
Marine euxinia during the melting of the Sturtian glaciation

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Abstract

The Neoproterozoic snowball Earth events include the Sturtian (717-660 Ma) and the Marinoan glaciation (~650-635 Ma). The snowball Earth hypothesis suggested that the global ocean was completely frozen during these glaciations. It is possible that global melting of ice sheets can cause significant marine stratification. In the aftermath of the Marinoan glaciation, this change has been tested. The Sturtian glaciation is the longest Snowball Earth event, but the marine redox conditions during the termination of the Sturtian glaciation remain unclear. Here we report massive pyrite from the top of the Sturtian Tiesiao diamictite from four drill cores in South China. Three types of pyrite are observed from the Tiesiao Formation: nodules, laminae and disseminated pyrite. Disseminated pyrite, including framboids, euhedral pyrite, are generally < 100 μm in size and are pervasively distributed in the matrix or within intergranular pores of diamictites and pebbly sandstones. The mean diameter of framboids ranges from 3.53 to 7.46 μm, and 59.20% of these framboid are < 5 μm. The proportion of framboids in all disseminated pyrites varies between 1.01–62.75%, with a mean value of 17.94%. Geochemical analysis of these pyrites shows low Co contents (mean=104.25ppm), low Co/Ni ratios (mean=0.79), but elevated sulfur isotope values (27.2–75.8‰). Iron chemistry shows FeHR/FeT > 0.38 in all samples and Fepy/FeHR > 0.8 in most samples. Meanwhile, there is a strong correlation between Fepy and FeHR. These results suggest that the ocean was stratified and H₂S-enriched during the melting of the Sturtian glaciation. Since maintaining marine euxinic conditions requires enough seawater sulfate and organic matter, our results show that continental weathering increased and that the marine biosphere recovered quickly after the Sturtian glaciation.

Keywords: snowball Earth, Cryogenian, sulfur isotope, pyrite

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