

Closed-System Oxygen Isotope Exchange in a Paleoproterozoic Evaporite Sequence

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Post-depositional processes including diagenesis and metamorphism could alter the $\delta^{18}\text{O}$ and obscure the original signal. We have studied the oxygen isotope composition of the Earth's oldest major evaporite succession from the Omega Basin, Russian Karelia and found an upward increasing $\delta^{18}\text{O}$ trend in three co-occurring phases; carbonates (from 13 ‰ to 22 ‰, VSMOW), sulfates (from 11 ‰ to 19 ‰), and silicates (from 10 ‰ to 21 ‰). After discounting the possibility of a high initial temperature gradient in the basin or a freshwater-to-open seawater transition, we propose that the linked upward increase in the $\delta^{18}\text{O}$ for carbonates, sulfates, and silicates is the result of an upward decrease in initial gypsum proportion in the chemical sediments. Low-grade metamorphic minerals talc, phlogopite, chlorite, and tourmaline indicate that crystallization fluids reacted with these chemical sediments at 200–300 °C, then oxygen exchange occurred between minerals and water. Mass-balance calculation based on elemental and mineralogy data is consistent with proposed closed-system re-equilibration causing the upward $\delta^{18}\text{O}$ shift of all three phases. These calculations further infer that the $\delta^{18}\text{O}$ of Paleoproterozoic seawater was at -1–2 ‰.