U-Pb age and geochemistry to unravel Variscan late- to post-tectonic magmatism

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The granitoid rocks near Penalva do Castelo, Central Portugal, are hosted by the Precambrian – Cambrian schist-metagreywacke Complex and are crosscut by LCT-REE pegmatites. The intrusives are framed by (1) the Jusbado – Penalva do Castelo semi – ductile shear zone, trending approximately N70°E related to the right lateral Variscan first deformation phase (D1), (2) the mainly NW- SW trending Dúrico – Beira system, and (3) a minor NNE – SSW right lateral displacement.

Five suites of monzogranite (G1 to G5) are late to posttectonic. They crystallized over a period of about 7 m.y. from a succession of magma batches related to the kinematic development of the third deformation phase of the Variscan Orogeny. The first (G1) late orogenic generation monzogranite yields a U-Pb zircon age of 301.5 ± 1.7 Ma. It is calc-alkaline, and ferroan (to magnesian), derived from partial melting of greywackes + amphibolite, with highly fractionated light and heavy REE's. G1 and G3 monzogranites, the latter postorogenic and formed at 298.0 ± 0.3 Ma, were emplaced as concentric isolated bodies along the Jusbado-Penalva of Castelo lineation. The emplacement of G2 at 297.0 \pm 1.1 Ma was controlled by the NW-SW-trending D1 structures. Monzogranite G2, like G3, G4 and G5, is alkaline-calcic and ferroan. G2 originated as a partial melt of amphibolite, with higher Th/U 0.41 -0.60.

The emplacement of the post orogenic intrusive suites G4 at 295.4 \pm 0.5 Ma and G5 at 294.12 \pm 0.29 Ma was probably controlled by a continuous interaction of the strike slip shear zones (1) and (2). Greywacke- derived melt defines the predominant protolith signature for G3, G4 and G5.

The extensional regime ended about 295 Ma, and the tectonic collapse controlled by the NNE graben was responsible for pegmatite emplacement at about 289 Ma, indicated by late monazite in G3, G4 and G5.