Japan Geoscience Union Meeting 2013
(May 19-24 2013 at Makuhari, Chiba, Japan)

BPT23-09 Room:301B Time:May 24 14:30-14:45

In-situ iron isotope analyses of pyrites from 3.5 to 3.2 Ga sedimentary rocks of the Barberton Greenstone Belt, Kaapvaal

Kazumi Yoshiya[1*], SAWAKI, Yusuke[1], SHIBUYA, Takazo[2], YAMAMOTO, Shinji[3], KOMIYA, Tsuyoshi[3], HIRATA, Takafumi[4], MARUYAMA, Shigenori[1]

[1]Tokyo Institute of Technology, [2]JAMSTEC, [3]The University of Tokyo, [4]Kyoto University

The Barberton Greenstone Belt (BGB), South Africa consists of volcano-sedimentary successions which, were deposited between 3.5 and 3.2 Ga, and is subdivided into three groups: the Onverwacht, Fig Tree, and Moodies groups (Viljoen and Viljoen, 1969). The Barberton Greenstone Belt underwent relatively low-grade tectonothermal events after the deposition, suitable to estimate the surface environmental events and biological evolution in the Middle Archean. Several putative morphological fossils (filamentous and spheroidal type) and trace fossils were reported from the Hooggenoeg and Kromberg formations in the Onverwacht Group (e.g. Engel et al., 1968; Walsh and Lowe, 1985; Schopf, 1992, 1993, 1999; Furnes et al., 2004; Glikson et al., 2008; Javaux et al., 2010).

Isotopic studies of sulfur and carbon of biogenic pyrites and organic carbons suggested activities of methanogen, sulfate-reducing bacteria and photosynthetic bacteria at 3.4 Ga (Ueno et al., 2006; Kakegawa and Ohmoto, 1999; Shen et al., 2001, 2009; Ueno et al., 2008; Philippot et al., 2007). On the other hand, it is well known that dissimilatory iron reduction (DIR) is one of the earliest metabolisms on Earth (Vargas et al., 1998; Lovley, 2004), but the evidence for the microbial DIR is still uncertain in the Archean (i.e. Craddock and Dauphas, 2011; Yamaguchi et al., 2005). We performed in-situ iron isotope analyses of individual pyrites in the sedimentary rocks from the BGB, using femtosecond laser ablation multi-collector ICP-MS technique (fs-LA-MC-ICP-MS) to find isotopic evidence for the microbial activity. We obtained a large variation of iron isotope values from -1.9 to +3.6 permil in $d^{56}Fe$ values for 139 pyrite grains in 24 samples: 7 cherts from the Hooggenoeg Complex, 10 cherts from the Noisy Complex, 2 cherts from the Kromberg Complex, 1 sandstone from the Fig Tree Group, and 4 sandstones from the Moodies Group, respectively. The $d^{56}Fe$ values in pyrites from the Hooggenoeg Complex show positive values, whereas those from the Noisy Complex show a wide variation from positive to negative $d^{56}Fe$ values. One of the main differences between these Complexies is their depositional environments. The Hooggenoeg Complex was considered to be deposited in deep-ocean, whereas that of the Noisy Complex was shallow. The negative $d^{56}Fe$ value of pyrites with a nadir down to -1.9 permil in the Moodies Group indicates the occurrence of microbial DIR in the middle archean shallow sea.

Keywords: Barberton Greenstone Belt (BGB), iron isotope, microbial dissimilatory iron reduction, pyrite, middle archean