Intra-crustal recycling and crustal-mantle interactions in North Gondwana revealed by oxygen isotopic composition of Neoproterozoic to Ordovician zircons from SW Iberia rocks

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In situ O-isotope compositions of detrital, inherited and melt-precipitated zircons with Neoproterozoic to Ordovician ages are presented to assess the crustal evolution of the North Gondwana margin. Different groups of pre-Mesozoic rocks from SW Iberia were targeted: i) Ediacaran paragneisses and meta-greywakes of the Ossa-Morena Zone – the Serie Negra Group deposited at ~ 560 Ma in a Cadomian magmatic arc setting (Pereira et al., 2008); ii) Early to Middle Cambrian orthogneisses and volcaniclastic rocks of the Ossa-Morena Zone – Evora Massif igneous complexes related to ensialic rifting at ~ 530–500 Ma (Pereira et al., 2008, Chichorro et al., 2008); iii) Late Cambrian to Early Ordovician volcaniclastic rocks and granites of the Ossa-Morena–Central Iberian transition zone – the Urra Formation and Portalegre granite formed at ~ 495– 488 Ma in a extensional setting (Solá et al., 2008); iv) Carboniferous granitoids (Nisa and Arraiolos granites) containing inherited zircons with Cambrian to Ordovician ages (Solá, this volume).

A compilation the results for the period ~ 3.4 Ga to ~ 450 Ma reveals that: **a)** Archean zircons show little variation in $\delta^{18}O$, with most values lying between 4.7 and 7.5‰, (average 6.2‰) comparable with usual $\delta^{18}O$ of zircons from Archean elsewhere (e.g., Valley et al., 2005); **b)** the range of $\delta^{18}O$ in Paleoproterozoic grains increases between 2.1 and 1.8 Ga with $\delta^{18}O$ >7.5‰, indicating increasing supracrustal recycling, but at ~ 1.8 Ga the $\delta^{18}O$ has mantle-like values (<5.1‰), documenting a crustal growth episode at this time; **c)** rare Mesoproterozoic grains have mildly evolved $\delta^{18}O$ values in the range 5.6–7.1‰); **d)** Tonian grains have low $\delta^{18}O$ values (4.2–5.6‰) typical of mantle-derived juvenile magmas but also higher values of 9.9‰ suggesting intra-crustal recycling; **e)** Cryogenian–Ordovician zircons show more variable and higher $\delta^{18}O$ values (~4 to >10‰), indicating great diversity and mixing of sources through intra-crustal recycling and crust–mantle interactions; **f)** some $\delta^{18}O$ values near to or below mantle composition (5.3 ± 0.3‰) were recorded at ~ 590 Ma (Ediacaran) suggesting input of mantle material into the crust; **g)** a decrease in variance of $\delta^{18}O$ occurs from 575 Ma to the Ediacaran/Cambrian boundary, suggesting a relative decrease in the magmatic contribution of surface-derived material; **h)** in Cambrian times, the average $\delta^{18}O$ is higher in the 536–520Ma interval (7.0‰) than in the 520–488 interval (6.2‰), which can be taken as a signal of gradual opening of the system to mantle-derived, mafic, rift-related igneous complexes; **i)** higher values of $\delta^{18}O$ (>7.5 ‰) recorded at ~ 623–574 Ma and 490–470Ma mark periods of pronounced increase in crustal recycling.

Chichorro, M. et al., 2008. Tectonophysics 461, 91-113.
Pereira, M.F. et al., 2008. Geological Society, London, Special Publications 297, 385-404.
Solá, A.R. et al., 2008. Tectonophysics 461, 114–129.