Investigating the plate motion of the Adriatic microplate by 3D thermomechanical modelling

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DOI: http://dx.doi.org/10.17169/refubium-41084

Mantle dynamics in the Alpine-Mediterranean area provides a complex geodynamic picture and is still subject of ongoing debate. The Adriatic microplate represents the central part of the Mediterranean and is affected by various subduction zones, like the Hellenic slab, the Calabrian slab or the Apenninic slab. These different processes pose challenges in making qualitative assumptions about the unique impact factors influencing the plate motion.

In this study, we conduct 3D thermomechanical forward simulations of the Alpine-Mediterranean area using the LaMEM (Kaus et al., 2016). Our simulations incorporate a viscoelastoplastic rheology and an internal free surface, enabling us to investigate both internal dynamics and surface response. The initial setup for the simulations is based on the kinematic reconstructions of Le Breton et al. (2021) at 35 Ma. Our objective is to determine the main driving forces behind the plate motion of the Adriatic microplate by examining the effects of different model parameters, such as the thermal structure, slab geometry, mantle viscosity, and brittle parameters of the crust.

Although these forward simulations do not yet precisely reproduce the present-day tectonic setting, they provide valuable insights into the parameters that influence the plate dynamics. Based on our findings, we have identified two distinct stages of plate motion affecting Adria over the past 35 million years. The initial phase is dominated by the northwards moving African plate, which pushes Adria to the north. However, as the Hellenic slab advances from the east and the Calabrian and Apenninic slabs propagate from the west, the Adriatic microplate is decoupling from the African plate which induces an anticlockwise rotation of Adria. The extent and the thermal structure of the Ionian oceanic lithosphere are significant parameters that influence the retreat of the Hellenic and Calabrian slab and therefore the rotation of Adria. Simultaneously, the northwards motion of Adria during the rotation is caused by the retreat of the Western Alpine slab.

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