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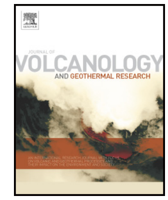

The eruptive chronology of the Ampato–Sabancaya volcanic complex (Southern Peru)

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A R T I C L E   I N F O

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A B S T R A C T

We have reconstructed the eruptive chronology of the Ampato–Sabancaya volcanic complex (Southern Peru) on the basis of extensive fieldwork, and a large dataset of geochronological (^{40}K–^{40}Ar, ^{14}C and ^{3}He) and geochemical (major and trace element) data. This volcanic complex is composed of two successive edifices that have experienced discontinuous volcanic activity from Middle Pleistocene to Holocene times. The Ampato compound volcano consists of a basal edifice constructed over at least two cone-building stages dated at 450–400 ka and 230–200 ka. After a period of quiescence, the Ampato Upper edifice was constructed firstly during an effusive stage (80–70 ka), and then by the formation of three successive peaks: the Northern, Southern (40–20 ka) and Central cones (20–10 ka). The Southern peak, which is the biggest, experienced large explosive phases, resulting in deposits such as the Corinta plinian fallout. During the Holocene, eruptive activity migrated to the NE and constructed the mostly effusive Sabancaya edifice. This cone comprised many andesitic and dacitic blocky lava flows and a young terminal cone, mostly composed of pyroclastic material. Most samples from the Ampato–Sabancaya define a broad high-K magmatic trend composed of andesites and dacites with a mineral assemblage of plagioclase, amphibole, biotite, ortho- and clino-pyroxene, and Fe–Ti oxides. A secondary trend also exists, corresponding to rare dacitic explosive eruptions (i.e. Corinta fallout and flow deposits). Both magmatic trends are derived by fractional crystallisation involving an amphibole-rich cumulate with variable amounts of upper crustal assimilation.

A marked change in the overall eruptive rate has been identified between Ampato (~0.1 km^3/ka) and Sabancaya (0.6–1.7 km^3/ka). This abrupt change demonstrates that eruptive rates have not been homogeneous throughout the volcano's history. Based on tephrochronologic studies, the Late Holocene Sabancaya activity is characterised by strong vulcanian events, although its erupted volume remained low and only produced a local impact through ash fallout. We have identified at least 6 eruptions during the last 4–5 ka, including the historical AD 1750–1784 and 1987–1998 events. On the basis of this recurrent low-to-moderate explosive activity, Sabancaya must be considered active and a potentially threatening volcano.

1. Introduction

Reconstructing the eruptive chronology of active volcanic systems represents a key step for any hazard assessment initiative. However, the recent eruptions of Chaitén (2008, Major and Lara, 2013) and Reventador volcanoes (2002, Hall et al., 2004) showed that the eruptive chronology of many active volcanic complexes remains poorly known. In the Andean cordillera, the Peruvian segment of the Central Volcanic Zone (CVZ) results from the subduction of the oceanic Nazca plate below the South American continental lithosphere. As a result, the volcanic front includes at least twelve volcanic centres of Pleistocene age (Fig. 1a) of which seven have experienced historical eruptive activity (i.e. since the arrival of the Spanish conquistadors in the 16th century). These volcanoes include El Misti (Thouret et al., 2001; Harpel et al., 2011), which threatens the city of Arequipa, the active volcanoes of Ubinas (Thouret et al., 2005; Rivera et al., 2014) and Sabancaya (Gerbe and Thouret, 2004), and Huaynaputina volcano (Thouret et al., 1999; Adams et al., 2001), which has had the biggest historical eruption in the Andes. However, little is still known about the eruptive chronology of some of these volcanic centres, such as the

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