Major element composition of the Hadean crust: constraints from high-pressure melting experiments

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Processes of the mantle-crust differentiation and composition of the crust in the Hadean era (> 4.0 Ga) are essential to understand the early stage of the chemical mantle evolution due to the extraction and recycling of the crust. The existence of the granitic-andesitic crust has been vigorously debated from analyses of the Hadean zircon and early Archean pelitic gneiss, but the processes to form the Hadean crust and its quantitative composition are still unclear. In this study, we aim to determine the major element composition of the Hadean crust.

We estimated the style of the igneous activity in the Hadean era before the plate-tectonics, referring previous mantle convection models at high MPT [1,2]. Then, the composition of the crust generated through melting of the primitive mantle peridotite was estimated from high pressure melting experiments [3] to be komatiitic and enriched in FeO, TiO_2, Na_2O, and K_2O. We assumed drip-like subduction and hydrous melting of this Fe, Ti, and alkali-rich komatiitic crust as a process to generate putative Hadean granitic-andesitic crust, and performed hydrous melting experiments with a piston-cylinder high pressure apparatus. The major element composition of the melt generated through the hydrous melting experiments was revealed to be picritic and enriched in Ti and alkali elements, reflecting the composition of the starting material. Thus, in the Hadean era before the plate-tectonics, the Fe, Ti, and alkali-rich komatiitic crust was generated firstly from the melting of the primitive mantle peridotite, and then subduction-related hydrous melting of the Fe, Ti, and alkali-rich komatiitic crust generated Ti- and alkali-rich picritic crust, not granitic-andesitic crust.

[1] Korenaga (2009) *Geophys J Int* **179**, 154-170. [2] Foley *et al*. (2014) *J Geophys Res: Solid Earth* **119**, 8538-8561. [3] Kondo *et al*. (2016) *Prog Earth Planet Sci* **3**, 25.