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Sense and non sense of shear criteria

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Tail geometry and stair stepping in porphyroclast systems have been regarded as the most important parameter in determining the kinematics of natural ductile shear zones, especially when the porphyroclast is circular in the XZ plane of deformation, with an assumption that the deformation was under simple shear condition. However, the addition of pure shear component to the simple shear (*Sr*, where *Sr* is the ratio of pure shear rate to simple shear rate) and confinement ($S = H/2R$, where H is the shear zone width and R is the circle radius) cannot be ruled out in most ductile shear zones; therefore, we use combinations of simple shear and pure shear, and different channel widths in the numerical models to test if stair stepping of tail geometry around circular inclusion can unequivocally be used as a shear sense criterion. Incompressible Navier-Stokes in 2-dimensional finite element modelling is used to investigate streamline configuration around rigid circular inclusions because recrystallization tails follow them.

This study shows that, in wide channels (S=200), the addition of a small component of pure shear to simple shear (*Sr*=0.05) considerably changes the flow pattern, and develops inverse stair stepping of tails. This can lead to a wrong interpretation of the shear sense if the stair stepping criterion is used. It is to be further noted that the stair stepping always exists when a pure shear component is added to the simple shear, and stair stepping increases with increasing confinement. For narrow channels (S=2), the

stair stepping is normal and prominent, and at Sr=0.5, δ structures may develop with stair stepping indicating the correct sense of shear.