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Using Precambrian carbonates for seawater isotope reconstructions: constraints from LA-ICP-MS U-Pb geochronology of a post-Sturtian cap dolomite, Brazil

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Global seawater isotope reconstructions from Precambrian marine carbonates must overcome particular difficulties on two fronts: i) accurate age constraints for global stratigraphic correlations and interpretations, and ii) the relative timing of syn- to post-depositional processes. Neoproterozoic cap dolomites have emerged as promising archives for seawater isotope reconstructions, in the context of major geochemical disturbances in the Earth system, including the evolution of complex life, significant shifts in the carbon cycle, Cryogenian glaciations, all in the tectonic framework of continental breakup. However, absolute age constraints are required to set the chronological context of such isotope reconstructions. The direct dating of carbonates by laser ablation ICP-MS U-Pb is an increasingly applied tool, which may help to overcome age uncertainties. Here, we investigate a suite of petrographic sections from the base of the Jacoca Formation cap dolomite, at the Capitão Farm section, Sergipano belt, Brazil, overlying the glacially influenced Sturtian Jacarecica Formation diamictite. The goals of our study are to: i) provide chronological constraints on the timing of the Sturtian deglaciation and ii) to reconstruct the diagenetic history of this unit after carbonate deposition. To this end, in-situ U-Pb geochronology was combined with X-ray diffraction (XRD), and selected element geochemistry data on two cogenetic dolomite phases (D1: finely crystalline dolomite and D2: coarsely rhombic dolomite texture) recognized by optical microscopy- and CL-imagery. Powder XRD patterns, Mg/(Mg+Ca) molar ratios for both D1 and D2 dolomite phases (0.43 to 0.50), as well as petrographic observations, demonstrate a dolomite-dominated mineralogy. Laser ablation U-Pb analyses of the D2 phase yield an isochron in Tera-Wasserburg space, with a lower intercept age of 670±16 Myr and an upper intercept common Pb $^{207}Pb/^{206}Pb$ value of 0.8805±0.0012. This, therefore, suggests an early dolomitization stage that is consistent with an expected ca. of 660 Myr for post-Sturtian cap dolomites. In contrast, data from an area of the D1 phase defines an isochron age of 555±30 Myr and a more radiogenic common initial $^{207}Pb/^{206}Pb$ value of 0.8375±0.0026, implying that the U-Pb system was reset long after carbonate dolomitization. The timing of this resetting overlaps with the known Pan-African/Brasiliano tectono-metamorphic event, which folded these geological units,

and suggests a post-depositional overprint. Our preliminary data indicates that: i) a reasonable Sturtian dolomitization age is recorded in the Jacoca Formation cap dolomite and that ii) a significant later diagenetic event appears to have reset the U-Pb carbonate system during an episode of crustal deformation. Therefore, U-Pb dating of ancient post-glacial cap dolomites can provide absolute age records of syn- to late-diagenetic geological processes that operated in the aftermath of Cryogenian glaciations. Consequently, these data can help both to anchor isotope and element geochemistry data interpretations, and to highlight potential complexities associated with the subsequent geological evolution of marine carbonate archives.