A reappraisal of geology of the Isua supracrustal belt

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The Earth is the only planet where liquid water and organisms are present. However, our knowledge of the early Earth as well as origin and early evolution of life is still poor because of little preservation of Eoarchean supracrustal rock. The Isua supracrustal belt is one of the best places for studying the environment and life in the Eoarchean because the supracrustal rocks underwent relatively low-grade metamorphisms compared with other Eoarchean supracrustal belts such as the Nulliak supracrustal rocks in northeastern Labrador and Nuvvuagittuq supracrustal belt in northern Quebec, Canada. In addition, the best preservation of outcrops in the Isua supracrustal belt enables us to elucidate the tectonics, surface environment and life in the early Earth. Therefore, many geological groups made geological maps of the Isua supracrustal belt (Appel et al., 1998; Komiya et al., 1999; Myers, 2001; Nutman & Friend, 2009) in addition to some classical studies (Allaart 1975; Nutman et al., 1984). But, the geological maps are different among each other. The classical geological maps suggested that the belt comprises two subunits with different lithostratigraphy, but they comprise conformably piled, volcano-sedimentary successions. However, Komiya et al. (1999) showed the northeastern part of the belt comprises fourteen subunits bounded by layer-parallel faults, which have similar lithostratigraphy from basaltic rock through chert to mafic clastic sedimentary rock in ascending order to each other. Since then, the geological structure of the Isua supracrustal belt has been considered as a tectonically piled complex with some subunits. However, the numbers of the subunits are highly different between two geological maps (Komiya et al., 1999; Nutman and Friend, 2009). Nutman and Friend (2009) considered that the Isua supracrustal belt basically comprises three units with different tectonothermal histories, which were formed in different places and collided later. On the other hand, Komiya et al. (1999) considered that the belt originated from an ancient accretionary complex, which was formed through successive accretion of many pieces of oceanic crust with similar lithostratigraphy at a single subduction zone. Recently, Nutman et al. (2016) found stromatolite there, and interpreted that carbonate rock and chert were shallow water sediment. On the other hand, Komiya et al. (1999) considered that they were derived from pelagic, deep-water sediment.

We made a new geological map of the northeastern part of the Isua supracrustal belt in order to solve the difference at 2017, again. Although some new outcrops such as pillowed ultramafic rock and carbonate rock were found in the middle and northern part, the geological map is consistent with the geological map, showed by Komiya et al. (1999). For example, Nutman & Friend (2009) interpreted that the southern part of the ISB comprises two tectonic units: Northern and Southern Units because U-Pb ages of zircons from pyroclastic rocks in the units are highly different each other. However, the occurrence of the "putative" pyroclastic rock suggests that they originate from felsic intrusions because they cut the surrounding supracrustal rocks, and the "putative" pyroclastic rock layers change into felsic intrusions in the northern extension. In addition, they interpreted the chert interlayered with carbonate rock was shallow-water sediment because of stromatolite. However, the rhythmical layers of carbonate rock and chert are not accompanied with clastic sedimentary rocks, suggesting that the sediment was deposited far away from a continent. In addition, distribution of the chert layers supports many subunits within the ISB. Although we need to correct our geological map for some points, the results seem to be still consistent with our old geological map.

Keywords: Isua supracrustal belt, Eoarchean, The early Earth, Origin and early evolution of life

