Fe isotope composition of the early Mesoproterozoic epicontinental Fe-sedimentation and its paleoceanographic significance

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Fe is not only the important ore-forming element but also the most abundant element engaging in redox chemistry, and is one of the element has been used biologically at very early stage. Thus understanding the geochemical cycling of Fe has great implications for the development of atmosphere oxygenation, ore genesis and the origin of life. The Xuanlong type iron ore deposits are early epicontinental sedimentation in North China Craton formed during the Mesoproterozoic Chuanlinggou period. They have potential to preserve paleoceanographic and biological signitures. Here we report the isotopic results of the Xuanlong type iron ore deposits.

Fe isotope compositions of bulk samples as well as mineral separates of hematite, magnetite and siderite, were measured using a Nu Plasma HR MC-ICP-MS at high-resolution mode after purification using anion exchange chromatography. The results show some important features: 1) Fe isotope compositions of iron ore bulk samples show heavy Fe isotope enrichment, whereas the wall rock-sandstone and shale are enriched in light Fe isotopes relatively; 2) The relative order of $\delta^{56}Fe_{IRMM-14}$ values appears to decrease from magnetite to hematite to siderite; 3) Fe isotope compositions of iron ore samples from decrease layers are different from bottom to top.

The average Fe isotope compositions obtained from Xuanlong type iron ore deposits in this study for iron ore bulk rocks show heavy Fe isotope enrichment, which is explained by partial oxidation of Fe and the variations in Fe isotope compositions may be explained in terms of different degree of precipitation. The variation in Fe isotope compositions of iron ore samples from different layers may imply the variation of the oxygen state of the ocean.

In all, the results abtained in this study demonstrate clearly that seawater was not oxygenated enough to quatitative Fe precipitation during the early Msoproterozoic even in the epicontinental evironment.