The salt of the earth: origin and fluxes of volcanic Cl

Chloride ions are ubiquitous in almost all volcanic and geothermal emissions. Part of that Cl may derive from the mantle while emissions from arc volcanoes contain a substantial recycled Cl component from the oceans. The oceans are an important reservoir for Cl in the terrestrial environment (concentration about 1.9 % Cl-, total mass 26 Zettagrams). The volcanic Cl fluxes are not very well known (0.4 –11 Tg Cl/a) because direct Cl flux measurements at active volcanoes are rare. Volcanic Cl is largely released in the form of dissolved Cl- or gaseous HCl. I discuss the various contributions of Cl to the surface environment from consideration of Cl/S ratios in concentrated crater lake brines and hot springs, and estimate a global Cl flux (5-10 Tg Cl/a) using the global volcanic Sulfur flux.

Part of the volcanogene Cl flux is hidden as a result of the retention of NaCl brines in deep volcanic and hydrothermal environments. These brines may ultimately reach the surface environment after substantial dilution and are as such no longer recognizable as part of the direct volcanic flux. An example from Chile is presented that contains diluted derivatives of a volcanic brine with 60% NaCl. The radioactive isotope 36-Cl can be used to trace the storage and evolution of recycled oceanic Cl in subduction zones, and our data suggests a relatively short storage time (several 1000 years) of many arc magmas between generation and eruption. The stable isotope 37-Cl may be used to trace the origin of the arc volcano Cl, and our data suggest that a large fraction of it is recycled seawater that was possibly transported with the slab/sediments as small hypersaline brine inclusions.