Geophysical Research Abstracts
Vol. 16, EGU2014-11773, 2014
EGU General Assembly 2014

Variations of water, sulphur, and chlorine in mafic to intermediate tephras along the Chilean Southern Volcanic Zone

Heidi Wehrmann (1), Kaj Hoernle (1), Guillaume Jacques (1), Dieter Garbe-Schönberg (2), Robert Trumbull (3), and Michael Wiedenbeck (3)

(1) GEOMAR Helmholtz Centre for Ocean Research Kiel, Germany (hwehrmann@geomar.de), (2) Institute of Geosciences, University of Kiel, Germany, (3) Helmholtz Centre Potsdam, GFZ German Research Centre for Geosciences, Potsdam, Germany

Relating along-arc variations in melt volatile concentrations to differences in the tectonic parameters of a subduction system can help to identify processes influencing the volatile inventories of arc magmas. Here we present pre-eruptive water, sulphur, and chlorine concentrations in olivine-hosted melt inclusions in mafic to intermediate tephras along the volcanic front of the Chilean Southern Volcanic Zone (SVZ) between 33°S and 43°S, determined by SIMS and electron microprobe. Additionally, melt water abundances were estimated by plagioclase-melt hygrometry.

We observe systematic along-arc variations in water content, H_2O/K_2O, and ratios of highly fluid-mobile to less fluid-mobile trace elements (e.g. Ba/Nb, Pb/Ce), with a peak observed in the Central (C)SVZ (38°S to 42°S). This suggests a strong involvement of slab fluids in these melts. Ratios of more incompatible to less incompatible trace elements, such as La/Yb, La/Sm, or Sm/Lu, are lower in the CSVZ, reflecting higher degrees of mantle melting. The higher-degree, hydrous flux melting beneath the CSVZ, as revealed from volatile and trace element geochemistry, coincides with peak volumes of extruded material in this arc segment, which is indicative of large magma production rates (Völker et al., 2011). Furthermore, a low-velocity seismic anomaly and high Vp/Vs ratios in this region have been interpreted by Dzierma et al. (2012) as the result of elevated fluid infiltration into the mantle wedge, originating from the subducting Valdivia Fracture Zone. Integration of the geophysical, morphological, and geochemical data suggests that the increased transport of water into the system through hydration of the incoming plate at fracture zones and bend faults leads to a generation of large amounts of water-rich, higher-degree melts, and subsequently to intense volcanic activity with respect to volcano volumes and eruption frequency.

An inverse along-arc trend is displayed by the melts' S and Cl concentrations, showing low values in the CSVZ and higher values towards the north and the south. Chlorine concentrations correlate with trace element indicators for the degree of melting and/or source enrichment, showing that the lowest Cl contents are generated through dilution in high-degree melts from the most depleted mantle sources.