6.5.P04

Sulfur isotope anomaly discovered in sulfide bed of later Archean Jingangku formation, Wutai group, Shanxi Province,China

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The later Archean Wutai group metamorphic rocks of 2.5 Ga are outcroped in Shanxi Province, China. Within this group, the Jingangku formation contains several ore beds of iron and sulphides. These ore beds are generally tens to hundreds m in length and in depths, and a few tenth of m to a few m in thickness. The iron ore consists mainly of magnetite and himatite. And the sulphide ore consists mainly of pyrite and pyrrhotite.

A multi-sulphur isotope study has been carried out for sulphide beds in the Jingangku formation. 15 samples of pyrite concentrates from banded and massive sulphide ore were analysed(Fig.1).

The obtained $\delta^{33}S$ values vary from –2.5‰ to +3.3‰, averaging –0.73‰; and the $\delta^{34}S$ values vary from –4.0‰ to +7.8‰, averaging –0.39‰.

Defining $\Delta^{33}S = \delta^{33}S - 0.514 \times \delta^{34}S$

The $\Delta^{33}S$ values for these samples vary from –0.14‰ to –0.79‰, averaging –0.53‰.

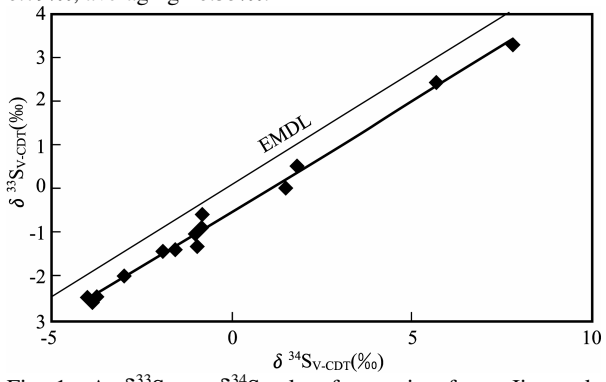

Fig 1: A $\delta^{33}S$ vs $\delta^{34}S$ plot for pyrite from Jingangku formation, Wutai group, Shanxi Province, China.
EMDL means the mass dependant isotope fractionation line for Earth materials.

It can be seen from Fig 1 that all data points distribute along a lineal line parallel to EMDL(the mass dependant fractionation line), but offset about –0.5‰.

These results imply that some effects of mass independent sulfur isotope fractionation are still reserved in sulfide bed of 2.5 Ga old Jingangku formation, although the effects of some late mass dependant isotope fractionation are overprinted on them.

6.5.P05

$\delta^{15}N$ signatures of late Archean shales from two drilling cores, Hamersley, Western Australia

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Microfossils and carbon isotopic compositions of Archean sedimentary rocks suggest that O_2-producing photoautotrophs (e.g. cyanobacteria) have been active since ~3.5Ga ago. However, a current popular idea postulates that the produced O_2 was completely consumed by reduced volcanic gases, resulting in an essentially O_2-free Archean atmosphere. Under such an anoxic atmosphere, the dominant N species in the oceans would have been N_2 and NH_4^+. We have determined the $\delta^{15}N$ values of kerogen and bulk-rock samples of the Mount McRae Shale (~2.5Ga) and the Jeerinah Formation (~2.7Ga) in two drill cores from the Hamersley district.

The McRae shales from a ~25m core section contain 2.2 to 9.6wt% of organic C, 0.06 to 0.15wt% of N with the N/org.C atomic ratio of 0.013 to 0.033; the N/C ratio of the kerogen ranges from 0.0044 to 0.0085. These data indicate that the biogenic N in the shales mostly (>~60%) resides in clays, rather than in kerogen. The kerogen is depleted in ^{15}N by 3 to 4‰ compared to the bulk rock ($\delta^{15}N$ = +1 to +6‰). This relationship is identical to that in Phanerozoic marine sediments. This suggests that most of the original N atoms, which were bound in organic matter, were released during diagenesis and fixed as NH_4^+ in clays replacing K^+. Therefore, the $\delta^{15}N$ value of the original organic matter lied closer to that of the bulk-rock, rather than of the kerogen. A trend of increasing bulk $\delta^{15}N$ values with increasing contents of bulk-rock N and organic C suggests the marine organic production under N limitation.

The $\delta^{15}N$ values of the Jeerinah shales vary from 0 to +10‰ in a ~100m core section. The bulk-rock sample with the highest N content has $\delta^{15}N$ value of ~0‰, suggesting a bacterial fixation of N_2. No negative $\delta^{15}N$ value was observed in any of the bulk samples from the both cores. These chemical and isotopic characteristics could be identical to the NO_3^--based N cycle of the modern oceans.