Journal of Volcanology and Geothermal Research 189 (2010) 291–318

Contents lists available at ScienceDirect

Journal of Volcanology and Geothermal Research

journal homepage: www.elsevier.com/locate/jvolgeores

The 2005 eruption of Ilamatepec (Santa Ana) volcano, El Salvador

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ARTICLE INFO

Article history:
Received 31 March 2009
Accepted 14 November 2009
Available online 11 December 2009

Keywords:
Ilamatepec volcano
El Salvador
2005 eruption
volcanic stratigraphy

ABSTRACT

We report the stratigraphic sequence of the 2005 eruption of Ilamatepec volcano together with sedimentological and chemical analyses of its products.
Structural and textural characteristics of the deposits indicate that the eruption was driven by a small-volume rhyolitic intrusion at shallow levels, which resulted first in the collapse of the existing hydrothermally altered fan of previous deposits inside the crater lake, driving phreatic explosions with launching of blocks on ballistic trajectories; later the magma interacted with lake waters producing several hydromagmatic pyroclastic density currents (PDCs). These flows were energetic enough to knock down pine trees up to distances of 1.8 km from the crater in the E-NE sector of the volcano. Finally, ejection of ballistic blocks that landed on previously emplaced, wet pyroclastic density current deposits, caused the generation of a lahar that flowed down the steep eastern flank toward the El Jabillal gully. Subsequent lahars occurred as a result of intense rain caused by hurricane Stan.
Radiocarbon ages on paleosols and charcoal fragments, separating previous volcanogenic sequences, indicate that similar eruptions have occurred more frequently in the past centuries, than previously thought.
The new data confirms that Ilamatepec volcano is one of the most active volcanoes in El Salvador. Nevertheless, more detailed studies of the eruptive sequence of Ilamatepec volcano are mandatory to establish future eruptive patterns.

1. Introduction

Ilamatepec volcano (13°51′N, 89°37.5′W), also known as Santa Ana, is the highest volcano in El Salvador (2381 masl) and one of the most active in the country, with more than one eruption per century since AD 1500 (Mooser et al., 1958). It is located at the southern margin of the Median Through, a structural Plio-Pleistocene depression that controls the eruptive activity in El Salvador (Carr and Stoiber, 1977; Fig. 1). Almost 15% of the entire population of El Salvador lives in a radius of 25 km from its summit (Pullinger, 1998).

Its summit area, with a radius of 1.5 km, consists of four coalescent craters. The youngest crater, to the SE (Fig. 2), formed after the 1904 eruption (Carr and Pointer, 1981), and hosts an acid lake with sulfate and chlorine waters ($SO_4/Cl \approx 1.5$ mass ratio, Bernard et al., 2004).

The presence of high-temperature fumaroles inside the western (inner) portion of the crater has been related to a *vapour-dominated* hydrothermal system located at low depth beneath the lake (Rodríguez et al., 2004; Bernard et al., 2004). Chemical data of lake waters collected between 2000 and 2002 show high contents of iron as Fe^{2+} (672 to 1314 mg/l) that were attributed to the interaction between olivine-basalts and/or basaltic andesites and phreatic waters (Bernard et al., 2004). The Fe^{2+}/Fe^{3+} ratio has been related to the H_2S/SO_2 ratio of the gases injected into the hydrothermal-lake system, leading to a higher Fe^{2+}/Fe^{3+} ratio and low lake temperatures during the repose periods of the volcano, as observed at Poás volcano (Rowe, 1994). According to Pullinger (1998) the main volcanic activity during the last thousand years consisted in phreatic and phreatomagmatic eruptions from both central craters, and parasite cones on the NW and SE flanks, located along a regional, 20 km long, NW-SE fault system, which has been active since the Late Pleistocene (Williams and Meyer-Abich, 1955; Pullinger, 1998).

On October 1st 2005 the volcano erupted, producing a "dense column of gas and wet ash, from the central crater, more than 10 km high" (Fig. 3) (SNET, Informe Especial No. 6), that produced "5 mm of ash fallout up to 12 km W from the crater" (SNET, Informe No. 17). The bulletins published by SNET (Servicio Nacional de Estudios Territoriales), the local authority in charge of monitoring the volcano, reported also the fallout of ballistic blocks as far as 2 km to the S of the crater, and hot lahars that reached up to 5 km SE from the crater in El Jabillal and Las Minas gullies (SNET, Informe No. 17). Since June 2005,

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doi:10.1016/j.jvolgeores.2009.11.016

