Carbon isotopic records of the Espanola Formation, Huronian Supergroup, Canada

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Kirschvink (1992) proposed the snowball Earth hypothesis for the Neoproterozoic glaciations based on paleomagnetic studies. Glacial diamictites are directly overlain by carbonate rocks, which are called cap carbonates. Presence of cap carbonates probably reflect post-glacial global warming event (e.g., Hoffman et al., 1998). The d13Ccarb values of basal part 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 revealed that the Makganyene diamictite, which is considered as a glacial deposit during the Paleoproterozoic (2.4 ~ 2.2Ga), in South Africa may also 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 very low d13Ccarb 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. Three tripartite cycles within the Huronian have been recognized and each cycle involves glacial 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. Although negative sift of d13Ccarb values may be recorded, carbon isotope stratigraphy for the Espanola Formation has not been well established yet. Therefore, in this study, we determined isotopic compositions of carbonate carbon and organic carbon using samples from outcrops and drill cores of the Espanola Formation.

According to our results, we found that the d13Ccarb values of the basal ~10 m part of the Espanola Formation are between –8 to -4 permil, and d13Corg values are between -32~-15 permil. Above this part, d13Ccarb values are between –3 to 0 permil, and d13Corg values are between -30~-11 permil.We will discuss the high-resolution vertical variations of the d13Ccarb and d13Corg values in the Espanola Formation, and compare with those of the cap carbonates in the Neoproterozoic.