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Genetic relation between EMI and EMII: implications from adakitic magma

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Chemical evolution of the solid Earth is one of important issue for earth science and thus has been studied by many researchers. Based on isotopic studies for ocean island basalts (OIBs), it has been revealed that there are at least four geochemically separated reservoirs existing in the mantle. Thus far, there is a general consensus that these reservoirs were produced by the formation of continent crust and, subduction of oceanic crust and sediments. Among these reservoirs, EMI and EMII have been considered closely relating to crustal materials and been inferred correspondence to lower and upper continental crust materials, respectively. However, isotopic trends of Walvis Ridge, Kerguelen, and Samoa require the existence both of EMI and EMII in their source mantle. Therefore, to elucidate the genetic relation between these components is essential to better understanding of the mantle reservoirs. However, only few research works have been conducted.

As mentioned previously, EMI and EMII components would relate to crustal materials. This indicates that the subduction process will be essential to produce these reservoirs, because continental crustal has been produced mainly at the subduction zone. However, modern subduction zone should not be suitable to investigate the relation between EMI and EMII components, because (1) geochemical reservoirs related to ancient crustal material, (2) difference of thermal structure between modern and ancient subduction zones leads to different magmatic processes. Hence, a study which takes this difference into account is required. Although, one may think that there are green stone belts as possible examples for ancient subduction zones, the rocks are usually metamorphosed and weathered, and thus these rocks are inappropriate. In order to overcome this difficulty, unusually hot subduction zones were selected as a modern analogy of ancient subduction zones. These subduction zones are characterized by the occurrence of adakitic magmas. Thus, we focused on adakitic magmas to examine the relation between EMI and EMII components.

We first compile geochemical data for adakitic magma from Aleutian, Cascades, Mexico, Panama, Costa Rica, Austral Chili, NE and SW Japan. Based on these data, we make a model suggesting, (1) adakitic magma with an age ca. 2.5 Ga can be an EMI component, (2) adakitic magma which suffered plagioclase fractionation can be a candidate for EMII component, supposing 2.5 Ga have passed. Thus, we conclude that slab melting and subsequent crystal fractionation played an essential role to produce EMI and EMII components.