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Morphological and volcanic evolution of the summit of Pico Volcano, Azores archipelago

Adriano Pimentel (1,2), Vittorio Zanon (1), Francisco Ferreira (1), Greta Marchini (1), and Marion Auxerre (3)

(1) Instituto de Investigação em Vulcanologia e Avaliação de Riscos (IVAR), Universidade dos Açores, Ponta Delgada, Portugal (adriano.hg.pimentel@azores.gov.pt), (2) Centro de Informação e Vigilância Sismovulcânica dos Açores (CIVISA), Ponta Delgada, Portugal, (3) Centre de Recherches Pétrographiques et Géochimiques (CRPG), Nancy, France

Ocean island volcanoes are dynamic geological structures. Their shape changes rapidly as they evolve through complex interactions among eruptions, magma intrusions, tectonics, mass wasting and subaerial erosion. The central volcanoes of the Azores islands (North Atlantic Ocean) show a wide variety of morphologies, ranging from conical edifices to incremental caldera complexes. In the absence of geochronological constraints on morphological changes we use a multidisciplinary approach combining morpho-structural analysis with seismicity, rock geochemistry and petrography to better constrain the model of the summit evolution of Pico Volcano. After the subaerial shield-building stage, this volcano grew up to 2351 m asl as a cone-shaped edifice with steep slopes (in excess of 40°) and without lateral cones above ∼1500 m asl. An older crater, now defined by a plateau at 2060-2010 m asl, formed southwest of the present summit. Subsequent dominantly effusive activity reconstructed a new volcanic cone slightly offset to NNE. This new summit was later truncated by a sub-circular pit-crater (550-m-wide), nowadays with a preserved crater wall on the SW and collapsed sector on the NE. The pit-crater was then partially occupied by the pahohehoe lavas of a 110-m-high spatter/lava cone (known as Piquinho). During the last summit eruption a 800-m-long ENE-WSW eruptive fissure cut Piquinho cone and the crater wall producing a small volume of scoria. The upper northern and eastern flanks show active rock slides that removed the NE half of the crater wall and formed debris-filled ravines. The southern edge of the older crater also shows ongoing geomorphological instability characterized by traction fissures and fresh ravines. Overall, two types of lavas were emitted contemporaneously in recent times by the whole volcano: olivine-and-clinopyroxene-bearing basalts (type A) were mostly erupted from lateral vents along different fracture systems intersecting the volcano, while plagioclase-bearing basalts and trachybasalts (type B) erupted almost exclusively from the summit. Therefore, two feeding systems were active simultaneously in Pico Volcano. Type A magmas ascended directly from the Moho Transition Zone through dyke intrusions, while type B magmas mostly formed in a shallow reservoir, believed to be the source of the frequent low-magnitude earthquakes (M $\leq$2) recorded at depths between 4 and 7 km. This reservoir should be located beneath the southern flank of the volcano, between the older crater and the coastline, and its position suggests a SSW dipping central conduit system linking it to the summit area.

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