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Bimodality of Lavas in the Post-Icod-Collapse succession in Tenerife - A crustal melting origin for the Teide-Pico Viejo phonolites?

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In Tenerife, the Teide-Pico Viejo central complex and associated rift zones show a marked bimodal composition of lavas. While the rift zones erupted mafic lavas exclusively, the central complex Teide-Pico Viejo erupted initially mafic (200ka – 15ka) and only recently felsic (phonolite) lavas (<10ka). Groundmass Sr-Nd-Pb-delta18O and feldspar delta18O data allow constraining the petrogenesis of the felsic products of Teide-Pico Viejo. Whole-rock trace element fingerprints distinguish phonolites as one of three compositional groups (primitive, transitional, evolved). Sediment contamination can be excluded by the distinctly too low 206Pb/204Pb ratios in North Atlantic sediment. Hydrothermally altered components possess too low 1/86Sr values. Compared to the primitive lavas, the phonolites possess a tightly confined range of 206Pb/204Pb and a larger range of 207Pb/204Pb ratios. In combination with the unusually high 87Sr/86Sr ratios in Teide phonolites (<0.7049), this points to the assimilation of highly evolved igneous country rock.

Isotope mixing hyperbolas yield mixing percentages for the two most radiogenic phonolites of 70 – 99.9 % contaminant. EC-RAFC modelling of the thermal evolution of phonolite magma yields r-values of 2, with differential r-values increasing to much higher values close to thermal equilibration. Both, mixing hyperbolas and EC-RAFC models, therefore indicate that bulk melts of highly evolved country rock had been incorporated during phonolite petrogenesis, and this to a large degree. Several of the Teide phonolites are indistinguishable from the highly evolved contaminant in major/trace element and isotope data (Sr, Nd, Pb and O). This indicates a potential for bulk melts of country rock that may form and erupt spatially decoupled from juvenile material. The continuum of combinations between assimilation and fractional crystallisation may thus have to be complemented with special cases in which pure crustal melts are erupted. These special cases persist outside the realm of the thermodynamic-geochemical models currently at hand (e.g. EC-RAFC), but need to be considered nevertheless. However, the general evolution of Teide-Pico Viejo lavas appears to be governed by assimilation and fractional crystallisation.