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Quantification of synmagmatic flow structures of the Vila Pouca de Aguiar Pluton, NE Portugal

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Methods based on fractal geometry offer the opportunity to quantify complex rock patterns (Kruhl, 2013), which provide information about the pattern forming processes. Mineral distribution patterns of Variscan post-tectonic granites from NW Portugal (Vila Pouca de Aguiar Pluton) were analysed with the MORFA and Map-Counting software (Peternell, 2011). The result of the analysis provides information about pattern inhomogeneity and anisotropy, i.e. magmatic flux directions and mineral equilibrium processes in the crystallizing magma chamber.

The investigated rock is a very homogenous, medium grained biotitic granite, with schlieren structures and mafic enclaves locally occurring. No magmatic foliation or lineation is visible in the rock. For the analysis of rock patterns, high resolution field photographs were taken from six rock surfaces (4.75 - 19 m²) and three perpendicular cuts within a quarry. The field photographs were converted to binary images of mineral distribution patterns and analysed with MORFA and Map-Counting. In case of MORFA, 4838 – 20037 single measurements were performed for each rock surface, in case of Map-Counting, 129717 - 533976.

Statistical evaluation of the general very weak pattern anisotropy results in a mean bulk orientation vector that varies in strength, dependent on the orientation of the analysed surface. Therefore, it was possible to determine an extreme weak subhorizontal magmatic foliation (012/15 NW) and a subhorizontal lineation (010/15 NW), which are in good coincidence with earlier anisotropy magnetic susceptibility (AMS) results of Sant'Ovaia & Noronha (2005). With MORFA, also the variation of the lineation can be determined, indicating magmatic flow partitioning scale-dependent into different domains. High variation is observable in the decimetre scale and bulk orientations reveal two perpendicular domains at the scale of several meter. Throughout homogenous results of the Map-Counting analysis with mean D_b -values of 1.55 indicate equilibrium conditions for mineral crystallization during emplacement of the pluton. Locally, feldspar rich domains show wider D_b -ranges caused by processes such as magma mixing and extraction.

References:

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