

Isotope geochemistry evidence for Laurussian-type sources of South Portuguese Zone Carboniferous turbidites (Variscan Orogeny)



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Abstract: New Rb–Sr isotopic data from South Portuguese Zone (SPZ) turbidites show that the ⁸⁷Sr/⁸⁶Sr(*t*) ratio increases from the basal Mértola Formation (Viséan–Serpukhovian: 0.706–0.707), through the Mira Formation (Serpukhovian–Bashkirian: 0.706–0.712) to the uppermost Brejeira Formation (Bashkirian–Moscovian: 0.713–0.715). In addition, estimated Nd T_{DM} model ages for the Mértola (1.29–1.09 Ga), Mira (1.58–1.1 Ga) and Brejeira (1.73–1.37 Ga) formations indicate inverted stratigraphy for their isotopic sources. The isotope geochemical data indicate significant changes in the sources from which the SPZ Carboniferous turbidites are derived, consistent with the progressive denudation of a continental magmatic arc built on the Laurussian margin. Mértola turbidites inherited their geochemical and isotopic characteristics from an adjacent dissected Middle–Late Devonian continental magmatic arc with an intermediate–felsic composition: that is a Laurussian (Rheic magmatic arc)-type source. The progressive erosion of its plutonic roots and older host continental basement rocks are indicated in the Mira and Brejeira formations by the increasing contribution of recycled ancient continental crust. The pronounced similarity between the Nd T_{DM} model ages and the detrital zircon populations of the Mira and Brejeira formations (SW Iberia) suggest that they share a common Laurussian (West Avalonia/Meguma terrane)-type source but a contribution from Gondwanan (Ossa-Morena)-type sources cannot be discarded.

The chemical composition of siliciclastic sedimentary rocks is mainly determined by the provenance of terrigenous sediments, and thus by the original composition of the source rocks (McLennan *et al.* 2003). These sources may comprise a complex mixture of igneous, metamorphic and recycled sedimentary rocks (McLennan *et al.* 1993), which makes it difficult to distinguish between provenances using only petrographical studies. During the last two decades, major- and trace-element geochemistry and radiogenic isotopes for bulk samples have been successfully used in provenance studies (Rollinson 1993; Murphy and Nance 2002; McLennan *et al.* 2003; Ugidos *et al.* 2003; Fuenlabrada *et al.* 2016). Improvements in detrital zircon U–Pb geochronology techniques have also provided a powerful tool for enabling the recognition of the range of different sources for siliciclastic sediments and sedimentary rocks (Gehrels 2012).

It has been demonstrated that the combined use of petrography, geochemistry and geochronology enables the recognition of different sources, identifies changes in provenance during the filling of sedimentary basins, and constrains the relevance of the tectonic setting in which siliciclastic sedimentary rocks were deposited (Dickinson *et al.* 1983; Thomas 2011). This approach can determine the relative contributions of distinct sources which provide detritus to the basins of a developing mountain chain as these settings commonly reflect evolving changes in source (Thomas *et al.* 2004).

In this paper, we investigate the provenance of Carboniferous siliciclastic strata from the synorogenic basins of SW Iberia in order to determine source terranes during the amalgamation of Pangaea during the Carboniferous (Appalachian–Variscan mountain belt). In SW Iberia, Carboniferous strata occur in three main tectonic units of the Variscan

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