Goldschmidt 2023 Abstract
https://doi.org/10.7185/gold2023.16689

Formation pathways of Precambrian sedimentary pyrite: insights from *in situ* Fe isotopes

JULIETTE DUPEYRON[1], MARIE-NOËLLE DECRAENE[2], JOHANNA MARIN-CARBONNE[3] AND VINCENT BUSIGNY[4]

[1]University of Lausanne
[2]Université de Lausanne
[3]Université de Lausanne,
[4]Institut de Physique du Globe de Paris, Université Paris Cité
Presenting Author: juliette.dupeyron@unil.ch

Iron isotope compositions (δ^{56}Fe) in sedimentary pyrite have been widely used as tracers of redox and chemical evolution of the ocean through geological time. Previous studies were mostly based on mechanical extraction of sulfides from bulk rock sample, and focused on visible macroscopic pyrites [1, 2], which may introduce a sampling bias. *In situ* analyses of micropyrite grains can provide a new insight into the processes of pyrite formation and their time evolution [3]. In this study [4], we compile ~ 2000 *in situ* iron isotope compositions of Archean to Paleoproterozoic sedimentary pyrite, from previous literature and new data from the Francevillian Group (2.2-2.06 Ga, Gabon), the Turee Creek Formation (2.43 Ga, Australia), the Tumbiana Formation (2.7 Ga, Australia) and the Buck Reef Formation (3.4 Ga, South Africa). Contrasting with bulk analyses, micropyrite displays a large and constant δ^{56}Fe range of -4 to +4 ‰, from 3.8 to 1.8 Ga. Micropyrite δ^{56}Fe values are not significantly influenced by metamorphic grade. A bimodal distribution of positive *versus* negative δ^{56}Fe values can be attributed to two different processes of pyrite formation, Fe (oxy)hydroxide sulfidation, *versus* kinetic and possibly microbially mediated pyrite precipitation. These processes are tightly related to rock lithology and thus to sedimentary conditions, and have existed since 3.8 Ga.

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