Tectonophysics 461 (2008) 21–43

Contents lists available at ScienceDirect

Tectonophysics

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

# The Cadomian Orogeny and the opening of the Rheic Ocean: The diacrony of geotectonic processes constrained by LA-ICP-MS U–Pb zircon dating (Ossa-Morena and Saxo-Thuringian Zones, Iberian and Bohemian Massifs)

Ulf Linnemann [a,*], Francisco Pereira [b], Teresa E. Jeffries [c], Kerstin Drost [a,d], Axel Gerdes [e]

[a] Staatliche Naturhistorische Sammlungen Dresden, Museum für Mineralogie und Geologie, Königsbrücker Landstr. 159, D-01109 Dresden, Germany
[b] Departamento de Geociências, Centro de Geofisica de Évora, Universidade de Évora, 544-7001 Évora, Portugal
[c] Natural History Museum, Cromwell Road, London SW7 5BD, UK
[d] AEON EarthLAB, Department of Geological Sciences, University of Cape Town, Rondebosch, 7701, South Africa
[e] Institut für Geowissenschaften, Johann Wolfgang Goethe-Universität, FE Mineralogie, Altenhöferallee 1, 60438 Frankfurt am Main, Germany

ARTICLE INFO

*Article history:*
Received 20 September 2007
Received in revised form 21 April 2008
Accepted 1 May 2008
Available online 10 May 2008

*Keywords:*
Cadomian Orogeny
Variscan Orogeny
Rheic Ocean
Avalonia
Cadomia
West African Craton
Gondwana
Peri-Gondwana
Saxo-Thuringain Zone
Ossa-Morena Zone
Bohemian Massif
Iberian Massif
Neoproterozoic
Ediacaran
Cambrian
Ordovician

ABSTRACT

Cadomian orogenic processes and their continuum to the opening of the Rheic Ocean were modeled by making use of new LA-ICP-MS U–Pb ages from detrital zircons of sedimentary rocks of Late Neoproterozoic (Ediacaran) and Cambro-Ordovician sediments of the Ossa-Morena Zone (Iberian Massif) compared with those from the Saxo-Thuringian Zones (Bohemian Massif). Presented data constrain a diachrony of Cadomian and related geotectonic processes along the northern realm of the Gondwana Supercontinent. Early stage of Cadomian evolution is characterized by a continental magmatic arc at the periphery of the West African Craton and a related back-arc basin opened at c. 590 to 570 Ma. Diacronic arc–continent collision was caused by oblique vector of subduction and started first in the East of Peri-Gondwana at c. 560–570 Ma and resulted at c. 543 Ma in the formation of a short-lived Cadomian retro-arc basin in the Saxo-Thuringian Zone. In contrast, more to the West in the Ossa-Morena Zone, the Cadomian back-arc basin was longer active, at least until c. 545 Ma. In that region, final magmatic pulse of the Cadomian magmatic arc at c. 550 Ma is documented by new zircon data. Closure of the Cadomian back-arc basin and arc–continent collision in the Ossa-Morena Zone occurred between c. 545 Ma and the overall onset of Cambrian plutonism at c. 540 Ma. A mid-oceanic ridge was subducted underneath the Cadomian orogen accompanied by slab break-off of the subducted oceanic plate. Oblique incision of the oceanic ridge into the continent caused the formation of rift basins during the Lower to Middle Cambrian (c. 530–500 Ma). This process continued and finally caused the opening of the Rheic Ocean documented by thick Lower Ordovician siliciclastic sediments and a final magmatic event at c. 490–485 Ma. Opening of the Cambrian rift basin and of the Rheic Ocean again was diachronic and started from the West of Peri-Gondwana and expanded eastward.



## 1. Introduction

The U–Pb dating of detrital zircon grains from clastic sediments by LA-ICP-MS (Laser Ablation and Inductive Coupled Plasma Mass Spectronometry) in the last decade became a powerful tool in provenance analysis (e.g. Fernández-Suárez et al., 2002; Jeffries et al., 2003; Gerdes and Zeh, 2006; Linnemann et al., 2007).

Our paper is an attempt to use the age spectra of detrital zircons from clastic sediments derived from the periphery of the Gondwana Supercontinent to reconstruct the main tectono-magmatic and basement exhumation events in the source area. Further, we attempt to demonstrate (i) common characteristics in the crustal evolution of the overall source area, and (ii) the utility of the ages from detrital zircon grains for the reconstruction of a diachrony of orogenic events along the Peri-Gondwanan margin in Late Neoproterozoic (Ediacaran) to Cambro-Ordovician time.

We use the age data of detrital zircons from two prominent basement inliers in the Variscides of Central and Western Europe, the Ossa-Morena Zone in the Iberian Massif and the Saxo-Thuringian Zone of the Bohemian Massif (Fig. 1). Both areas formed by a combination of Ediacaran Cadomian orogenic processes and Cambro-Ordovician rifting, an extensional event that led to the opening of the Rheic Ocean (e.g. Robardet, 2002; Linnemann et al., 2007). In our paper we first present new U–Pb LA-ICP-MS datings of detrital zircons of Ediacaran and Cambro-Ordovician sandstones in the Ossa-Morena Zone (Iberia). The data are compared with U–Pb dates of detrital zircons from coeval volcano-sedimentary units of the Saxo-Thuringian Zone by Linnemann et al. (2007). Our results demonstrate the east to

* Corresponding author.
*E-mail address:* ulf.linnemann@snsd.smwk.sachsen.de (U. Linnemann).

0040-1951/$ – see front matter © 2008 Elsevier B.V. All rights reserved.
doi:10.1016/j.tecto.2008.05.002