Ductile-brittle deformation in the hanging-wall of the South Tibetan Detachment System (Southern Tibet)

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The South Tibetan Detachment System (Burg et al. 1984, Burchfiel et al. 1998) is characterized by a lower ductile shear zone, an upper low-angle normal fault and high-angle normal faults (Carosi et al. 1998, Searle 2003). The low-angle normal fault puts in contact the base of the Tibetan Sedimentary Sequence with the high-grade sillimanite-bearing schists and mylonitic leucogranites of the Greater Himlayan Sequence and, in several places, the intervening North Col Formation. In the Rongbuck valley, Sa'er and Nyalam areas (southern Tibet) a sharp contact of the low-angle normal fault is associated to breccias and cataclasites.

Samples collected from the Ordovician rocks up to Triassic rocks reveal that temperature increases toward the bottom of the Ordovician limestone. Localized high-strain zones have been recognized in the Ordovician limestone where it is transformed in calcmylonites. Calcite crystals show a shape preferred orientation and grainsize reduction in cm-size bands and show mechanical twins mainly of Type II with lesser amount of Types I and III (Passchier and Trouw 2006) suggesting a temperature of deformation in the range of 200-300°C.

Ductile deformation at the base of the limestone is heterogeneous and gives rise to mylonitic bands post-dating D1 folds. Quartz and calcite displacement-controlled fibres around pyrite crystals, asymmetric tails around polycristalline calcite or calcite/dolomite aggregates, foliation boudinage and asymmetric boudinage of calcite veins confirm a top-to-the NE sense of shear, in agreement with the movement of the South Tibetan Detachment System.

Moving to the Silurian, Devonian and Carboniferous sequences primary structures are well-preserved and deformation mechanisms show a sharp transition to low-temperature mechanisms, being pressure-solution dominant both in limestone, sandstones and conglomerates. In limestone pressure solution is linked to the development of calcite veins nearly perpendicular to pressure solution seams showing cross-cutting relationships.

The ductile shear zones recognized at the base of the Tibetan Sedimentary Sequence cannot be attributed to the thickening stage (with south verging deformation and lithostatic load of the overlying Tibetan Sedimentary Sequence) but it is related to the earlier ductile activity of the South Tibetan Detachment.

Further brittle deformation of the South Tibetan Detachment System localized mainly at the base of the Ordovician limestone giving rise to breccias, cataclasites and ultracataclasites. However, "ghosts" of recrystallized pseudotachilites, preserving the geometry of injection veins, have been detected even in the underlying mylonitic granites in the Nyalam section, testifying their involvement in brittle deformation.

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