## The 503rd Geodynamics Seminar

# Major element composition of the Hadean crust: Constraints from Sm-Nd isotope systematics and high-pressure melting experiments


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The major element composition of the Hadean crust has essential role on the mantle chemical evolution and habitability in the early Earth, since the major element composition constraints the physical properties such as density and viscosity, that in turn constrain the formation and recycling of the crust, and also constrains the concentration of primary elements for life (nutrients) such as phosphorous (P) and potassium (K) in the crust and controls the water-rock reaction at the surface.

In this study, firstly I estimated melting condition (pressure, temperature, and melt fraction) of the Hadean silicate differentiation that is required to explain the $^{142}Nd/^{144}Nd$ anomaly in the Archean rocks relative to the $^{142}Nd/^{144}Nd$ range of the accessible silicate Earth (ASE). As the result, the required melting condition was small melt fraction (<3.2%) near the solidus temperature at deep upper mantle (1750 °C, 7 GPa). Then, I estimated major element composition of the melt to be Fe-Ti-P-rich ultramafic, by using data in my previous melting experiments of a primitive mantle peridotite composition (Kondo et al. 2016). Density and viscosity of the melt was estimated from the major element composition, and it was concluded that the Fe-Ti-P-rich ultramafic melt would have ascended in the Hadean mantle and formed the Hadean primary crust. Subsequently, I investigated the major element composition of the crust generated from the hydrous melting of the Hadean primary crust, that had been suggested from the initial $^{176}Hf/^{177}Hf$ ratio and oxygen isotope ratio of the Hadean zircons. I performed melting experiments of the synthesized starting material of hydrous Fe-Ti-P-rich ultramafic composition at conditions of 1000-1300 °C, 1.0-3.0 GPa, and Ni-NiO buffer, with a piston cylinder apparatus. As the experimental result, melts had Ti-P-rich mafic compositions. Density and viscosity estimated from the major element composition of the experimental melts suggested that these melts would have ascend in the lithosphere to form the Hadean secondary crust. The Hadean primary and secondary crust would have contributed to the habitability due to their high contents of Mg and nutrients, and finally subducted to the Earth's interior due to their high density after cooling at the surface.


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