Experimental Melting Study of Basalt-Peridotite Hybrid Source

*Shan Gao[1], Eiichi Takahashi[1], Kyoko N. Matsukage[1], Jun-Ichi Kimura[2], Toshihiro Suzuki[1]

1.Graduate School of Science, Tokyo Institute of Technology, 2.JAMSTEC

Very high productivity of magma in flood basalts and other LIPs is one of the major difficulties in mantle plume hypothesis (Coffin and Eldholm, 1994). Selective fusion of large amount of recycled oceanic crust entrained in the first phase of mantle plume has been proposed to explain flood basalts (e.g. Columbia River Basalt: Takahashi et al., 1998). Magma genesis in other hot spots may be largely influenced by recycled oceanic crust component involved in the mantle plume (e.g., Hawaii; Hauri et al., 1996; Takahashi & Nakajima., 2002; Sobolev et al., 2007). Therefore, understanding the melting processes in the basalt/peridotite hybrid plume source is very important. In order to figure out the geochemistry of recycled component as well as their melting process in Hawaiian hot spot, we conducted a series of high-P, high-T experiments. Melting experiments (1~10hrs) were performed under 2.9GPa with Boyd-England type piston-cylinder (1460~1540°C for dry experiments, 1400~1500°C for hydrous experiments) and 5GPa with Kawai-type multi-anvil (1550~1650°C for dry experiments, 1350~1550°C for hydrous experiments), at the Magma Factory, Tokyo Tech. Spinel lherzolite KLB-1 (Takahashi 1986) was employed as peridotite component. Two basalts were used as recycled component: Fe-enriched Columbia River basalt (CRB72-180, Takahashi et al., 1998) and N-type MORB (NAM-7, Yasuda et al., 1994).
In dry experiments below peridotite dry solidus, melt compositions ranged from basaltic andesite to tholeiite. Opx reaction band generated between basalt and peridotite layer hindered chemical reaction. On the other hand, alkali basalt was formed in hydrous run products because H_2O promoted melting process in both layers. Compared with melts formed by N-MORB-peridotite runs, those layered experiments with CRB are enriched in FeO, TiO_2, K_2O and light REE at given MgO. In other words, melts produced by CRB-peridotite layered experiments are close to alkali basalts in OIB and tholeiite in Hawaii, while those by layered experiments with N-MORB are poor in above elements. Thus we propose that Fe-rich Archean or Proterozoic tholeiite (BVSP 1980) would be a possible candidate for recycled component in OIB source.

Keywords: hybrid plume, oceanic crust component, melting experiments

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