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Changing Carboniferous Arc Magmatism in the Ossa-Morena Zone (Southwest Iberia): Implications for the Variscan Belt

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Abstract: Carboniferous magmatism in southwestern Iberia was continuously active for more than 60 m.y. during the development of the Appalachian-Variscan belt of North America, North Africa and Western-Central Europe. This collisional orogen that records the closure of the Rheic Ocean is essential to understanding the late Paleozoic amalgamation of the Pangea supercontinent. However, the oblique convergence between Laurussia and Gondwana that lasted from the Devonian to the Carboniferous was likely more complex. Recently, a new tectonic model has regarded the Iberia Variscan belt as the site of coeval collisional and accretionary orogenic processes. Early Carboniferous plutonic rocks of southwest Iberia indicate arc magmatism in Gondwana. The Ossa-Morena Zone (OMZ) acted as the upper plate in relation to the geometry of the Paleotethys subduction. This active accretionary-extensional margin was progressively involved in a collisional phase during the Late Carboniferous. Together, the Évora Massif and the Beja Igneous Complex include three successive stages of bimodal magmatism, with a chemical composition indicative of a long-lived subduction process lasting from the Tournaisian to the Moscovian in the OMZ. The earliest stage of arc magmatism includes the Tournaisian Beja and Torrão gabbro-dioritic rocks of the Layered Gabbroic Sequence. We present new geochemical and Nd isotopic and U-Pb geochronological data for magmatic rocks from the Main (Visean-Serpukhovian) and Latest (Bashkirian-Moscovian) stages of arc magmatism. Visean Toca da Moura trachyandesite and rhyolites and Bashkirian Baleizão porphyries and Alcáçovas quartz diorite share enriched, continental-crust like characteristics, as indicated by major and trace elements, mainly suggesting the addition of calc-alkaline magma extracted from various mantle sources in a subduction-related setting (i.e., Paleotethys subduction). New U-Pb zircon geochronology data have allowed us to establish a crystallization age of 317 ± 3 Ma (Bashkirian) for Alcáçovas quartz diorite that confirms a temporal link with Baleizão porphyry. Positive εNd(t) values for the Carboniferous igneous rocks of the Beja Igneous Complex and the Évora gneiss dome indicate production of new juvenile crust, whereas negative εNd(t) values also suggest different grades of magma evolution involving crustal contamination. The production and evolution of Carboniferous continental crust in the OMZ was most likely associated with the development of an active continental margin during the convergence of the Paleotethys Ocean with Gondwana, involving juvenile materials and different grades of crustal contamination.

Keywords: arc magmatism; Variscan belt; wr-geochemistry; Sm-Nd isotopes; U-Pb geochronology; Paleotethys margin

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1. Introduction

The production and preservation of the juvenile continental crust are mainly associated with tectonic processes in complex zones of lithosphere-asthenosphere interplay