Insight into the variability within the Proterozoic sulphur cycle

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Recent sulphur isotope evidence has placed the activation of the oxidative sulphur cycle in the mid-late Mesoproterozoic [1]. However, characterizing the state of the oceanic sulphur cycle preceding these events is equally as important, and the focus of this work. It has been postulated that the middle Proterozoic ocean contained widespread sulfidic waters [2], with recent iron speciation work constraining the onset of such conditions to the late Paleoproterozoic [3]. We use the Animike Basin, North America, which captured the onset of sulfidic deep waters [3], to constrain the front end of this dramatic oceanic condition and in order to identify an isotopic fingerprint of such a condition. Our hypothesis stems from preliminary results from Animike Basin black shales (Rove Fm.), which suggest a dynamic oceanic sulphur cycle that requires significant sulphide loss. We also consider the recent proposal [4] that this sulphide loss may be related to the degassing of the sulfidic portions of the water column.

Here we present sulphur isotope (^{32}S, ^{33}S, ^{34}S, ^{36}S) measurements of marine sedimentary pyrite to test the possible presence of a "sulfidic ocean fingerprint" and characterize the nature of the middle Proterozoic sulphur cycle. This examination relies on small $^{33}S/^{32}S$ (and $^{36}S/^{32}S$) isotopic variability in the context of much larger $^{34}S/^{32}S$ change. This framework, and the modelling treatments therein, provide the template for interpreting these results. In addition to the aforementioned hypothesis, we provide new insight into the evolution of the middle Proterozoic oceanic seawater sulphate reservoir and apply unique interpretations provided by high precision ^{36}S data.

References

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