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GSA Annual Meeting in Seattle, Washington, USA - 2017

Paper No. 249-10

Presentation Time: 4:00 PM

STABLE ISOTOPE GEOCHEMISTRY OF A LATE ARCHEAN MICROBIAL ECOSYSTEM: DIVERSITY IN THE PRE-GOE OCEANS

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The evolution of microbial communities preceding the Great Oxidation Event (GOE) has become a subject of considerable interest and exploration, particularly regarding the early diversity of microbial metabolisms and the onset of oxygenic photosynthesis. The paleobiological record of Archean deposits continues to grow, and the morphological range of ancient microfossils has been greatly expanded in recent years. However, most studies of early microbial ecosystems have been focused on shallow-marine deposits due to their enhanced preservation, and offshore deposits are often overlooked, providing a partially restricted view of biological diversity in the Archean oceans. To address these issues, we studied the stable isotope geochemistry of fossiliferous cherts from the deep-marine unit of the upper Gamoha Formation, part of the Neoproterozoic (~2.52 Ga) Transvaal Supergroup in South Africa. High-resolution isotopic measurements were obtained using secondary ion mass spectrometry (SIMS) to analyze carbon isotopes ($\delta^{13}\text{C}$) of several large, organic-walled microfossils, described as possible sulfur-oxidizing bacteria, and sulfur isotopes ($\delta^{34}\text{S}$) of associated pyrite grains. $\delta^{13}\text{C}$ values of the fossils range from -41 to -32‰ (VPDB), whereas $\delta^{34}\text{S}$ values of pyrite grains range from -0.7 to +6.3‰ (VCDT), and the isotopic variability appears to be correlated with differences in fossil morphologies and pyrite textures, respectively. Such fine-scale isotopic heterogeneity within this unit is consistent with the presence of an active and diverse microbial ecosystem capable of cycling carbon and sulfur in an offshore environment of the late Archean ocean. Comparing these data with similar studies of other Archean deposits will further improve our understanding of biological evolution and diversity in Earth's oceans prior to the GOE.

Session No. 249

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Tuesday, 24 October 2017: 1:30 PM-5:30 PM

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