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Post-Nappe brittle tectonics in the North-Western Alps: a field guide

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Abstract: In the last ten years several works have been carried out to reconstruct the recent tectonic evolution of the Alps. A strong collaboration mainly between researchers of the Alpine countries (France, Italy, Switzerland and Austria) has revealed a complex tectonic history which severely reworked the structure of this collisional belt from the Oligocene to the Present. These studies are a positive example of cooperation between different branches of the earth sciences. Central topics are structural geology/tectonics and geochronology, but many other disciplines contributed, as petrography, geochemistry, remote sensing, seismotectonics, geomorphology/active tectonics, paleomagnetism, thermal modeling, analogue and numerical mechanical modeling, etc.

In this paper a review of relevant data for the North-western Alps axial sector (from the Simplon to the Gran Paradiso Massif) is given, in the form of virtual field excursions covering different interdisciplinary topics. An interactive map, showing base geology, regional-scale structural analyses, geochronological records and seismicity results, guides the reader through several “key outcrops” or “key areas” where detailed data are exposed.

These data will be illustrated in the framework of an integrated reconstruction of the Oligocene to Present tectonic evolution in the NW Alps axial domain (Penninic-Austroalpine nappe stack and most internal part of the Helvetic domain). In this large area, centered around the Aosta Valley, two brittle tectonic phases post-date the Cretaceous-Eocene ductile deformation. A NW-SE extension developed in the Oligocene (D1) along three main conjugate fault systems arranged in an orthorhombic symmetry (N-, NW- and SE-dipping). During the Miocene, a general rearrangement of the strain pattern led to a SW-directed extension (D2), probably continuing up to the Present, within a large block bounded by a network of seismogenic shear zones, the most important being the Chamonix, Rhone, Simplon, and Ospizio Sottile faults. Geochronology data (mainly fission tracks), highlight the differential exhumation of large fault-bounded blocks, and syn-kinematic hydrothermal veins and calc-alkaline to shoshonitic dikes constrain the age of deformation.

Finally, a review of crustal- and lithospheric-scale interpretations of this tectonic evolution is also discussed, with emphasis on likely solutions to the apparent paradox of a dominant extensional deformation in an active collisional mountain belt.

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