Deformation and magnetic fabric of the Capinha granite (Fundão, Central Portugal): ascent and emplacement mechanisms during the late-Variscan crustal thinning

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GEOLOGICAL SETTING

- The **Capinha** area is located in the **Central Iberian zone (Central Portugal,** Figure 1**)** and is characterized by several Variscan granites intruded in the Neoproterozoic metasedimentary rocks from the Beiras group (Schist Greywacke Complex, SGC).

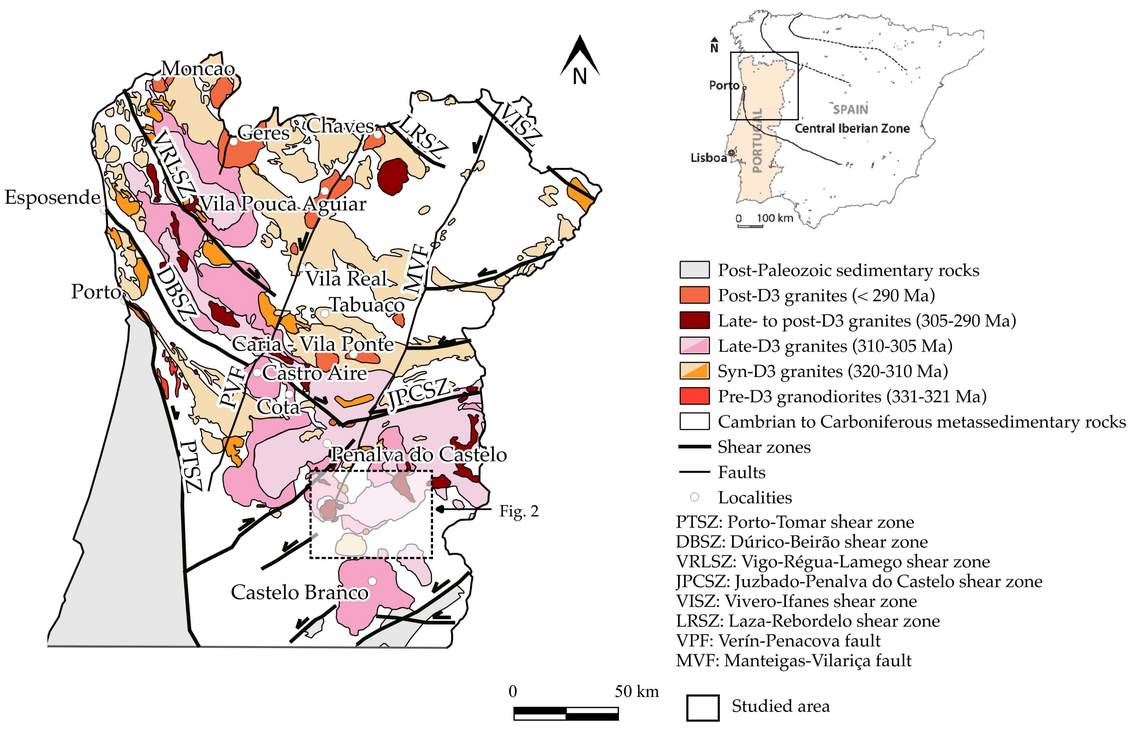

Figure 1. Spatial distribution of the Variscan granites and the major structures in the central and northern Portugal (adapted from Ferreira et al., 1987).

GOAL

The main goal of the study is to identify the deformation patterns and provide crucial information to investigate the evolution of the magnetic fabrics in a late-orogenic granite emplaced during the crustal thinning, at the end of the Variscan orogeny.

METHODS

- ✓ *Fieldwork*
- ✓ *Petrography*
- ✓ *Microstructural studies*
- ✓ *Anisotropy of Magnetic Susceptibility*

RESULTS

- The **CG exhibit a paramagnetic behaviour** with a K mean of 73 μSI, belonging to the **ilmenite-type granites** (Figure 3a).
- At several scales, the **CG does not show any magmatic flow or ductile deformation patterns** displaying P_{para} **of about 1.6%, which corresponds to dominant magmatic to submagmatic microstructures.** The P_{para} highest values are concentrated in the NE border associated to prolate ellipsoids (linear fabric) (Figure 3b and c).
- The orientation of the **magnetic foliation is variable ranging from NNW-SSE to NNE-SSW (Figure 4a$_1$)**, and **generally, are sub-horizontal, being vertical dips observed in the NE border, near the intersection of the NW-SE and the NE-SW fractures.**
  - The magnetic foliation follows **concentric trajectories**, with the NE-SW symmetry axis **(Figure 4a2$_2$)**.
- The **magnetic lineations are mainly sub-horizontal NNE-SSW parallel to the granite major axis (Figure 4b$_1$), although, in the SW border the lineations tend to be parallelized to the contact**.
  - The lineations describe a **magma flow to SSW (Figure 4b$_2$), with a suppose feeder zone in the north-eastern zone**, where the lineation is vertical in analogy with the vertical foliation.
- The common **gently magnetic fabric suggests the roof of the CG intrusion**.

