Exhumation mechanisms of the Tauern window, Eastern-Alps

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The Tauern Window, in the central part of the Eastern-Alps, is a thermal and structural dome which exposes Penninic basement and cover units, in addition to parts of the Austroalpine basement that are overprinted by Tertiary metamorphism. The peak of Tertiary metamorphism was attained approximately at 30My ago, followed by cooling and exhumation throughout the Miocene. Most of the Tertiary exhumation of the Eastern-Alps, was localized in the Tauern Window, from the Early Oligocene to the late Miocene.

Two end-member interpretations of the exhumation mechanisms exist at present: exhumation is controlled either by orogen-parallel extension or by folding and erosion. Both mechanisms rely on structural evidence. E-W extension is well documented at the western (Brenner Fault) and at the Eastern (Katschberg Fault) margins of the window. In contrast, upright folding dominates the internal structure of the dome, and in particular of its western part, where fold amplitudes attain more than 10 km. It is the aim of this study to assess the relative importance of these two processes during exhumation.

The first results obtained by compilation of previous apatite and zircon fission track ages indicate a concentric younging of both the apatite and zircon ages toward the core of the Tauern window. The concentric iso-age lines globally follow the two main strikes of the axial planes of the upright folds of the western and eastern Tauern Window, suggesting that folding and erosion mainly controlled the exhumation process. This cooling pattern is in contrast to the one expected by a process of extensional unroofing, which results in iso-age lines parallel to the extensional fault and progressively younging towards the extensional fault (e.g., Foster et al., 2001).

Independent evidence on the possible mechanism controlling the most recent exhumation may be obtained by reconstructing the palostresses deduced from the inversion of fault slip data. First results of this investigation indicate E-W extension along N-S striking normal faults at the eastern and western margins, and strike-slip fault systems associated with an E-W extension in the core of the Tauern Window. Pure compressional regimes play a minor role in the accommodation of the brittle deformation. Therefore, the brittle structures presently observed in the central part of the Tauern Window are not consistent with the hypothesis of folding-erosion as the main exhumation mechanism.

New fission track ages, combined with previous data, will be used to visualize the 3D geometry of isochrones for the Fission Tracks. This model will permit to determine the wavelength and amplitude of the folded isochrones and the degree of thinning -telescoping- of these isochrones along the extensional faults. These results will be used to discriminate the amounts of folding and of extensional unroofing in the exhumation process of the Tauern window. At the same time, new and complementary fault slip data will be collected in order to answer this apparent paradox between the type of brittle deformation and the exhumation process of the dome.