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First evidence of Cadomian felsic magmatism in the Évora-Aracena Domain, Ossa-Morena Zone, SW Iberian Massif

Primeira evidência de magmatismo félsico Cadomiano no Domínio Évora-Aracena, Zona de Ossa-Morena, SW do Maciço Ibérico

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Sumário: *Dados geoquímicos obtidos em meta-riólitos da região de Viana do Alentejo incluídos na formação Xistos de Moura permitem diferenciar 3 grupos distintos: Grupo I – rico em HREE com assinatura orogénica; Grupo II – também enriquecido em HREE, mas apresentando natureza anorogénica; e Grupo III - anorogénico, mais enriquecido em REE que os anteriores. Tais informações, quando combinadas com dados geocronológicos U-Pb, obtidos em amostras dos grupos I e III, permitem afirmar que estes riólitos resultaram de um magmatismo contínuo entre a Orogenia Cadomiana e o evento rift-to-drift do Câmbrico.*

Palavras-chave: *Zona de Ossa-Morena, Gondwana, geocronologia, geoquímica, rifting*

Key words: Ossa-Morena Zone, Gondwana, geochronology, geochemistry, rifting

Ossa-Morena Zone (OMZ) has unique features in the Iberian Massif with the presence of a Neoproterozoic basement formed during the Cadomian Orogeny, overlapped by Palaeozoic units. Along the S boundary of OMZ, the Évora-Aracena Metamorphic Belt (EAMB) is composed of high grade metamorphic terrains. Presence of felsic volcanic rocks in the Viana do Alentejo region of the EAMB was first described by Carvalhosa (1972), who placed such rocks in the Viana do Alentejo gneiss unit and the Xistos de Moura formation (Fig. 1). This study focus on the latter, with whole-rock/isotopic geochemical data being obtained in 6 samples from 4 different areas (PMT-1 and PMT-2 – Oriola Sector; PMT-3 and PMT-5 – S. Bartolomeu Sector; PMT-12B – Viana Dam Sector; PMT-17 – Portel Sector), 2 of which were also the subject of LA-ICP-MS U-Pb dating (PMT-2 and PMT-17).

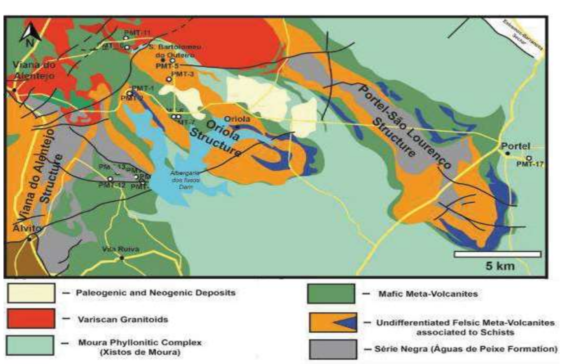

Fig. 2 - Location of the studied Viana do Alentejo meta-rhyolites.

Three groups of rhyolites were defined: a) Group I – Meta-acid rocks from Oriola sector; b) Group II - Meta-acid rocks from S. Bartolomeu and Viana Dam sectors; and c) Group III - Meta-acid rocks from Portel sector (Cachapuz, 2021). Group I rhyolites are enriched in HREE (HREEt = 9.15-9.35 ppm), present εNd_{320} values between -10.1 and -11.8 and T_{DM} ages = 1.8-2.0 Ga, while also displaying an orogenic signature. Group II felsic rocks are even more enriched in HREE (HREEt = 24.3-39.5 ppm), have higher εNd_{320} (-0.7 to +3.0) and younger T_{DM} ages (0.8-1.1 Ga) and show an anorogenic signature. As for Group III, the Portel rhyolite shows high contents of both LREE and HREE (REEt = 338 ppm), while also displaying an intraplate signature.

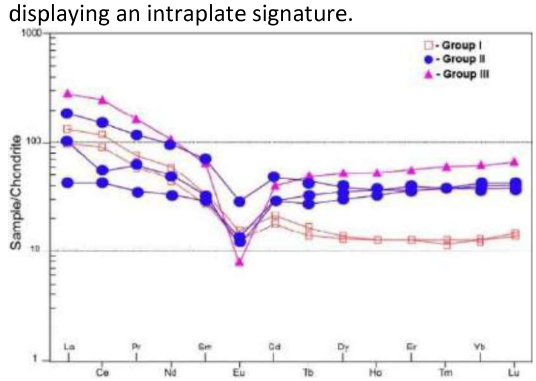

Fig. 2 - REE patterns for the Viana do Alentejo rhyolites.

