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Iron isotopic composition of the Palaeoproterozoic Hotazel Formation in the Kalahari Manganese Field, South Africa

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Kalahari manganese deposit in the Palaeoproterozoic Hotazel Formation of Transvaal Supergroup of South Africa is the world's largest layered manganese deposit. It has alternating layers structure of three manganese rich layers and banded iron formation. This banded iron formation and manganese deposits of Hotazel Formation were formed at approximately the same time as Global Oxidation Event, which was the period of explosive growth of oxygen in Earth ' s atmosphere. In addition, the relevance of the snowball Earth event of Huronian glaciation has also been suggested from its formation age. Iron isotopes are sensitive indicators of the redox state, and it is suitable for estimating the marine environment when the banded iron formation was formed. Although a prior study on the iron isotope analysis of manganese deposits and banded iron formation of Hotazel Formation has been reported by Tsikos et al. in 2010, it is hard to say enough data is gathered.

In this study, drill core that was collected from the Kalahari manganese deposit in South Africa was subjected to iron isotope analysis with MC-ICP-MS and XRD analysis, and the results were compared with those of Tsikos et al.(2010). In isotopic analysis, δ56Fe values of drill core samples for the standard sample IRMM-14 were measured.

From the results, low δ56Fe values (not higher than -0.70 ‰) throughout the all samples were measured. When limited to manganese-rich layers, δ56Fe values are between -1.66 and -2.86 ‰. Relationship between Fe-Mn ratio and δ56Fe value showed that δ56Fe value have a tendency to drop to a lower value with the increasing abundance ratio of manganese to iron in a formation. This results are consistent with those of Tsikos et al.(2010). In other words, this results support their theory that banded iron formation has a role as a sink of heavy iron isotopes, and manganese are deposited in an environment that was rich in light iron isotopes.

Reference

Harilaos Tsikos, Alan Matthews, Yigal Erel, John M. Moore, 2010. Iron isotopes constrain biogeochemical redox cycling of iron and manganese in a Palaeoproterozoic stratified basin. Earth and Planetary Science Letters 298, 125-134. doi: 10.1016/j.epsl.2010.07.032

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