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Coupled Cr-Cd-Sr-U isotopes, I/Ca and trace elements to reconstruct paleoenvironmental conditions in the Ediacaran/Cambrian Bambuí basin of western Gondwana

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The Ediacaran-Cambrian carbonate/siliciclastic Bambuí Group of Brazil is ideal for testing biogeochemical variability on ancient ecosystems as it contains remnants of the first complex life forms and it presents wide variations in proxies for seawater chemistry throughout its stratigraphy. Our results from carbonate and siliciclastic samples from two drill cores indicate a complex evolving biogeochemical landscape, and can be subdivided in four major chemostratigraphic intervals: I-1) the post-glacial cap carbonate at the base of the Sete Lagoas Formation, which preserves a short-lived negative $\delta^{13}C$ excursion and a sharp increase of $^{87}Sr/^{86}Sr$ from ca. 0.7075 to >0.7080. Short-lived oxic conditions in the wake of the Marinoan glaciation (ca. 635-600 Ma) are marked by a peak of $\delta^{53}Cr$ to +0.5‰, I/(Ca+Mg) up to 2 µmol/mol and $\delta^{238}U$ rising from -0.4‰ to >-0.2‰. A quick recovery of primary productivity is indicated by $\delta^{144}Cd$ rising to +0.4‰; I-2) middle to upper Sete Lagoas Fm., with $\delta^{13}C$ around 0‰ and slowly increasing. Anoxic conditions are indicated by unfractionated $\delta^{53}Cr$ and a decrease of both I/(Ca+Mg) and $\delta^{238}U$, lower primary bioproductivity by lower $\delta^{144}Cd$ that persists upwards, and basin restriction by lower $^{87}Sr/^{86}Sr$ of ca. 0.7075, with fleeting and short-lived colonization of shallow-water oxic oases by biomineralizing organisms (600-540 Ma); I-3) upper Sete Lagoas Fm., where a transgression is marked by a sharp increase in $\delta^{13}C$ to >+15‰ (the Middle Bambuí Excursion – MIBE). The overlying Serra de Santa Helena Fm. likely straddles the Ediacaran/Cambrian transition and marks a return to oxic conditions, with increasing I/(Ca+Mg) up to ca. 3 µmol/mol, $\delta^{238}U$ to -0.3‰ and $\delta^{53}Cr$ up to +1‰; I-4) the Lagoa do Jacaré Fm., which marks a sea-level fall and the return to anoxic conditions indicated by concomitant decreases in $\delta^{53}Cr$, I/(Ca+Mg) and $\delta^{238}U$ to -0.3‰, accompanied by typical early Cambrian $^{87}Sr/^{86}Sr$ of 0.7085, indicating renewed communication with the ocean. Our integrated results comprise a multi-proxy study that stresses the importance of biogeochemical cycles on the distribution of the first complex life forms. This work is supported by CNPq, Brazil (Instituto GeoAtlântico, 405653/2022-0; Universal 408815/2021-3; Productivity in Science 304509/2021-3) and Instituto Serrapilheira (Project MOBILE, Serra-1912-31510).