Geol. Paläont. Mitt. Innsbruck, ISSN 0378–6870, Band 25, S. 1–242, 2001

DUCTILE TO BRITTLE FAULTING IN THE FOOTWALL OF THE BRENNER NORMAL FAULT AND ITS CONNECTION TO THE INNTAL STRIKE-SLIP FAULT SYSTEM (THE TYROL, EASTERN ALPS)

Franz Reiter, Rainer Brandner, Kurt Decker, Hugo Ortner & Gerhard Wiesmayr

The data presented derive from a regional structural geology survey covering a complete section through the western Tauern Window and adjacent Austroalpine Units carried out by order of the Brenner Base Tunnel Company (BBT) (compare DECKER et al., this volume).

Brenner fault and Silltal fault: The Neogene orogen-scale Brenner low-angle normal fault at the W margin of the Tauern Window (Fig. 1) is characterized by a several hundred meters thick mylonite zone (BEHRMANN, 1988; SELVERSTONE, 1988). Displacement continuosly decreases from the center of the Tauern Window towards the N and S (FÜGENSCHUH ET AL., 1997). The northern continuation of the mylonite zone between the Lower Austroalpine N of the Tauern Window and the Ötztal Crystalline Basement (OCB) is formed by a discrete brittle fault referred to as Silltal fault (BEHRMANN, 1988). Comparable fully brittle structures can be traced southwards into the Tauern Window (e.g. in the area of Gossensaß). The faults are assumed to operate during the late stage of orogen-parallel extension post-dating fission track cooling ages of about 13Ma (FÜGENSCHUH et al., 1997). Structural investigations at the Silltal fault near Innsbruck revealed that the fault continuously bends to NW-directed strike. Kinematic indicators in ultracataclasites indicate a Top SW normal movement on moderately SW-dipping fault planes. The Silltal fault is displaced by E- and N-striking high angle faults offsetting it by several tens of meters.

Normal faulting and subsequent folding in the footwall of the Brenner fault: The most prominent structures in the footwall of the Brenner fault in the Tauern Window are meso- to macroscale W-directed semi-ductile and brittle normal faults and tension gashes. Subordinate conjugate normal faults indicate E-W extension. Many of these fault sets on the northern limb of the Tux antiform indicate a post-extensional northward tilting in the order of 10-20°. We assume that the conjugates are not older than the zircon fission track ages (10-15 Ma, FÜGENSCHUH et al, 1997). The structures therefore may indicate continued updoming of the Tauern structure during or after the Late Miocene.

NE-striking sinistral ductile to brittle shear zones: Several NE-striking ductile to brittle shear zones with subvertical mylonitic foliation, 5-15° W-plunging stretching lineation and sinistral shear indicators were mapped on the northern limb of the Tux antiform. The shear zones commonly involve rocks of the "Altes Dach"-Complex acting as low-competence zones between the Zentralgneis units. Towards the Brenner normal fault the shear zones link up with SSW-striking oblique normal faults not penetrating the Brenner mylonite zone. Brittle (re-) activation of these shear zones with similar kinematics is indicated by slickensides paralleling the stretching lineation and cataclasites. These brittle faults cause minor displacement of the cover sequences. At this point of the study brittle

