Generation and evolution of volatile-rich magmas from El Hierro, Canary Islands

ZOLTÁN TARACSÁK[1], MARGARET E. HARTLEY[1], MARC-ANTOINE LONGPRÉ[2], RAY BURGESS[1], MARIE EDMONDS[3]

[1]University of Manchester, School of Earth and Environmental Sciences, Manchester M13 9PL, UK
[2]School of Earth and Environmental Sciences, Queens College, City University of New York, Flushing, NY 11367, USA
[3]Department of Earth Sciences, Univesity of Cambridge, Cambridge CB2 3EQ, UK

El Hierro is the youngest island of the Canary Islands, but was subject to relatively few studies until the most recent submarine basaltic eruption off its southern flank between October 2011 and March 2012. This volumetrically modest eruption was fed by an extremely volatile-rich (H, C, F, S, Cl) magma and emitted unusually large amounts of volatiles into the environment. Detailed studies of older volcanics on El Hierro are lacking, especially with regard to volatile elements. It remains an outstanding question whether the volatile-rich character of the 2011-2012 eruption is typical, or not, for El Hierro magmas.

We have analysed a set of 105 olivine- and clinopyroxene-hosted melt inclusions and glasses from young (<12 ka) subaerial volcanics for major, trace and volatile (H_2O, C, F, S, Cl) elements using EPMA and SIMS. Carbon concentrations are in the same range as for the 2011-2012 eruption (up to 3500 ppm), while water concentrations are also high (up to 1.8 wt% H_2O). Carbon/trace element ratios (CO_2/Nb = 0-38, CO_2/Ba = 0-8.3) show that most melt inclusions have either trapped a partially carbon degassed melt or that most of the carbon has degassed into inclusion-hosted bubbles. Many of the inclusions host fluid bubbles that occupy >20% of the total inclusion volume, which suggest two phase entrapment of a melt and a gas phase. H_2O/Ce ratios are dominantly in the range 70-100, significantly lower than undegassed MORB (H_2O/Ce~220), with only 3 inclusions having H_2O/Ce>160. This may indicate loss of water by diffusion through the host. F/Nd is higher than the canonical value for undegassed MORB (~21.0) in all melt inclusion (21.8-48.3). This may be related to F enrichment of the El Hierro mantle source.

Volatile elements in the melt inclusions show similar compositional ranges to those from the 2011-2012 submarine eruption, indicating that El Hierro magmas probably originate from a highly volatile-enriched mantle containing recycled crustal and/or metasomatised material.