Numerical simulation of natural fibrous vein microstructure

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Syntectonic fibrous veins are a unique tool for structural geologists to analyse progressive deformation in rocks, because they are assumed to track the opening of the fracture. For the basic grain-scale mechanism, Ramsay (1980) proposed the crack-seal mechanism, consisting of repeated microfracturing, each followed by sealing due to crystallization from solution. Cox (1987) and Williams & Urai (1989) have shown, that the long axis of the fibrous crystals do not always grow parallel to the opening direction, because fibres do not connect bedding on both sides of the fracture in all cases. Therefore a simple 2-D model was presented for crystal growth in a crack-seal environment, assuming complete sealing after each cracking event and isotropic crystal growth rates (Urai, Williams and van Roermond 1991). We used a computer programme based on the kinematic assumptions of the 2-D model, and allowing for anisotropic growth rates. First, using reasonable values of the input parameters, we successfully simulated the microstructure of an antiaxial fibrous vein in slate. Then we carried out a sensitivity analysis using different opening increments and directions, number of initial crystals and the crack morphologies Results so far are as follows: The amount of initial grains does not affect the number of surviving fibres. The grain boundaries of the fibrous crystals are locked to marked ridges at the wall. Consequently the width of the fibre is determined by the spacing of the ridges along the wall. Furthermore the grain boundary will curve and become wavy if the offset of the ridge is large enough to force the grain boundary to step over the ridge. · Whether the crystal growth is anisotropic or isotropic does not affect the fibre shape, if all grains reach the wall before the next crack event starts (complete sealing) and the crack events itself are small. · Natural fibrous veins can be simulated with the wall and crystal size of natural veins as input parameters. The validity of the basic assumptions of the model is discussed in the light of modern theories of crystal growth (van Suchtelen, 1995), and alternative mechanisms proposed by Bons and Jessell (1997) and Fisher and Brantley (1992).

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