Sulfur non mass dependent anomalies in modern river water of Archean catchment

DAN ASAEL[1], NOAH PLANAVSKY[1], ERIC BELLEFROID[1], AXEL HOFMANN[2], CHRISTOPHER REINHARD[3]

[11]Department of Geology and Geophysics, Yale University, New Haven, CT 06511, USA
[2]Department of Geology, University of Johannesburg, PO Box 524, Johannesburg, South Africa
[3]School of Earth & Atmospheric Sciences, Georgia Institute of Technology, Georgia, USA

Non Mass Dependent sedimentary (NMD) sulfur isotope anomalies are a critical part of the toolkit used to track the redox evolution of the atmosphere during early Earth history. The terminal disappearance of the NMD signal from the rock record 2.32 billion years ago [1,2], referred as the Great Oxidation Event (GOE), is commonly interpreted to represent the end of long period of an extremely oxygen poor atmosphere (less than ca. 10-5 times of the present level).

Recent modeling work [3] suggested that under an oxygenated atmosphere, successive recycling of crustal rocks can deliver and bury NMD sulfur anomalies in contemporaneous sedimentary rocks. This would allow for short-term swings to higher atmospheric oxygen levels when sedimentary rocks carry small NMD anomalies. A critical aspect of this model is that the upper continental crust has a positive NMD anomaly, as is suggested by Archean sedimentary sulfur isotope compilations. In this study we tested this idea by determining the sulfur isotope composition of surface waters from regions dominated by Archean sedimentary rocks. Specifically, we used a MC-ICP-MS (NeptunePlus) to measure the sulfur isotopic compositions of water samples from rivers and lakes in South Africa and Ontario with catchment basins that cover Archean rocks. Our preliminary results show NMD sulfur anomalies of Archean rocks can be recycled into modern river waters. Small positive NMD sulfur anomalies seems to be common. This supports preferential subduction of sulfur with negative NMD anomalies, which we feel is most consistent with the more oxidized sulfur exit channel carrying a negative NMD anomaly.

[1] Farquhar et al., 2000, Science.
[2] Bekker et al., 2004, Nature.
[3] Reinhard et al., 2013, Nature.