Geology of the Eoarchean Nuvvuagittuq supracrustal belt, northeastern Canada: Reappraisal of Protoliths and ages of the sedimentary rocks

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The Nuvvuagittuq supracrustal belt in the northeastern Canada is one of the oldest supracrustal rocks in the world, thus the geological, petrological and geochemical study allows us to constrain the evolution of surface environment and sold earth in the early earth. The belt consists of ultramafic rocks, coarse-graind and fine-grained greenstone, banded iron formation (BIF), siliceous rock, carbonate rock, and conglomerate. The ultramafic rocks and coarse-grained greenstone are considered as ultramafic and grabbroic intrusions, respectively. The fine-grained greensone is classified into three types based on the petrography: cummingtonite-bearing amphibolite (faux-amphibolite), hornblende-bearing amphibolite (green-amphibolite) and actinolite-bearing greenschist. The greenschist occurs only in the southwestern area. The faux- and green-amphibolite are ubiquitously present over the belt. Moreover, O'Neil et al. (2011) classified the amphibolite into three types based on their TiO_2 contents and REE patterns. The BIF mainly occurs in three areas, and has different occurrence and petrography. The BIF in the northwestern area is accompanied with the ultramafic rocks, and comprises interlayering of magnetite and amphibole/serpentine/talc. The BIF in the southwestern area occurs together with fine-grained greenstone, and mainly contains hematite and quartz (jaspillite). Dodd et al. (2017) found possible biogenic fabric, formed by iron-oxiding bacteria in the jaspillite. The BIF in the southeastern part is interlayered with the faux-amphibolite, and occurs above the siliceous rock. It mainly comporises magnetite and quartz.

The belt is intruded by some precursors of orthogneiss, whose igneous ages of *ca.* 3.8 Ga and constrain the minimum age of the belt. O'Neil et al. (2008, 2012) proposed that the igneous age of the fine-grained amphibolite is *ca.* 4.38 Ga based on a putative $^{147}Sm/^{144}Nd$-$^{142}Nd/^{144}Nd$ isochron age. On the other hand, Cates et al. (2013) proposed that a felsic layer within the faux-amphibolite originates from a clastic felsic sedimentary rock, and the maximum age of the belt is *ca.* 3.78 Ga based on ages of the zircons. David et al. (2009) interpreted a felsic layer as a volcanosedimentary rock, and proposed that the supracrustal rock was formd at 3817 Ma based on the ages of zircons.

We made a quite detailed geological map using a drone, which enables easily to trace even tens centimeter layers and intrusions. Many tens centimeter thick intrusions with an intermediate composition are present in the faux-amphibolite, whereas no intrusions are apparently found in the green-amphibolite. The distribution of the two types of amphibolite corresponds to that of three geochemical types of greenstone proposed by O'Neil et al. (2011), suggesting that the geochemical signature is due to secondary alteration. In addition, the apparent isochron on the $^{147}Sm/^{144}Nd$-$^{142}Nd/^{144}Nd$ diagram possibly originates from mixing between the mafic/ultramafic component and secondary intermediate component. O'Neil et al. (2008) proposed that the Nd isochron age of gabbroic dikes is 4.3 Ga. But, the gabboric dikes are younger than 3.8 Ga, and the isochron is putative because our map clearly shows that some thin gabbroic dikes are intruded into ambient orthogneiss, whose age is *ca.* 3.8 Ga. We found many conglomerate layers over the belt, but the layers finally change felsic intrusions. The occurrence means that they are putative conglomerate. In addition, the carbonate rocks occur along the felsic intrusions, suggesting they also have metasomatic origin. The petrograhy and occurrence of the BIF in the northwestern area indicate that the BIF was formed from metamorphism of the ultramafic rock. The siliceous rock is intruded by many felsic intrusions and quartz veins, but the detailed map can differentiate between the siliceous layers and intrusions, and shows that the siliceous layers originate from siliceous sediment.

Keywords: Hadean, Early Earth, Early life, Surface environment