4D kinematics of the Neogene Eastern Alps: An ArcGis based analysis of horizontal and vertical kinematics

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Prior to the Neogene, the evolution of the Alps may be considered to have started with the final subduction of oceanic lithosphere and the onset of continent – continent collision. The enigmatic Augenstein landscape indicates that topography was low (Frisch et al. 1998). Rapid extension in the Pannonian basin allowed an open eastern boundary and much of the N-S convergence was compensated by east-west extension. Since the basin inversion in the east, a change from extension to a regime of compression caused rapid, tectonically driven uplift at the orogen margins. This change in the external boundary conditions can be used as a time marker against which changes in horizontal and vertical kinematics, including present day erosion rates of the orogen, can be evaluated.

As part of the TOPO Alps project "4D kinematics of the Neogene Eastern Alps" we present a high resolution database on both, horizontal and vertical kinematics of the orogen. By using the natural-neighbour interpolation tool provided by the ESRI-ArcMap9.3 GIS software, we created maps with zircon- (ZFT) and apatite fission track (AFT) ages covering the Eastern Alps.

The maps show patterns of relatively young ages (ZFT $\leq$ 20, AFT $\leq$ 15 Ma) in the Tauern Window, the Niedere Tauern and Pohorje Mountains, suggesting that these units underwent the strongest denudation in Middle Miocene times. These conclusions is supported by long mean AFT lengths ($\geq$ 13 µm) and accelerated exhumation rates calculated from samples with paired zircon and apatite fission track- and/or zircon and apatite (U-Th)/He ages. On the contrary areas with older zircon- and apatite fission track ages are characterized by a trend to shorter mean AFT lengths ($\leq$ 13µm) and relatively low exhumation rates. These areas to the East of the Tauern Window, namely the Gurktal block, the Kor- and Saualpe exhibit remnants of paleosurfaces of unknown age.

The evaluation of data on horizontal kinematics of major fault zones and sedimentary record of intramonane basins to the east of the Tauern Window suggests four different main deformation stages: (1) pre-Karpatian N to NW directed compression causing strike slip motion and large offset in km scale; (2) Badenian to Sarmation phase of extension accompanied with the formation of intramontane basins; (3) Late Miocene E-W compression causing fault reactivation, basin inversion and uplift of distinct regions; (4) Pliocene to recent NW to N compression with mainly strike slip faulting, seismology and recent uplift patterns.

While many of these details are known, an orogen-scale compilation and interpretation is still missing.

References:

Frisch W., Kuhlemann J., Dunkl I., Brügel A., (1998). Palinspastic reconstruction and topographic evolution of the Eastern Alps during late Tertiary extrusion. Tectonophysics, 297, 1-15.