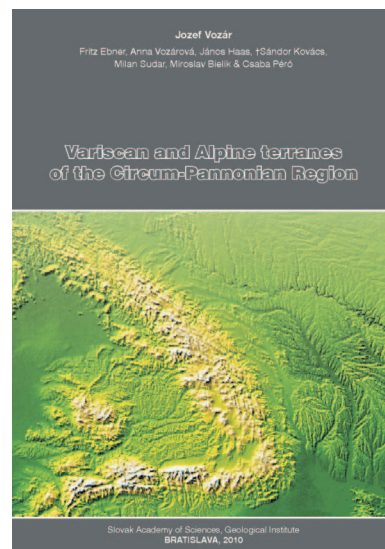


## BOOK REVIEW

## “Variscan and Alpine terranes of the Circum-Pannonian Region”

Editors:

J. Vozár, F. Ebner, A. Vozárová, J. Haas, S. Kovács, M. Sudar,  
M. Bielík & C. Péro



The Circum-Pannonian Region is formed by a collage of peri-Gondwanan terranes with a very complex geological history. Deciphering and understanding it has been a challenging task for generations of geologists. The recently published monograph represents a remarkable and thoroughly done attempt. It is a result of many years of cooperation of the geological community of the Carpatho-Balkan countries co-ordinated by JOZEF VOZÁR as the main editor. They have attempted to map and describe the Late Early Paleozoic paleotectonic evolution stratigraphically from Devonian to middle Jurassic times when this region was gradually assembled by accretion and amalgamation of oceanic and continental domains later masked by a strong Alpine overprint. The editors together with the other 31 authors have thus summarized the current state of knowledge on the Variscan and Alpine tectono-sedimentary terranes in the Circum-Pannonian Region of Austria, Slovakia, Hungary, Slovenia, Croatia, Serbia, Romania and adjacent parts of Italy and Bulgaria. The history is divided into four time slices which represent particular stages in the tectono-sedimentary development of the region. These include: (1) a pre-Variscan to early Variscan, basically Devonian to Early Carboniferous stage, (2) a late-Variscan (Late Carboniferous to Permian) molasse stage, (3) a Triassic, initial Neotethyan rifting stage and (4) a Jurassic, maximum Neotethyan spreading stage of development. The monograph consists of 231 pages of A4 size supplemented by 74 coloured tectono-stratigraphic and paleo-environmental maps. Anybody who is interested in the geology of the region will surely appreciate the 232 stratigraphic type-profiles of particular terranes, the position of which is localized in maps.

The monograph is divided into six chapters, four of them presenting the main evolutionary stages of the region and the remaining two focused on conceptual principles of terrane analysis and deep structure of the region derived from geophysical data. Each chapter is an autonomous “unit” with its own abstract and reference list, which help the reader to grasp its main ideas quickly.

In the first chapter “**Terrane philosophy — Application of the terrane concept to the Circum-Pannonian Region**”, the authors explain thoroughly the concept of terranes and problems related to its application in the Circum-Pannonian Region. They basically follow the original Keppie & Dallmeyer (1990) definition of terranes as crustal units separated by faults or melanges or zones with telescoped oceanic lithosphere and characterized by an internal continuity of stratigraphy, biota, structure, metamorphism, igneous petrology, metallogeny, geophysical properties and paleomagnetic record. Differences between neighbouring terranes cannot be explained by lateral transition of these parameters. Terranes originate by tectonic separation either by rifting or large-scale strike-slip tectonics which result in their further displacement until they are docked to a different crustal unit in a new paleo-geographical and geotectonic position. In the pre-Neogene basement of the Pannonian Basin and its Alpine-Carpatho-Dinaridic surroundings the authors distinguished five Alpine mega-tectonic composite units called megaterranes: ALCAPA, TISIA, ADRIA-DINARIA, VARDAR, DACIA underlain by a previously amalgamated collage of Variscan terranes and by Neotethyan oceanic crust. All these hierarchically arranged terrane units achieved their present position after long-lasting and complex movements ranging from Early Paleozoic times to the Early Miocene.

The second chapter, “**Devonian-Carboniferous pre-flysch and flysch environments in the Circum-Pannonian Region**”, describes Devonian-Early Carboniferous sedimentary sequences of particular megaterranes and reconstructs their relationship. The authors also discuss the paleo-geographical position and tectonic evolution of Variscan terranes derived from the northern margin of Gondwana or the oceanic domain between Gondwana and Laurussia. Widespread medium- to high-grade metamorphic complexes are mostly Late Devonian/Early Carboniferous in age although locally they can be even older. Orogenic events formerly assigned to the classical Variscan tectonic phases (Bretonic, Sudetic and Asturian) or undifferentiated Carnic phase (Vai 1975), are indicated by a Late Serpukhovian to early Moscovian hiatus resulting from collision of these Variscan terranes with the southern margin of Laurussia. It is well documented in the E Alps and W Carpathians of the ALCAPA megaterrane and in most parts of the DACIA megaterrane. In more southerly located areas this phase is either absent or not defined due to poor stratigraphy. After the main phases of the Variscan orogene, most of the terranes were already accreted to the southern margin of Laurussia.

