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Evidence for multi-cycle sedimentation and provenance constraints from detrital zircon U–Pb ages: Triassic strata of the Lusitanian basin (western Iberia)

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ABSTRACT

Laser ablation ICP-MS U–Pb analyses were conducted on detrital zircons of Triassic sandstone and conglomerate from the Lusitanian basin in order to: i) document the age spectra of detrital zircon; ii) compare U–Pb detrital zircon ages with previous published data obtained from Upper Carboniferous, Ordovician, Cambrian and Ediacaran sedimentary rocks of the pre-Mesozoic basement of western Iberia; iii) discuss potential sources; and iv) test the hypothesis of sedimentary recycling. U–Pb dating of zircons established a maximum depositional age for this deposit as Permian (ca. 296 Ma), which is about sixty million years older compared to the fossil content recognized in previous studies (Upper Triassic). The distribution of detrital zircon ages obtained points to common source areas: the Ossa–Morena and Central Iberian zones that outcrop in and close to the Porto–Tomar fault zone. The high degree of immaturity and evidence of little transport of the Triassic sediment suggests that granite may constitute primary crystalline sources. The Carboniferous age of ca. 330 Ma for the best estimate of crystallization for a granite pebble in a Triassic conglomerate and the Permian–Carboniferous ages (<ca. 315 Ma) found in detrital zircons provide evidence of the denudation of Variscan and Cimmerian granites during the infilling of continental rift basins in western Iberia. The zircon age spectra found in Triassic strata are also the result of recycling from the Upper Carboniferous Buçaco basin, which probably acted as an intermediate sediment repository. U–Pb data in this study suggest that the detritus from the Triassic sandstone and conglomerate of the Lusitanian basin is derived from local source areas with features typical of Gondwana, with no sediment from external sources from Laurussia or southwestern Iberia.

1. Introduction

Sandstone and conglomerate petrography has been widely used in order to identify different types of source rock, providing unique information about provenance. In regions where information on the source of sediments and the occurrence of sediment recycling is difficult to evaluate using petrography, detrital zircon U–Pb geochronology may provide a useful tool for tracing ancient zircon fertility events (Pereira et al., 2011). Further information on the age of sources may be obtained using U–Pb dating of detrital zircon (Thomas, 2011; von Eynatten and Dunkl, 2012). U–Pb analysis of the age populations of detrital zircons in sandstone and conglomerate allows for the interpretation of provenance by matching detrital zircon ages with the crystallization ages of potential source rocks (Fedo et al., 2003; Gehrels et al., 2011), in which zircon originally formed or which was subsequently recycled from it (Sircombe and Hazelton, 2004), acting as intermediate sediment repositories. If a sedimentary deposit includes detrital zircons, reworked through multiple sedimentary cycles, derived from the recycling of older rocks and mixed with younger primary crystalline sources, this may lead to the misinterpretation of exclusively primary sources and sedimentary provenance (Gehrels et al., 2011). Therefore, detrital zircon ages are of critical importance for creating a geological historical profile of sedimentary basins and their surrounding (local) and remote (external) source regions (Fedo et al., 2003).

In recent years, there has been an increase in the production of detrital zircon U–Pb geochronology data deriving from the pre-Mesozoic basement rocks of the Variscan orogenic belt which has contributed

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