Fission track dating as a correlation tool for complex structural datasets: constraints for the postmetamorphic evolution of the axial NW Alps

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The analysis of postmetamorphic deformation in collision orogens is an exercise frought with uncertainties. In strongly deformed areas where fault orientation is not scale-invariant, the strain field inferred from mesoscale structures may differ from strain on a regional scale. Structural analyses on different scales, comprising detailed field mapping on large areas, are thus required for reliable regional reconstructions, as well as independent methods to constrain the age of mesoscale deformation in the brittle field, and suitable techniques to evaluate throws along major faults in the lack of stratigraphic markers.

Fission-track analysis, already employed to constrain throws along major faults, is a powerful tool to constrain the age of mesoscale deformation (Malusà et al. 2009). Fault-rock types and related deformation mechanisms show in fact a generalized progression with depth, from gouge/breccias to cataclasites and mylonites the former, and from frictional-plastic to viscous the latter. Transition from frictional to viscous flow, also dependent on strain and lithology, is prominently controlled by temperature in the crust. Therefore, the analysis of fault rocks gives indications on the crustal level where mesoscale structures have formed. Because fission-track analysis provides chronological constraints on the passage of a rock mass through a given crustal level, the age of both mesoscale structures and related axes of global incremental strain can thus be determined.

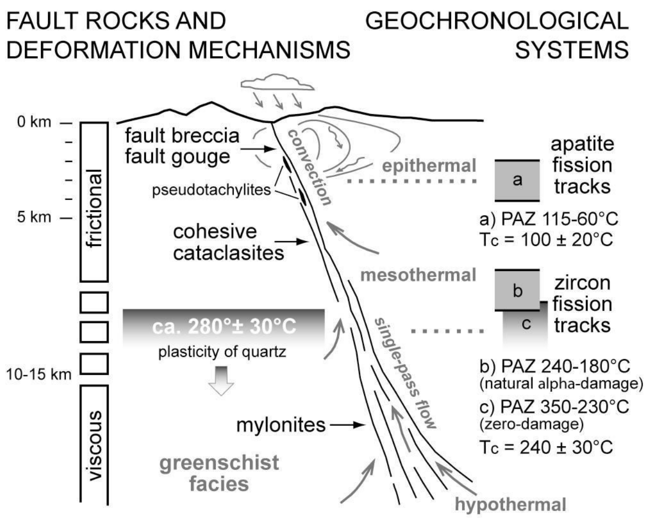

Figure 1 (after Malusà et al. 2009)

This approach is here applied to a multiscale field-geology study in the northwestern Alps. We mapped in the field the network of major faults over an area >600 km^2. Mesoscale strain-axes related to different deformation events were distinguished. Sets of coeval strain axes were plotted on synoptic maps, and the resulting patterns were compared with the kinematics of the regional-scale structures in order to deduce a likely regional-scale strain field for the study area, and its variation through time. Results provide new insights on the postmetamorphic evolution of the Western Alps and, more in general, on extensional tectonics and strain partitioning within transpressional orogenic belts.

References:

Malusà MG, R Polino, M Zattin (2009). Strain partitioning in the axial NW Alps since the Oligocene. Tectonics, 28, TC3005, doi:10.1029/2008TC002370, 1-26.