Goldschmidt 2023 Abstract
https://doi.org/10.7185/gold2023.18217

Unravelling the origin and fate of the primitive high-Mg# basaltic andesites and andesites from Puñalica volcano (Ecuador)

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Puñalica volcano (~18 ka) is a 300 m-high cone located in central Ecuador and its rocks are among the most primitive of the Ecuadorian arc. It comprises lava flows and tephra displaying high-Mg# basaltic-andesite and andesite (52-60 wt.% SiO_2, 50-67 Mg#) compositions. In this contribution we unravel the petrogenetic story for Puñalica magmas based on a comprehensive study that includes field work, petrographic descriptions, whole-rock (major, trace, Sr-Nd-Pb isotopic data) and mineral geochemistry. Volcanic products from Puñalica contain olivine, clinopyroxene, and plagioclase phenocrysts. Olivine (Fo_{78-85}) phenocrysts (<5% vol.) are subhedral to rounded and they are generally present as isolated minerals while clinopyroxenes and plagioclases form aggregates. Plagioclases show two clear steps of crystallization represented by two compositional groups that are distinguished in zoned phenocrysts. The first group varies from An_{84} to An_{47} and forms the core of phenocrysts while the second group varies from An_{67} to An_{59} and crystalizes around the former.Clinopyroxenes also display two families: one represented by cores of Mg# 68-74 surrounded by rims of Mg# 56-66 compositions. These characteristics can be explained by a recharge of an olivine-bearing magma into a reservoir where clinopyroxene and plagioclases were already crystallizing. No petrographic evidence of wall-rock assimilation was observed on these rocks. The least silicic rocks from Puñalica are extremely enriched in Th and LREE and display concomitantly primitive characteristics. Such rocks show high radiogenic Nd compositions and the least radiogenic Sr isotopic values of the entire Ecuadorian arc. We interpret that these magmas result from a variable degree of mantle melting triggered by the addition of Th-rich hydrous siliceous melts. Similar Th and LREE enrichments are observed in other Ecuadorian volcanoes but only in more evolved rocks (i.e., dacites). The primitive characteristics of these magmas coupled with an enriched nature, make Puñalica products unique in the arc. Puñalica lavas clearly suggest that primitive mantle-derived magmas can reach the surface even passing through a thick continental crust (>50 km) with an extremely low crustal imprint. This conclusion is drastically different from that of previous studies in the Ecuadorian arc that see a dominant role of crustal processes.