CONCLUSIONS

During the late stages of the Variscan orogeny, **ductile extensional detachments promoted the thinning of a previously thickened crust, providing the opening of pre-existing structures and the production of new ones.** These **structures act as conduits for a passive magma ascending and emplacement at shallow levels**. Therefore, it is suggested that the CG magma ascent and emplaced in the intersection of NE-SW and NW-SE pre-existing fractures, located in the NE zone, and flowed to the SW, developing a small asymmetric laccolith, poorly eroded, with a tongue-shaped body.

Acknowledgments:
This work was supported by the Fundação para a Ciência e Tecnologia (FCT) (grant number SFRH/BD/115324/2016). The authors thank Department of Geosciences, Environment and Spatial Planning at Faculty of Sciences of the University of Porto and the Earth Sciences Institute (Porto Pole, Project COMPETE 2020 (UID/GEO/04683/2013), reference POCI-01-0145-FEDER-007690) for making the laboratories available for carrying out the studies presented in this paper. The authors must thank to the POCTEP- Interreg Project 0284_ESMIMET_3_E "Development of exploitation environmental and energy techniques in metallic mining" for the technical support.

- The **Capinha granite** (CG) occurs as a small circular circumscribed body exposed over an area of about 7 km^2, intruded into low grade metamorphic schist-greywackes of SGC, ~15 km to the north-east of Fundão village (Figure 2). **The CG is a muscovite>biotite, médium-grained, slightly porphyritic granite.**
- The contact is sharp, intrusive and discordant with the general trending of the D_1 and D_3 Variscan structures marked in the metasedimentary rocks of the SGC.
- The SGC sequences display dominant NW-SE trend foliation (S_1) with vertical or subvertical dips (80° to 85°SW).

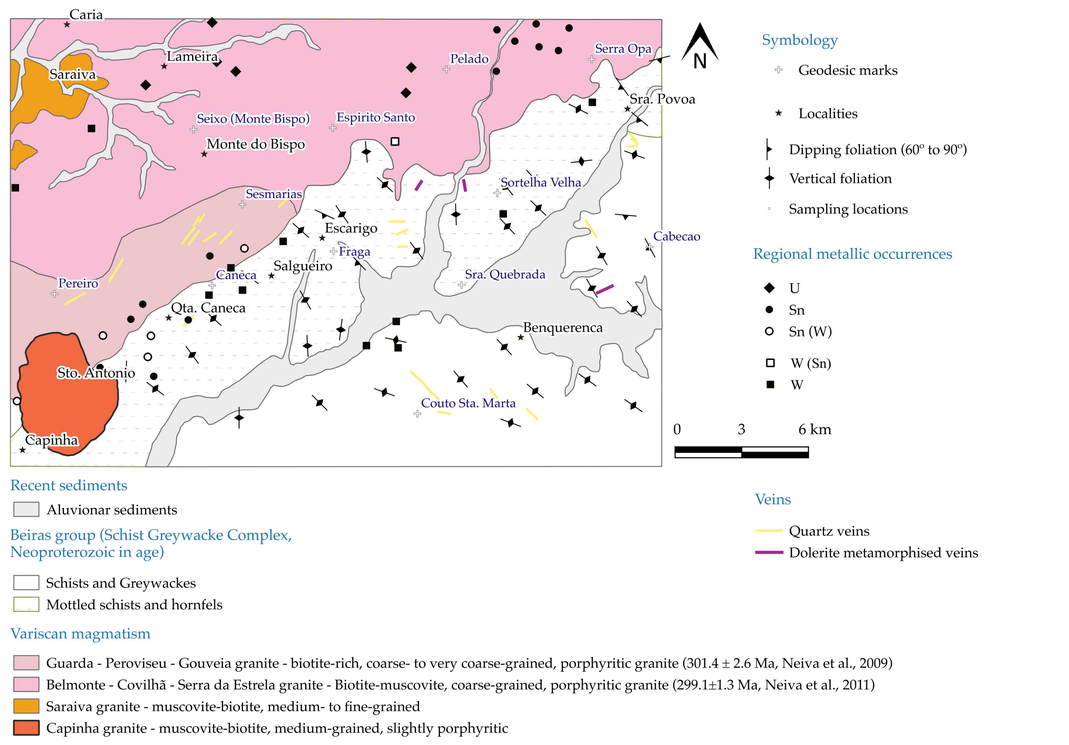

Figure 2. Geological sketch map of the Capinha area and metallic occurrences (adapted from Cândido de Medeiros et al., 1964; Teixeira et al., 1965).