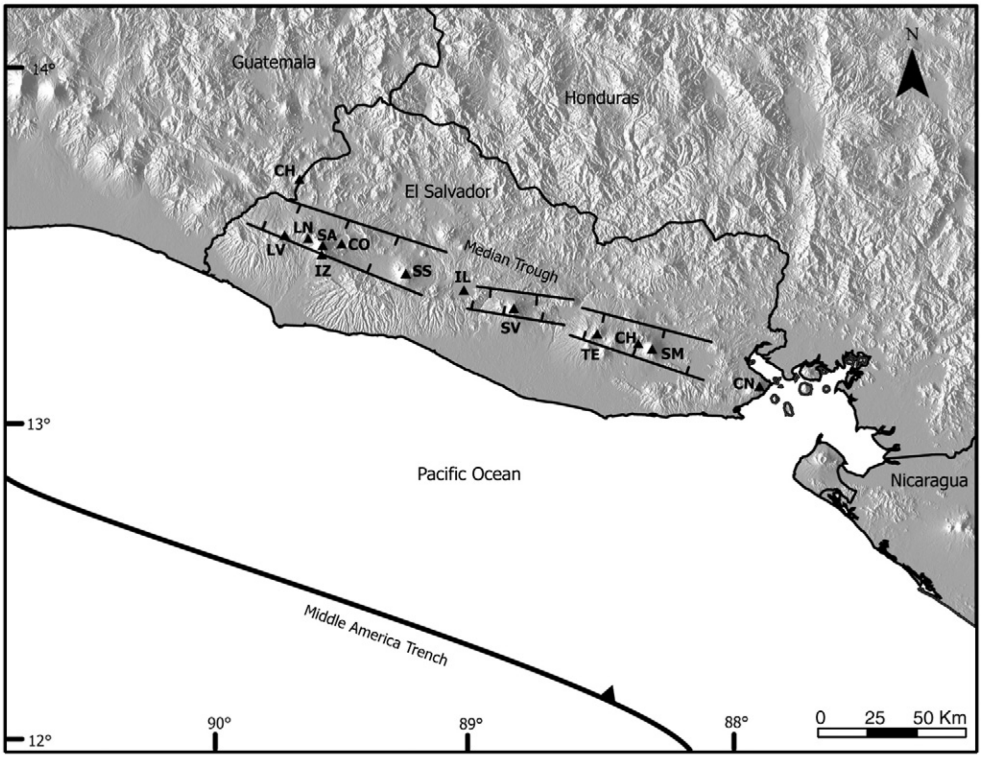

Fig. 1. Simplified regional sketch map showing main volcanoes and active faults of El Salvador. CH = Chinameca; LN = Los Naranjos; LV = Laguna Verde; SA = Santa Ana; IZ = Izalco; CO = Coatepeque; SS = San Salvador; IL = Ilopango; SV = San Vicente; TE = Tecapa; SM = San Miguel; CN = Conchagua.

SNET bulletins indicated the common occurrence of landslides inside the western portion of the crater (SNET, Informes No. 1–2), a change in the color of the lake and an increase in its level, opening of fissures in a N–S direction across the fumarolic field, an increase in the number of seismic events and the energy released, vapour columns up to 600 m high, and the incandescence of rocks in an approximate area of 200 m^2 (SNET, Informes Especiales No. 3–4–5, Fig. 4A–B). Ash falls of non-juvenile material were reported on June 16th depositing a thin layer of approximately 0.5 mm in the northern and western sectors of the volcano (SNET, Informes Especiales No. 1–2). The increase in both gas emissions and seismic events was attributed to the behaviour of the hydrothermal system, more active during the rainy season (SNET, Informe Especial No. 4); intense emissions were able to lift non-juvenile ash, which were dispersed by low-altitude winds (SNET, Informe Especial No. 5). Volcano monitoring was intensified after these signals. Bulletins published by SNET reported contradictory information in regard to the onset of the eruption and the temporal succession of events. These discrepancies can be attributed to poor weather conditions and intense rain produced by the arrival of hurricane *Stan* in El Salvador, which coincided with the beginning of the eruption (http://earthobservatory.nasa.gov). This situation prevented direct observation of the crater and fieldwork.

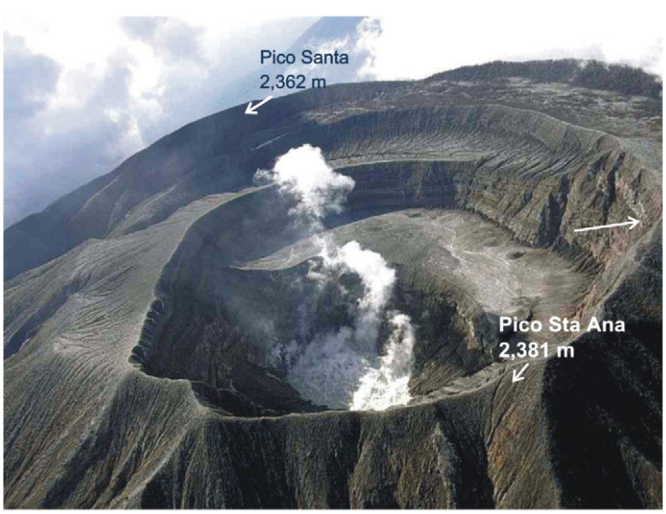

Fig. 2. Aerial view toward the SW of Ilamatepec volcano. Arrow points to the north. Photo taken after the 2005 eruption showing the four nested craters, which became progressively younger from NW to SE. The active crater is in the foreground (photo by C. Pullinger, October 26, 2005).

Fig. 3. View of Ilamatepec volcano from Sonsonate (15 km SW from the crater) showing an ash charged column produced during the morning of October 1, 2005. Photo by M. Flores (La Prensa Gráfica, El Salvador).