REE compositions of Setouchi HMA and basalt; an implication for mantle compositional shift during Japan Sea opening

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The Japan Sea is a backarc basin situated behind the SW and NE Japan arcs. Based on the paleomagnetic and K-Ar age data, the Japan Sea was formed during middle Miocene following rapid rotational movement of the SW Japan arc sliver (e.g., Otofuji et al., 1985, 1991; Kaneoka et al., 1990, 1992; Tatsumi et al., 2001). This mega-tectonic event should be taken into account to understand the effect of backarc spreading on the mantle wedge beneath the arc.

The geochemical influence of the Japan Sea opening upon the NE and SW Japan Arcs had been studied. In the NE Japan arc, Sr and Nd isotopic compositions of volcanic rocks in the back-arc side were shifted from enriched to deplete during the Japan Sea opening (Nohda and Wasserburg 1986; Nohda et al., 1988). However, those in trench side were invariant through the time (Tatsumi et al., 1988). In the SW Japan, geochemical studies had also been conducted (e.g., Morris and Kagami, 1989; Nakamura et al., 1990; Iwamori 1992; Uto et al. 1994). These suggested that the magmatism in SW Japan related to the deeper mantle material and/or sub-continental lithosphere. Isotopic study for the silicic rocks demonstrated broad isotopic shifts during the Japan Sea opening (Terakado et al., 1997).

Although there was volcanic activity in SW Japan arc (Setouchi magmatism), which genetically related to back arc opening, it has never been studied in the view of the geochemical effect of back arc opening upon the mantle wedge. Therefore, we analyzed REE compositions of primitive high magnesian andesites (HMAs) and basalt from this area. Following REE features can be explained by source compositional change during the Japan Sea opening but not be explained by different amount of slab derived components, (1) older HMA from Osaka (13.9 Ma) have higher light rare earth elements (LREE) and lower heavy rare earth elements (HREE) concentrations than younger HMA from Shodo-Shima (12.5 Ma), (2) REE pattern of Shodo-Shima HMA had higher and steeper than that of Shodo-Shima basalt. In order to test the source compositional change, mixing calculation was conducted based on the assumptions that the Osaka HMA and Tsushima basin (part of the Japan Sea) basalt were produced by melting of pre-existing enriched mantle and depleted asthenosphere, respectively. The result indicated that 30-70% of asthenospheric material and 70-30% of enriched pre-existing mantle can account for REE patterns of Shodo-Shima HMA and consistent with the model. If this is the case, relation among short lived Setouchi magmatism, SW Japan rotation and Japan Sea opening was comprehensively understood.