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## U-Pb detrital zircon ages during tectonic inversion: provenance analysis of siliciclastic sequences of the Ossa-Morena Zone

### Idades U-Pb de zircão detrítico durante a inversão tectónica: análise de proveniências de sequências siliciclásticas da Zona de Ossa-Morena

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**Sumário:** *Análise de proveniência de sucessões detríticas da Zona de Ossa-Morena é reinterpretada a fim de demarcar os estádios de inversão tectónica do Ciclo Varisco. Zircões detríticos de unidades de Rift do Câmbrio médio-superior (Fm de Ossa, Fm de Fatuquedo) mostram não ter existido variações significativas das áreas fonte quando comparadas com os sedimentos ediacarianos, que refletem erosão/reciclagem da crosta Pan-Africana e do Arco Cadomiano, espelhando a herança típica do Norte do Gondwana. O padrão da Fm da Colorada grava o início da subducção, pois mostra que o soco da ZOM já está em inversão, embora ainda com exumação limitada dos depocentros em Rift do Câmbrio. Por sua vez, as curvas da Fm de Terena já são consistentes com exumação ativa e erosão/reciclagem sub-aérea das sequências vulcano-sedimentares sin-Rift, refletindo as primeiras fases colisionais variscas.*

**Palavras-chave:** Zircão, Análise de proveniências, Fm Ossa - Fatuquedo, Fm Colorada, Fm Terena

**Key words:** Zircon, Sedimentary provenance, Ossa-Fatuquedo Fm, Colorada Fm, Terena Fm.

The inversion stage of a sedimentary basin is marked by the time where the sedimentary infill is exposed at surface, which is triggered by changing from an extensional to a compressive stage. Regarding the Variscan convergence in the Iberian Massif, it is crucial to know the timing of the transition from the Drift stage to the stage of convergence-subduction in each peri-Gondwanan/Laurussian terrane. We believe that the tectonic inversion is imprinted in the probabilistic data of the detrital zircon ages placed in lithostratigraphic units of Ossa-Morena Zone (OMZ). Therefore, provenance analysis of several mid-upper Cambrian to Lower Devonian siliciclastic successions of the OMZ (after Pereira et al., 2014) are presented and reinterpreted.

#### Geological context of the analysed samples

**Ossa/Fatuquedo Fms.:** Both sandstone units are mid-upper Cambrian equivalents, characterizing the last stages of the rift stage. Overlying these units is a passive-margin succession formed by distal shales and sandstones of the **Colorada Fm.** (Upper Ordovician-Lower Silurian). Silurian is represented by pelagic, euxinic sequences (graphite shales, cherts and ampelites), whereas Lower Devonian **Terena Fm.** is composed of a flysch succession, representing the oldest synorogenic deposits in the Iberian Massif and

marking the initial continental collisional stage (Borrego et al., 2006).

#### U-Pb Detrital Zircon age Patterns

**Ossa Fm.:** The probability density plots (PDP) show a striking similarity to the Ediacaran sediments of Série Negra suggesting that Rift-to-Drift sedimentation was marked by slight variations in source-areas from the exhumation and denudation of crustal blocks with similar zircon-forming events typical of North Gondwana. The youngest detrital zircon found is Ediacaran (551 Ma). A strong input of Pan-African ages (670-653 Ma) is a major feature, but Cadomian ages (~570 Ma) are also present. Rift-related ages are absent. Erosion and recycling of Paleoproterozoic rocks (2.1-1.8 Ga), typical of NW-Gondwana margin, are present in the PDP curves. Mesoproterozoic ages are almost absent and Tonian ages are subsidiary; **Fatuquedo Fm.:** Just one zircon (ca. 529 Ma) defines the Maximum Deposition Age (MDA), which means that the subaerial erosion of Rift-related rocks continued very limited. The scarcity or absence of Cambrian ages in Fatuquedo and Ossa Fms. suggest that the coeval magmatism was essentially submarine or related to intrusive complexes. The same Pan-African Stage II zircons founded in Ossa Fm are present in Fatuquedo. As in the Ossa Fm., there are also Paleoproterozoic ages (2.2-1.7 Ga) and rare

