Detrital zircon age fingerprinting of NW and SW Iberia Variscan basins: Constraints for the pre-Pangea terrane assemblage analysis and paleogeography

Ícaro Dias da Silva¹, Manuel Francisco Pereira², Emílio González Clavijo³, José R. Martínez Catalán¹, Juan Gómez Barreiro⁴, José Brandão Silva¹, Ulf Linnemann⁵, Mandy Hofmann⁵, Andreas Gärtner⁵, and Johannes Zieger⁵

¹Instituto Dom Luiz (IDL), Faculdade de Ciências da Universidade de Lisboa, Campo Grande, Lisboa, Portugal (ifsilva@fc.ul.pt; jbsilva@fc.ul.pt)
²Instituto de Ciências da Terra, Departamento de Geociências, Escola de Ciências e Tecnologia, Universidade de Évora, Portugal (mpereira@uevora.pt)
³Instituto Geológico y Minero de España, Investigación y Prospectiva Geocientífica, Salamanca, Spain (e.clavijo@igme.es)
⁴Dept. of Geology, University of Salamanca, 37008, Salamanca, Spain (jrmc@usal.es; jugb@usal.es)
⁵Senckenberg Naturhistorische Sammlungen Dresden, Königsbrücker Landstr. 159, D-01109 Dresden, Germany (Ulf.Linnemann@senckenberg.de; Mandy.Hofmann@senckenberg.de; andreas.gaertner@senckenberg.de; johannes.zieger@senckenberg.de)

Synorogenic basins could be linked to a wide variety of sedimentary environments, from continental to deep-marine, in distinct geodynamic settings. The sedimentary evolution of synorogenic basins is mainly controlled by the existence of relief rejuvenation and denudation within and in the surroundings areas. Accumulation of sediment in such basins could react to changes in tectonic settings. Successive extensional or contractional events that are common during the formation of an orogenic belt can induce variations on basin depth, basin depocenter migration and/or repetition of sedimentation-erosion cycles.

Detrital zircon age fingerprinting of sedimentary basins has proven to be a very sensitive tool for analyzing large and local scale changes in source-terranes, contributing to refine regional paleogeographic models. Recognition of potential source areas could be done by using statistically robust techniques. Kolmogorov-Smirnoff test (K-S) and Multidimensional Scaling (MDS) has been successfully applied to define the fingerprints of sedimentary rocks using detrital zircon age populations and compare with those from potential terrane sources. Comparative statistical analysis of detrital zircon age populations from particular sources and basin strata may be useful to prove sedimentary provenance and distance from source areas, to identify intra-basin sediment recycling and to track multi-source mixing along drainage systems.

During the Late Devonian-Carboniferous amalgamation of Pangea extensive marine sedimentation occurred in the Variscan orogen on both Laurussia and Gondwana collision margins. Remains of such synorogenic basins are currently located in different sectors of the European Variscan belt, including Iberia.
Recent provenance studies conducted in SW Iberia Variscan basins have distinguished the contribution of three distinct terrane sources “Gondwana-“, “Laurussia-“ and “Variscan magmatic arc-“ types, in some cases admitting sediment recycling and mixing of sources. Statistical analysis of detrital zircon age population from NW Iberia Variscan basin allowed us to distinguish two major sources a “Middle Ordovician-Silurian magmatic episode”-type and a “Gondwana”-type. These two types appear to correspond to source areas belonging to the nearby autochthonous and allochthonous units. Gondwanan-type source includes six sub-types whose contributions varied throughout synorogenic basins evolution, indicating that where sedimentary recycling seems to have been relevant.

Provenance studies on Variscan basins proved to be essential to test if whether or not NW Iberia and SW Iberia synorogenic basins have developed in geographical proximity of Paleozoic Laurussian- or Gondwanan-terrane sources. The differences found between the sources of NW and SW Variscan basins suggest that they would be geographically separated and influenced by independent drainage systems. This finding has provided a better understanding of the framing of Iberia synorogenic basins in paleographic models of Pangea amalgamation.

Acknowledgements: This study was supported by SYNTHESIS3 project DE-TAF-5798, by “Estímulo ao Emprego Científico – Norma Transitória” by CGL2016-78560-P (MICINN) and by FCT- project UID/GEO/50019/2019 - Instituto Dom Luiz.