Geophysical Journal International

Geophys. J. Int. (2012) doi: 10.1111/j.1365-246X.2011.05320.x

Palaeomagnetic study of a subaerial volcanic ridge (São Jorge Island, Azores) for the past 1.3 Myr: evidence for the Cobb Mountain Subchron, volcano flank instability and tectonomagmatic implications

P. F. Silva,[1] B. Henry,[2] F. O. Marques,[3] A. Hildenbrand,[4,5] P. Madureira,[6] C. A. Mériaux[3] and Z. Kratinová[3,7]

[1]*ISEL/DEC and IDL (Universidade de Lisboa), Lisboa, Portugal. E-mail: pmfsilva@fc.ul.pt*
[2]*Palaeomagnetism, IPGP and CNRS, Saint-Maur cedex, France*
[3]*Universidade de Lisboa, IDL, Lisboa, Portugal*
[4]*Université Paris-Sud, Laboratoire IDES, UMR8148, Orsay,* F-91405*, France*
[5]*CNRS, Orsay,* F-91405*, France*
[6]*Centro de Geofísica de Évora and Departamento de Geociências, Universidade de Évora, Évora, Portugal*
[7]*Institute of Geophysics, Academy of Sciences of the Czech Republic, Prague, Czech Republic*

Accepted 2011 November 28. Received 2011 November 17; in original form 2011 September 3

SUMMARY

We present a palaeomagnetic study on 38 lava flows and 20 dykes encompassing the past 1.3 Myr on S. Jorge Island (Azores Archipelago—North Atlantic Ocean). The sections sampled in the southeastern and central/western parts of the island record reversed and normal polarities, respectively. They indicate a mean palaeomagnetic pole (81.3°N, 160.7°E, $K = 33$ and $A_{95} = 3.4°$) with a latitude shallower than that expected from Geocentric Axial Dipole assumption, suggesting an effect of non-dipolar components of the Earth magnetic field. Virtual Geomagnetic Poles of eight flows and two dykes closely follow the contemporaneous records of the Cobb Mountain Subchron (ODP/DSDP programs) and constrain the age transition from reversed to normal polarity at *ca.* 1.207 ± 0.017 Ma. Volcano flank instabilities, probably related to dyke emplacement along an NNW–SSE direction, led to southwestward tilting of the lava pile towards the sea. Two spatially and temporally distinct dyke systems have been recognized on the island. The eastern is dominated by NNW–SSE trending dykes emplaced before the end of the Matuyama Chron, whereas in the central/western parts the eruptive fissures oriented WNW–ESE controlled the westward growth of the S. Jorge Island during the Brunhes Chron. Both directions are consistent with the present-day regional stress conditions deduced from plate kinematics and tectonomorphology and suggest the emplacement of dykes along pre-existing fractures. The distinct timing and location of each dyke system likely results from a slight shift of the magmatic source.

Key words: Palaeomagnetic secular variation; Palaeomagnetism applied to tectonics; Palaeomagnetism applied to geologic processes; Reversals: process, time scale, magnetostratigraphy; Rock and mineral magnetism; Atlantic Ocean.

1 INTRODUCTION

Palaeomagnetism is the only tool that enables the study of the ancient geomagnetic field behaviour. To improve the quality of global geomagnetic field models, it is necessary to improve the spatial–temporal coverage. The nine islands of the Azores Archipelago in the North Atlantic are preferential targets for such propose, because they comprise a large amount of thick lava piles, some of which have been isotopically dated. However, to our knowledge only one palaeomagnetic study has been reported for S. Miguel Island in the Azores (Johnson *et al.* 1998).

The island of S. Jorge is a volcanic ridge, elongated along the WNW–ESE direction (Fig. 1a). Recently, new precise geochronological data on lava successions exposed along the island width have evidenced distinct and fast phases of volcanic construction since *ca.* 1.3 Ma (Hildenbrand *et al.* 2008). Dyke swarms with three main orientations intruded the various lava piles, but are still of unknown absolute age.