Facies change and color variation of Paleoproterozoic sedimentary rocks of the Gowganda Formation, Huronian Supergroup, Canada

Takemaru Hirai[1]; Eiichi Tajika[2]; Ryuji Tada[3]; Yukio Isozaki[4]; Shinji Yamamoto[5]; Kazuhisa Goto[6]; Shogo Tachibana[7]; Joseph L. Kirschvink[8]

[1] Earth and Planetary Sci., Tokyo Univ.; [2] Dept. Earth Planet. Sci., Univ. of Tokyo; [3] DEPS, Univ. Tokyo; [4] Earth Sci. & Astron., Univ. Tokyo Komaba; [5] Earth and Planetary Sci., Tokyo Univ; [6] Earth and Planetary Sci., Univ. Tokyo; [7] Earth and Planet. Sci., Univ. of Tokyo; [8] GPS, Caltech

1. Introduction

The Huronian Supergroup, exposed on the northern shore of Lake Huron, Canada, is a typical series of formations recording Paleoproterozoic glaciations (2.2 ~ 2.4 Ga). It is possible that the atmospheric oxygen content would have increased drastically during the same period,. The increase of the oxygen content has been discussed mainly by investigating distribution of redox-sensitive minerals and the mass-independent fractionation of sulfur isotopes. However, we still do not know details about when and how the atmospheric oxygen content increased.

In this respect, the Huronian Supergroup could be unique since it may have continuous records of transition of the Earth's surface environment from reducing state to oxidizing state. We therefore investigated the Huronian Supergroup to clarify how redox state and sedimentary environment changed during the early Paleoproterozoic.

2. Reconstruction of sedimentary environment

There are three glacial diamictite horizons in the Huronian Supergroup. The Gowganda Formation is the youngest diamictite unit where the first red bed is observed in the Huronian Supergroup (Rainbird and Donaldson, 1988), and it is the most probable unit which may record the process of global oxidation of the surface environment. Bekker et al. (2001) suggests that the Gowganda Formation should be correlated with the Makganyene Diamictite Formation, the glacial sediments exposed in northwestern part of South Africa. Kirschvink et al. (2000) pointed out the importance of the to manganese deposits directly overlying this formation which suggests increase of atmospheric oxygen content at that time. We attempt to clarify the relationship between the sedimentary environment and the redox state in the Gowganda Formation.

We collected rock samples from the drilling core obtained from the site 30 km to the NW of Cobalt, Ontario, Canada which covers from base of the lower unit (Coleman Member) to top of the upper unit (Firstbrook Member) of the Gowganda Formation and the basal part of overlying Lorrain Formation. The Coleman Member consists of repetition of diamictites, laminated argillite with dropstones and normally graded sandstones, indicating the repeated expansions and recession of ice sheet. The Firstbrook Member consists of thick laminated argillite, wavy sandstone, turbidity sandstones, parallel- and cross-laminated sandstone and overlain by the Lorrain conglomerate. These facies changes suggest rapid rise in sea or lake level after the glaciation followed by regression.

3. Redness of sedimentary rocks

Color of the core samples changes from greenish in the lower part of the Gowganda Formation to reddish in the upper part. It is possible that this change reflects oxidation of iron minerals owing to the changes in redox change of the surface environment. Then, redness could be used as an indicator of the redox state. We measured the redness of core samples quantitatively using spectrometer and compared with lithology of the core samples. We found that the redness (a*) of rocks correlates well with the lithofacies. We also investigated the mineralogy of the samples by XRD and found that the vertical change of the redness shows the fluctuation pattern similar to that of hematite contents. It is therefore suggested that the redness may reflect hematite contents. As the next step, it is necessary to confirm whether this redness change directly reflects the primary Fe2+/Fe3+ ratio.