The Nulliak Supracrustal Rocks, Labrador, Canada: Their occurrence, age, and the oldest evidence for life

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The vestiges of life in the Eoarchean rocks provide a potential to elucidate the origin of life in the early Earth. However, it is often failed to find the evidence from many terrains such as the 3.83 Ga Akilia association and 3.75 Ga Nuvvuagittuq supracrustal belt[1] so that biogenic graphite was so far found only in >3.7 Ga Isua supracrustal belt (ISB)[2]. Recent geological and geochronological studies on the Nulliak supracrustal rocks (NSR) in the Saglek Block, northeastern Labrador, Canada revealed that the NSR contains mafic volcanic rocks, chemical sedimentary rocks of banded iron formation, chert and carbonate rock, and clastic sedimentary rocks of pelitic rock and conglomerate, and were intruded by over 3.9 Ga orthogneisses (Iqaluk Gneiss). In addition, the geological structures suggest that it was an Eoarchean accretionary complex, similar to the ISB[3]. The carbonate rocks have positive Eu and Y/Ho anomalies but lack Ce anomaly. Here, we report total organic carbon (TOC) contents and carbon isotope values of graphite ($\delta^{13}C_{org}$) and carbonate ($\delta^{13}C_{carb}$) in the oldest sedimentary rocks[3]. Some pelitic rocks and conglomerates have quite low $\delta^{13}C_{org}$ values of -28.2 and -27.6‰, respectively; comparable to the lowest values in the Eoarchean rocks. The consistency between crystallization temperature of the graphite, estimated from Raman spectroscopic analyses, and metamorphic temperature of the host rocks, reinforces that the graphite does not originate from later contamination. A clear correlation between the $\delta^{13}C_{org}$ values and metamorphic grade indicates that a variation of $\delta^{13}C_{org}$ values is due to the metamorphism, and that a primary $\delta^{13}C_{org}$ value is lower than the minimum $\delta^{13}C_{org}$ value. We concluded the large fractionation between the $\delta^{13}C_{carb}$ and $\delta^{13}C_{org}$ values, up to 25‰, provides the oldest evidence for organism >3.9 Ga.

[1] Fedo & Whitehouse (2002) *Science* **296**, 1448-1452. Papineau *et al*. (2011) *Nature Geosci* **4**, 376-379. [2] Ohtomo et al. (2014) *Nature Geosci* **7**, 25-28. Rosing (1999) *Science* **283**, 674-676. Ueno et al. (2002) *GCA* **66**, 1257-1268 (2002). [3] Komiya *et al*. (2015) *Tectonophysics* **662**, 40-66.