

Along arc compositional variations of fluorine and chlorine in Southern Volcanic Zone, Chile

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To investigate the along-arc compositional variation of F and Cl in arc volcanic rocks associated with the age and thermal structures of the subducting slab, we analyzed halogen contents in lavas obtained from 10 volcanoes along the Quaternary volcanic front of the central and southern parts of Southern Volcanic Zone (CSVZ and SSVZ) of the Andean arc in Chile.

The average F contents of samples from central and southern SVZ is 260 ± 140 ppm, which are close to that of MORB (250 ± 50 ppm; Saal et al., 2002). In contrast, the average Cl contents is 610 ± 250 ppm and significantly higher than that of MORB (20–50 ppm; John et al., 2011). The F contents in the CSVZ and SSVZ are broadly constant, the samples from the southernmost SSVZ, situated near the CTJ, show high F contents. On the other hand, the Cl contents are high in the samples from the northernmost CSVZ and the southernmost SSVZ.

We estimated melting conditions based on the major and trace element compositions obtained for the same samples (Shinjo et al., 2013) and calculated F and Cl contents in the source mantle of arc magmas in SVZ. The average of the F and Cl contents of the source mantle in SVZ are 22 ± 6 ppm and 96 ± 49 ppm, respectively. Considering F and Cl contents in the depleted mantle (DM: F=16ppm, Cl=1 ppm; Saal et al., 2002), F in the SVZ source mantle is dominantly derived from the wedge mantle with the DM composition, whereas the almost all of Cl is derived from the subducted slab. In addition, the contents of F and Cl in the source mantle beneath the SSVZ are lower than those in the source mantle beneath the CSVZ. This indicates that the high F and Cl contents in the SSVZ lavas resulted from low degree of partial melting of their source mantle, and the contribution of the slab is greater in the CSVZ than in the SSVZ.