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Contrasting magmatic flow patterns during granite emplacement: an example from Central-Northern Portugal

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Anisotropy of magnetic susceptibility (AMS) has been successfully applied by several researchers to granitic rocks, contributing significantly to the understanding of the emplacement mechanisms of these rocks. In most reported cases, however, this technique was applied to relatively small and circumscribed massifs. Only a few referred to large nested batholiths.

The granites of Viseu-Cota and Alcafache, in Central-Northern Portugal, are part of a large composite late-Variscan batholith that crops out in the Central Iberian Zone. Both granites are coarse porphyritic biotitic monzogranites, but the Alcafache granite also contains muscovite. Based on field and petrological data, it has been proposed a close genetic and chronological relationship between the two granites, involving a multiple installation mechanism with partial overlapping in time of consecutive intrusive stages (Azevedo & Nolan, 1998). A full structural characterization by classical methods was not possible, though, due to the low anisotropy of the rocks. In order to overcome these difficulties and improve the understanding of the genesis and emplacement mechanisms of Viseu-Cota and Alcafache granites, an AMS study was carried out, based on 823 oriented cylindrical samples collected from 93 different sites, each site about 1 km from the neighbouring ones. The magnetic susceptibility data were obtained on a Kappabridge-KLY2 instrument (Agico, Brno), working at a fixed frequency of 920 Hz and an applied field of 300 A/m, the anisotropy ellipsoid being

estimated from 15 measurements on each sample.

The magnetic susceptibility (MS) data show a paramagnetic character for both granites, with average values of 17.3x10-5 SI for Viseu-Cota and 12.8x10-5 SI for Alcafache granite, which is well correlated with the biotite content of the rock. Taking into account the contribution of paramagnetic phases only, the estimated AMS values are below 3% everywhere within the studied area, except in the vicinity of a local shear zone, where a maximum of 4.6% was reached. The orientations of both magnetic foliation and lineation are clearly different in the two granites and can be summarized as follows: in the Viseu-Cota granite both foliation and lineation are steeply plunging; in contrast, in Alcafache granite the foliation is mostly moderately to gently dipping and the lineation, with few exceptions, has a consistent NE-SW direction and gentle plunge. Due to the good correlation between the MS ellipsoid and the mineral fabric, as well as the lack of evidence of solid-state deformation, the magnetic fabrics can be equated to the magmatic fabrics.

The patterns of magmatic flow inferred from AMS observations suggest that the two magmas have undergone different emplacement kinematics. Given the close genetic and chronological relationship between them, it is proposed that either a rapidly changing tectonics and/or different space conditions during the emplacement processes must have occurred.

References

Azevedo, M. R.; Nolan, J. (1998) – Hercynian late-post-tectonic granitic rocks from the Fornos de Algodres area (Northern Central Portugal). Lithos 44: 1-20.