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Temporary ocean oxygenation in the wake of the Sturtian glaciation

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The nature of ocean redox chemistry across the Cryogenian Sturtian glaciation (ca. 717–659 Ma) is important for understanding the relationship between environmental conditions and the subsequent emergence of animal ecosystems. This transition has led to the proposition of various hypotheses regarding the mechanisms that drove global ocean oxygenation and, ultimately animal evolution [1,2]. Here we present integrated geochemical data of carbonate/dolomite-associated uranium isotope, δ 238UCAU, iron-speciation and elemental analyses for pre-glacial, glacial and post-glacial shallow marine sediments deposited across the Sturtian Snowball Earth glaciation in Islay, Scotland. The primary data may potentially reveal various in global marine redox through this under-investigated time interval. After screening the data for post-deposition alternation and localised porewater diagenesis (e.g. anomalously high Mn/Sr and U conc.), the post-glacial samples have a mean δ238UCAU value of −0.40 ± 0.05% (2SD) similar to the modern ocean, coeval iron-speciation values of FeHR/FeT < 0.22, consistent with deposition beneath localised oxic waters. In contrast, the overlying late post-glacial and the underlying glacial and pre-glacial successions bracketing this oxic event have FeHR/FeT > 0.38 consistent with formation beneath anoxic-ferruginous waters with average δ238UCAU values of -0.10 % for pre-Sturtian samples. The data suggests a short-lived change from localised anoxic to oxic waters across the transition from icehouse to greenhouse conditions, followed by a reversal to anoxic waters. While our findings support previous studies pointing to a link between Snowball Earth deglaciation and ocean oxygenation [3,4], they further suggest that oxygenation after the post-Sturtian Snowball may have been transient, perhaps due to the approaching Marinoan Snowball glaciation.

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Chen *et al.*, (2015). *Nature communications*, vol. 6(1), p.7142.

Scheller *et al.*, (2018). *Precambrian Res*, vol. 319, pp. 173–186.

Lau et al., (2017). *Earth Planet Sci Lett*, vol. 458, pp. 282–292.

Sahoo *et al. (2012). Nature*, vol. 489 (7417), pp. 546–549.