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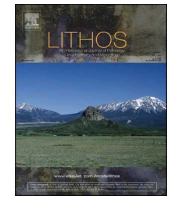


# Petrological and geochemical constraints on the magmatic evolution at the Ampato-Sabancaya compound volcano (Peru)

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A B S T R A C T

In order to gain insights into continental arc magmatic processes, we have conducted a petrological and geochemical study of major and trace elements and Sr, Nd, and Pb isotopes of the Ampato-Sabancaya compound volcano, which belongs to the Andean Central Volcanic Zone (CVZ). Whole-rock compositions for Ampato and Sabancaya range from andesites to dacites (56.7–69.3 wt% $SiO_2$) and both belong to a medium- to high-K calk-alkaline magmatic series. Ampato-Sabancaya samples are characterized by high contents of large-ion lithophile elements (LILE; e.g., K, Rb, Ba, Th), low concentrations of high field strength elements (HFSE; e.g., Nb, Zr) and heavy rare earth elements (HREE; e.g., Yb), with consequently high La/Yb and Sr/Y ratios. An increase in these ratios is usually interpreted as a result of magmatic differentiation in the presence of garnet in the deep crust. A detailed analysis reveals that the rocks of Ampato-Sabancaya display three different compositional groups. (1) The first, composed mainly of andesites (56.7–59.8 wt% $SiO_2$), corresponds to lavas from the early stage of the Ampato Basal edifice, as well as pyroclastic deposits from the Ampato Upper edifice. (2) The second group corresponds to andesitic and dacitic compositions (60.0–67.3 wt% $SiO_2$) from the Ampato Basal edifice (Moldepampa stage), the Ampato Upper edifice, and the Sabancaya edifice. (3) The third group corresponds to dacitic compositions (65.0–69.3 wt% $SiO_2$) associated with the Corinta Plinian fallout and pyroclastic flow deposits from the Ampato Upper edifice. This last group of dacites, erupted during the Ampato Upper edifice stage, have drastically different compositions from the other groups with Sr/Y (<27) and Sm/Yb (<4.7) ratios lower than other lavas and lacking evidence of amphibole and/or garnet fractionation during their genesis. As a whole, Sr, Nd, Pd isotopic ratios suggest that mantle-derived magmas are significantly affected by assimilation processes during their evolution, due to the thick (65–70 km) continental crust beneath the CVZ in southern Peru. In summary, the magmatic evolution of group 1 and 2 can be explained by a two-step model in which primitive magmas evolved in the deep crust in the so-called melting-assimilation-storage-homogenization (MASH)-type reservoirs by assimilation-fractional crystallization (AFC) processes involving garnet and/or amphibole. Then, amphibole-dominated upper crustal AFC processes and magma mixing are responsible for the geochemical diversity of the main ASCV trend. In contrats, the group 3 dacites followed an upper crustal AFC process (without amphibole) from a different primitive magma, which did not suffer the high pressure, garnet-dominated AFC processes. This evolution highlights the complexities associated to magma genesis and differentiation at continental arcs contructed on a thick crust.

## 1. Introduction

The volcanic arc along the Andean Cordillera results from the subduction of the oceanic Nazca plate below the continental South American plate. This volcanic arc is divided into three active arc segments, the Northern (NVZ), Central (CVZ), and Southern (SVZ) volcanic zones (Fig. 1a). In addition, the Austral volcanic zone (AVZ) results from subduction of the Antartica plate below the South American plate. The

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