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Late Cretaceous to present kinematic evolution of the Europe-Iberia-Africa plate boundaries

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The Mesozoic-Cenozoic kinematics of the Iberian plate represents a key issue in the reconstruction of Mediterranean geodynamics. However, the multiple existing models for Iberian plate boundaries reveal that the detailed reconstruction of Iberia evolutionary stages is far from being unraveled. These models are based on two contrasting interpretations that strongly constrained the Iberian orogenic systems evolution since late Santonian to present, which developed across the two Iberian plate boundaries (Pyrenees and Betic-Rif) during the Africa–Europe convergence. In the classical models, Iberia was part of Africa until middle Oligocene times and the Africa–Europe convergence was accommodated along its northern boundary, which represented the only active plate boundary during this period (Bay of Biscay and King's Trough–Pyrenees). In the subsequent kinematic phase, from Late Oligocene to present, Iberia was instead part of the European plate and the convergence of Africa was accommodated across the Betic–Rif orogenic system. Conversely, recent studies suggest that the convergence of Africa with respect to Iberia was already active at the Santonian–Campanian boundary (Chron C34, 83.5 Ma), accommodating nearly 80 km of convergence until the early Oligocene. According to these models, shortening related to Africa–Europe convergence is partitioned between the northern and southern boundaries of the Iberian plate. In this scenario, the Azores Gibraltar Fracture Zone was already an active plate boundary between Iberia and Africa since the Late Cretaceous.
Here we explore the geological implications of a new published kinematic model for the North America–Iberia–Europe–Africa–Morocco plate system. The predicted N–S convergence rates and motion paths of Africa–Iberia and Iberia–Europe have been calculated across the Betic-Rif domain and the Pyrenees–Bay of Biscay, and then compared with the temporal distribution of shortening reported in recent works, which are inferred from crustal-scale balanced and restored sections. This comparison between the total amount of shortening reported in different studies, which are calculated through different methodologies and independent data sources, and the correlation between field-based geological studies with the large-scale plate reconstructions, allows to constrain the geometry of the margins and to reconstruct the detailed kinematics across the northern and southern Iberian boundaries during the Africa–Europe convergence.

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