2-D kinematic restoration of the western Tauern Window using thermochronological constraints

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The Tauern Window (TW) in the European Alps has a high tectonic complexity. It is a key area to understand a number of important orogenic processes. During the Cretaceous, subduction and accretion of the Penninic realm beneath the northern margin of Adria (Austroalpine) began, which led to collision between Europe (Subpenninic) and the Adria margin, from Eocene to early Oligocene. This resulted in the Penninic and Subpenninic nappe stack in the southward-dipping orogenic wedge. After the "Tauernkristallisation"-event, indentation of the Dolomites Indenter (Eastern Southern Alps) is heralded in the last deformation stage, which bent the primarily W-E striking, dextral Periadriatic Fault System (PFS) separating the Eastern from the Southern Alps, and finally caused this fault system to be sinistrally offset by the NNE-SSW-striking Giudicarie fault system in the Miocene. This last deformation stage resulted in strong N-S shortening (ca. 70 km) of the western TW in front of the Dolomites indenter as well as W-E extension, which formed the Katschberg and Brenner Normal Faults (eastern and western border of the TW), and to lateral extrusion towards the east involving major strike-slip faults (e.g., Inntal Fault, PFS, SEMP). It is widely assumed that all these processes happened synkinematically exhuming the western TW up to ca. 20 km (derived from the throw of the Brenner Normal Fault and by the metamorphic conditions reached). However, the quantitative deformation history of the western TW, and in particular its Subpenninic core (Venediger Duplex, VD), has never been investigated in detail. Our goal is therefore to quantify the deformation and kinematics accommodated by the VD in a first step by restoring the Brenner Base Tunnel cross-section using the software MOVE (Ptx). Since standard balancing of this structure is not possible due to penetrative deformation, we integrate Zircon Fission Track data (partial annealing zone of 240 – 180°C and closure temperature ca. 210°C) as marker for the transition from brittle to viscous conditions in the felsic rocks of the VD: Any folding in the VD must be older than the ZFT age of the corresponding unit. For this reason, we first displaced the whole duplex structure down along the Sub-Tauern Ramp below the Zircon Fission Track annealing zone. We then unfolded the gneiss cores individually until a symmetrical duplex structure was modeled, which reached 20 km depth. Since the modeling of vertical exhumation, N-S shortening and displacement along the Sub-Tauern Ramp strongly depends on the geothermal gradient (GG), we tested different GG. Resulting exhumation rates related to a GG of 30°C/km and 50°/km fit well with former studies, which means that 30-50°C/km is a reasonable range for the GG during the last deformation stage.