International Journal of Earth Sciences (2021) 110:2179–2201
https://doi.org/10.1007/s00531-021-02067-z

ORIGINAL PAPER

Exhumation of an anatectic complex by channel flow and extrusion tectonics: structural and metamorphic evidence from the Porto–Viseu Metamorphic Belt, Central-Iberian Zone

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Received: 23 January 2021 / Accepted: 3 June 2021 / Published online: 22 June 2021

Abstract

Structural and metamorphic analyses of the Porto–Viseu Metamorphic Belt (PVMB), an anatectic complex located in the Central-Iberian Zone (CIZ), Iberian Variscan Massif, constrain the kinematic features of the polyphase Variscan deformation, as well as the boundary conditions associated with the exhumation and emplacement of the belt onto the CIZ's lower-grade metasediments. A sharp metamorphic contrast is evident between the lowest grade rocks of the anatectic complex—garnet-staurolite mylonitic schists with a minimum metamorphic peak at $P = 5.7$ kbar and $T = 635$ °C—and the host chlorite-biotite metasediments of the CIZ. Additional P–T estimates for metatexites in the PVMB provided $P = 7.6$–7.9 kbar and $T = 770$–810 °C, confirming high-grade metamorphic peak conditions. The temperature jump between the anatectic complex and the low-grade host rocks exceeds 400 °C if the anatectic core of the belt (metatexites, diatexites, and S-type granites) is considered, implying a vertical difference of 10–17 km. The PVMB is limited in the NE by a D2 shear zone displaying normal kinematics, which has been explained so far by extensional tectonics. However, the SW boundary is limited by a D2 shear zone showing reverse kinematics. This pair of coeval and antithetical ductile shear zones bordering the PVMB, associated with the increase of the metamorphic grade towards the axial domain of the belt, is consistent with anatectic channel flow, followed by extrusion tectonics of the PVMB within an overall D2 compressive setting.

Keywords Variscan orogeny · Anatectic complex · Antithetical kinematics · Channel flow · P–T modelling

Introduction

Anatectic complexes are the result of partial melting of the middle and lower crust under conditions of high-grade metamorphism and are usually associated in space to syn-orogenic granitic bodies (Wimmenauer and Brihni 2007; Bento dos Santos et al. 2011a; Pereira et al. 2017b). For this reason, many anatectic complexes present the highest temperature record of an orogenic belt, which makes their study crucial to understanding the overall metamorphic evolution of an orogenic belt (e.g.: Sawyer et al. 2011; Bento dos Santos et al. 2011b; Pereira et al. 2017a), the scale and timing of the processes of deformation, metamorphism, magmatism and exhumation (e.g.: Vielzeuf and Holloway 1988; Whitney et al. 2004; Bento dos Santos et al. 2010) and, in a larger and global perspective, the processes of compositional differentiation and secular evolution of the crust (e.g.: Fyfe 1973; Aranovich et al. 2014).

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