



The missing Rhenic Ocean magmatic arcs: Provenance analysis of Late Paleozoic sedimentary clastic rocks of SW Iberia

M.F. Pereira ^{a,*}, M. Chichorro ^b, S.T. Johnston ^c, G. Gutiérrez-Alonso ^d, J.B. Silva ^e, U. Linnemann ^f, M. Hofmann ^f, K. Drost ^g

^a IDL, Departamento de Geociências, ECT, Universidade de Évora, Apartado 94, 7001-554 Évora, Portugal

^b CICEGe, Faculdade de Ciências e Tecnologia, Universidade Nova de Lisboa, Quinta da Torre, 2829-516 Caparica, Portugal

^c School of Earth and Ocean Sciences, University of Victoria, Canada, Victoria, British Columbia, Canada V8W 3P6

^d Departamento de Geología, Facultad de Ciencias, Universidad de Salamanca, 37008 Salamanca, Spain

^e IDL, Departamento de Geología, Faculdade de Ciências, Universidade de Lisboa, Edifício C6, Campo Grande, Lisboa, Portugal

^f Senckenberg Naturhistorische Sammlungen Dresden, Königsbrücker Landstr. 159, D-01109 Dresden, Germany

^g Department of Earth Science and Centre for Geobiology, University of Bergen, Allégaten 41, 5007 Bergen, Norway

ARTICLE INFO

Article history:

Received 9 December 2011

Received in revised form 20 March 2012

Accepted 28 March 2012

Available online 16 April 2012

Handling Editor: R.D. Nance

Keywords:

U–Pb geochronology

Detrital zircons

Mid- and Late Devonian

Early Carboniferous

Variscan belt

ABSTRACT

Early Carboniferous turbiditic sedimentary rocks in synorogenic basins located on both sides of the Rhenic suture in SW Iberia were studied for provenance analysis. An enigmatic feature of this suture, which resulted from closure of the Rhenic Ocean with the amalgamation of Pangea in the Late Carboniferous, is that there are no recognizable mid- to Late Devonian subduction-related magmatic rocks, which should have been generated during the process of subduction, on either side of it. U–Pb LA–ICP–MS geochronology of detrital zircons from Early Carboniferous turbidites in the vicinity of the Rhenic suture in SW Iberia, where it separates the Ossa–Morena Zone (with Gondwana continental basement) to the north from the South Portuguese Zone (with unknown/Meguma? continental basement) to the south, reveals the abundance of mid- to Late Devonian (51–81%) and Early Carboniferous (13–25%) ages. The Cabrela and Mértola turbidites of the Ossa–Morena and South Portuguese zones, respectively, are largely devoid of older zircons, differing from the age spectra of detrital zircons in the oldest (Late Devonian) strata in the underlying South Portuguese Zone, which contain abundant Cambrian and Neoproterozoic ages. Mid- to Late Devonian zircons in the Cabrela Formation (age cluster at c. 391 Ma, Eifelian–Givetian transition) and Mértola Formation (age clusters at c. 369 Ma and at c. 387 Ma, Famennian and Givetian respectively) are attributable to a source terrane made up of magmatic rocks with a simple geological history lacking both multiple tectonic events and older continental basement. The terrane capable of sourcing sediments dispersed on both sides of the suture is interpreted to have been completely removed by erosion in SW Iberia. Given that closure of the Rhenic Ocean required subduction of its oceanic lithosphere and the absence of significant arc magmatism on either side of the Rhenic suture, we suggest: 1) the source of the zircons in the SW Iberia basins was a short-lived Rhenic ocean magmatic arc, and 2) given the lack of older zircons in the SW Iberia basins, this short-lived arc was probably developed in an intra-oceanic environment.

© 2012 International Association for Gondwana Research. Published by Elsevier B.V. All rights reserved.

1. Introduction

Deciphering the processes responsible for the closure of the Rhenic Ocean is crucial to understanding the late Paleozoic amalgamation of Pangea. The Rhenic suture between the two main continental blocks that made up Pangea, Laurussia and Gondwana, can be traced along the Ouachita–Appalachian–Variscan orogenic system across North America and Western-Central Europe (e.g. [Matte, 2001](#); [Nance et al., 2010](#)) ([Fig. 1](#)).

In the northern Appalachians, terranes inferred to lie west of the Rhenic suture include Avalonia and the more outboard Meguma. The Meguma terrane is exposed in southern Nova Scotia and is interpreted to extend seaward over a wide area from the Grand Banks to Cape Cod ([van Staal et al., 2009](#)). Mid–Late Devonian granitoid intrusions that have a collisional geochemical signature ([Tate and Clarke, 1997](#); [Moran et al., 2007](#)) characterize the Meguma terrane and are interpreted to record subduction of Rhenic oceanic lithosphere to the northeast beneath Laurentia ([van Staal et al., 2009](#); and references therein). If correct, the Rhenic suture is constrained to lie offshore of the North American Atlantic margin, east of the Meguma terrane ([van Staal and Barr, 2012](#)).

* Corresponding author.

E-mail address: mpereira@uevora.pt (M.F. Pereira).