3.2 Ga seawater sulfate implied from sulfur isotopic compositions of barite crystals in Pilbara, Western Australia

T. MIKI[1]*, S. KIYOKAWA[1], N. TAKAHATA[2], A. ISHIDA[2], T. ITO[3], M. IKEHARA[4], K. E. YAMAGUCHI[5,6] AND Y. SANO[2]

[1] Kyushu University, Fukuoka 819-0395, Japan (*correspondence: 3SC15023G@s.kyushu-u.ac.jp)
[2] University of Tokyo, Japan
[3] Ibaraki University, Japan
[4] Kochi University, Japan
[5] Toho University, Japan
[6] NASA, US

Sulfur isotopic ratio ($\delta^{34}S$) of past sulfate minerals is a good proxy for redox state and microbial sulfate reducing systems in the Precambrian. However, reports of $\delta^{34}S$ of Archean sulfate are scarce because of the limited occurrences of sulfate deposits. Therefore, we focused on newly discovered sedimentary barite ($BaSO_4$) layers from the 3.2Ga Dixon Island Formation, which is considered to have been deposited in a relatively deep open sea environment [1].

The Dixon Island Formation is located in the coastal Pilbara terrane, Western Australia and shows low metamorphic grade [2]. Barite layers alternate with black chert layers in the Black Chert Member of the Dixon Island Formation that overlies hydrothermal vein networks. Though most of them are silicified [1], there exist small crystals of barite (less than 200 μm in diameter) which are regarded to be remnants of original barite. We crushed three rock samples from different horizons, separated twelve fine barite grains in total, and performed micro-meter scale $\delta^{34}S$ analyses using a NanoSIMS.

As a result, we obtained scattered $\delta^{34}S$ values of -2.1 ± 1.1 to +18.7 ± 0.9‰ (Avg. = +6.5 ± 6.3‰) from twelve crystals. On the other hand, averages in each rock sample were +3.4 ± 5.8, +7.8 ± 8.0 and +8.4 ± 3.6‰.

There are two possible causes of the dispersion of $\delta^{34}S$ of barite crystals: 1) change in hydrothermal activities or 2) a gradual microbial sulfate reduction in a sulfate-limited condition (Rayleigh fractionation). However, no change in mineral occurrences and rock facies eliminate the former. Moreover, fluctuations of bulk $\delta^{34}S$ [3] and micro-meter scale heterogeneity of $\delta^{34}S$ of pyrite [4] possibly supports the latter.

[1] Kiyokawa *et al*. (2006) *Geol Soc Am Bull* **118**, 3-22. [2] Kiyokawa & Taira (1998) *Precambrian Res* **88**, 109-142. [3] Sakamoto (2010) *Master's thesis,* unpublished. [4] Miki (2015) *Master's thesis,* unpublished.