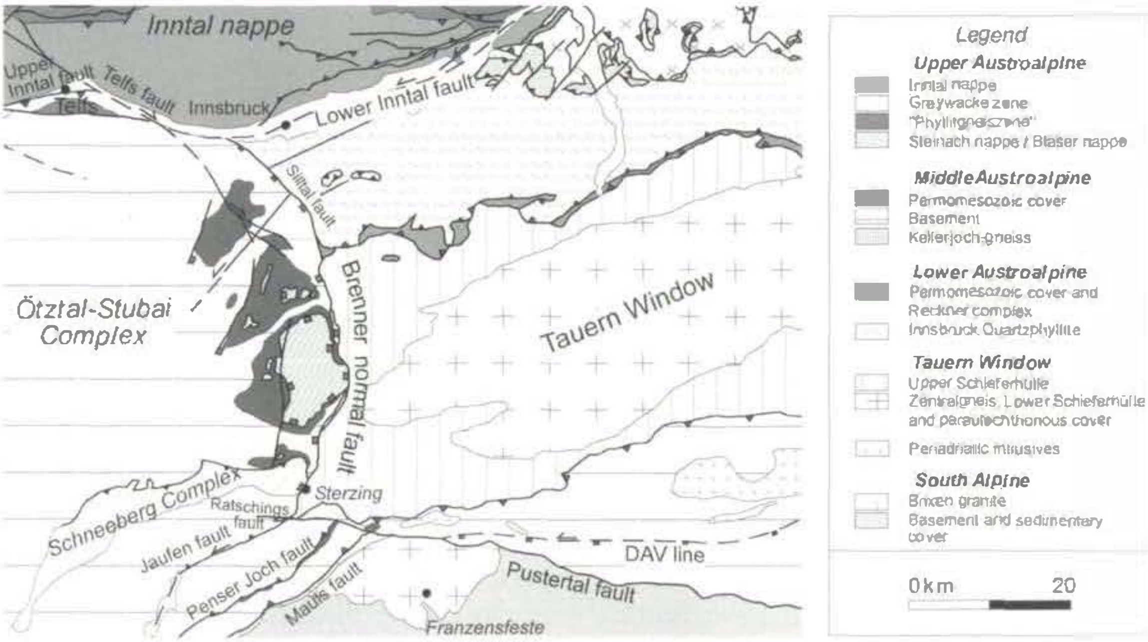

Fig. 1: Tectonic map of the western Tauern Window and surroundings

strike-slip faulting can be interpreted either as resulting from a continuous ductile-brittle deformation process during exhumation of the Tauern Window, or as a later reactivation of ductile shear zones. Due to the consistently W-dipping stretching and slickenside lineations the faults separate zones of higher exhumation in the south from zones of lower exhumation in the north. The ENE striking boundary between the Tauern Window and the Lower Austroalpine is overprinted by semiductile sinistral shear zones, which do not crosscut the Silltal fault. The jump in fission track ages from 16 to 35 Ma across this tectonic contact (FÜGENSCHUH et al., 1997) can be explained by faster eastward exhumation of the Tauern window with respect to the Lower Austroalpine Units. Both units apparently were uncoupeled by the described ENE-striking sinistral shear zones comparable to the "Tauernnordrandstörung" further east.

The Connection between the Silltal and the Inntal fault: Neogene northward movement of the Adriatic indenter caused both N-S contraction of the Tauern Window (which there was coeval with the activity of the Brenner normal fault), N-directed thrusting of the OCB at its northern margin, and S-directed back-thrusting along the southern margin of the OCB. The Upper Inntal fault can be regarded as a steepened thrust of OCB over the southern margin of the Northern Calcareous Alps (NCA). The regional trend and slip direction of the northern Silltal fault supports a kinematic link with post-Oligocene fault movement of the NE-striking sinistral Lower Inntal E of Innsbruck. Ultracataclasites of the Silltal fault are dissected by conjugate E-W-extensional faults and conjugate NNE- and ENE-trending strike slip faults. From the strike-slip faults we infer that the post-13 Ma extension at the Silltal fault (FÜGENSCHUH et al., 1997) was followed by a Late Miocene NE-directed contraction, which might be correlated with an E-W compressional phase at 9 Ma, previously documented for the Vienna basin and Eastern NCA (PERESSON & DECKER, 1997)

References

BEHRMANN, J.H. (1988): Crustal-scale extension in a convergent orogen: the Sterzing-Steinach mylonite zone in the Eastern Alps. – Geodinamica Acta (Paris), **2**, 63–73.

FÜGENSCHUH, B., SEWARD, D., & MANCKTELOW, N.S. (1997): Exhumation in a convergent orogen: the western Tauern window. – Terra Nova, **9**, 213–217.

PERESSON, H. & DECKER, K. (1997): Far-field effects of Late Miocene subduction in the Eastern Carpathians: E-W compression and inversion of structures in the Alpine-Carpathian-Pannonian region. – Tectonics **16**, 38–56.

SELVERSTONE, J. (1988): Evidence for east-west crustal extension in the eastern Alps: implications for the unroofing history of the Tauern Window. – Tectonics, **7**, 87–105.

This work was supported by the Brenner Base Tunnel Company (BBT), Innsbruck, Austria.

Authors' addresses:
Rainer Brandner, Hugo Ortner, Franz Reiter, Institut für Geologie und Paläontologie, Universität Innsbruck, Innrain 52, A-6020 Innsbruck, Austria; Kurt Decker, Gerhard Wiesmayr, Institut für Geologie, Universität Wien, Althanstraße 14, A-1090 Vienna, Austria