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Progressive orogenic deformation recorded in a mylonite sample from the Dent Blanche Basal Thrust (Pennine Alps)

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The Dent Blanche Basal Thrust (DBBT) represents an Alpine reverse fault along which the continental Dent Blanche Nappe was thrust onto the ocean-derived Combin Zone. Ductile NW-directed shearing associated with Early Tertiary nappe emplacement was localized along this fault resulting in the formation of intensely sheared rocks. These basal mylonites have locally been overprinted by later deformation phases associated with post-nappe compression. In the following, microstructures of a mylonite sample from a locality near the village Ollomont in the Valpelline of Italy are described and correlated with orogen-scale deformational events.
The penetrative mylonitic foliation (S1) dips to the E (88/23) and is defined by a distinct metamorphic layering consisting of alternating, sub-mm thin layers of quartz and fine-grained silicates, mainly white mica ± epidote ± feldspar. The mylonitic stretching lineation (L1) is an aggregate lineation that dips to the ESE (119/19). In some parts, a grain shape preferred orientation of quartz grains defines an oblique foliation which probably developed as a result of combined subgrain rotation and grain boundary migration during simple shear deformation (Passchier & Trouw, 2005). The orientation of elongated quartz grains indicates top-NW shearing and is interpreted to reflect the bulk shear sense during nappe emplacement (D1). This type of dynamically recrystallised quartz also indicates deformation at temperatures around 500°C (Stipp et al., 2002). In most parts of the Ollomont mylonite, a secondary foliation (S2) and lineation (L2) are produced by a SE-dipping crenulation cleavage with NE-dipping (47/17) axes. In some spots, this non-penetrative feature is only slightly developed and gradational whereas in others it is a discrete compressional crenulation cleavage with large fold amplitudes in microlithons. This secondary foliation is interpreted to have formed as a result of late-stage orogen-perpendicular (NW-SE) shortening (D2) associated with continental collision. The oblique foliation defined by dynamically recrystallised quartz also represents the axial plane cleavage to the microfolds in some parts suggesting ongoing quartz deformation with a flattening geometry in a pure shear regime during D2. Since the primary stretching lineation (L1) and crenulation axes (L2) are almost perpendicular to each other, the orientation of the principal stresses during formation of the mylonitic foliation and the crenulation cleavage was the same and only the orientation of the mylonite with respect to the regional stress field changed. This was probably due to the onset of collisional tectonics resulting in changes of overall nappe geometry.
The Ollomont mylonite represents a high strain zone at the base of the Dent Blanche Nappe. Its progressive microstructural evolution is interpreted as the result of continuous deformation in the course of Alpine orogeny. Due to strain-partitioning on a handspecimen-scale, microstructures associated with early-stage nappe stacking and late-stage compression can be observed and studied in one single sample.

References

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