Regarding U-Pb data, most zircons from **Portel's Rhyolite (PMT-17; Group III)** present rounded shapes with few elongated prismatic zircons with bipyramidal terminations. 20 spots were analysed, 19 of which yielded concordant ages, with the latter ones displaying Th/U = 1.2 - 4.0. Most $^{206}Pb/^{238}U$ ages are between 502-679 Ma. The youngest cluster provides a Concordia age of 504.16±1.98 (n=3; MSWD=0.25; p=0.62), being interpreted as the crystallization age. Also relevant are clusters at 613 and 672 Ma. Some analyses yield Late Palaeozoic – Mesozoic ages (227-232 Ma), 1 spot yields a Mesoproterozoic age (1590 Ma), 2 Paleoproterozoic ages (1908 and 1974 Ma) and 1 Archean age (2733 Ma).

As for **Oriola's Rhyolite (PMT-2; Group I)**, zircons are frequently elongated with bipyramidal terminations. 50 spots were analysed, 41 of those presenting concordant ages. These have Th/U = 0.5 - 4.3, being the youngest $^{206}Pb/^{238}U$ ages between 500 and 713 Ma, the majority of which concentrate in 3 big groups with weighted mean average ages of 596, 619 and 639 Ma. Older $^{207}Pb/^{235}U$ ages are mainly Paleoproterozoic (1809-2199 Ma), with 2 analysis yielding an Archean age (2657 and 2854 Ma). Ages below 550 Ma are dispersed and interpreted as Pb loss, implying that the following cluster that provides a Concordia age of 595.40±1.38 (n=5; MSWD=0.32; p=0.57) is interpreted as the crystallization age (Fig. 3).

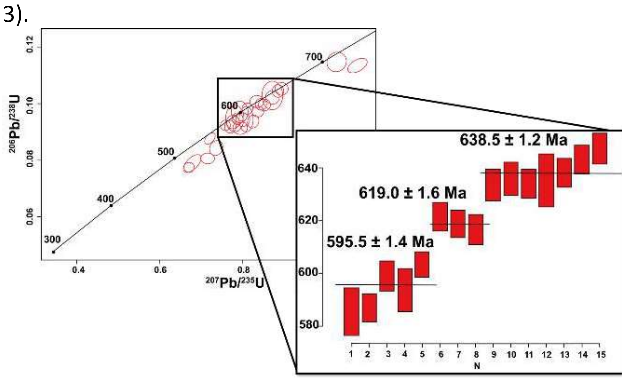

Fig. 3 - Wetherill concordia diagram showing U-Pb ages between 300 and 700 Ma from PMT-2 rhyolite.

Geodynamic Interpretation

Group I and II rhyolites present very similar geochemical characteristics to early-rift felsic volcanic rocks studied by Sánchez-García et al. (2010) in the Bodonal-Cala Volcano-sedimentary Complex and Calera and Barreiros massifs. However, the geochronological data obtained in sample PMT-2 seems to indicate an Ediacaran crystallization age (~595 Ma). Such Cadomian felsic age is a novelty in the EAMB. We also interpret the relative proximity of zircons between 640 and 500 Ma (Fig. 3) as the result of several magmatic pulses in succession, during the Cadomian and the Cambrian rifting sequence, hence the quasi-concordant ~500 Ma cluster of the younger zircons. In this last pulse, the melting temperature is likely very low, leading to the absence of new zircon, but providing Pb loss to already crystallized rocks. Although no U-Pb data was obtained for S. Bartolomeu and/or Viana-Dam rhyolites, their anorogenic signature and higher εNd_{320} suggest that they were formed during the Cambrian magmatism ("early rift event") in continuous magmatic pulses between the Cadomian Orogeny and the Cambrian rift-to-drift events. As for the Portel Group III rhyolite (PMT-17), this sample denotes an even greater mantle influence, showing geochemical similarities with main rift felsic volcanic rocks (Sánchez-García et al., 2010). Such geodynamic context appears to be confirmed by the U-Pb with a 504 Ma as its crystallization age. As for the ages of the other clusters (613 and 672 Ma), these are likely inherited and related to the Pan-African basement (Chichorro et al., 2022). As a final note, intrusion of these volcanic rocks within the Xistos de Moura Formation points to a minimum Cambrian (Wuliuan/Drumian transition) age for this unit.

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