

Paleoproterozoic ocean temperatures using triple oxygen isotope values from the 1.88 Ga Gunflint Formation

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Unlike Phanerozoic chert, which is formed via diagenetic processes, Precambrian chert may have formed from an amorphous silica gel at the sediment-water interface in an ocean that was supersaturated with respect to silica. Since this chert may have formed directly from ocean water, the oxygen isotope composition of Precambrian chert is frequently used as a proxy for ocean paleotemperatures. However, Precambrian chert formation is still enigmatic. In this study, we present triple oxygen isotope values (paired $\delta^{17}\text{O}$ - $\delta^{18}\text{O}$) of 1.88 Ga chert and carbonate from the Gunflint Formation to better understand the chert formation processes and whether we can use Gunflint chert as a proxy for paleotemperatures. The 1.88 Ga Gunflint Formation represents a shallow marine ramp preserving shallow to deep water facies. Chert from the shallow water setting hosts silicified microbial mats and exceptionally preserved microfossils while banded chert is found in the deeper water setting. Arenitic chert and silica-rich shale facies represent intermediate portions of the ramp. Preliminary results do not find any differences in the triple oxygen isotope compositions of different chert facies. All chert triple oxygen isotope values from our dataset indicate that samples have likely undergone some degree of alteration. We use the triple oxygen isotope values to estimate a range of alteration scenarios and compare our results to seawater oxygen isotope evolution models. From this work, we find that, although Gunflint chert preserves features indicative of precipitation near the sediment-water interface, the chert most likely has undergone some alteration after burial. However, using a diagenetic model and the measured triple oxygen isotope values, we can “see-through” the diagenesis and estimate that the 1.88 Ga ocean in this region was around 40 °C.