Tertiary tectono-metamorphic evolution of the Leventina nappe (Central Alps, Switzerland)

Roger Rütti*,***, Didier Marquer** & Alan B. Thompson*.

*Institute of Mineralogy and Petrography, ETH Zurich, 8092 Zurich, Switzerland.
** Département des Géosciences, EA 2642, Université de Franche-Comté, 16, Route de Gray, 25030 Besançon-Cedex, France.
*** Schweiz. Geotechnische Kommission (SGTK), c/o ETH Zurich, 8092 Zurich, Switzerland.

The infrapenninic Leventina nappe represents the lowermost unit outcropping in the Alpine nappe stack and corresponds to the northernmost slice of the European margin that was entrained into the Alpine continental accretionary prism during the Alpine continental collision. The internal structural configuration and the pressure-temperature conditions of the unit during the Alpine metamorphic event are barely known and have never been the subject of research in recent times. This study of the internal structure of the Leventina nappe, through detailed mapping of structures and shear zone patterns, and the investigation of the Si (pfu) content of white micas (coexisting with biotite + K-feldspar + quartz) along a north–south profile, yield details regarding the tectonic and metamorphic history of the Leventina nappe. These new data allow the proposition of a kinematic model for this unit during the Tertiary Alpine tectonics.

The Leventina nappe underwent three phases of ductile deformation. Foliation S1 is mostly subparallel to the regionally dominant structural fabric, the S2 foliation. This foliation is penetratively developed in the hanging wall toward the Simano nappe, whereas in the core, S2 is only weakly developed. A 50-200 m wide mylonite, with a D2 top–to–NW sense of shear marks the boundary to the Simano nappe. In outcrops only fine shear bands (D2, mm to cm wide) are commonly observed showing a top–to–NW sense of shear throughout the unit. Structural data of this study and by Rütti et al. (2005) show that the D2 deformation was the same in the Leventina and the overlying Simano nappe. At the end of D2 deformation phase, the superposition of these two units corresponds to the actual position before they were folded by the subsequent D3 deformation phase. Deformation phase D3 generated only locally a new axial plane foliation S3 at the outcrop scale. However, large-scale effects of this phase are clearly observed with the D3 Leventina antiform. Brittle deformation is manifested by ultracataclasites, fault gouge and kink folds and affect the main foliation S2. A shallow-dipping several hundreds of meter long cataclastic fault was encountered during the excavation of the Gotthard Base Tunnel (Bonzanigo & Oppizzi, 2006).

Microtextural evidence and phengite geobarometry were used to constrain the temperature and pressure conditions of the Leventina nappe. The formation of myrmekites in the Leventina nappe occurs along the dominant foliation S2, constraining temperatures for this deformation phase between 550–650 °C, respectively north and south of the Leventina nappe. Average Si (pfu) composition of white micas of the Leventina nappe ranges between 3.15–3.36 corresponding to pressures between 5 and 10 kbar. Si (pfu) values are always higher in the core than on the rim of white micas oriented along the main foliation. The higher Si (pfu) values reflect pressure conditions at around 8 and 10 kbar, respectively north and south of

the nappe. The P-T-path shows that the estimates for the Leventina nappe concur with the estimated conditions for the Simano nappe during D2 and D3 (Rütti, 2003), implying a common metamorphic and deformation history during these two phases of the Alpine Tertiary tectonics. They are related with the underthrusting of the thinned European margin in the continental accretionary prism during late Eocene time.

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