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Plate motion model of Western and Central Mediterranean-Alpine area since 200 Ma

Eline Le Breton (1), Kamil Ustaszewski (2), Dietmar Müller (3), and Samuel H. J. Russel (3)

(1) Institute for Geological Sciences, Freie Universität Berlin, Berlin, Germany (eline.lebreton@fu-berlin.de), (2) Institute for Geological Sciences, Friedrich-Schiller-Universität Jena, Jena, Germany, (3) EarthByte Group, School of Geosciences, The University of Sydney, NSW 2006, Australia

A goal of the German MB-4D Priority Program (part of the AlpArray initiative) is to integrate 3D imaging of the crust-mantle system beneath the Alps with geologic observations and modelling to look both backwards and forwards in time, the 4th dimension. Here, we present an updated kinematic reconstruction of the past motion of the tectonic plates (Adria, Iberia, Europe, Africa) and micro-continental blocks (AlKaPeCa, Corsica-Sardinia, Briançonnais, AlCaPa, Tisza, Dacia) involved in the Alpine orogeny since 200 Ma. Our model is based on a compilation of geological and geophysical data and published reconstructions of the Western and Central Mediterranean-Alpine area. The novelty is that our model is incorporated into a global deforming plate motion model, in an absolute reference frame, constructed using GPlates software (www.gplates.org, see also Müller et al., this volume).

The motions of Europe, Africa and Iberia are constrained in the global plate motion model by reconstructing continental rifting and spreading of the Atlantic Ocean. The motion of Adria is well constrained back to 20 Ma by geological and geophysical data from surrounding orogens (Alps, Apennines, Dinarides) and basins (Liguro-Provencal Basin and Sicily Channel Rift Zone). However, uncertainties increase further back in time. Our main assumptions are that (1) the Ionian Basin is oceanic and opened in Triassic time and that, therefore, no significant extension or convergence has occurred between Adria and Africa since 200 Ma, and (2) Corsica-Sardinia was part of the Iberian plate between 200 Ma and 83.5 Ma. We then used tectonic reconstructions of the Provence fold-and-thrust belt and opening of the Liguro-Provencal Basin to constrain the motion of Corsica-Sardinia relative to Europe since 83.5 Ma. For motion of the AlKaPeCa micro-continent and the AlCaPa-Tisza-Dacia units, we used published tectonic restorations of the Western Mediterranean and the Alpine-Carpathian-Dinaridic system, respectively.

A first interesting outcome of our model is that northern Adria must have moved relative to Apulia/Africa to allow enough space between Corsica and Adria at 200 Ma. As previously proposed, we accommodate this motion along a sinistral strike-slip zone (c. 150 km of total displacement in Mesozoic time), which likely forms a precursor of the presently seismically active Mid-Adriatic Ridge. This solution avoids any major extension or convergence between Adria and Africa. Secondly, the Alpine Tethys Ocean must have been a narrow basin of maximum 400 km width in a NW-SE direction that opened between ca. 170 and 130 Ma. Spreading rates were therefore ultra-slow, c. 5 mm/yr. Major questions arise regarding the role of the Mid-Adriatic Ridge in Mesozoic time and its recent reactivation, the extent of the Neotethyan and Alpine Tethyan oceans, and the nature of lithosphere under the latter. Nevertheless, we propose a first deforming plate motion model for the Mediterranean-Alpine area that includes the progressive contractional Alpine deformation between rigid Adria and Europe, using GPlates. This allows quantitative analyses (e.g. plate velocities, finite strain and crustal thickness through time) and thus provides a basis for more detailed regional tectonic reconstructions, geodynamic and paleoclimate models.