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CONSTRAINTS ON THE EXHUMATION OF THE ADULA NAPPE (PART 1): A TOP-NORTH MEGA-SHEAR ZONE IN THE ROOF OF THE NAPPE

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The Adula nappe in the Central Alps is one of the world's best exposed and studied eclogite-bearing terranes. Metamorphic conditions determined from Alpine, Tertiary-age eclogites and garnet peridotites display a southward increase of maximum P and T, in accordance with the generally assumed southward subduction direction. The Adula nappe is overlain by the Tambo nappe across the metasedimentary, ophiolite-bearing Misox zone. Since the Tambo nappe is devoid of Alpine eclogite and suffered much lower P than the Adula nappe, and in view of the assumed southward subduction, top-S directed shearing along the Misox zone would be expected if the exhumation of the Adula nappe had occurred in the way of popular exhumation models (e.g., CHEMENDA 1995, ERNST 1999). We conducted a combined field mapping and textural study in the area San Bernardino pass – San Bernardino village in order to test this prediction. This study largely confirmed earlier results (e.g., BAUMGARTNER & LÖW 1983, MEYRE & PUSCHNIG 1993, PARTZSCH 1998) but added some important modifications.

The upper Adula nappe and the overlying Misox zone together form a mylonitic mega-shear zone active during the „Zapport phase" under amphibolite to greenschist facies conditions. Older fabrics of the „Trescolmen phase" are preserved within eclogite boudins found in several layers near the top of the Adula nappe. Two samples of eclogite-facies mylonite measured on the neutron diffractometer SV7-b at Forschungszentrum Jülich yielded strong omphacite fabrics, symmetric with respect to the Y-Z plane, suggestive of non-rotational, constrictional rather than plane-strain, deformation under eclogite facies conditions. The stretching lineation in the least overprinted boudins is east-west (associated with a foliation dipping east at steeper angles than in the surrounding Zapport-phase mylonites) and rotates towards N-S with increasing degree of Zapport-phase structural and metamorphic overprint. Inferences on the kinematic directions of the high-pressure deformation and the early stages of exhumation remain speculative because we do not know if and by what amount the presently east-west-trending eclogite-facies lineation has been rotated during the Zapport phase. The pressure gap between the high-P Adula nappe and the lower-P overlying units approximately coincides with the top of boudin-rich layers in the uppermost Adula nappe which contain not only the above-mentioned eclogite boudins but also olivine-rich boudins representing mantle rock. This suggests that the material missing between the Adula nappe and the overlying units, whose removal was responsible for the pressure gap, was constituted in part by mantle rock.

The eclogites were exhumed *from below into* the top-N-directed Zapport-phase shear zone. The orientation of the Zapport foliation (shallowly E-dipping) and lineation (N-S to NNW-SSE) is uniform in the Adula nappe and the Misox zone. Abundant and consistent shear sense criteria indicate top-N sense of shear. Overprinting of the Zapport foliation by southeast-vergent minor

folds of the Niemet-Beverin backshearing phase indicates that the Zapport phase predates the Niemet-Beverin phase, in contrast to earlier WORK (PARTZSCH 1998, SCHMID et al. 1996) suggesting contemporaneity between Zapport phase and Niemet-Beverin phase. This overprint is also demonstrated by combined neutron texture and grain shape analysis of quartz mylonites, showing that an asymmetric, top-North quartz fabric (Zapport) was overprinted and rotated during top-east shearing (Niemet-Beverin), and by spectacular fold overprinting in the southern Adula nappe (NAGEL, this volume).

The following inferences are made regarding the early exhumation of the Adula eclogites:

After the closure of the Valais basin represented by the Misox zone, the Adula nappe, representing the distal European continental margin, was subducted under a mantle wedge belonging to the Briançonnais (Tambo-Suretta) terrane.

Removal of the Briançonnais mantle wedge led to the pressure gap between the Adula and overlying nappes. The Zapport top-north shear zone formed during this event, when the Tambo and Suretta nappes were detached from their lower crust and mantle and were underthrust by the Misox zone and the Adula nappe.

The Adula nappe was exhumed from below into this shear zone, the kinematic direction of this exhumation still being unknown. A top-S shear zone as predicted by models may have existed but if it did, has been completely erased by Zapport deformation.

Although top-SE to top-E extensional shearing occurred in the area, this was not responsible for the early exhumation of the eclogites because these had already been exhumed to amphibolite-facies conditions before or during the preceding Zapport-phase shearing.

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