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Microstructural and textural evolution of quartz during incremental ductile deformation of granitoids (Arolla unit, Western Alps, Italy)

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We investigated the quartz microstructures and texture in a series of samples representative of four different incremental stages of ductile deformation from a weakly deformed granitoid (stage 1) to a mylonitic granitoid (stage 4). The rocks belong to the Austroalpine Arolla unit, Western Alps, and ductile deformation occurred under greenschist facies conditions. The protolith consists of plagioclase (53%), quartz (28%), K-feldspar (10%), biotite (5%) and hornblende (3%). From the earliest stages, deformation is mainly accomplished by flow of fine-grained sericite + epidote + albite matrix developed from pervasive replacement of magmatic plagioclase. The quartz grains are dispersed in the plagioclase-derived matrix and behave as shortening domains up to stage 4 of deformation. Aim of the study is to describe the development of CPOs in old grains and recrystallized grains of the progressively mylonitized granitoids. The CPO of quartz in mylonitic granitoids (polyphase rocks) is then compared with that of mylonitic pure quartz veins also sampled within the Arolla unit. Texture analysis has been carried out by U-stage and optical orientation imaging (CIP method). In stage 1 samples quartz porphyroclasts display a random CPO and show only incipient recrystallization by bulging. In stage 2 samples quartz porphyroclasts tend to develop a weak CPO, roughly referable to a slightly asymmetric Type-I crossed girdle. In these samples recrystallization is very minor and the old grains show undulose extinction, deformation bands and conjugate sets of shear bands inclined at about 60° to the foliation. In stage 3 samples, quartz shows ca.10% volume of recrystallized grains that preferentially develop along conjugate shear bands. Irrespective of the crystallographic orientation of the host grain, the CPO of recrystallized aggregates systematically shows paired symmetric maxima, eventually within a rough circle gir-

dle with an orthorhombic symmetry. In stage 4 sample quartz is largely recrystallized (up to 85% of recrystallized grains) and forms elongated ribbons. Depending on the initial orientation of the parent grain, the CPO of recrystallized grains shows opposing asymmetry. The CPO cannot be referred to any of the standard girdles commonly observed in mylonitic quartzites. On the contrary, the CPO of mylonitic quartz veins shows a typical asymmetric single girdle, which is consistent with a recrystallization, under greenschist facies conditions, dominated by progressive subgrain rotation. In deformed granitoids, the strong microscale strain partitioning between feldspars-derived fine-grained matrix and quartz ribbons prevents the attainment of a steady state texture even at high bulk mylonitic strains. Therefore, care should be taken in systematically considering quartz CPO in polyphase rocks as a gauge of deformation parameters during natural flow of the lithosphere.