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Linking the sub-volcanic plutonic complex and the magmatic evolution at La Gomera volcano, Canary Islands.

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Ocean-island basalts (OIBs) geochemistry has been extensively studied to determine the nature and melting characteristics of OIB mantle sources. Yet, fractional crystallization, magma mixing and/or crystal accumulation are recognized as important processes modifying the chemistry of OIB magmas during their journey to the surface. Although the influence of these magmatic processes may be evaluated based on the magmas petrography and geochemistry, the depth at which they take place, and the general architecture of the magmatic systems often remain open to questions.

To bring additional light on the role of sub-volcanic magmatic systems in the evolution of OIB basalts, we investigated the Basal Complex (BC) at La Gomera volcano, Canary Islands. The BC refers to an appreciable volume of plutonic rocks crosscut by an important dyke swarm associated with subsequent volcanic phases. The BC has been exposed by lateral collapse of the volcano in the Miocene. The plutonic rocks comprise mostly wehrlite, pyroxenites, olivine gabbros and gabbros showing diffuse transitions and locally mm to m scale vertical layering. The dykes, crosscutting the plutonic complex, are characterized by aphanitic to coarse-grained porphyritic to ankaramitic textures. Textural observations and mineral chemistry indicate that disaggregation and dispersion of cumulates of mafic crystals largely contributed to the strongly porphyritic texture shown by the dykes.

Based on petrological, mineralogical and geochemical data, we show that the role of the shallow plutonic complex in the magmatic evolution is twofold: (1) The plutonic rocks represent cumulates complementary to the differentiation trend recorded by basaltic to basaltic trachy-andesite aphyric magmas (~8 to 3 wt% MgO), thus demonstrating the importance of a second step of crystallization-differentiation in the shallow sub-volcanic magmatic system in controlling the chemical diversity of mafic melts. (2) Cannibalization of crystals from “hot” cumulates contribute to the production of porphyritic to ankaramitic lavas, hence strongly influencing the textural diversity of mafic magmas. Overall, our results suggest that the role of shallow subvolcanic magmatic reservoirs in the evolution of alkaline magmas may be underestimated in the Canary Islands.