Archean, Mesoproterozoic and Tonian ages; **Colorada Fm.:** the youngest detrital zircons in these quartzites are Cambrian (532 and 501 Ma). The most significant age peaks are Cryogenian (666 and 615 Ma) Pan-African Stage II ages. Ediacaran Cadomian ages (~550 Ma) are also present, but the most significant feature is the abundance of 971-889 Ma Tonian ages. This is a distinctive feature when compared to the Ediacaran *Série Negra* succession and the Cambrian formations; **Terena Fm.:** The MDA of these greywackes is  $479.5 \pm 8.4$  Ma (Lower Ordovician;  $n=3$ ;  $MSWD=0.35$ ;  $p=0.71$ ). This suggests that no igneous rocks younger than 482 Ma were emplaced in SW OMZ, which is consistent with the literature. The most significant detrital zircon ages are Lower Cambrian (509-521 Ma) which is the age interval of the Cambrian rift-related magmatism in SW OMZ. Cambrian ages are even more abundant than Pan-African/Cadomian ages, whose maximum peak is ~610 Ma, the most representative Pan-African age in Iberia (Chichorro et al., 2022).

### Conclusions

U-Pb dating of detrital zircons from the Rift stage Cambrian siliciclastic rocks (Fatuquedo Fm. and Ossa Fm.) show that there were no significant variations in the source-areas when compared with the Ediacaran sediments under the influence of the Pan-African crust denudation and active Cadomian arc erosion, maintaining the features of the Paleoproterozoic zircon-forming events typical of North Gondwana. The irrelevance of Stenian-Tonian detrital zircon ages is interpreted by us, admitting an closed-system behaviour induced by the mega-cordillera of the Trans-Sahara Belt which acted as a barrier for the large distance transport sediments. Colorada Fm. PDP exposes four main evidence: i) erosion/recycling of older crust (Neoarchean), as well as the maintenance of the recycling of Eburnean crust; ii) sudden opening

of the system to Stenian-Tonian ages (mainly Tonian); iii) maintenance of the recycling Pan-African crust, including the ca 615 Ma signal; iv) erosion of Cadomian arc magmatic rocks (ca. 551 Ma). This suggests that the basement of OMZ is already in an inversion stage, but yet with very limited denudation of the Cambrian Rift-related sequences. On the other hand the remarkable and sudden influence of Tonian zircons is the expression of the opening of the system to exotic and very distal provenances. As it was advocated to Stenian-Tonian detrital zircon in N-CIZ Floian quartzites (Chichorro et al., 2022), the passive margin sedimentation in OMZ is also under influence of long-distance transport mechanism suggesting that, at that time, the Trans-Saharan Belt had already become a vast peneplain with a large drainage system. We propose that the Pan-African-Cadomian crust in up-lift/exhumation and the Trans-Sahara Belt barrier in active peneplanation is the tectonic effect of the contractional deformation in the transition Ordovician-Silurian (ca. 444 Ma) related with the beginning of the intraoceanic subduction. The abrupt influx of Rift-related Cambrian zircons in the Terena Fm. greywackes PDP is consistent with active exhumation and sub-aerial erosion and reworking of the syn-rift crust. The sources for the clastic sediments are essentially proximal, consisting in the well-dated lower/middle Cambrian Rift-to-Drift volcano-sedimentary sequences. The ~610 Ma age peak, the most persistent detrital Inherited age in the Iberian Massif emphasizes the Pan-African basement as an effective and proximal source. Terena sediments, thus reflect continental response to active collision after Rheic Ocean consumption and the first stages of continental collision. During the Lower Devonian Period the Trans-Sahara Belt seems to be again in up-lift as a response to active collision and therefore acting once again as a continental barrier.

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