

SCG065-04

会場:301B

時間:5月23日 15:00-15:15

大陸地殻とマントル端成分「EM1とEM2」の起源としてのスラブ融解 Slab melting as a key to understand origins of continental crust and mantle reservoirs "EM1 and EM2"

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It has been widely accepted that at least three enriched geochemical reservoirs must exist in the mantle to explain the isotopic diversity of ocean island basalts (OIBs). These reservoirs are known as enriched mantle 1 (EM1), enriched mantle 2 (EM2) and high-u (HIMU; $u = 238\text{U}/204\text{Pb}$) (e.g., White, 1985; Zindler and Hart, 1986). Understanding the origins of these reservoirs is essential for understanding Earth's chemical evolution and thus many studies have been conducted. Proposed origins for HIMU (and FOZO) is recycling of oceanic crust, namely, single process has been widely accepted. Origins of EM1 and EM2, on the other hand, are still divergent: (1) recycling of oceanic crust with variable amounts of continental crustal materials via sediment subduction or tectonic erosion, (2) delamination of continental crust, or (3) recycling of metasomatized oceanic lithosphere (e.g., McKenzie and O Nions, 1983; Weaver, 1991; Chauvel et al., 1992; Hofmann, 1997; Stracke et al. 2003, 2005; Workman et al., 2004; Willbold and Stracke, 2006). Recent studies of the origin of EM1 and EM2 suggest that the source materials of these magmas have variable chemical and isotopic compositions, suggesting that continental crustal material recycling via tectonic erosion can be a suitable origin of these magmas, because chemical variations of continental crust are much greater than those of oceanic crust (Willbold and Stracke, 2006). Although the proposed models successfully explain the origin of EM1 and EM2 reservoirs, a study that examines the relationship between ancient subduction zones, production of continental crust, and isotopic variations between EM1 and EM2 reservoirs could yield significant information. Geochemical modeling of the origin of EM1 and EM2 is, therefore, conducted from the perspective of slab melting, i.e., adakite production. For the model, the average composition of adakites is estimated from literature data for 18 trace elements. The estimated adakite composition 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, in particular for acidic adakites. To test the effect of chemical variations on the isotopic composition of recycled adakites, correlations between trace elements and SiO_2 concentrations, and the MELTS program are employed. The results suggest that recycling of a basic adakite ($\text{SiO}_2 = 55\%$) can account for EM1 isotopic signatures with age of about 2.0 Gyr. The isotopic compositions of less-basic adakites and their evolved magmas shift towards EM2 values with increasing SiO_2 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.

キーワード: スラブ融解, アダカイト, EM1, EM2, 大陸地殻

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