



Estimating displacement along the Brenner Fault and orogen-parallel extension in the Eastern Alps

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The major structure accommodating orogen-parallel extension in the Eastern Alps was inferred to be the Brenner Fault, which forms the western boundary of the Tauern Window. The estimated amount of extension along this fault varies between a minimum of 10-20 km to a maximum of > 70 km. All investigations that attempted to constrain this amount of extension, calculated the fault-plane parallel displacement, required to restore the difference of structural level between foot-wall and hanging wall, as constrained by geo-barometry. However, these calculations neglected the component of exhumation of the footwall resulting from folding and erosion. Therefore, the total amount of extensional displacement was systematically overestimated. In the present study we calculate the vertical offset along the Brenner fault, by projecting along a N-S cross section a tectonic surface, inferred to have occupied the same structural level in the hanging wall and in the foot wall of the Brenner Fault. This tectonic surface is the base of the Patscherkofel unit in the footwall and the base of the Ötztal basement in the hanging wall. This approach allows one to quantify the vertical offset and its variations all along the strike of the Brenner Fault. This construction shows that the vertical offset of the chosen marker horizon on both sides of the Brenner Fault varies strongly and continuously along the strike of the Brenner Fault, attaining a maximum value of 15 km at the hinge of the folded footwall (Tauern dome). The along-strike change of vertical offset is explained by large-scale upright folding of the footwall that did not affect the hanging-wall of the Brenner Fault. Therefore, the difference of vertical offset between the area of the Brenner Pass and the area immediately south of Innsbruck, which corresponds to ca. 10 km, defines the shortening (upright folding) component of exhumation of the footwall. The remaining 5 km of the vertical offset must be attributed to extensional deformation, which consequently amounts to 5 km. The Brenner Fault itself is barely folded, its dip varies between 20° and 40°, and it crosscuts the upright folds of the western Tauern Window. Given the offset of 5 km, the dipping angle of the fault constrains the extensional displacement between 6 and 14 km. The most significant part of orogen-parallel extension is accommodated within the footwall of the Brenner Fault along a series of sinistral, ENE-striking shear zones. Therefore the Tauern Window was primarily exhumed by folding and erosion, not by extensional unroofing. The most significant part of orogen-parallel extension within the Tauern Window is probably accommodated along a series of sinistral, ENE-striking shear zones.