Understanding the degassing of young volcanic systems using noble gases

Conference or Workshop Item

Understanding the degassing of young volcanic systems using noble gases

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Incompatible inert trace elements He, Ne and Ar are widely used to characterize magmatic reservoirs and to study volcanic processes. Their isotopic signature and fractionation (e.g. $^{4}He/^{40}Ar$ ratio) provide useful information on magma source, magma differentiation and contamination. Several studies have investigated sources, reservoirs and chemical controls of noble gases, but few efforts have been made to study which factors control noble gas incorporation and release during degassing episodes.

The aim of this research is to identify these factors and to test how they influence noble gas behaviour in volcanic rocks with different degassing histories. This will help improve our understanding of how noble gases are recycled into the atmosphere during volcanism. Particular attention will be given to the behaviour of Ar because of its use in $^{40}Ar/^{39}Ar$ dating. A better knowledge of how Ar is trapped and released from volcanic rocks will help find a solution to the 'excess argon problem': the presence of an excess portion of Ar inside rocks that is not related to atmospheric Ar nor to the radiogenic decay of ^{40}K, complicates $^{40}Ar/^{39}Ar$ age dating. Younger volcanic rocks are more affected by this problem due to their lower concentrations of radiogenic Ar with respect to non-radiogenic Ar.

In this study, samples from 0 to 2 Ma are used to study rocks with different proportion of radiogenic and excess Ar. A variety of materials (pumice, ash, non-vesicular glass, crystals) and deposit types (pyroclastic fall, ignimbrites, lavas, and Pele's hair) from Tenerife (Spain), Etna (Italy) and Masaya (Nicaragua), will be used to test how noble gases vary in response of cooling rate (Pele's hairs vs. lavas vs. mode of pyroclastic emplacement), depositional environment (distal vs. proximal) and physical characteristics of the deposit (grain size, crystals vs. bubbles, rock porosity).

Petrographic, SEM and XRF analysis will be conducted to characterise mineral assemblages, textures and chemistry of the samples; noble gas concentration and distribution will be determined by laser ablation mass spectrometry; the internal structure and topology (e.g. form, distribution and connectivity of vesicles) will be quantified using X-ray microtomography in order to identify fast-pathways for the release of noble gases from volcanic materials during degassing episodes.