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Fluorine content reveals new insight into arc magmatism of Southern Volcanic Zone, Chile.

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The halogen elements have high partition coefficients in aqueous fluid (Bureau et al., 2000), but the difference in their partition coefficients for aqueous fluid/silicate melt/silicate minerals/organic matter results in distinct elemental ratios in seawater, pore fluid, sediment, oceanic crust and mantle (e.g., Johson et al., 2000; Burgess et al., 2002; Palme and O'Neil, 2004). For instance, fluorine is incorporated into apatite, amphibole and phengite (Svensen et al., 2001) while iodine has a high abundance in organic-rich marine sediments because it is an essential element for life. These characteristics make halogens useful to trace water cycling in subduction zones (e.g., Fehn et al., 2003; Muramatsu et al., 2007; Sumino et al., 2010). Recently, subduction of marine pore fluid into the mantle has been suggested based on noble gas isotopes in the mantle (Holland and Ballentine, 2006) and halogen compositions of exhumed mantle wedge peridotites (Sumino et al., 2010). However, only a little is known about the behavior of halogen elements during subduction processes and their fate in the earth ′ s mantle. Therefore, we newly analyzed halogen concentrations in regional representative lavas obtained from 13 volcanoes on the Quaternary volcanic front of the Southern Volcanic Zone (SVZ) of Andean arc in Chile. In this presentation, we focus on fluorine content that has least influence of degassing on volcanism.

Fluorine contents of most analyzed samples are 100-300 ppm. To understand behavior of fluorine on fractional crystallization, the correlations of SiO2 and FeO∗/MgO with fluorine data from a volcano are plotted. This result indicates that the fluorine dependency with these parameters changes at SiO2 = 55 wt% and FeO∗/MgO = 4.2, resulting from apatite crystallization and removal from the magma. Thus, the evolved rock samples from which apatite crystallized were excluded from further discussion.

We compared fluorine with major and trace element data obtained by previous study (Shinjoe et al., 2013) and newly revealed that the fluorine concentrations of selected samples were not correlated with boron concentrations. This means that fluorine shows different behavior in the subduction zone magmatism though both fluorine and boron are fluid-mobile elements. The basaltic samples from Hudson, the southernmost volcano of SVZ, show very high fluorine concentration (∼1000 ppm). Similar anomalies were confirmed also with Nb and Ta. The chemical characteristics suggest that the magma source of this region has been derived from the metasomatized mantle wedge by influence of slab-derived melt (Kilian and Behrmann 2003; Shinjoe et al., 2013). The fluorine concentration possibly becomes new sensitive detector of slab-derived melt in arc volcanism.

Keywords: fluorine, subduction zone, slab melt, slab fluid