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Winged inclusions under high-strain simple shear

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In this study we investigate pinch-and-swell objects, which have been subjected to layer parallel shear deformation. We use a high-resolution mechanical numerical model, which allows to model finite strains up to $\gamma = 40$. The developing structures have been called winged inclusions, which have geometrically similarities with δ-clast systems and rolling structures. However, our model results suggest markedly different mechanical evolution for winged inclusions, which has to be considered when these structures are used as shear sense indicator or finite strain gauge. During the early stages of formation winged inclusions may resemble mirror images of sigmoidal objects and miss-interpretations will lead to a wrong interpretation of the shear sense. During high-shear strain, the structures may be approximately described as consisting of a pulsating faster rotating core and thinning tails that experience differential slower rotation. The viscosity ratio and the shape of the winged inclusion have a significant influence on the rotation rate. The tails are subject to ptygmatic folding when they rotate through the field of instantaneous shortening and may unfold again in the field of instantaneous stretching. During on-going shearing the trailing wing may become the leading wing and finally unfold after rotation of 180° resulting again in a pinch and swell shaped objects. Therefore winged inclusions record little information about the finite strain. Rootless intrafolial folds with opposing closures have geometrically strong similarities with winged inclusions. It is speculated that the formation of winged inclusions might be an efficient mechanisms to produce rootless intrafolial folds, which might influence the rheological behaviour of natural highly strained rocks.