



## Magnetotelluric images of the hydrothermal and magmatic system beneath Volcan Misti (Peru)

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### ABSTRACT

Volcan Misti, situated in the Central Volcanic Zone (CVZ) is considered one of the most hazardous volcanoes in South America. Petrophysical and mineralogical studies of the erupted materials inferred the presence of an interactive and stratified magmatic system, composed of two to three magma reservoirs. However, its geometry and the relationships with tectonic and seismic activity remain largely unresolved due to the lack of high-resolution geophysical imaging. To address this question, 42 broadband magnetotelluric (MT) stations were deployed around the volcanic edifice to construct the first three-dimensional electrical resistivity model of the magmatic and hydrothermal system. The data were inverted and the resulting model was characterized by three low-resistivity features. The first is a conductive layer, ~1 km thick (5 to 40  $\Omega\text{m}$ ), that extends laterally beneath the volcanic edifice and is interpreted as a clay cap. The second feature corresponds to an inferred low-resistivity body (10–30  $\Omega\text{m}$ ), located at sea level. The third is a low-resistivity body (< 10  $\Omega\text{m}$ ) imaged at ~10 km below sea level, located slightly east of the volcano (~2.5 km). The resistivity of this feature is interpreted as indicative of the presence of andesitic melts, suggesting a melt fraction in the range 4–24% for the temperature range 900–950 °C. The seismicity associated with the volcano is minimal and concentrated just beneath the crater at a depth of ~2.5 km. The shallow depth of the seismicity, together with the MT model, suggests that the recharge and supply of magma occur in a cryptic manner.

### 1. Introduction

Volcan Misti (5820 m above sea level) is classified as an active volcano within the Central Volcanic Zone of the Andes (CVZ; De Silva and Francis, 1991; Aguilera et al., 2022). The CVZ is one of the three volcanic segments along the South American continent where active volcanism occurs (Fig. 1a). Volcanism in the CVZ is the result of the subduction of the oceanic Nazca Plate beneath the South American Plate, with a convergence rate of approximately 9 cm/year (Romanyuk, 2009) and a slab dip angle ranging between 20° and 30° (Müller et al., 2008).

Volcan Misti is considered one of the most hazardous in South America, as it lies only 17 km from the city of Arequipa (Fig. 1b), the second most populous city in Peru, with a population of 1.3 million inhabitants (INEI, Instituto Nacional de Estadística e Informática; last census carried out in 2017). The city is built atop a WNW–ESE-trending tectonic depression, interpreted as a pull-apart basin associated with two regional fault systems: the Huanca Fault (referred to as the Chili Fault in this study) and the Aguada-Blanca Fault. Both faults exhibit NW–SE orientations and a dominant normal-slip component (Thouret et al., 2001; Benavente et al., 2017).

The internal structure of Volcan Misti has been characterized at

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