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Slab-fluids contain chlorine

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We found that the fluid inclusions of sub-arc mantle peridotites have 5.1 wt. % NaCl beneath the Pinatubo, a frontal volcano (Kawamoto et al., 2013 PNAS) and 3.7 wt. % NaCl beneath the Ichino-megata, a rear-arc volcano (Kumagai et al., under review). Based on these observations, we suggest that the slab-derived fluids are saline fluids.

In order to understand the effects of salinity on the arc-magma chemsitry, two series of elemental partitioning experiments between silicate melts and aqueous fluids have been carrying out with and without Cl in synchrotron facilities. The experiments show that highly saline fluids can transfer Pb, Rb, and Cs more effectively than Sr and Ba from subducting oceanic lithosphere to the mantle wedge. As suggested by Keppler (1996, Nature), saline fluids can be an important agent to transfer large ion lithophile elements. Geochemical studies have suggested that three chemical components are involved in the formation of arc-basalts: the depleted mantle, aqueous fluid, and melt components (Pearce et al., 2005 G-cube). If supercritical fluids contain Cl and then subsequently separate into aqueous fluids and melts (Kawamoto et al., 2012, PNAS), then it follows that such aqueous fluids will inherit much of the Cl and also some of the large ion lithophile elements to explain qualitatively the geochemical features of Mariana arc basalts. In contrast, Cl-free aqueous fluids may not be able to transfer Pb to the magma source. Our partitioning experiments were conducted using highly saline fluids (12-25 wt % (Na, K)Cl). Based on the geochemical features, slab-fluids are likely to contain Cl, although their amount remains to be quantified.

References

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