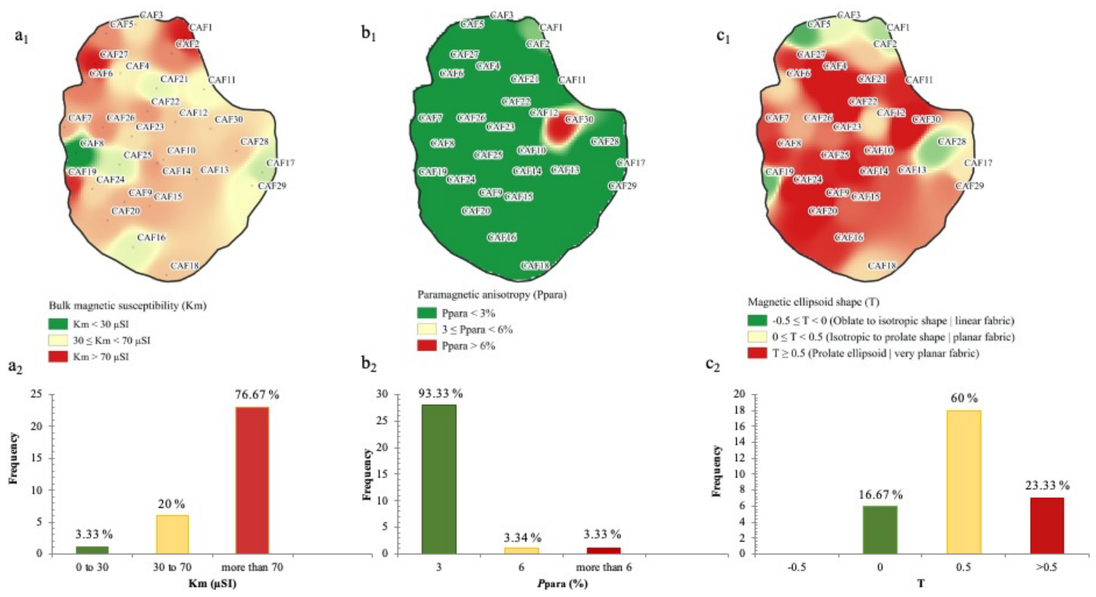

Figure 3. Domain and frequency distribution of (a) bulk magnetic susceptibility (K_m, μSI), (b) paramagnetic anisotropy percentage (P_{para}, %), and (c) magnetic ellipsoid shape parameter (T) in Capinha granite.

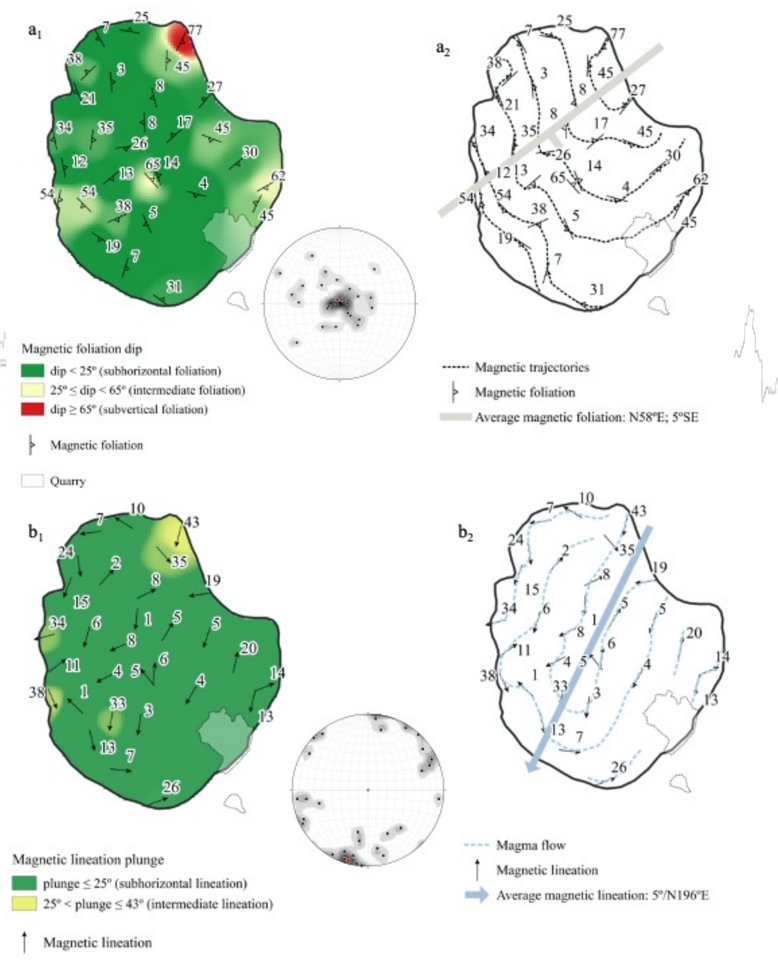

Figure 4. Magnetic foliation and lineation within the Capinha granite. Stereograms: equal-area, lower-hemisphere projection, contour intervals with uniform distribution. (a_1) Strike and dip of magnetic foliation at individual sampling sites. (a_2) Interpretative form-line map (magnetic trajectories) of magnetic foliations. (b_1) Plunge and trend of magnetic lineation at individual sampling sites (b_2) Interpretative magma flow based on magnetic lineations.