

# **Fe and Mg isotope fractionations in ferruginous sedimentary rocks from the ~3.2 Ga Moodies Group, Barberton Greenstone Belt, South Africa**

TSUBASA OTAKE<sup>1</sup>, MR. RYOHEI SUGIURA<sup>1</sup>, KI-CHEOL SHIN<sup>2</sup>, YOKO OHTOMO<sup>1</sup>, PROF. TAKESHI KAKEGAWA, PH.D.<sup>3</sup> AND TSUTOMU SATO<sup>1</sup>

<sup>1</sup>Faculty of Engineering, Hokkaido University

<sup>2</sup>Research Institute for Humanity and Nature

<sup>3</sup>Graduate School of Science, Tohoku University

Presenting Author: totake@eng.hokudai.ac.jp

Isotopic signatures in ferruginous chemical sedimentary rocks such as Banded Iron Formation have the potential to provide information on ocean chemistry and evolution of marine biosphere on the early Earth. However, mineral transformation during diagenesis and metamorphism makes it difficult to reconcile the original signatures precipitated from the ancient seawater. In this study, we focus on ferruginous sedimentary rock, which is locally called magnetite shale, that was deposited in a shallow ocean in a lower section (MdS1) of the ~3.2Ga Moodies Group in the Barberton Greenstone Belt, South Africa. We investigated variations in the bulk Fe and Mg isotopic ratios of different group (i.e., magnetite-rich and carbonate-rich groups) samples in the section obtained from a crosscut of an underground mine. The bulk  $\delta^{56}\text{Fe}$  values tend to decrease with decreasing the Fe/Ti ratios of the bulk chemical compositions as well as clay/sand ratio of the detrital components. No significant difference was observed in the trend of the bulk  $\delta^{56}\text{Fe}$  values between magnetite-rich and carbonate-rich groups. Assuming that the sand/clay ratio reflect depositional depth of the sediments, the variation in Fe isotope ratios likely record the partial precipitation of dissolved ferrous iron, which was derived from the deep ocean, associated with Rayleigh-type isotope fractionation. Furthermore, estimated isotope effect during the partial precipitation is only explained by involving oxidative precipitation processes. On the other hand, the bulk Mg isotope ratios are linearly correlated to Mg distributions between carbonate (e.g., ankerite and Mg-siderite) and silicate (e.g., biotite and chlorite) minerals that were obtained by sequential chemical extraction. This suggests that the bulk  $\delta^{26}\text{Mg}$  values are governed by the mixing of the two end-member minerals. This linearity further suggests that Mg isotope ratios of the end-member carbonate and silicate minerals were homogeneous, respectively, among all the samples regardless the rock-types or carbonate contents. The Mg isotopic homogeneity of the carbonate minerals implies that Mg in the carbonate minerals precipitated in an open system near the seafloor. Thus, both Fe and Mg isotope ratios of ferruginous sedimentary rocks in the Moodies Group preserve their primary signatures when precipitated from ~3.2 Ga ocean.