The third chapter called “**Late Variscan (Carboniferous to Permian) environments in the Circum-Pannonian Region**” describes late orogenic to postorogenic Pennsylvanian to Permian environments. In external parts of terranes, upper Bashkirian to Moscovian shallow marine siliciclastics or carbonates overlap variably metamorphosed Variscan basement or deformed syn-orogenic flysch of Mississippian to Early Pennsylvanian age. In internal parts of terranes, continental deposition started mostly around the Moscovian/Kasimovian boundary and lasted until the Permian. Shallow marine siliciclastics to carbonates and locally also evaporites locally evolved during the Permian. The Variscan orogenic belt of the Circum-Pannonian Region was significantly affected by post-Variscan rifting.

The fourth chapter describes “**Triassic environments in the Circum-Pannonian Region related to the initial Neotethyan rifting stage**”. It provides a thorough overview of the Triassic terranes and their early Alpine/early Neotethyan evolution beginning with the Middle Permian transgression on the eastern part of the Carnic-Dinaric microplate. The transgression reached its maximum extent in the

early Middle Triassic characterized by intense carbonate deposition. Around the Anisian/Ladinian boundary the rifting processes disrupted the carbonate ramp and produced the new oceanic crust of the Neotethys. Rifting processes and climatic oscillations resulted in a differentiation into a complex of sedimentary environments.

To better understand this complexity, the authors provide facies correlation diagrams and a table depicting relationships between terranes. The tectonic and facies complexity is also well expressed in 81 lithostratigraphic profiles.

Chapter five, "**Jurassic environments in the Circum-Pannonian Region**" summarizes the Jurassic successions of particular terranes, their facies complexity and relationships. The Jurassic is an important period in tectonic development of the Circum-Pannonian Region. Closure of the westernmost part of the Neotethys Ocean and subsequent opening of the Piedmont-Penninic Ocean as an eastern continuation of the early Atlantic Ocean in the western Mediterranean area resulted in significant changes in setting of the Circum-Pannonian terranes and in turn in paleo-geography of the region. Similarly to the previous chapter, the number of lithostratigraphic profiles substantially contributes to better understanding of the complexity of depositional settings.

The sixth and final chapter focuses on the "**Gravity and seismic modelling in the Carpathian-Pannonian Region**". The team of authors gathered, unified and homogenized gravity databases from different countries which together with potential field data provided a base for 2D and 3D combined modelling of the surface heat flow, geoid, gravity and topography data. These parameters, in turn enabled determination of the lithospheric thermal structure along nine transects across the Western and Eastern Carpathians, Pannonian Basin and European Platform. The 3D density model of the Western Carpathian-Pannonian Region is also completely new. The results of the complex geophysical modelling have improved our knowledge of the crustal and lithospheric thickness and structure of the region. The lithospheric thickness varies from 160 km under the Eastern Alps up to 240 km beneath the foreland of the Eastern Carpathians, where the thickened lithosphere is interpreted as a remnant of subducted slab. Thin lithosphere with about 60–100 km was confirmed beneath the Pannonian Basin. Petrological analysis of the xenoliths in this region indicates significant mantle uplift. In addition, the presented geophysical models have improved definition of horizontal and vertical crustal boundaries between different tectonic units.

At first glance, the common style of most figures and of the text gives an impression of a completely compact monograph. Only minor differences in styles can be recognized when reading it. This is, however, not surprising assuming that several dozen authors contributed to this book. Absence of explanation to some figures makes it more difficult to fully understand them. As a geologist working mostly in classical Variscan areas without a stronger Alpine overprint I would also appreciate a series of paleo-geographical maps explaining the tectonic and paleo-geographical development of the area within the studied stratigraphic interval but such maps occur only in some chapters. A series of simplified paleo-geographical maps from the late Devonian to the Jurassic would be more than welcome. On the other hand the complexity of tectonic and in turn, of paleo-geographical development of the area prevents such unambiguous reconstructions. In any case, the above mentioned comments do not reduce the importance of the monograph and its overall contribution to development of knowledge of the rich geological history of the study area. The monograph, without any doubts, provides a modern, thorough and consistent overview of the current knowledge on the Variscan and Alpine terranes of the Circum-Pannonian Region. Such a monograph should not be absent from the library of any geologist dealing with sedimentology, tectonics and stratigraphy. It is a real guidebook to the terranes of this part of Europe!

*S. Opluštil, Charles University in Prague*