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Magnetic Fabric Study of a Complex Mafic Dyke of Pico Island (Azores Archipelago)

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A b s t r a c t

Anisotropy of magnetic susceptibility (AMS) and anisotropy of anhysteretic remanent magnetization (AARM) data have been obtained from a vertical, two meters thick, mafic dyke (intruding volcanic lava flow pile dated between 190 and 125 ka – Costa *et al*. (2015), Silva *et al*. (2018)), located on the southern margin of the Pico Island (Azores Archipelago). Its central part is constituted by different volcanic "facies" characterized by discontinuous cores with concentric rings. Locally, the latter form an almost circular sub-horizontal "structure". This "composite" magmatic "dyke" seems to correspond to a sequence of lateral magma pulses. Comparison between AMS and AARM fabrics indicate that inverse fabric related to single-domain grains has negligible effects on AMS. According to the scale used, different interpretations of the flow regime are possible:

At the dyke scale, AMS fabric is dominated by oblate shape and scattering of the minimum axes K_3 along a vertical plane perpendicular to the dyke plane, suggesting a vertical magma movement according to global foliation imbrication (Geoffroy *et al*. 2002). However, when considered the maximum principal axes K_1 as flow indicator (Knight and Walker 1988), horizontal magma flow is suggested. The same remark can be made on a section across the dyke at the scale of one concentric horizontal magmatic structure. However, when considered distinct domains of the dyke, i.e., looking at a smaller scale, different pat-

terns appear. On a dyke border, K_1 presents various inclinations, suggesting oblique flow. Some samples give vertical magnetic foliation perpendicular to dyke plane and, in another part of the dyke, K_1 presents strong plunge in a direction oblique to the dyke plane.

Looking in more detail at the results in different parts of the dyke, magnetic data show a certain coherence. Magnetic foliation in the concentric rings follows the ring shape, explaining the K_3 distribution with a vertical plane. On a dyke border, foliation imbrication clearly points out horizontal flow vector, an interpretation that is reinforced by a well defined sub-vertical magnetic zone axis (Henry 1997); K_1 presents directions scattered between this magnetic zone axis and the horizontal direction obtained in most sites and then appears to be "composite", explaining its oblique orientation in part of the samples. The other plunging K_1 axes also coincide with the corresponding magnetic zone axis. Magnetic foliation perpendicular to flow corresponds to the middle of circular structures and likely to particular flow conditions in restricted "channels", likely with a dominant pure shear stress regime.

All this complexity can be therefore simply explained by horizontal propagation of magma (related to successive magma pulses) towards the South, i.e., from its volcanic center toward its limit. The observed sub-horizontal "tube" then does not represent a "rolling" embedded structure during an upward magma movement, but a kind of horizontal pipe in the core of a partly "cooled" dyke. This particular dyke shows how complex the flow can be and how important is a dense sampling strategy.

Keywords: AMS, Dyke, Flow, Imbrication, Magnetic zone axis.

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References

Costa, A.C.G., A. Hildenbrand, F.O. Marques, A.L.R. Sibrant, and A. Santos de Campos (2015), Catastrophic flank collapses and slumping in Pico Island during the last 130 kyr (Pico-Faial ridge, Azores Triple Junction), *J. Volcanol. Geoth. Res*. **302**, 33–46.

Geoffroy, L., J.P. Callot, C. Aubourg, and M. Moreira (2002), Magnetic and plagioclase linear fabric discrepancy in dykes: a new way to define the flow vector using magnetic foliation, *Terra Nova* **14**, 183–190.

Henry, B. (1997), The magnetic zone axis: a new element of magnetic fabric for the interpretation of the magnetic lineation, *Tectonophysics* **271**, 325–329.

Knight, M.D., and G.P.L. Walker (1988), Magma flow directions in dikes of the Koolau Complex, Oahu, determined from magnetic fabric studies, *J. Geophys. Res*. **93**, B5, 4301–4319.

Silva, P.F., B. Henry, F.O. Marques, A. Hildenbrand, A. Lopes, P. Madureira, J. Madeira, J.C. Nunes, and Z. Roxerova (2018), Volcano-tectonic framework of a linear volcanic ridge (Faial-Pico ridge, Azores Archipelago) assessed by paleomagnetic studies, *J. Volcanol. Geoth. Res*. **352**, 78–91.