

Detrital zircon geochronology of the Carboniferous Baixo Alentejo Flysch Group (South Portugal); constraints on the provenance and geodynamic evolution of the South Portuguese Zone

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Abstract: U–Pb detrital zircon data from the Baixo Alentejo Flysch Group in the South Portuguese Zone show significant age differences between formations. The Visean Mértola Formation and Serpukhovian to early Bashkirian Mira Formation are dominated by zircons in the 316–388 Ma age range, whereas the late Bashkirian to late Moscovian Brejeira Formation is dominated by zircons with an age range of 498–687 Ma. Detrital zircons spanning an age range of 0.9–1.1 Ga are present in the Brejeira Formation but are absent in the Mértola and Mira formations. Detrital zircon ages of the Mértola and Mira formations indicate provenance from an extra-basinal source (Ossa–Morena Zone) with a minor intra-basinal contribution (South Portuguese Zone). The abundant presence of detrital zircon with age ranges of 500–750 and 0.9–1.1 Ga in the Brejeira Formation suggests a sediment source from the Avalon–Meguma terranes with limited recycling from the SW Portugal Domain. The different inferred source areas for the Baixo Alentejo Flysch Group formations are attributed to the presence of a forebulge that was formed in Mid-Visean times during the foreland phase of the South Portuguese Zone. The forebulge acted as a physical barrier separating sub-basins that accumulated the Mértola–Mira and Brejeira sediments respectively.

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The South Portuguese Zone is one of the main units of the Variscan Iberian Massif (Fig. 1; inset). It represents an external thrust belt and foreland basin and is correlated with the Cornwall Zone in Britain and Ireland and with the Rheohercynian and Moravo-Silesian zones in the Rhenish Massif (Franke 1989; Oliveira & Quesada 1998; Ribeiro *et al.* 1990; Murphy *et al.* 2010). All these Variscan zones contain flysch-type basins where deposition commenced in Visean and continued to Pennsylvanian times. The source areas for the sediments in these basins are thought to be the internal Variscan zones such as the Saxo-Thuringian Zone, the Moldanubian Zone and the Ossa–Morena Zone, which were believed to be undergoing contemporaneous uplift (Floyd *et al.* 1990; Oliveira & Quesada 1998; McCann 1999; Bábek *et al.* 2004; Kornphil 2004; Leveridge & Hartley 2006). However, the source areas for the sedimentary rocks of the South Portuguese Zone, particularly those of the youngest units (the Baixo Alentejo Flysch Group) are uncertain (Jorge *et al.* 2013).

The detrital record of sedimentary basins that occur adjacent to tectonic terranes with distinct tectonothermal histories can be used to discriminate their original source area(s) (e.g. Fedo *et al.* 1995; Murphy & Nance 2002; Dickinson 2008; Pointon *et al.* 2012). This is particularly important in geological settings where tectonic terranes have been deeply exhumed and no clear link between the source(s) and the sink is preserved. U–Pb ages of single detrital zircon grains are commonly used in sedimentary provenance analysis, providing a reliable guide to the ages of basement source rocks

(Moecher & Samson 2006; Dickinson 2008; Pointon *et al.* 2011; Thomas 2011) and can be integrated with other techniques such as petrographic studies and geochemical data (e.g. Dickinson & Suczek 1979; Ingersoll *et al.* 1984; Taylor & McLennan 1985; Wronkiewicz & Condie 1987; McLennan 1989; McLennan *et al.* 1990, 1993; Zuffa 1991; McLennan & Hemming 1992).

Regional geological setting

The northern boundary of the South Portuguese Zone with the Ossa–Morena Zone is defined by the Beja Acebuches Ophiolite, whereas to the south the contact is an angular unconformity with the Mesozoic sedimentary rocks of the Algarve Basin (Fig. 1). The Beja Acebuches Ophiolite (390–350 Ma) (Ribeiro *et al.* 2010) is interpreted as a remnant of the Rheic Ocean, which separated the Euramerican South Portuguese Zone from the Gondwanan Ossa–Morena Zone (Oliveira 1990; Quesada *et al.* 1994; Oliveira & Quesada 1998; Braid *et al.* 2011; Oliveira *et al.* 2013a). The South Portuguese Zone is divided into four domains (Oliveira 1990; Ribeiro *et al.* 1990), which are, from NE to SW, the Pulo do Lobo Suture Zone, the Pyrite Belt, the Baixo Alentejo Flysch Group and the SW Portugal Domain (Fig. 1). These domains trend NW–SE near the Atlantic coast to east–west inland and generally young towards the SW (Fig. 1).

The Pulo do Lobo Suture Zone has been interpreted as representing an exhumed suture zone or accretionary prism that records