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Booth No. 188 SUPERHEAVY PYRITE FORMATION IN HYPERSALINE LAKES OF EAST AFRICA: A PALEOSALINITY PROXY FOR LAKE MAGADI HSPDP CORES

Tuesday, 6 November 2018

09:00 AM - 06:30 PM

📍 *Indiana Convention Center - Halls J-K*

Superheavy pyrite (pyrite showing “reversed fractionation”, i.e., enriched in ^{34}S compared to its source or coexisting sulfate) is well known in both ancient and modern marine environments, although mechanisms for its origin have been debated (Fike et al., 2015; Cui et al., 2018). Despite much of this debate, relatively minor effort has been made to document and understand modern occurrences of superheavy pyrite, particularly in terrestrial settings. In any biochemical pathway involving a negative fractionation factor, superheavy pyrite formation must involve both a mechanism for ^{34}S -enrichment of a sulfate reservoir compared to its source, and sulfate reduction from this distinct ^{34}S -enriched reservoir. Here, we describe a mechanism that incorporates these two processes and documents the formation of superheavy pyrite in hypersaline lakes of East Africa (Lakes Magadi and Nasikie Engida, Kenya). As salinity increases in these shallow and highly evaporative lakes, there is a net loss of sulfate compared to conservative ions. As this evaporative concentration proceeds, dissolved sulfate used in microbial sulfate reduction (MSR) is continuously enriched in ^{34}S compared to the source sulfate (the latter occurring as hot spring waters entering the lakes). Although no sulfate minerals are precipitated from the evolving lake waters, the volatile loss of ^{34}S -depleted sulfide by MSR leaves the remaining sulfate reservoir continuously ^{34}S -enriched with respect to the initial source sulfate. Thus sulfide minerals precipitated in sediments would appear “superheavy” in the sedimentary record. We describe a model that couples the rate of evaporative concentration to the rate of sulfate reduction and sulfide loss, and thereby describes the $^{34}\text{S}/^{32}\text{S}$ ratio of sulfide minerals preserved as a function of salinity. We consider the implications of this mechanism for the environments represented by superheavy pyrite preserved in terrestrial sediments of the East African Rift System. We suggest that this mechanism, documented from the waters of Lakes Magadi and nearby Nasikie Engida, can be applied to understand paleosalinity variations recorded by pyrite in sediment cores from hypersaline lakes such as the HSPDP Lake Magadi (MGD) core, and thus provide additional context for paleoclimate records of human evolution.

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