Gondwana Research 28 (2015) 735–756

Contents lists available at ScienceDirect

Gondwana Research

journal homepage: www.elsevier.com/locate/gr

SHRIMP U–Pb zircon dating of the Valencia del Ventoso plutonic complex, Ossa-Morena Zone, SW Iberia: Early Carboniferous intra-orogenic extension-related 'calc-alkaline' magmatism

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ARTICLE INFO

Article history:
Received 1 October 2013
Received in revised form 23 May 2014
Accepted 29 May 2014
Available online 9 July 2014

Handling Editor: A. Kröner

Keywords:
Variscan
Ossa-Morena Zone
Zircon geochronology
IBERSEIS Reflective Body
Magma mixing

ABSTRACT

Mantle- and crustal-derived orogenic magmas provide insights into sources tapped during terrane accretion and supercontinent amalgamation. During Pangea formation volumetrically minor, but common, mafic–intermediate 'calc-alkaline' stocks intruded coeval granitoid plutons throughout the European Variscan. The Iberian Peninsula preserves the westernmost segment of this Upper Paleozoic orogeny that resulted from collision of Laurentia and Gondwana. Whether the widespread calc-alkaline mafic–intermediate stocks may be used as petrogenetic tectonomagmatic markers of ancient subduction zones is an important question. Early Carboniferous calc-alkaline plutonic rocks from the Ossa-Morena Zone (OMZ), a northern Gondwana continental block, have traditionally been related to subduction. However, recent studies suggest that the tectonomagmatic regime at that time was continental collision. In this context, a link is made between Early Carboniferous intraplating of ultramafic and mafic sills into the mid-crust, the IBERSEIS Reflective Body (IRB), and the Variscan magmatism in the Olivenza–Monesterio antiform of the OMZ. Here we show that the OMZ Valencia del Ventoso plutonic complex comprising alkaline, calc-alkaline, metaluminous and peraluminous compositions formed during the Visean–Bashkirian, c. 334–320 Ma SHRIMP U–Pb zircon. The calc-alkaline character is, apparently, a result of intra-orogenic extension-related interaction of mantle-derived alkaline mafic and crustal-derived peraluminous felsic magma during terrane accretion. The new age is some c. 15–30 million years younger than previously defined and so coeval with IRB formation. All evidence points towards active subduction having ceased prior to the latest Devonian–earliest Carboniferous. Thus the younger age places the Olivenza–Monesterio antiform calc-alkaline magmatism after collision of the OMZ and the South Portuguese Zone, to the south. During Pangea formation other, comparable, Early Carboniferous extensional events have been described in adjacent terranes in northern Gondwana and Avalonia–Laurentia. Whether orogenic mafic magmatism provokes or results from crustal melting apparently depends on the process controlling, and the timing, of the mantle melting event.

1. Introduction

Syn-orogenic magmatic rocks record tectonomagmatic processes, providing information about mantle and crustal sources tapped during terrane accretion and supercontinent amalgamation. This raises the question, then, of the significance of minor, but widespread, mafic–intermediate intrusions in granitoid batholiths. Clearly, coeval mafic magmatism may play a role in crustal melt generation through heat transfer by mantle wedge convection, asthenospheric upwelling or under- and intraplating of mafic magmas into the crust (e.g., Fyfe, 1973; England and Thompson, 1986; Huppert and Sparks, 1989; Clemens, 1998, 2006; Brown, 2007, 2010). However, the extent to which such magmas may be used as markers of tectonomagmatic context is a matter of some debate (e.g., Arculus, 2003; Scarrow et al., 2009; Eyal et al., 2010; Erkül, 2011; Seghedi et al., 2011; Zhang et al., 2011; Kurt et al., 2013).

Throughout the European Variscan province mafic–intermediate 'calc-alkaline' stocks are common within granitoid plutons (Pitcher, 1993 and references therein). The Iberian Massif is the most extensive Pre-Mesozoic expression of the province. In the south of the massif, the Ossa-Morena Zone (OMZ) continental block, formed of Neoproterozoic to Carboniferous rocks, juxtaposed with the Central Iberian Zone (CIZ) and the South Portuguese Zone (SPZ) during the latest Devonian–earliest Carboniferous (Matte, 2001 and references therein). The calc-alkaline character of the OMZ Variscan magmatism has led to it being linked with subduction (e.g., Pons, 1982; Giese et al., 1994; Quesada et al., 1994; Castro et al., 1996; Sarrionandia, 2005). But, it is not clear whether calc-alkaline rocks should be directly linked with active or ancient subduction zones (e.g., Arculus, 2003; Pearce, 2008; Maurice et al., 2009; Scarrow et al., 2009). Notably, a short-lived intra-orogenic extensional event occurred during the main Variscan collision (Apraiz and Eguíluz,

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http://dx.doi.org/10.1016/j.gr.2014.05.013
1342-937X/

