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Mafic intrusion remobilising silicic magma under El Hierro, Canary Islands

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The 2011 submarine eruption at El Hierro, Canary Islands, has produced volcanic bombs that degas at sea surface, boil seawater and sink when cooled and degassed. At the beginning of the eruption white coloured pumices enveloped in darker coloured spatters floated on land. These composite pumices show evidence of magma mingling with folds and undulations of the darker coloured magma within the white pumice suggesting magma mingling in a viscous regime. The white pumice is highly vesicular and resembles foam. Most of the vesicular structure is made of tightly packed, polygonal bubbles of uniform size ([U+F0BB] 100 [U+F06D]m), suggesting a single event of homogeneous bubble nucleation. An earlier event of heterogeneous bubble nucleation is indicated by the presence of a few large bubbles developed around tiny quartz crystals.
Both the darker and lighter coloured pumices are almost aphyric. A few olivine crystals with perfect euhedral morphology occur within the darker part. Rare olivines of same composition are also found in the white pumice glass but then display somewhat rounded outlines and hopper-type structure. Melt inclusions in olivines of the darker pumice are of the same composition as the enveloping mafic glass, whereas olivines in the mixing boundary layer have melt inclusions of less mafic composition. The whole-rock composition and slightly more evolved glass composition are of basanitc and alkali rhyolitic composition (at the limit of the trachyte field) according to the TAS classification. Such rhyolitic compositions are rare in the Canaries. Analyses of residual volatile concentration in the glasses show that the silicic glass is highly degassed (F: 511 $\pm$222; Cl: 202 $\pm$58; S: below detection limit; values in ppm,1SD, n=10), whereas the basanitic glass still has very high halogene concentrations (F: 1354 $\pm$151; Cl: 1026 $\pm$47; S: 362 $\pm$29; 1SD, n=10). In-situ analysis of trace element compositions of the dark glasses reveal typical basanitic compositions with elevated incompatible element concentrations and primitive mantle normalised spectra characteristic for the Canary Island basanites (e.g. La is of 100 times higher concentration than primitive mantle with important LREE enrichments). In contrast, the trace element composition of the alkali rhyolite shows surprisingly low concentrations for all elements except the most incompatible ones (such as Rb, Ba, K and Th). All other measured incompatible LILE, HFSE and REE have significantly lower concentration than the basanitic counterpart. This differences increase with the atomic number of the REE reaching maximum for the MREE and thus forming an intriguing U-shaped rhyolite spectra. Furthermore, unusual U-depletion is observed in the rhyolite. Other negative spikes, such as those for Sr and P, are readily accounted for by the removal of plagioclase and apatite during magma evolution from a basanite to a more evolved melt.
The results obtained so far suggest an intrusion of gas-rich basanitic melt at the base of an evolved intrusion remobilising a stagnant phonolitic melt present as late differentiate in the crust. Interaction with old oceanic crust and the volcanic edifice can be quantified and shown to have modified the phonolite melt composition and produced the alkali rhyolitic composition of the white floating pumice. Extensive gas exsolution shortly before the melt-glass transition explains the foam texture and the low volatile concentrations in the quenched alkali rhyolite.