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## Age constraints on the Late Cretaceous alkaline magmatism on the West Iberian Margin

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### ABSTRACT

The onshore sector of the West Iberian Margin (WIM) was the locus of several cycles of magmatic activity during the Mesozoic, the most voluminous of which was of alkaline nature and occurred between 70 and 100 Ma. This cycle took place in a post-rift environment, during the 35° counter-clockwise rotation of Iberia and initiation of the alpine compression. It includes the subvolcanic complexes of Sintra, Sines, and Monchique, the volcanic complex of Lisbon and several other minor intrusions, covering an area of approximately 325 km<sup>2</sup>. Previous cycles were tholeiitic and transitional in nature, occurring around 200 Ma and 130–135 Ma, respectively.

New LA-ICP-MS U-Pb, <sup>40</sup>Ar/<sup>39</sup>Ar, K-Ar and Rb-Sr ages on several intrusions distributed along the onshore WIM are presented, which combined with previously published data allows us to constrain the duration of the Late Cretaceous alkaline cycle to circa 22 Ma (94–72 Ma) and define two pulses of magmatic activity. The first one (94–88 Ma) occurred during the opening of the Bay of Biscay and consequent rotation of Iberia and clusters above N38°20'. The second pulse (75–72 Ma) has a wider geographical distribution, from N37° to N39°. This final pulse occurred during the initial stages of the Alpine orogeny in Iberia that led to the formation of the Pyrenees and Betics and to tectonic inversion of the Mesozoic basins.

Isotope and trace element geochemistry point to a sublithospheric source for the alkaline magmatism that clearly distinguishes it from the previous cycles which had an important lithospheric mantle component. Also, it allows the discrimination between the two different alkaline pulses in terms of trace element abundance and residual mantle mineralogy. It is speculated that these differences might be the result of distinct magma ascent rates due to either more or less favourable tectonic settings that avoided or allowed the interaction with metasomatized lithosphere and equilibration with K rich minerals like amphibole and/or phlogopite.

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### 1. Introduction

The onshore sector of the West Iberian Margin (WIM) was the locus of several cycles of magmatic activity during the Mesozoic. Occurrences related to the first two cycles display tholeiitic and transitional affinities (Martins, 1991; Martins et al., 2008) and ages around 200 Ma (e.g. Dunn et al., 1998; Verati et al., 2007) and

130–135 Ma (Ferreira and Macedo, 1979), respectively. The last cycle was the most voluminous, shows an alkaline nature, and took place between 70 and 100 Ma (Ferreira and Macedo, 1979).

This cycle includes the NNW-SSE aligned subvolcanic complexes of Sintra, Sines, and Monchique, the volcanic complex of Lisbon and several other minor intrusions (Fig. 1). These rocks are discontinuously exposed from parallels 39° N to 37° N and cover an area of approximately 325 km<sup>2</sup> (Fig. 1). With the exception of the Monchique alkaline complex, all the alkaline rocks were emplaced within the Mesozoic Lusitanian and Algarve rift basins, developed in relation to the opening of the Atlantic.

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