

## Role of adakites for the origin of EMI and EMII

Gen Shimoda<sup>1\*</sup>

<sup>1</sup>GSJ AIST

It has been widely accepted that at least three enriched geochemical reservoirs must exist in the mantle to explain the isotopic variations observed in ocean island basalts (OIBs). These reservoirs are known as enriched mantle 1 (EM1), enriched mantle 2 (EM2) and HIMU (238U/204Pb) (e.g., Zindler and Hart, 1986). As these reservoirs have been considered to be produced the Earth's major differentiation process(es), many studies have been conducted to evaluate the reservoirs' origins. Accordingly, it has been suggested that the reservoirs are produced by the recycling of continental/oceanic crustal materials probably stored in the deepest mantle (e.g., Zindler and Hart, 1986; Hofmann, 1997; Stracke et al., 2005).

Among the mantle reservoirs, EM1 and EM2 should have a particularly close chemical connection because many island chains have Sr and Nd isotopic compositions that form linear arrays extending from FOZO (focus zone; Hart et al., 1992) or DMM (depleted MORB (mid-ocean ridge basalt) mantle; Zindler and Hart, 1986) to intermediate composition between EM1 and EM2. Moreover, it has been suggested that the source material of EM1- and EM2-type basalts could have specific trace element compositions at each site (Willbold and Stracke, 2006). These geochemical characteristics could suggest that a process capable of producing the isotopic difference between EM1 and EM2 may have operated. Thus, the development of a model that can account for both EM1 and EM2 compositions would be a significant step forward in understanding the origins of two reservoirs most commonly discussed separately (Zindler and Hart, 1986; Weaver, 1991; Workman et al., 2004).

In a present study, I conducted geochemical modeling of the origin of EM1 and EM2 from the perspective of adakite production. For the model, the average composition of adakites is re-estimated from published data for eighteen trace elements. The average composition of adakites can be explained by melting of oceanic crust without sediment contribution. The compiled data further suggest that the mantle-slab melt reaction would play a major role in the production of basic adakites. In addition, crystal fractionation in the magma chamber should produce additional chemical variations in adakites. To examine the effect of chemical variations on the isotopic composition of recycled adakites, broad correlations between trace elements and SiO<sub>2</sub> concentrations, and the MELTS program are employed. The results suggest that recycling of a basic adakite (SiO<sub>2</sub> = 55%) can account for EM1 isotopic signatures with storage times of about 2.0 Gyr. The isotopic compositions of less-basic adakites and their evolved magmas shift towards EM2 values with increasing SiO<sub>2</sub> concentrations. In particular, evolved acidic adakite can yield EM2 isotopic signatures. These lines of evidence suggest that the recycling of adakites at various stages of evolution can conceivably produce the entire isotopic range between EM1 and EM2 reservoirs. Consequently, adakite recycling via sediment subduction or subduction erosion can account for the origins of EM1 and EM2 reservoirs. In this context, residual garnet under high pressure and plagioclase fractionation at low pressure might play an essential role in producing the chemical variations among adakites that ultimately govern the isotopic compositions of these geochemical reservoirs.

Keywords: Mantle reservoir, EMI, EMII, adakites, slab melting