
Tectonic significance of porphyroblast inclusion trails in the Betic-Rif belt investigated through texturally controlled geochronology and thermobarometry

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Résumé

Three sets of porphyroblast inclusion trails with regionally consistent trends have been recently demonstrated in the Betic-Rif orogen (Aerden et al., 2022; Ruiz-Fuentes & Aerden, 2023). Based on microstructural relative timing criteria and preliminary Sm-Nd garnet ages ranging from 35Ma to 13Ma, a sequence was proposed of WNW-ESE trending inclusion trails followed by NE-SW ones during the Oligocene, followed by an alternation of NE-SW and NNW-SSE inclusion trails during the Miocene. The three main directions were tentatively correlated with successive vectors of relative plate motion between Africa, Iberia and the Alborán Domain. Therefore, porphyroblasts in the Betic Cordillera potentially provide a powerful micro-structural framework for correlating metamorphic and structural paths between different areas and tectonic units. To further test the relative and absolute timing of different inclusion-trail sets, we have performed in-situ U-Th-Pb dating of monazite grains, Ar-Ar dating of micas associated with the matrix foliation, thermobarometric modelling of phase equilibria, and Zr-in-rutile geothermometry in four samples of the Alpujárride Complex plus one Nevado-Filábride sample. Our geochronological results only provide a minimum age of 21Ma for the WNW-ESE inclusion trail set, present in two of our Alpujárride samples, which nevertheless confirms that this set predates the NNW-SSE and NE-SW sets. The age of NNW-SSE inclusion trails in a third Alpujárride samples is constrained to ca. 20Ma, coinciding with the opening of the Alborán Sea, whereas NE-SW trending inclusion trails in a fourth Alpujárride sample formed around 17.5 Ma during development of a subvertical crenulation cleavage that can be linked to collision of the Alborán Domain with the South Iberian margin. The Nevado-Filábride sample contains a mixture of all three inclusion-trail sets hosted by garnet porphyroblasts exhibiting systematic differences in size and chemical composition. Monazite grains provide a maximum of 14.5Ma for NE-SW inclusion-trail set in this sample, which simultaneously serves as a minimum age for NNW-SSE and WNW-ESE inclusion trails. Our results not only confirm the previously established inclusion-trail sequence but also show that metamorphic activity in the Alpujárride Complex continued until the late-Burdigalian, only ceasing a few million years earlier as in the Nevado-Filábride Complex.

Mots-Clés: Porphyroblast kinematics, Betic Cordillera, Metamorphic ages

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