

Carbon isotope study of the Espanola Formation, Huronian Supergroup, Canada

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Large-scale glaciations occurred during the Neoproterozoic and the Paleoproterozoic. Kirschvink (1992) proposed the 'snowball Earth' hypothesis for the Neoproterozoic glaciations based on paleomagnetic studies. That is to say, the surface of the Earth was globally covered by ice at that time (Kirschvink, 1992). In the case of the Neoproterozoic snowball Earth events, glacial diamictites are directly overlain by carbonate rocks. These carbonate rocks are called 'cap carbonates' and considered to represent post-glacial global warming event. The $\delta^{13}\text{C}_{\text{carb}}$ values of cap carbonates are universally low, and in some cases approaching mantle values of approximately -6 permil (e. g., Hoffman et al., 1998; Hoffman and Schrag, 2002).

Paleomagnetic study also revealed that the Makganyene diamictite, which is considered as a glacial deposit during the Paleoproterozoic (2.4 ~ 2.2Ga), in South Africa may have deposited at low paleolatitude of 11 +/- 5 degree (Evans et al., 1997). Therefore, the snowball Earth event would have also occurred during the Paleoproterozoic. There is a possible cap carbonate called the Mooidraai dolomite above the Makganyene diamictite, which also have a very low $\delta^{13}\text{C}_{\text{carb}}$ values (-15 ~ 0 permil, Kirschvink et al., 2000).

The Huronian Supergroup (2.5 ~ 2.2Ga), which outcrops on the northern margin of the Lake Huron, Ontario, is one of the best-exposed Paleoproterozoic successions in the world. The Huronian Supergroup is preserved in an area extending about 340 km in an east-west direction and nearly 300 km in a north-south direction (Young, 1991). Three tripartite cycles within the Huronian has been recognized and each cycle involves diamictite: the Ramsay Lake Formation, the Bruce Formation, and the Gowganda Formation in ascending order (Young, 1991). Although the depositional ages of these diamictites have been poorly constrained, one of these diamictites may correlate with the Makganyene diamictite in South Africa.

Diamictites in the Ramsay Lake Formation and the Gowganda Formation are overlain by mudstone-dominated units and cross-bedded sandstones (Young, 1991), whereas the diamictite in the Bruce Formation is conformably overlain by the carbonate-rich sediments called the Espanola Formation (e. g., Young, 1991). The Espanola Formation is the only widespread carbonate unit of the Huronian Supergroup (Bennett and Tomlinson, 1997). Therefore, there is a possibility that the Espanola Formation is the cap carbonate of the Paleoproterozoic snowball Earth event. If so, negative shift of $\delta^{13}\text{C}_{\text{carb}}$ values may be recorded. However, carbon isotope stratigraphy for the Espanola Formation has not been well established yet. Therefore, in this study, we conducted analyses of carbon isotope of carbonate and organic carbon using the samples from the Espanola Formation.

According to our preliminary results, the $\delta^{13}\text{C}_{\text{carb}}$ values of the Espanola Formation are between -3 to 0 permil, and $\delta^{13}\text{C}_{\text{org}}$ values are between -30 and -11 permil. We will discuss the vertical variation of the $\delta^{13}\text{C}_{\text{carb}}$ and $\delta^{13}\text{C}_{\text{org}}$ values in the Espanola Formation, and compare with those of the cap carbonates in the Neoproterozoic.