STRAIN GEOMETRY EFFECTS ON QUARTZ CPO AND DEFORMATION MECHANISMS: A FIELD BASED STUDY FROM A SHEARED METACONGLOMERATE IN THE SCANDINAVIAN CALEDONIDES

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ABSTRACT: The relationship between strain geometry (flattening vs. constriction), deformation mechanisms and microfabrics is poorly understood and can only be explored by numerical modeling or in areas where strain markers reveal spatial variations in strain geometry. In this work we evaluate such features from a Neoproterozoic quartz metaconglomerate in a Caledonian thrust nappe in the Scandinavian Caledonides at the Sandvikshytten area near Bergen, Norway. This strongly deformed greenschist facies rock shows systematic variations in strain geometry, from strong limb flattening strain to plane and constrictional strain around the hinges of a 100 m scale syn-thrusting fold. Crystallographic preferred orientation (CPO) measurements acquired with the EBSD technique are used in this work to identify crystallographic fabric of quartz in order to investigate their dominant deformation mechanisms throughout the variation of deformation. The analysed samples are representative from the three different strain domains of the fold (flattening, plane and constrictional). The results indicate that the most effective dynamic recrystallization mechanism is the subgrain rotation with a minor contribution of bulging. The intracrystalline deformation occurs most commonly under the rhombohedral {π}<a> slip system, but the basal system (c)<a> is the strongest when it is active. We suggest that the expressive activation of the {π}<a> system is related to the mechanical formation of Dauphiné twins. Such twinning is indicated by the grain boundary map which shows the penetrative distribution of 60° grain boundaries and the concentration of rotation axes of 60° around the <c> axes. The rhombohedral systems {r}<a> and {z}<a> are active only in the quartz crystals from pebbles, where muscovite is scarce and therefore with more quartz-quartz interfaces. The relationship between strain geometry and CPOs on the constrictional and planar strain domains corresponds to what was described by previous numerical models and experimental deformation analysis. On the other hand the observed crystallographic orientation patterns on the flattening strain domain differs from the former models and indicate a much stronger recrystallization than what would be expected for the described deformation conditions. The <c> axes distribution of this sample suggests that quartz was generated by precipitation within the beginning of deformation, which created an initial preferred orientation that was rotated due to the slip systems activation, leading to the unusual crystallographic orientations within the flattening strain domain.

KEYWORDS: QUARTZ DEFORMATION; SCANDINAVIAN CALEDONIDES; EBSD