The genesis of Aoertuokaneshen manganese ore deposits in western Kunlun, China: Constraints from in-situ S isotopic evidence

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The Aoertuokaneshen manganese carbonate ore deposit, located in the western Kunlun, China, was hosted within the Upper Carboniferous argillaceous limestone [1]. Both alabandite and pyrite are presented in the ores as lamination, in addition the the alabandite also occurs as disseminated and the pyrite occurs as framboids. The laminated structure indicated that the alabandites and pyrites may have formed at the sedimentary stage.

In-situ sulfur isotopic compositions of the laminated alabandite varied between -16‰ and -9‰, with obvious increases from the upper and lower part to the middle part within a single laminate, and the $\delta^{34}S$ values of disseminated alabandite ranged from -17‰ to -15‰. In-situ sulfur isotopic compositions of laminated pyrite ranged from -5‰ to 1‰, with increases from the upper and lower part to the middle part within a single laminate, and the $\delta^{34}S$ value of framboid pyrite is -18.9‰. The sulfur isotope fractionation between laminated alabandite and pyrite was at ca. 10‰.

In a closed system, the $\delta^{34}S$ of sulfides would gradually increase from bottom to upper layer, inconsistent with the symmetric structure of $\delta^{34}S$ here in the layers. We explained it as a mixing model of bacterial sulfate reduction sulfur and hydrothermal sulfur. In early stage, the sulfur was mainly sourced from the bacterial sulfate reduction, resulting very negative $\delta^{34}S$. Then the hydrothermal sulfur was input, inducing the increase of $\delta^{34}S$. When the hydrothermal sulfur was gradually exhausted, the $\delta^{34}S$ decreased down again. Combined with previous geochemical study [2], we suggested that the manganese ore deposit was formed related to sea-floor hydrothermal activity in the basin.

[1] Gao et al. (2018) Acta Petrologica Sinica 23, 41-58
[2] Zhang et al. (2018) Geological Review 64, 361-377.