Geochemical constraints on the Earth environment after the Lomagundi Event; The Cape Smith belt, Canada

*Kento Motomura[1], Shoichi Kiyokawa[1], Minoru Ikehara[2], Takashi Sano[3], Kentaro Tanaka[4], Tsubasa Miki[4], Yuji Sano[4]

1. Kyushu Univ., 2. Kochi Univ., 3. National Museum of Nature and Science, 4. Univ. of Tokyo

The beginning of the Paleoproterozoic era (ca. 2.5–1.6 Ga) is characterized by Great Oxidation Event (GOE: ca. 2.5–2.3 Ga) and subsequent positive carbon isotope excursion event (Lomagundi Event: ca. 2.2–2.0 Ga). These events represent dynamic changes between the Archean and Proterozoic Earth environment including the primary production, oceanic sulfate level, and redox structure (e.g. Lyons et al., 2014). Last two decades, several studies have cleared the Earth environment during ca. 2.5–2.0 Ga, however, aftermath of the events is poorly constrained. In this study, we measured organic carbon isotope ($\delta^{13}C_{org}$) of black shales deposited ca. 1.96 Ga and estimated Earth environment after the Lomagundi Event.

Two core samples consisting of sandstone–black shale alternations were drilled at the Cape Smith belt, Canada (4G8069 and 718.3333). These two drilling points are 10 km off each other. Sedimentary sequences composing a part of 4G8069 and 718.3333 are regarded as Povungnituk Group sediments which were deposited on the continental margin of the Superior at about 1.96 Ga (St-Onge & Lucas, 1990). Komatiitic lava overlying the sandstone–black shale sequence is observed at the top of the 4G8069 core. 718.3333 core also contains komatiitic lava, but the lava is observed ~100 m above our sampling intervals. Microscopic observation revealed that the black shales are rich in organic matter and pyrrhotite which origin is likely to sedimentary pyrite generated by bacterial sulfate reduction.

$\delta^{13}C_{org}$ values of the 4G8069 core range from −32.0 ‰to −29.5 ‰and show systematic changes. Two carbon isotope excursions (CIEs) are identified from the 4G8069 core: CIE 1) the gradual increase from bottom of the sequence (−32.0 ‰) to 45 m point (−29.5 ‰), CIE 2) the gradual decrease between 45 m and 50 m (−32.1 ‰), and subsequent increase toward the top (−31.0 ‰). CIE is also observed in the 718.3333 core, which shows gradual decrease from −30.6 ‰to −33.2 ‰, and subsequent increase toward −31.9 ‰.

CIE 1 of the 4G8069 core could be comparable with CIE of the 718.3333 core based on ~100 m distance from the komatiitic lava. Therefore, it is plausible that CIEs occurred at least twice after the Lomagundi Event. There are two possibilities for the trigger of the CIEs: (1) volcanic activities or (2) oxidative weathering could cause CIEs.

References

Lyons, TW, Reinhard, CT, and Planavsky, NJ, 2014, The rise of oxygen in Earth’ s early ocean and atmosphere: Nature, v. 506, p.307-315.

St-Onge, MR, and Lucas, SB, 1990, Evolution of the Cape Smith Belt: Early Proterozoic continental underthrusting, ophiolite obduction and thick-skinned folding. In The Early Proterozoic Trans-Hudson Orogen of North America, v. 37, p. 313-351.

Keywords: Paleoproterozoic, Organic carbon isotope

