

The Alps-Carpathians-Dinarides-connection: a compilation of tectonic units

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Discussions of the complex evolution in time and space of the Alps, Dinarides and Carpathians, grouping around the Pannonian and Transylvanian basins, rely on the availability of a tectonic map of this entire system which goes across national boundaries. We produced a map arrived at by compiling existing geological maps and by using subsurface information taken from the literature for those parts of the system that are covered by very thick Mio-Pliocene (in case of the Pannonian basin) or Mid-Cretaceous to Pliocene deposits (in case of the Transylvanian basin). This map will serve as a base map for a series of retro-deformations we plan to perform in the future. The retro-deformation of Mio-Pliocene rotations and translations was sketched for the first time by the pioneering work of Balla (1987).

We attempt to establish links between Alps Dinarides and Carpathians with a tectonic map that is accompanied by a series of crustal-scale profiles across Alps, Carpathians and Dinarides, as well as by an compilation of the ages of thrusting. Late Jurassic obduction was followed by thrusting during Early Cretaceous ("Austrian" phase), Late Cretaceous (i.e. "pre-Gosau" phase), end-Cretaceous to early Tertiary ("Laramic" phase) and Tertiary ("Dinaric" phase) times.

The maps and profiles, based on those of Schmid et al. (2004a,b) concerning the Alps, individualised the following most important tectonic elements, grouped into the following series of first-order tectonic units:

1. Miocene thrust belt: This thrust belt is the only feature that is common to Alps and Carpathians and which can be followed from the Alps all the way around the East Carpathians into the bending zone NW of Bucharest.

2. Europe-derived units: Alps and "Dacia": These comprise, from external to internal, (a) the Pre-Balkan south of Moesia (b) the Helvetic and Subpenninic units of the Alps and the Danubian nappes of the South Carpathians, (c) the Briançonnais terrane of the Alps that terminates west of the Tauern window, (d) the Infrabucovinian, Getic and Sredna Gora nappes, and (e) the Serbo-Macedonian, Supragetic, Subbucovinian, Bucovinian and Biharia nappes.

3. Inner Balkanides: These units are also Europe-derived but they exhibit an opposite vergence in respect to the Outer Balkanides (Pre-Balkan, Stara Planina and Sredna Gora) and they consist of (a) the Rhodope and (b) the Sakar-Strandja units.

4. "Tisza" block: This block exhibits mixed European and Apulian affinities. We distinguished, from external to internal, (a) the Mecsek nappe system that is closest to the eastern extension of the Piemont-Liguria ocean beyond Alps and West Carpathians (b) the Bihor nappe system and (c) the Codru nappe system that is

closest to the passive margin adjacent to Neotethys (Transylvanides or Metalliferous Mountains).

5. Apulia-derived far-travelled nappes of the Alps and Western Carpathians:

We mapped, from external to internal (a) Lower Austroalpine nappes and Tatricum, (b) Upper Austroalpine nappes representing the northern margin of Meliata, (c) an Eoalpine high-pressure belt that marks an eclogitic suture located near the westernmost tip of the Neotethys embayment and which mostly consists of eclogitized continental crust, and (d) the Upper Austroalpine nappes that represent the southwestern margin of Meliata and that occupy a paleogeographic position that is close to that of the easternmost Southern Alps.

6. Apulia-derived thrust sheets (Southern Alps and Dinarides): These consist of (a) the Southern Alps, (b) the Budva-Cukali units, representing the northern prolongation of the intracontinental pelagic Pindos basin, wedging out north of Kotor bay. (c) the Dalmatian and High Karst zones of the external Dinarides. (d) the Pre-Karst and Bosnian Flysch units representing a more internal part of the Dinaric platform, (e) the East Bosnian-Durmitor nappes, overlain by the most external units of the Dinaridic ophiolite belt, and (f) the Jadar, Ivanjica, Korab and Pelagonides, including the Bükk mountains of Northern Hungary, continental blocks positioned below the main body of the obducted ophiolites.

7. Ophiolites, suture zones and accretionary prisms with oceanic components: These belts may be traced a long way along strike, but their interrelationships still remain rather unclear in many cases. They are, from external to internal (a) Ceahlau-Severin ocean, (b) the Valais-Rhenodanubian-Magura or North Penninic ocean, that extends into the West Carpathians (Magura flysch), (c) the Pieniny klippen belt consisting of elements derived from continental ribbons of uncertain origin as well as elements of the Piemont-Liguria ocean, (d) the Piemont-Liguria-Kriscevo-Solnok-Sava ocean whose scar we trace from the Alps eastwards around the eastern tip of ALCAPA in northern Romania. There they cross the Carpathian mountains and join the Mid-Hungarian fault system that links them with that part of the Vardar ocean that stayed open until the Cretaceous-Tertiary boundary (Sava belt), (e) the Meliata-Darno-Szavarskö-Dinaridic-W-Vardar-Mirdita ophiolites and Jurassic accretionary prisms, consisting of remnants of Triassic ocean floor (Meliata) and parts of the Jurassic "Vardar" ocean (all the other elements) that simply represent the Jurassic parts of Neotethys which were obducted onto the Meliata accretionary prism and the distal passive margin of the Dinarides during the Latest Jurassic, and (f) the Transylvanian-South Apuseni-eastern Vardar ophiolitic units which represent parts of the Vardar ocean, which were thrust eastwards over the Serbomacedonian and Biharia continental units during the Late Jurassic and the Early Cretaceous.

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