# Destruction of emergent tuff cones in Faial Island, Azores: influence of tectonics and marine erosion

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The island of Faial is the westernmost of the central islands of the Azores archipelago (North Atlantic Ocean), and is located east of the Mid-Atlantic Ridge. The Azores are in a unique geodynamic setting at the triple junction of the North-American, Eurasian and Nubia lithospheric plates (Searle, 1980; Madeira and Ribeiro, 1990; Vogt and Jung, 2004) (Fig. 1a)

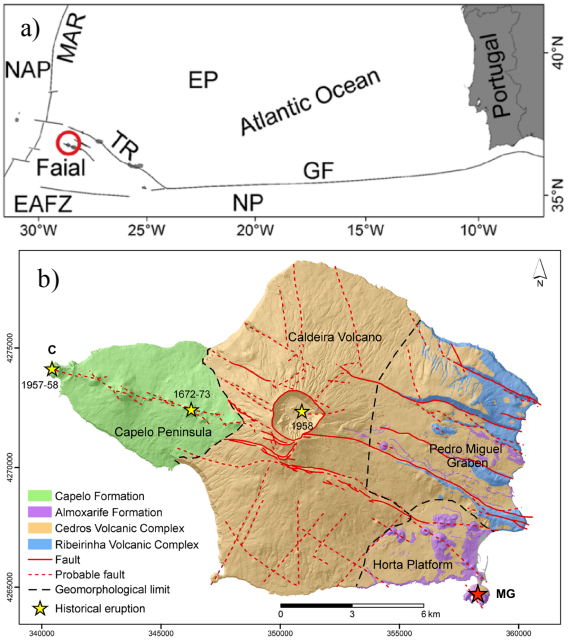


Fig. 1 – a) Geological setting of the Azores Islands. NAP: North American Plate, EP: Eurasian Plate, NP Nubian Plate, MAR: Mid-Atlantic Ridge, TR: Terceira Rift, EAFZ: East Azores Fracture Zone, GF: Gloria Fault; b) simplified geological map of Faial Island, C-Capelinhos, MG-Monte da Guia (modified from Pimentel et al., 2015).

The central part of Faial is dominated by the Caldeira central volcano, which corresponds to the main massif of the island, truncated by a summit collapse crater of 2 km across and 400 m deep (Fig. 1b). Horta fissure zone, located on the south-east of Faial, is a lava platform with several scoria cones and one tuff cone (Monte da Guia; Fig. 1b).

On the western end of the island, the Capelo fissure zone is a ridge formed by cinder cones and the remant of the tuff cone formed during the 1957-58 historic eruption of Capelinhos (Fig. 1b).

The Azores are located in the northern hemisphere subtropical anticyclones zone dominated by the Azores anticyclone that influences the circum North Atlantic climate.

Between autumn and winter, these islands are frequently affected by low-pressure systems, associated to the southern migration of the polar front, causing recurrent storms and periods of high winds. During spring and summer, the climate is regulated by the establishment of the Azores High closer to the archipelago reducing the precipitation.).

The ocean circulation pattern in the Azores area is governed by two main branches the Gulf Stream: the North Atlantic Current and the Azores Current. The coasts of the islands are, therefore, considered as wave dominated coasts following the Davis and Hayes (1984) classification scheme.

In this work, we focused on Capelinhos and Monte da Guia tuff cones (Fig. 1b) as case study to show the influence of tectonic and marine erosion on destruction of monogenetic landforms at oceanic islands.

Capelinhos tuff cone is located at the western tip of Capelo peninsula (Fig. 1b) The tuff cone is the product of three distinct eruptive pulses that begun up to 1.2 km off-shore the Costado da Nau cliff in 1957-1958 (e.g. Castelo Branco et al., 1959; Zbyszewski and Veiga Ferreira, 1959). Today, about 3/5 of the original tuff cone have been removed by partial collapses, and the joined action of wind and waves (Fig. 2).

Fig. 2 – Capelinhos cliff showing the remaining tuff and scoria cones with a complex network of dykes

The careful study of the structure of the palagonitized tuff sequences around the remnant of the cone, revealed the existence of an incompletely

developed network of both radially-and tangentially-arranged fractures similarly to other tuff-cones in the area (Zanon et al., 2009). The intensive erosion allowed the exposure of the inner structure of the cone, where there are three main dyke complexes which survived to the erosion.

.Monte da Guia is a tuff cone located in the south-east of Horta platform (Fig. 1b). It is connected to the main land by a narrow isthmus composed of sand and pebbles that contact with a deeply eroded and collapsed older scoria cone (Fig. 3). Differently from Capelinhos, there are neither scoria cones nor lava flows associated. The steep slopes are constituted by highly palagonitized hydromagmatic tuff, with scattered basaltic bombs which plastered upon the surface on landing. The tuff cone is higher in the northern part, while progressively grades to the sea towards the S. A considerable mass movement has affected the SE flank of Monte da Guia. The run-out of this mass movement succession attains a depth of 750 m and extends across a flow-wise distance exceeding 6 km.

Fig. 3 – Monte da Guia tuff cone. Google Earth (2020).

At Capelinhos, regional tectonic influenced the morphology of the submerged basement along this direction, favored magma intrusion along parallel feeder dykes and determined the breaching of the cone towards the west. Partial gravitational collapse and rock-falls also keep on occurring along this direction, acting a strict morphological control on the erosion of the cone.

It is speculated that the emplacement of the Monte da Guia cone very close to the shelf edge overloaded this section of the island margin and eventually led to the collapse which produced the incision extending across the shelf margin and slope. Likely, seismic activity and the fact that the heavy volcanic load was possibly emplaced over shelf sediment deposits may have facilitated the failure.

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