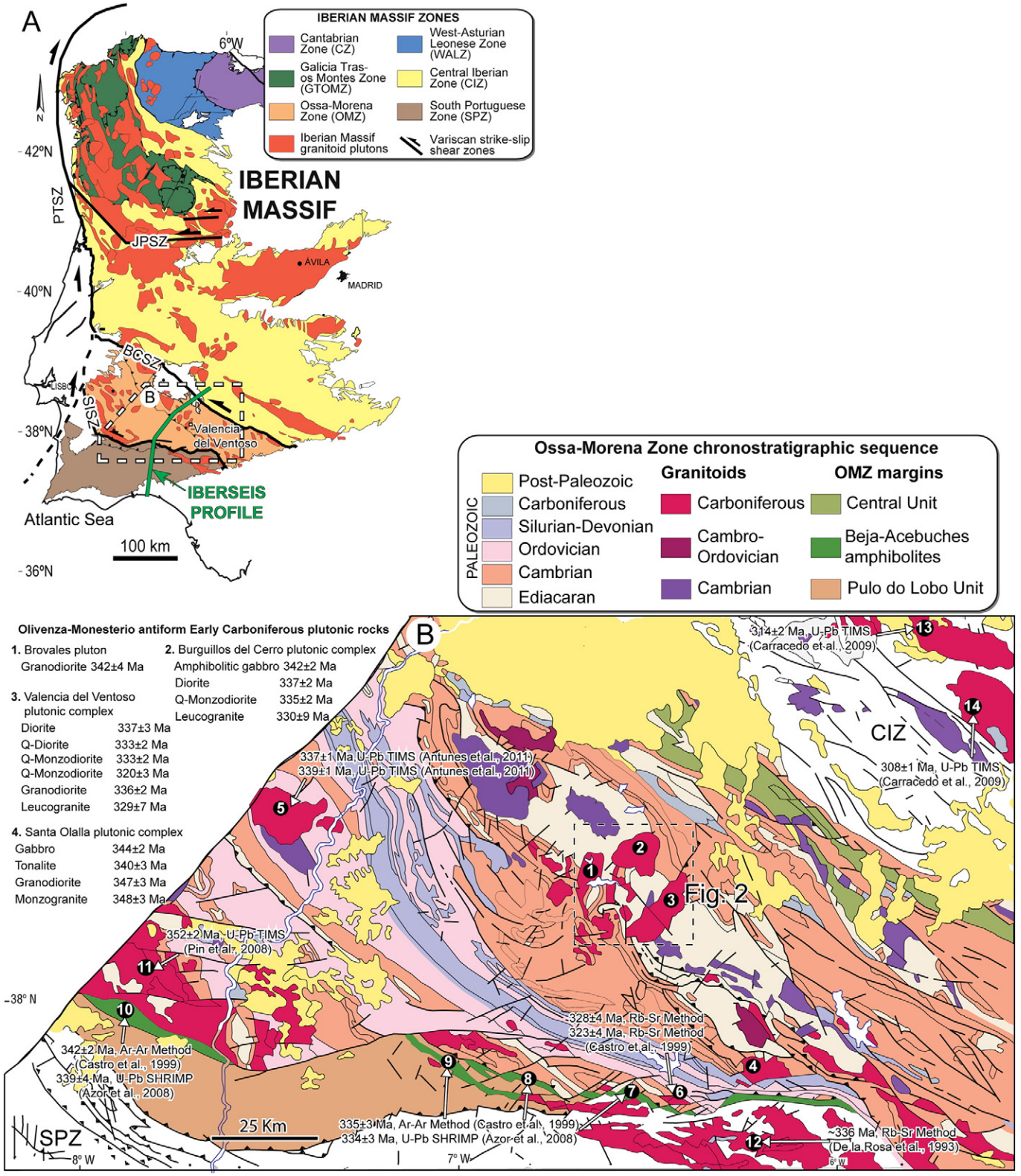

Fig. 1. A) Zones of the Iberian Massif indicating the distribution of granitoids, modified from Bea et al. (2006). B) Chronostratigraphical sequence of the eastern OMZ showing the different stages and highlighting the Pulo do Lobo Unit and the OMZ boundaries with the CIZ and the SPZ, modified from Gabaldón et al. (2001). In addition we summarize published ages for the Early Carboniferous magmatism. Detailed information summarizes the published ages for the Olivenza–Monesterio antiform pluton facies: 1 — Brovales pluton (Kober method, Montero et al., 2000); 2 — Burguillos del Cerro plutonic complex (amphibolitic gabbro, diorite and Q-monzodiorite dated by amphibole Ar–Ar, Dallmeyer et al., 1995; leucogranite dated by WR Rb–Sr, Bachiller et al., 1997); 3 — Valencia del Ventoso plutonic complex (U–Pb SHRIMP, present work); and 4 — the Santa Olalla pluton (tonalite and monzogranite by U–Pb TIMS, Romero et al., 2006; gabbro and granodiorite dated by U–Pb SHRIMP, Ordoñez-Casado et al., 2008). In addition, information for other plutonic and metamorphic rocks includes: 5 — Reguengos de Monaraz Massif; 6 — Aracena Belt norites; 7, 8, 9, 10 — Beja-Acebuches amphibolites and gabbros, note that Ar–Ar ages indicate the age of metamorphism whereas U–Pb SHRIMP ages indicate the protolith age; 11 — Beja igneous complex; 12 — North Sevilla batholith, emplaced in the South Portuguese Zone; 13 and 14 — Pedroches Batholith, emplaced in the Central Iberian Zone.