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New constraints on Neogene counter-clockwise rotation of Adria relative to Europe

Eline Le Breton (1), Mark R. Handy (1), Giancarlo Molli (2), and Kamil Ustaszewski (3)

(1) Freie Universität Berlin, Institute for Geological Sciences, Berlin, Germany (eline.lebreton@fu-berlin.de), (2) Università di Pisa, Department of Earth Sciences, Pisa, Italy, (3) Friedrich-Schiller-Universität Jena, Institue of Geosciences, Jena, Germany

The Adriatic microplate (Adria) is a key player in the geodynamics of Alpine-Mediterranean belts because of its location between two converging plates, Europe and Africa. Most of Adria has been subducted and is presently surrounded by deformed margins comprising the Alps, Apennines, Dinarides and the Calabrian Arc. The Alps-Apennines and Alps-Dinarides junctions are marked by switches in subduction polarity, with Adria being the indenting upper plate in the Alps and the lower plate in the Apennines and Dinarides. Reconstructing Neogene motion and rotation of Adria is therefore key to understanding how such contrasting orogenic styles develop within a similar convergent tectonic regime.

We propose a new kinematic reconstruction that balances shortening and extension in the northern Apennines; it reveals that Adria rotated counter-clockwise as it subducted beneath the European Plate to the west and to the east, while indenting the Alps to the north. Syn-collisional back-arc extension in the Liguro-Provençal and northern Tyrrhenian basins exceeds collisional shortening in the northern Apennines, indicating that after 20 Ma Adria and Europe diverged. When combined with existing estimates of Neogene shortening in the Western and Eastern Alps, this overall divergence in the Apennines constrains Adria to have moved to the NW while rotating counter-clockwise relative to Europe. We furthermore consider the length of the present Adriatic slab (135 km) imaged by P-wave tomography in the southern Dinarides to represent the maximum convergence since late Paleogene slab-breakoff, constraining Adria to have rotated 6.5° counter-clockwise about an axis in northwestern Italy.

Thus, the best fit of available structural data from the Apennines, Alps and Dinarides constrains Adria to have moved 113 km to the NW (azimuth 325°) while rotating 6.5° counter-clockwise relative to Europe since 20 Ma. Our model predicts some 80-100 km of Neogene extension between Adria and Africa, most likely accommodated along a NW-SE striking rift system on the African margin and by transtension along NW-SE striking transform faults in the Ionian Sea. We propose that this Neogene motion of Adria resulted from a combination of Africa pushing from the south, the Adriatic-Hellenic slab pulling to the northeast and crustal wedging in the Western Alps, which acted as a pivot and stopped further northwestward motion of Adria.