important group of zircon ages comes from syn- to posttectonic plutons that crosscut the metamorphic section and thus can also be used as reliable markers for the restoration of the geodynamic evolution of the Complex.

We review the available zircon age data in the framework of the allochthon subdivision scheme. In the LA, alpine granitoids are less than 34 Ma old and postdate stacking of the nappe pile. The MA additionally contains Late Cretaceous (70 - 65 Ma), Late Paleocene-Early Eocene (57 – 53 Ma) and Middle-Late Eocene (46 - 37 Ma) granitoids. Tertiary and Late Cretaceous granitoids are also found in the UA. Orthogneiss protoliths in the LA are mostly Variscan/Late Variscan (319 to 270 Ma) with a few older samples. In the MA, this age group occurs as well but most are 164 to 136 magmatic arc granitoids. In the western part of the UA (Vertiskos, Ograzhden), 460 to 432 orthogneiss protoliths occur. In the eastern Rhodopes both Variscan and Jurassic protoliths occur in units presently attributed to the UA (Kimi, Kardzhali units) but these series may also contain parts of the MA. Protoliths of mafic rocks are around 570 Ma (UA), 470 to 430 (UA and MA), 312 - 253 Ma (UA and MA), and ca. 160 Ma (MA, UMA).

The age distribution provides constraints for the paleogeographic reconstruction. It is compatible with a model where the units were stacked by Late Cretaceous to Palaeogene southwestward thrusting, the UA representing Europe, the LA Apulia, and the MA comprising elements of the Vardar Ocean (160 Ma ophiolite), adjacent magmatic arcs (Late Jurassic granitoids), and possibly Pelagonian continental and Pindos-Cyclades oceanic crust. The UMA comes from the Vardar Ocean and associated arcs as well but was thrust towards north onto Europe already in the Late Jurassic to Early Cretaceous.

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Distinguishing different generations of deformation structures by structural and magnetic fabric analyses: examples from the Central gneiss (Tauern window) and Tschigotgranodiorite (Eastern Alps)

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The classical methods of structural geology prove the polyphase tectonometamorphic history of rocks mostly relying on relationships between different generations of foliations, lineations and folds. In schists and paragneisses due to their varied and finer grained composition, the relationships between different generations of foliations and lineations are easier to define. In contrary, the monotonous and coarse-grained orthogneisses make this task more complicate and it is often difficult to distinguish between different generations of structures.

The anisotropy of magnetic susceptibility (AMS) is a standard method for structural investigations of undeformed and deformed igneous, sedimentary and metamorphic rocks. In deformed rocks and shear zones AMS can reveal the position of the finite-strain axes. In such cases the principal axes of the magnetic ellipsoid ($K_{max} \geq K_{int} \geq K_{min}$) are in agreement with the X, Y and Z strain axes (i.e. with the stretching lineation and mylonitic foliation). On the other hand the magnetic lineation (K_{max}) can parallel the intersection of two different planar fabrics. In these cases the pole to the magnetic foliation (K_{min}) coincides with the mylonitic foliation pole (Z axes) but the other two axes of the magnetic ellipsoid K_{max} and K_{int} can differ from X and Y strain axes.

We have studied two different orthogneiss bodies, the Central Gneiss of the Tauern Window and the Tschigot Granodiorite, hosted by the Texel Unit. Both orthogneisses belong to units which underwent a polyphase tectonometamorphic evolution. On outcrop and sample scale the studied rocks show strain partitioning and intensive deformation being localized in cm to decametre wide shear zones. While the sheared parts are characterized by a strong and coherent mylonitic foliation, intensity of deformation varies significantly in the surrounding rock. Within the shear zones there is perfect agreement between the AMS and structural data. There Kmax and the measured stretching lineation are parallel and the pole of Kmin fits the pole of the mylonitic foliation. The less deformed parts are more complicated due to the presence of different generations of competing foliations and lineations. By combining structural and AMS data we distinguish between different foliations and lineations some of which are not observable at outcrop scale. Thus, some lineations which due to the field observations were assumed as stretching lineations, after the interpretation of AMS data are reinterpreted as intersection lineations. The latter is the intersection of either two macroscopically defined foliations or a macroscopically defined foliation and an optically invisible but magnetically defined foliation.

The parallelism between magnetic and field structures in the shear zones shows that the intensive shearing fully overprints and reorients the preexisting structural and magnetic features. In less deformed orthogneisses combination of structural and AMS data can be used to decipher macroscopically undetected penetrative features and thus to detect different generations of deformation.

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Early exhumation of the Aiguilles Rouges and Mont Blanc massifs, European Alps

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Although the exhumation history of the external crystalline massifs of the European Alps has been studied in detail, little is known about the timing and kinematic of the initiation of exhumation. Here we present new zircon fission track, apatite fission track and apatite (U-Th-Sm)/He data from the central Aiguilles Rouges massif, collected from the NW prolongation of the densely sampled Mont Blanc tunnel transect. This profile together with another densely sampled profile through the NW Aiguilles Rouges and Mont Blanc massif along the Rhône valley are used to investigate the (early) exhumation history of the Mont Blanc and Aiguilles Rouges external crystalline massifs. We use a variety of methods with increasing complexity and parameterisation to infer the exhumation history: (i) the age-elevation approach, (ii) transdimensional inverse thermal modelling, (iii) 1D thermal-kinematic modelling, and (iv) state-of-the-art 3D numerical-kinematic modelling (Pecube).