Journal of Volcanology and Geothermal Research 352 (2018) 78–91

Contents lists available at ScienceDirect

Journal of Volcanology and Geothermal Research

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

# Volcano-tectonic evolution of a linear volcanic ridge (Pico-Faial Ridge, Azores Triple Junction) assessed by paleomagnetic studies

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ARTICLE INFO

*Article history:*
Received 12 January 2017
Received in revised form 2 January 2018
Accepted 6 January 2018
Available online 10 January 2018

*Keywords:*
Paleomagnetism
Tilting
Azores
Volcanism
Tectonics
Magma chambers

ABSTRACT

The morphology of volcanic oceanic islands results from the interplay between constructive and destructive processes, and tectonics. In this study, the analysis of the paleomagnetic directions obtained on well-dated volcanic rocks is used as a tool to assess tilting related to tectonics and large-scale volcano instability along the Pico-Faial linear volcanic ridge (Azores Triple Junction, Central-North Atlantic). For this purpose, 530 specimens from 46 lava flows and one dyke from Pico and Faial islands were submitted to thermal and alternating magnetic fields demagnetizations. Detailed rock magnetic analyses, including thermomagnetic analyses and classical high magnetic field experiments revealed titanomagnetites with different Ti-content as the primary magnetic carrier, capable of recording stable remanent magnetizations. In both islands, the paleomagnetic analysis yields a Characteristic Remanent Magnetization, which presents island mean direction with normal and reversed polarities in agreement with the islands location and the age of the studied lava flows, indicating a primary thermoremanent magnetization. Field observations and paleomagnetic data show that lava flows were emplaced on pre-existing slopes and were later affected by significant tilting. In Faial Island, magmatic inflation and normal faults making up an island-scale graben, can be responsible for the tilting. In Pico Island, inflation related to magma intrusion during flow emplacement can be at the origin of the inferred tilting, whereas gradual downward movement of the SE flank by slumping processes appears mostly translational.



## 1. Introduction

Volcanic oceanic islands, such as those forming the Azores Archipelago, are by nature unstable structures generally marked by rapid growth alternating with destruction by a variety of mass-wasting processes, including large-scale sector collapses, caldera subsidence, fault generation/rupture, shallow landslides and coastal erosion (e.g. Moore et al., 1989; Lipman and Moore, 1996; Hildenbrand et al., 2008, 2012a; Queiroz et al., 2008; Mitchell et al., 2012; Silva et al., 2012; Costa et al., 2014, 2015; Ramalho et al., 2013, 2015; Sibrant et al., 2014, 2015a, 2015b, 2016; Quartau et al., 2015, 2016).

Geodetic studies based on GPS and interferometric synthetic aperture radar (InSAR) have been crucial in characterizing present-day deformation of volcanic edifices for short time windows (e.g., Navarro et al., 2003; Catita et al., 2005; Catalão et al., 2006; Baker and Amelung, 2012; Miranda et al., 2012; Hildenbrand et al., 2012b; Mendes et al., 2013; Marques et al., 2015). However, when seeking to integrate the deformation processes over longer time periods, different magnetic approaches have proved an asset in distinguishing initial topography effects and intra-island rotations (e.g., Riley et al., 1999; Henry et al., 2003a; Delcamp et al., 2010; Silva et al., 2012; Trippanera et al., 2014). Lava flows and dykes have an original attitude (strike and dip) that can later be changed by a variety of processes, particularly tectonic and gravitational instability. Therefore, the problem addressed here is to discern original attitude from post-emplacement deformation. In order to accomplish this objective, we used

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https://doi.org/10.1016/j.jvolgeores.2018.01.005
0377-0273/