PRECIPITATION FROM SUPERSATURATED FLUIDS IN FRACTURES: AN INTEGRATED APPROACH

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Although veins in the Earth's crust are long known due to their association to ore minerals (Agricola 1559, Delius 1770), the mechanism of their formation is not well understood. It involves a complex interplay of material transport and local precipitation during ongoing deformation. However, veins are frequently used as kinematic indicators during progressive deformation, if their grain morphology is fibrous. Currently the study of the mechanism of fibrous vein formation undergoes a revival after Taber´s (1916) and Muegge´s (1928) pioneering work almost 100 years ago. One aspect discussed is the opening mechanism, i.e. the crack-seal versus continuous growth model (Koehn 2000, Li 2000, Wiltschko and Morse 2001). We studied the problem along three approaches: First, we examined outcrops exposing various types of veins at upper crustal levels (antitaxial, syntaxial, ataxial and blocky). Secondly, we carried out numerical simulations of vein growth, by the crack-seal mechanism. Thirdly, we developed a machine for crystal growth experiments in transmitted light, which allows vein growth of analogue material during lateral advection. Our natural antitaxial veins are calcite fibres hosted in black slates. They are located near faults, and can be shown to be isolated in three dimensions. This requires material flux through the matrix, which is not in isotopic equilibrium with the vein. Numerical simulations of natural antitaxial veins show that fibres develop if the opening increments of the vein wall are less than 10 µm. Above, grains develop a elongated-blocky morphology. Experiments show the complexity of polycrystal growth from supersaturated solution. Grain growth depends on the velocity of fluid flow, crystal facet orientation, and on the growth competition of neighbouring grains. The reaction versus transport rate determines the length scale at which the vein becomes sealed during lateral advection.

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