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The Aiguablava dyke swarm: emplacement and paleostress in a fractured basement

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A structural analysis has been performed in the Upper Permian lamprophyric dyke swarm of Aiguablava (NE Spain). Dyke emplacement is related to the presence of a widespread joint network, likely developed during the cooling and decompression of the late Variscan granitic host rocks.
In order to characterize the patterns of both the joint system and the dyke swarm, a trend frequency analysis has been performed using the circular scanlines method (Mauldon et al., 2001). The sub-vertical joint pattern consists on two major orthogonal sets at ≈N23º, ≈N113º and secondary sets at ≈N0º and ≈N90º, among others. These four fracture sets are interpreted as previous to the lamprophyre intrusion event, because they are either exploited or cross-cut by the lamprophyres. The subvertical dykes have a mean N113º trend, which corresponds to the trend of one of the main joint sets. Despite this overall orientation of dykes, segmentation is a noticeable feature at the Dm- to cm-scale, and this is probably related to the localized dyke intrusion into the other pre-existing secondary joint sets.
Dyke opening directions has been measured from matching dyke jogs or markers in the host rock, with a mean orientation of 021/04. A three-dimensional paleostress analysis has been carried out from dyke orientations, applying the Mohr circle construction of Jolly and Sanderson (1997), and the parameters R' (driving pressure ratio, R'= 0.156) and φ (stress ratio, $\varphi = 0.45$) were calculated. From this analysis, we have obtained a sub-vertical maximum ($\sigma 1$) and a NNE-SSW minimum ($\sigma 3$) stress axes, consistent with the sub-horizontal mean trend of dyke opening measured in the field. It is inferred that many of the pre-existing joint sets were exploited by magmatic dykes, being the ≈N113º joint set (normal to $\sigma 3$) the most favourable for dyke emplacement. At that time, magmatic pressure related to dyke intrusion, Pm, was lower than the intermediate principal stress axis, $\sigma 2$.
Our paleostress analysis denotes the control exerted by a pre-existing fracture pattern on emplacement of the dyke swarm under a regional extensional regime.

References:
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