Extreme environmental changes accompanying the Marinoan deglaciation: multiple O and S isotope evidence from NW Canada

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The Marinoan snowball Earth glaciation ca. 635 Ma punctuates the tumultuous environmental transition from the Cryogenian to Ediacaran period, with some of the most unusual isotopic shifts found in the stratigraphic record [1]. Triple oxygen isotopes of sulfate deposited in the Marionoan aftermath suggest extremely high pCO2, supporting a snowball Earth scenario [2]. Here we explore environmental changes accompanying the Marinoan deglaciation, through measurements of multiple oxygen ($\delta^{18}O$, $\Delta^{17}O$) and multiple sulfur isotopes ($\delta^{34}S$, $\Delta^{33}S$) on barites collected from the top of the Ravensthroat cap carbonate in northwest Canada. Our oxygen isotope data documents the extreme 17O depletion that to date has been recorded in four other paleo-continents [2,3,4,5]. We record $\Delta^{17}O$ values as low as -0.75‰ at the base of the barite layer, and values near -0.1‰ at the top. Likewise sulfur isotope compositions show large variations, with $\delta^{34}S$ values ranging between +27 and +45 ‰ in barite, and between -6 and +33 ‰ from trace pyrite inclusions within the barite. The $\Delta^{33}S$ values from both S pools (sulfate and sulfide) vary between -0.037 and +0.086 ‰. In a genetic framework, the S isotopic covariation occuring within the barite layer places firm constraints on the dynamic evolution of size and microbial influences on the post glacial marine sulfate reservoir. Furthermore this uniquely coupled data s *et al*lows us to explore the relative influence of pCO2 and primary production on evolving $\Delta^{17}O$ values in the immediate aftermath of the Marinoan glaciation.

[1] Hoffman *et al* (1998), *Science* **281**, 1342-1346 [2] Bao *et al*, (2008), *Nature* **453**, 504-506 [3] Killingsworth *et al* (2013), *PNAS* [4] Bao *et al* (2011) *Precambrain Research* **216-219**, 152-161 [5] Bao *et al* (2009) *Science* **323**, 119-122