -5‰, straddling the Mirassol D'oeste cap dolostone and the lower Guia Fm. limestone. The carbonate samples show slightly MREE(Middle Rare Earth Element)-enriched patterns and Y/Ho ratios mostly above 30, indicating deposition in near shore to open seawater settings. Authigenic $d^{53}Cr$ values are variably fractionated throughout, reaching up to ca. 0.5‰, indicating important oxidative continental weathering and delivery of Cr(VI). Conversely, Ce/Ce* negative anomalies are ubiquitous, with most values in between 0.65 and 0.80, indicating important Ce cycling and manganese oxide precipitation under an oxic water column. Authigenic $d^{114}Cd$ values are mostly positively fractionated, reaching up to 0.6‰ and indicating increased uptake of Cd, among other nutrients, into phototrophic plankton, supporting primary productivity levels comparable to modern surface waters. Finally, although Sr concentrations are generally low (<100 ppm), the lowest $^{87}Sr/^{86}Sr$ ratios ~0.7076-0.7080 indicate typical late Ediacaran seawater signatures. Our results shed light on the post-glacial dynamics in southwestern Gondwana, and indicate deposition under transient oxygenated conditions and quick recovery of primary productivity levels upon deglaciation of the Marinoan Snowball Earth. This work is supported by CNPq, Brazil (Universal 403233/2025-9; Instituto GeoAtlântico, 405653/2022-0; Productivity in Science 304509/2021-3) and by Instituto Serrapilheira (Project MOBILE, Serra-1912-31510).