The Eastern Greywacke Zone – a 400 Ma story from Gondwana decay to Alpine assembly

Fritz, Harald[1]; Nievoll, Josef[2,3]; Gallhofer, Daniela[1]; Hauzenberger, Christoph[1]; Gritsch, Bernadette[1]; Pfatschbacher, Michael[1]; Krenn, Kurt[1]; Karner-Rühl, Kevin[1]; Haas, Isabella[1]; Eichinger, Stefanie[3]

1 Institute for Earth Sciences, University of Graz, Universitätsplatz 2, A-8010 Graz, Austria; 2 Gumpendorfer Straße 83–85/2/48, A-1060 Vienna, Austria; 3 Institute of Applied Geosciences, Graz University of Technology, Rechbauerstraße 12, A-8010 Graz, Austria.

The Greywacke Zone (GWZ) was originally defined as the hilly domain between the Northern Calcareous Alps and the “crystalline” rocks of the central axis of the Alps. Despite of this insignificant description from the 19th century it turned out that the units exposed contain information relevant for Early Paleozoic break-off of north Gondwana fragments, two Paleozoic orogenies, closure and obduction of Meliata oceanic fragment and distribution of early Alpine nappes. The area of interest consists, from tectonic bottom to top, of the Veitsch Nappe, a sequence of Carboniferous shallow marine molasse sediments and the Silbersberg Nappe, a succession of Permian metaclastics interbedded with acidic and basic volcanics. Slices of amphibolite and gneiss (“Kaintaleck slices”) are either interpreted as part of the Silbersberg Nappe or as individual Kaintal Nappe. The greatest extend by area is represented by the Tirolic-Noric nappe system with Paleozoic metasediments and metavolcanics transgressively overlain by Permo-Mesozoic sediments in Tirolic facies. The uppermost tectonic unit is the Mürzalpen Nappe with Permo-Mesozoic sediments in Juvavic facies that are not part of the GWZ. The Tirolic-Noric nappe assembly consists of four internal nappes, the Hocheck, Rossegg, Steinbach, and Aschbach Nappes. All of them contain andesitic to rhyolitic metavolcanics that range in age between c. 480 and 445 Ma and are interbedded, in the Steinbach Nappe, by sandstones. The sediments within individual nappes differ significantly in facies. Upper Ordovician to Silurian shallow marine sediments occur within the Hocheck and Rossegg Nappes (Rad Formation) and continental slope deposits within the Steinbach Nappe (Stocker Formation). The Sommerauer Formation of the Aschbach Nappe contains turbidites interpreted as channel or lobe sediments deposited on the ocean floor. The pre-tectonic arrangement as derived from profile balancing gives a NW-SE arrangement of nappes and facies domains with continental slope deposits in the today’s northwest and a shallow marine platform in the southeast. The metavolcanics are interpreted to document magmatic pulses from the end of the Ceneric Orogeny to the opening of the Paleo-Tethys Ocean. Simultaneously with deposition of platform carbonates in the Noric Group an early, Eo-Variscan tectonic activity is recorded within the Kaintaleck metamorphic slices (c. 380 Ma). Undated tholeiitic basalts with MORB affinity evolved potentially already in the Late Neoproterozoic / Cambrian and accreted in the Middle Devonian. This Eo-Variscan event is further supported by c. 390 Ma old detrital zircons from Permian Silbersberg sandstones that document existence of a Middle Devonian magmatic / metamorphic hinterland. Other detrital zircon spectra from Carboniferous and Permo-Mesozoic sediments of the Veitsch and Tirolic-Noric nappes show a pronounced Tournaisian peak (c. 356 Ma) documenting erosion from a second, Meso-Variscan source. The detrital zircon age data show also that the clastic Permo-Mesozoic sediments of individual nappes were not delivered from the same source. We argue for large-scale lateral displacement along transform systems when the Meliata Ocean was closing and Piemont-Liguria was opening, probably during the Jurassic. Final Meliata closure and accretion is evident from gabbro occurrences incorporated at the base of the Juvavic nappes, followed by topwest stacking along the Noric Thrust at conditions of c. 420 °C prior c. 100 Ma.