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From Tethyan Oceans to the Western Mediterranean II - Processes of subduction and orogeny in time slices and comparison with seismic tomographic images

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The kinematic model outlined in part I of this contribution (Schmid et al. 2010) prescribes the motion of reference points on five temporarily independent plates (Adria, Iberia, Alcapia, Alkapecia, Africa) with respect to Europe. It provides a new framework for the Early Mesozoic to Recent evolutions of the various branches of Neotethys and Alpine Tethys which led to the rise of the Tertiary Alpine mountain chains presently surrounding the Western Mediterranean Sea. We envisage the following evolution, as presented in a new series of plate tectonic maps and cross sections that extend down to the mantle transitional zone: (1) Simultaneous spreading of the Piemont-Liguria Ocean and obduction of part of the Vardar Ocean (170-131 Ma); (2) Simultaneous spreading of the Valais Ocean and orogenesis in the Eastern Alps (131-94 Ma) were linked by a large E-W trending transform that reached from the Bay of Biscay in the W to the foundering Neotethyan subduction slab along the NE margin of the African plate; (3) Subduction of the Western Ligurian Ocean along the Alps-Corsica-Betics system initiated while the Eastern Ligurian Ocean remained open and was part of a united Africa-Adria-Alcapia plate (94-67 Ma); (4) Northward motion of an initially united Adria-Africa plate began at 84 Ma and accelerated from 67-35 Ma, leading to subduction of the remaining Western Ligurian Ocean, as well as of the entire Piemont and Valais parts of Alpine Tethys which were attached to the downgoing European slab. After 67 Ma, Adria separated from Africa; its NW translation and counterclockwise rotation with respect to Europe and Africa were accommodated by very slow widening of the Ionian Basin; (5) 35 Ma-Recent roll-back subduction of the Eastern Ligurian part of Alpine Tethys coincided with collision in the Western Alps and involved the formation of the Betics-Rif arc and the Calabrian Trench-Arc system. The formation of these arcuate systems was driven primarily by the gravitational pull of the negatively buoyant Adriatic and African slabs that comprised the Ionian-Eastern Ligurian oceanic lithosphere; this largely Mesozoic oceanic domain had remained open until 35 Ma ago. Whereas the upper European plate stretched I the Western Mediterranean area to accommodate simultaneous subduction and slab retreat all around the former Alkapecia microplate (Michard et al. 2006), the continental core of the Adriatic microplate acted as a rigid indenter, causing E-directed extrusion of the Eastern Alps and shortening in the external Dinarides. The amount of subducted lithosphere in our plate reconstructions can be correlated with slab material imaged by seismic tomography within the mantle transitional zone beneath the Alps and Apennines, as well as beneath parts of the Pannonian Basin, the Adriatic Sea and the Western Mediterranean. The predicted amount of lithosphere subducted exceeds the estimated volume of slab material in the mantle transitional zone. This could be due either to partial decay of the thermal anomaly and/or to descent of a significant volume of the subducted material into the lower mantle.

Michard, A., Negro, F., Saddiqi, O., Bouybaouene, M.L., Chalouan, A., Montigny, R. Goffé, B. 2006. Pressure-temperature-time constraints on the Maghrebide mountain building: evidence from the Rif-Betic transect (Marocco, Spain), Algerian correlations, and geodynamic implications. C.R. Geoscience 338: 92-114.

Schmid S.M., Handy M.R., Bousquet R., Kissling E., & Bernoulli D. 2010: From Tethyan Oceans to the Western Mediterranean I - Plate reconstructions from the Present back to the Early Mesozoic. Geophysical Research Abstracts Vol. 12, EGU2010-1910.