

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

Stefan M. Schmid¹, Bernhard Fügenschuh², Liviu Matenco³, Ralf Schuster⁴,
Matthias Tischler¹ & Kamil Ustaszewski¹

- 1 Geologisch-Paläontologisches Institut, Basel University, Bernoullistr. 35, 4058 Basel, Switzerland (Stefan.Schmid@unibas.ch)
- 2 Geology and Paleontology, Innsbruck University, Innrain 52f, A-6020 Innsbruck, Austria
- 3 Netherlands Centre for Integrated Solid Earth Sciences, Vrije Universiteit, Faculty of Earth and Life Sciences, De Boelelaan 1085, 1081 HV Amsterdam, The Netherlands (liviu.matenco@falw.vu.nl)
- 4 Geologische Bundesanstalt, Rasumofskygasse 23, A-1031 Wien (Ralf.Schuster@cc.geoloba.ac.at)

Discussions of the complex evolution in time and space of the Alps, Dinarides and Carpathians rely on the availability of a tectonic map of this entire system. We produced a map arrived at by compiling existing geological maps and by using subsurface information taken from the literature which will serve as a base map for a series of planned retro-deformations. The retro-deformation of Mio-Pliocene rotations and translations was sketched for the first time by the pioneering work of Balla (1987). There is also a large amount of very differing reconstructions regarding the opening of the various oceanic domains of Neo-Tethys, including the Alpine Tethys (e.g. Haas and Pero 2004; Stampfli and Borel 2004).

Our map, which is based on the map by Schmid et al. (2004a) 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 (Schmid et al. 2004a), (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. It broke off Europe during the middle Jurassic. 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 which is closest to the passive margin adjacent to Neotethys (Transylvanides or Metalliferous Mountains), an ocean that must have been located well south of the Piemont-Liguria ocean within the area of the future Tisza-Dacia „block“. We attributed the Biharia nappe system to Dacia rather than to Tisza, as is conventionally postulated.

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 (as is the case for the Lower Austroalpine) and which include the Northern Calcareous Alps, basement nappes such as the Silvretta and Seckau units, as well as the Veporicum and Gemicum of the West Carpathians, (c) an eoalpine high-pressure belt that marks an eclogitic suture located near the westernmost tip of the Neotethys embayment and which mostly consist 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. We abandoned the concept of a „Middle Austroalpine“ nappe system in favor of this new subdivision, first proposed by Schmid et al. (2004a).
6. **Apulia-derived thrust sheets (Southern Alps and Dinarides):** These consist of (b) the Southern Alps (b) the Budva-Cukali units, (c) the Dalmatian and High Karst zones, (d) the Pre-Karst and Bosnian Flysch units, (e) the East Bosnian-Durmitor nappes, and (f) the Jadar, Ivanjica, Korab and Pelagonides, including the Bükk mountains of Northern Hungary.
7. **Ophiolites, suture zones and accretionary prisms with oceanic components:** These comprise a series of elements, which may be traced a long way along strike, but whose interrelationships remain rather unclear in many cases. They are (a) the Ceahlau-Severin ocean (b) the Valais-Rhenodanubian-Magura or North Penninic ocean, (c) the Pieniny klippen belt (d) the Piemont-Liguria-Kriscevo-Solnok-Sava ocean, (e) the Meliata-Darno-Szavarskö-Dinaridic- W-Vardar-Mirdita ophiolites and Jurassic accretionary prisms obducted during the Latest Jurassic, and (f) the Transylvanian-South Apuseni-eastern Vardar ophiolitic units which represent parts of the Vardar ocean thrust eastwards over the Serbomacedonian and Biharia continental units.

We acknowledge the contributions we received from numerous colleagues in Central and Southeastern Europe, particularly M. Sandulescu (Bukarest), D. Plasienska (Bratislava), B. Tomljenovic (Zagreb), L. Csontos (Budapest), L. Fodor (Budapest), S. Kovacs (Budapest), H. Hrvatovic (Sarajevo) S. Karamata (Belgrade), M. Sudar (Belgrade), N. Gerzina (Belgrade) and I. Balintoni (Cluj). This map may be obtained any time as a color version by writing to Stefan.Schmid@unibas.ch.