^{18}O-depleted sulfate fingerprint of Paleoproterozoic glacial meltwater

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After the Great Oxidation Event (GOE) at ~2.45 Ga, the onset of oxidative weathering, in conjunction with mechanical weathering from globally extensive glaciations [1, 2], should have resulted in the most intense fluxes of sulfate in Earth history up to that point. However, sulfate concentrations and isotope compositions around the GOE are not well constrained [3]. To constrain the GOE sulfate record, we extracted and measured oxygen-18 of trace sedimentary barite ($BaSO_4$) from drill cores of the Turee Creek Group, W. Australia, that record multiple glacial diamictite layers occurring between 2.45 to 2.22 Ga [4]. The barites from Turee Creek cores have $\delta^{18}O$ as low as -19.5‰ and average -10.4‰ (n=34), a record of sulfate oxygen-18 depletion that indicates a glacial meltwater source of oxygen. These sulfate $\delta^{18}O$ depletions are only comparable to that directly measured from relatively more recent, 635 Myr, snowball Earth glacial sediments [5]. The Turee Creek oxygen-18 depleted sulfate was measured from carbonates that occur 500 m above the Meteorite Bore Member, the nearest glaciogenic horizon. These extremely oxygen-18 depleted sulfates testify to the profound nature of Paleoproterozoic glaciation, and may imply that globally extensive glaciation lasted much longer than indicated by the episodic presence of glacial diamictites alone.

[1] Kopp *et al.,* (2005) *Proc. Natl. Acad. Sci. U.S.A.* **102**, 11131. [2] Hoffman (2013) *Chem. Geol.* **362**, 143. [3] Lyons *et al.,* (2014) *Nature* **506,** 7488. [4] Van Kranendonk and Mazumder (2015) *Geol. Soc. Am. Bull.* **127**, 596. [5] Peng *et al.* (2013) *Geol.* **41**, 367.