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Deformation of the Monte Rosa nappe along the Stellihorn shear zone and the nappe's tail as revealed by neutron texture goniometry of mylonitic quartzites

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The Monte Rosa nappe in the Pennine Alps was subject to Tertiary eclogite-facies metamorphism. During subsequent exhumation, the nappe's southern boundary with the overlying units was sheared and folded in the course of four deformation phases (D_1 to D_4). Northwest-vergent shear movements (D_1) were followed by large-scale folding and (south)west-vergent shearing (D_2). These are postdated by another generation of large-scale folds and contemporaneous southeast-vergent shearing (D_3). During D_4 the Pennine units were steepened along the Periadriatic line in the southern limb of the Vanzone antiform (D_4).

Within the Monte Rosa nappe, intense D_1 to D_3 shearing took place along the Stellihorn shear zone. This shear zone divides the nappe into an upper and lower part and a western and eastern part in cross section and map view, respectively. The deformation in the shear zone took mainly place under greenschist-facies conditions.

The Stellihorn mylonites in many cases reveal the polyphase deformation D_1 to D_3 in that the foliation plane bears two or three mineral lineations. Pole figures of quartz , {m}, and {a} obtained by neutron texture goniometry document the three deformation phases and according shear senses by mostly „monoclinic“ symmetries, i.e. oblique girdles and point maxima rotated from the pole to the foliation (in case of {c}) and the stretching lineation ({m}, {a}).

Shear senses observed in the Stellihorn shear zone, either in conventional ways, i.e. in the field and in thin sections, or by neutron diffractometry, were compared to those of

the tail-shaped northeastern appendix of the Monte Rosa nappe along the Insubric line. This tail is bent around the Vanzone antiform into a steep northwestward dip, probably due to movements along the Insubric line. The kinematic history at least of southwestern parts of the tail is comparable to that of the Stellihorn shear zone, although it has to be assumed that in the tail stretching lineations were rotated to a certain amount within the foliation during steepening. Farther in the northeast, the tail is intensely deformed by dextral shearing. Quartz textures show a slight tendence of {c} to arrange close to the centres of the diagrams indicating a stronger influence of prism <a> slip and thus higher temperatures for dextral than for sinistral shearing. The according stretching lineations generally have moderate dip angles with azimuths changing between northeast and southwest several times. After rotation into the horizontal, shear senses of dextral shearing are similarly oriented as those of D_2 in the Stellihorn shear zone while sinistral shearing would be (north)east-vergent in the horizontal plane. Since there is no equivalent of these shear senses in the Stellihorn shear zone, we interpret sinistral shearing in the tail to be restricted to this part of the nappe. It postdates the entire kinematic history of the Stellihorn shear zone and probably effected much of the thinning within the tail.

The results imply that some of the deformation in the Alpine Southern Steep Belt which in the present orientation suggests strike-slip or backthrusting, is in fact older than the steepening of the belt and related to foreward thrusting or extension.