3D reconstruction of the sole shear zone of the Adula nappe and its repercussion on the Alpine regional geology

Filippo Luca Schenker[1], Matteo Maino[2], Alessia Tagliaferri[1, 3], Michele Perozzo[2], Claudio Castelletti[4], Daphné Giacomazzi[1], Alessia Vandelli[5], Rocco Wennubst[1], Yves Gouffon[6], Christian Ambrosi[1]

[1] University of Applied Sciences and Arts of Southern Switzerland (SUPSI), Institute of Earth Sciences, Dipartimento ambiente costruzioni e design, CH-6850 Mendrisio (filippo.schenker@supsi.ch)
[2] Department of Earth and Environmental Sciences, University of Pavia, via Ferrata 1, 27100 Pavia, Italy
[3] University of Lausanne (UNIL), Institute of Earth Sciences (ISTE), Bâtiment Géopolis, Quartier UNIL-Mouline, CH-1015 Lausanne
[4] CSD Ingegneri SA, Via P.Lucchini 12, CH-6900 Lugano
[5] Geosfera, Via Cresperone 9A, CH-6932 Breganzona
[6] Swiss Geological Survey, Federal Office of Topography swisstopo, Seftigenstrasse 264, CH-3084 Wabern

Intense shearing stretches and elongates deformable bodies within a viscous matrix preferentially along the shear direction. Hence, constrictional structures are typical and sometimes diagnostic of crustal shear zones within a non-coaxial deformation. In such a geodynamic scenario, the deformational evolution leads to the loss of the lateral continuity of the more competent lithological units, challenging the large-scale geological mapping, potentially resulting in misleading regional interpretations.

Here we present detailed geological maps and profiles (scale 1:10’000) along the crustal shear zone at the base of the Adula nappe, the largest high-pressure unit of the Central Alps. Overall, geological data show that the lithological contacts are horizontal or dip gently E-SE, parallel to the penetrative foliation developed at amphibolite metamorphic facies conditions. On the foliation plane, the mineral and stretching lineation is oriented from NNW-SSE to N-S independently on the orientation of the schistosity. However, within this general trend, up to several km-long gneissic bodies (mostly ortogneisses) deflect the foliation steeply to the E or to the W depicting large-scale prolate ellipsoids, elongated parallel to the mineral and stretching lineation. Around these deflections, folds with axes parallel to this prolate bodies show, on the plane sub-orthogonal to the lineation, concentric- or Ω-shapes typical of sheath folds. In addition, large-scale Ω-folds have been mapped over 30 km along the shear zone building large-scale structures such as tectonic windows. We conclude that the most complete explanation for these complex structural patterns is the progressive constrictional shear regime during the emplacement of the Adula nappe in the Eocene-Oligocene, without invoking a regional polyphase deformation. The crustal shear zone was active at upper amphibolitic Barrovian metamorphic condition, during the vanishing stage of the exhumation of the nappe, entailing fast exhumation rates with significant heat advection and/or shear heating along the nappe boundaries.