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New Re-Os geochronology and radiogenic isotope data from the Shaler Supergroup, NW Canada: Investigating geochemical dynamics of the Tonian oceans

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The Tonian Period (ca. 1000–717 Ma) represents a crucial turning point in the coevolution of life and environment, featuring a dynamic interplay between carbon-cycle perturbations, supercontinent breakup, and the rise of eukaryotes to ecological prominence. Chronological and geochemical data for well-preserved sedimentary Tonian strata are essential for investigating possible connections between tectonics, ocean chemistry and redox states, and paleobiological change. However, precise radioisotopic age constraints are lacking, which, along with a paucity of high-resolution radiogenic geochemical data, has limited efforts to assess the timing of paleoenvironmental change and its possible connection to evolving tectonic regimes, despite biogeochemical implications (i.e., nutrient delivery, redox landscape).

Here, we report Re-Os geochronology and radiogenic isotopic data from well-preserved sedimentary strata of the Shaler Supergroup preserved in the Amundsen Basin, NWT, Canada. Our age precisely constrains the timing of the global Bitter Springs carbon isotope anomaly as preserved in the Wynniatt Formation (upper Shaler Supergroup), improving both its estimated duration and utility as a tie point for chemostratigraphic correlation. We also present carbonate $^{87}Sr/^{86}Sr$ data from the lower and middle Shaler Supergroup, which vastly improve the resolution of the Tonian seawater $^{87}Sr/^{86}Sr$ record, extending into the early Tonian where existing data are sparse and lack firm temporal context. Together, these data constrain the timing and nature of Tonian geochemical dynamics—both locally in the Amundsen Basin and globally—and provide context for potential drivers of changing paleoenvironmental conditions through this important time at the dawn of the evolution of complex life.