Geophysical Research Abstracts
Vol. 17, EGU2015-9667, 2015
EGU General Assembly 2015

Volatile budget of Tenerife phonolites inferred from combined haüyne-apatite mineral records

Lauren B. Cooper (1), Olivier Bachmann (1), and Christian Huber (2)

(1) Department of Earth Sciences, Institute of Geochemistry and Petrology, ETH Zurich, Switzerland (lauren.cooper@erdw.ethz.ch), (2) School of Earth and Atmospheric Sciences, Georgia Institute of Technology, Atlanta, Georgia, USA

Intermediate to silicic volcanic eruptions often emit more S than predicted by petrological models—this is called the “excess S problem.” While most common minerals in these magmas are poor in volatile elements, the occurrence of large phenocrysts of S-rich haüyne (up to ~13 wt% SO_3) in phonolites holds much promise for better constraining volcanic volatile budgets in differentiated alkaline magmatic systems. We have examined textural zonation patterns in haüyne separates from Tenerife (Spain), using mineral oil to enhance grain transparency. Included phases were characterized by energy dispersive spectroscopy, X-ray maps, and Raman spectroscopy. Slow growth of haüyne, inferred from zones with few inclusions, likely represents cooling-induced crystallization from S-rich melt during storage in the upper crust. By contrast, rapid growth of phenocrystic haüyne, generating “wispy” zones containing Fe-rich haüyne laths and zones rich in melt inclusions, fluid inclusions, and Fe-sulfide inclusions, may be associated with magma recharge and/or upward percolation of a low-density fluid phase (i.e. “gas sparging”). Both processes could bring new pulses of S from deep within the magmatic system. Zones containing thousands of fluid inclusions provide direct physical evidence that the melt was fluid-saturated during periods of rapid haüyne growth. Transfer of S-rich fluid should occur in all volatile-rich magmatic systems, including dacitic-rhyolitic arc systems with large S excesses, but is difficult to document in such magmas devoid of a large S-rich mineral phase like haüyne.

Apatite, a mineral present in all volcanic rocks, may also contain information about S. We have observed intricate chemical zonation in backscattered electron images of apatite microphenocrysts from the same Tenerife samples. Variations in volatile and trace element concentrations between successive zones (measured via wavelength dispersive spectroscopy and laser ablation-inductively coupled plasma-mass spectroscopy, respectively) were used to identify magmatic processes occurring in the chamber prior to eruption (e.g., crystallization, magma recharge, gas sparging, and fluid exsolution). Thus, the integration of haüyne and apatite mineral records may be used to better understand the mechanisms of S movement in phonolitic systems, within both the melt and exsolved fluid phases.