Pre-Alpine tectonic evolution of the Eastern Alps: From Prototethys to Paleotethys

Franz Neubauer[1], Yongjiang Liu[2], Yunpeng Dong[3], Ruihong Chang[1], Johann Genser[1], Sihua Yuan[4]

*[1] Department of Geography and Geology, Paris-Lodron-University of Salzburg, Austria. * Corresponding author: e-mails: franz.neubauer@plus.ac.at; ruihong.chang@stud.sbg.ac.at*
[2] Frontiers Science Center for Deep Ocean Multispheres and Earth System, Ocean University of China, Qingdao 266100, China; e-mail: liuyongjiang@ouc.edu.cn
[3] State Key Laboratory of Continental Dynamics, Department of Geology, Northwest University, Northern Taibai Str. 229, Xi'an 710069, China; e-mail: dongyp@nwu.edu.cn
[4] College of Earth Science, Institute of Disaster Prevention, Sanhe 065201, Hebei, China; e-mail: yuansihua@126.com

In all reconstructions published during the last two decades, the Austroalpine and the correlative Southalpine basement units of the Eastern Alps were considered to represent a uniform continental block that split off from the northern Gondwana margin during Early Paleozoic times and collided with microcontinental blocks during the Variscan orogeny in the early Late Carboniferous. Afterwards, these units formed finally the outboard part of the European Variscides adjacent to the Paleotethys Ocean. The combined Austroalpine/Southalpine basement extends to the Western Carpathians, contains Ediacaran and Early Paleozoic ophiolites and magmatic arcs and Devonian passive margin successions and represents a key region for resolving the Late Neoproterozoic to Late Paleozoic tectonic evolution of the basement in the Alpine-Mediterranean Mountain belts. The Austroalpine and Southalpine basement contains well-known fossil-rich Ordovician and Silurian rift and mainly Devonian passive margin successions summarized as the Noric and Carnic domains, which were juxtaposed to amphibolite-grade metamorphic complexes during Early Carboniferous plate collision. In the metamorphic units the following main stages of tectonic evolution are: Two distinct Ediacaran to Cambrian arc systems were recognized, correlating with subduction of the Prototethys (Ran) Ocean. The continental Wechsel Arc stopped its activity during Late Cambrian times, whereas the Silvretta-Gleinalpe Arc was reactivated at the Devonian/Carboniferous boundary during subduction of the Devonian Balkan-Carpathian Ocean. The Prototethyan oceanic crust is preserved in the ophiolitic Upper Neoproterozoic to Middle Ordovician Speik Complex, that was obducted onto the Silvretta-Gleinalpe Arc during Late Ordovician to Early Silurian times. On the other hand, the Noric domain was initially part of the northern Gondwana margin and includes a virtually continuous sedimentary section ranging from the Early Ordovician to earliest Pennsylvanian. It started with an Early to Late Ordovician rift succession with mafic and acidic volcanic rocks related to rifting of parts of the Noric domain from the northern Gondwana margin forming an oceanic basin (Rheic Ocean of previous interpretations) in between and back-arc rifting is the likely setting. In both Noric and Carnic domains, Silurian strata were deposited during a tectonically quiet period followed by onset of a second rifting period during Late Silurian times, which resulted in deposition of thick Devonian carbonates heralding the opening of the Balkan-Carpathian Ocean and separation of the Paleo-Adria microcontinent from Gondwana. Late Devonian–Carboniferous plate convergence led to subduction of this oceanic rift followed by subduction of the Paleo-Adria margin underneath the accreted Variscan convergence belt, collision and Late Carboniferous intramontane molasse deposition. However, new data argues that a third ophiolitic belt, the Plankogel ophiolitic mélange, which formed as part of the Paleotethys Ocean during the Devonian and was reactivated as trench during initial consumption of the Paleotethys Ocean during late Permian–Triassic times. In this preliminary model, Mid-Late Triassic plutonic and volcanic rocks of the Southern Alps are considered to represent the magmatic arc associated with the Paleotethys subduction. (For more details of data and models, see Neubauer et al., 2022, Pre-Alpine tectonic evolution of the Eastern Alps: From Prototethys to Paleotethys. Earth-Science Reviews 226, 103923).

Acknowledgements. The study was financially supported by the NSF of China (grant no. 91755212).