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Late Cretaceous magmatism offshore the central West Iberian Margin

Magmatismo do Cretácico Superior no offshore da margem central oeste Ibérica

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Sumário: A análise de dados de reflexão sísmica, combinados com modelos de inversão de dados potenciais (gravimetria-magnética), revela a presença, natureza e detalhes de um sistema magmático localizado no offshore da Margem Oeste Ibérica. As evidências incluem o vulcão de Fontanelas com escoadas de lavas associadas, a Intrusão do Esporão da Estremadura, e diversos complexos de soleiras, enquanto manifestações da Província Alcalina Atlântica, do Cretácico superior. Este sistema magmático sugere implicações nos modelos de ascensão adiabática no manto, tentativamente associados a uma pluma mantélica duradoura e enraizada na anomalia centro-este atlântica.

Palavras-chave: Vulcão de Fontanelas, Intrusão do Esporão da Estremadura, Cretácico superior, tectono-magmatismo, Margem Oeste Ibérica

Key words: Fontanelas volcano, Estremadura Spur intrusion, tectono-magmatism, West Iberian Margin

The evolution of the West Iberian Margin (WIM) is punctuated by three discrete magmatic events, that include (Martins et al., 2008; Mata et al., 2015): 1) the tholeiitic episode associated with the Central Atlantic magmatic Province (~200 M.a.); 2) the transitional magmatic event (150-148 M.a.); and 3) the Late Cretaceous alkaline (100-70 M.a.), from which the Sintra, Sines and Monchique intrusions, the Lisbon Volcanic Complex and numerous other occurrences are typical examples on outcrops. Evidence of magmatism from this later event is poorly known on the offshore of the WIM and its impacts on the evolution of the margin are still unclear. Herein, we report the evidence of a complex plumbing system that includes the Estremadura Spur Intrusion (Pereira et al., 2021), the Fontanelas volcano (Miranda, 2010; Miranda et al., 2010; Pereira et al., 2022) and associated sill complexes, to provide insights on how these relate with the overall evolution of the margin, and its implications for improved knowledge of the Central Atlantic Alkaline Province. Using seismic reflection datasets and potential field data models (gravimetric and magnetic) from the Estremadura Spur, offshore central Portugal, the nature, and architecture of magmatic features are revealed, and its tectono-magmatic controls for magma emplacement are disclosed (Pereira et al., 2021; Pereira et al., 2022; Escada et al., 2022).

The Estremadura Spur Intrusion

The Estremadura Spur Intrusion is a sizeable laccolith with a total volume of about 532 km³ that intrudes Late Cretaceous strata. 3D gravity and magnetic inversion and 2D magnetic forward modelling suggest that the composition of the laccolith is predominantly granitic. Seismic stratigraphy of the area suggests that magmatic emplacement occurred during the Cenomanian-Maastrichtian, a period associated with the counter-clockwise rotation of Iberia during the opening of the Bay of Biscay. The study of the tectono-magmatic interplay provides insights on the evolving stress field, that by the Cenomanian onset of emplacement shows the presence of localised radial and concentric faulting in the area of the intrusion, later affected by broader pre-Maastrichtian NE-SW compressive stresses.

The Fontanelas volcano and associated lava flows

The Fontanelas volcano is a unique example of a buried edifice imaged with 2D and 3D seismic data. With a total height of ~2800 m, the base of the volcanic complex extends over an area of ~500 km², showing evidence of multiple secondary vents. The internal architecture of the volcano provides information on the growth of the composite edifice. Geochemical analysis of dredges collected at the crest of the Fontanelas volcano yielded highly vesicular alkaline basalts (Miranda, 2010). Integration of 3D gravity and magnetic inversion and 2D magnetic

forward modelling provide additional insights on the overall nature of the edifice, supporting a dominant basaltic composition. Our analysis of 3D seismic data reveals the presence of two distinct events of offshore extrusive magmatism. The first, preceding the build-up of the volcanic edifice reveals multiple and superimposed fan-shape to tabular crenulated submarine sheet or 'a'ā lava flows, sourced from a fissure-type feature located SE of the Fontanelas volcano. The second group of lava flows is visible at the SW flank of the volcano, comprising dendritic and lobate lava flows (either pahoehoe or submarine lobate flows) directly associated with the final stages of volcanic build-up.

Sills and Sill Complexes

Throughout the study area, more than 100 sills and sill complexes were mapped and measured. Sills are characterised by distinct geometries (planar to saucer-shaped), dominantly intruding 250–500 m strata older than mid-Campanian age. On average sills are 30-to 40-m thick, with individual areas that can reach 59 km².

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References

- Escada, C., Represas, P., Santos, F., Pereira, R., Mata, J. and Rosas, F.M. (2022) New Evidence of Late Cretaceous Magmatism on the Offshore Central West Iberian Margin (Estremadura Spur) from Potential Field Data. *Tectonophysics*, 832.
- Martins, L. T., Madeira, J., Youbi, N., Munhá, J., Mata, J., and Kerrich, R. (2008). Rift-related magmatism of the Central Atlantic Magmatic Province in Algarve, Southern Portugal. *Lithos*, 101, 102–124.
- Mata, J., Alves, C. F., Martins, L., Miranda, R., Madeira, J., Pimentel, N., Martins, S., Azevedo, M. R., Youbi, N., De Min, A., Almeida, I. M., Bensalah, M. K., and Terrinha, P. (2015). 40Ar/39Ar ages and petrogenesis of the West Iberian Margin onshore magmatism at the jurassic-cretaceous transition: Geodynamic implications and assessment of open-system processes involving saline materials. *Lithos*, 236–237, 156–172.
- Pereira, R., Mata, J., Ramalho, R.S., Rosas, F.M., Silva, B., Represas, P. and Escada, C. (2022) Nature, Timing and Magnitude of Buried Late Cretaceous Magmatism on the Central West Iberian Margin. *Basin Research*, 34, 771-796.
- Pereira, R., Rosas, F., Mata, J., Represas, P., Escada, C. and Silva, B. (2021) Interplay of Tectonics and Magmatism During Post-Rift Inversion on the Central West Iberian Margin (Estremadura Spur). *Basin Research*, 33, 1497-1519.
- Miranda, R. (2010) Petrogenesis and Geochronology of the Late Cretaceous Alkaline Magmatism in the West Iberian Margin. PhD Thesis, Universidade de Lisboa, Lisboa.
- Miranda, R., Terrinha, P., Mata, J., Azevêdo, M.d.R., Chadwick, J., Lourenço, N. and Moreira, M. (2010). Caracterização Geoquímica Do Monte Submarino De Fontanelas, Margem Oeste Ibérica. X Congresso de geoquímica dos países de língua oficial portuguesa, XVI Semana de geoquímica, Porto, Portugal, Universidade do Porto.

Final Remarks

The offshore WIM is characterised by multiple evidence of Late Cretaceous magmatic features, which are part of the Atlantic Alkaline Province. The plumbing system was emplaced in two main pulses of activity: 1) Coniacian(?) to lower Campanian(?), characterised by fissural and fault-controlled volcanism, showing massive lobate/sheet lava flows; and (2) a voluminous intrusive and extrusive event of mid to late Campanian age, that includes the intrusion of the Estremadura Spur laccolith and the prominent Fontanelas compound volcano with associated dendritic lava flows. The study area also reveals the interplay of magmatic emplacement and tectonics, with the Estremadura Spur Intrusion acting as a rigid body accommodating the regional stresses associated with the progressive rotation of the compressive stress fields from a NE-SW trend during the Campanian-Paleocene(?), towards a NW-SE direction during the Paleocene-Miocene.