Goldschmidt 2025 Abstract
https://doi.org/10.7185/gold2025.30914

A geochemical investigation of the Sara Sara volcano (Peru): a Pleistocene edifice of the northern termination of the Andean Central volcanic zone

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The Andean Central Volcanic Zone (CVZ) is a volcanic segment located along the Andean arc, between 14° and 27°S that is constructed on a continental crust up to 70 km thick. The current arc is composed of Quaternary stratovolcanoes resulting from the subduction of the oceanic Nazca plate below the South American crust. In this contribution, we focused on Sara Sara, a Pleistocene edifice located in the northern termination of the CVZ. This region was specially selected because the geometry of the subducting slab shows a transition from a flat slab northward to a “normal” subduction angle southward. In this specific geodynamical situation, we expect that the crustal imprint should be magnified due to a weaker mantle signature associated to the limited mantle column below Sara Sara. In addition, Sara Sara is the only volcano located on the Paracas crustal domain. Consequently, the Sara-Sara volcano is a prime target for understanding the impact of the continental crust on the formation of arc magmas.

Following intensive fieldwork and a petrographic characterisation, we carried out a detailed major (N=108), trace (N=44) and Sr-Nd-Pb (N=38) isotopic characterisation of Sara-Sara eruptive products and the surrounding adventive cones. Our result reveal that this volcano generated a continuous series of dacites and rhyolites, with hight maximum values for La/Yb, Dy/Yb and Nb/Ta ratios. Isotopic ratios show the lowest range of variability among the stratovolcanoes of the Peruvian CVZ.

In this work, we demonstrate that the andesitic magmas of the adventive cones are the parent magmas of the differentiated Sara-Sara series and that the dacites and rhyolites result from an upper crustal fractional crystallisation process, coupled with the assimilation of the Paracas domain rocks. Secondly, on the basis of the high Dy/Yb and Nb/Ta ratios of the andesitic magmas and the overall positive correlation observed between such ratios, we will discuss the deep crustal process, which seems to be controlled by a leading role of the garnet and rutile as residual phases of the partial melting of crustal materials at the base of the crust.