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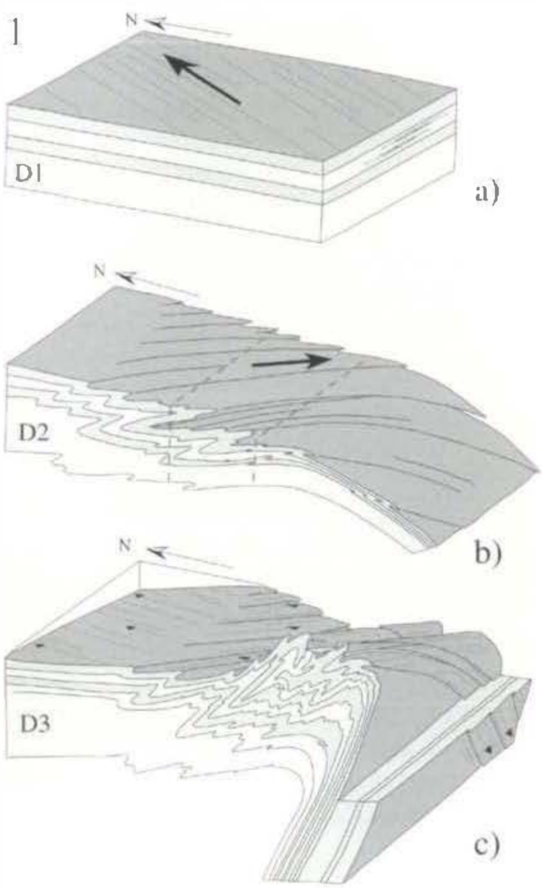
CONSTRAINTS ON THE EXHUMATION OF THE ADULA NAPPE (PART 2): OLIGOCENE UNROOFING OF THE LEPONTINE CORE COMPLEX

Thorsten Nagel & Stefan M. Schmid

After initial exhumation from eclogite facies conditions the Adula nappe was affected by intense amphibolite facies overprint at deep to mid crustal levels. Isograds of this stage clearly crosscut nappe boundaries and hence postdate nappe stacking of the Lower Penninic nappes. The exposure area of amphibolite facies conditions, the so called Lepontine Dome, shows a strongly asymmetric distribution of metamorphic grade. From north to south metamorphic conditions increase continuously from upper greenshist to high amphibolite facies conditions within the gently northeastwards dipping nappe pile. At its southern border the whole nappe pile is reoriented into a vertical to even overturned position by a series of huge backfolds. The southern limb of these backfolds, the Southern steep belt, is a complex high strain zone which also represents the abrupt southern border of alpine metamorphism. Recently the contribution of Miocene orogen parallel extension to the exhumation of the Lepontine has been emphasized. However the overall geometry of the Lepontine as well as the distribution of metamorphism clearly points to a dominant exhumation along the southern steep belt (see SCHMID et al., 1987).

Fig. 1



In the southern Adula nappe three ductile deformation phases under progressively decreasing pressures can be distinguished (see also GROND et al., 1995). The first phase D1 (Zapport phase, Fig.1a) is associated with tight to isoclinal folds, an intense axial planar foliation, and a NNE-SSW-trending stretching lineation parallel to fold axes. Shear sense indicators denote TopN directed transport related to D1. Deformation ceased at conditions of 600-650 °C/ 11-13 kbar in the middle Adula nappe. Structures of the second phase D2 (Fig.1b) overprint the established nappe boundary between the Adula and the underlying Simano nappe. D2 leads to the formation of narrow to tight southwestverging folds at different scales associated with TopSE directed shearing. Where D2-deformation is intense a new axial planar foliation S2 is developed. Synkinematic microstructures indicate decompression at conditions of 650-700 °C/ 9-12 kbar during D2 in the vicinity of the backfolds. Large scale folds of the third phase D3 lead over from flat lying nappes in the north into the Southern Steep Belt (Fig.1c). In the lower Val Mesolcina intense D3 folding is associated with an E-W-trending stretching lineation parallel to fold axes, however no axial planar foliation is developed. At this place conditions of 650-750 °C/4-6 kbar were reached during backfolding D3. From north to south dominant pervasive deformation becomes progressively younger. In the north NNE-SSW trending structures are related to D1. Towards South they become overprinted by D2, which leads to a southward anticlockwise rotation of the dominant finite stretching lineation in mapview.

The foliation in the northern part of the Southern Steep Belt is affected by D3-folds and seems to belong to the second deformation phase. We infer that the Southern Steep Belt was active as a south dipping fault zone with a normal sense of shear during D2. From a purely geometric point of view D2 can best be attributed to the upper Oligocene Niemet-Beverin phase in the higher middle Penninic units.

We conclude that major exhumation of the Central Alps along the present Southern Steep Belt occurred in Oligocene time. During the upper Oligocene the Central Alps were exhumed mainly tectonically by orogen-oblique movement along a southdipping shearzone. In mid Oligocene time this shear zone was folded into an upright position and exhumation continued by backthrusting and erosion probably accompanied by E-W extension.

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Authors' addresses:
Thorsten Nagel, Geologisches Institut, Universität Bonn, Nussallee 8, 53115-Bonn, Germany; Stefan M. Schmid, Geologisches Institut, Universität Basel, Bernoullistr. 32, 4056 Basel, Switzerland