Ber. Inst. Erdwiss. K.-F.-Univ. Graz	ISSN 1608-8166	Band 20/1	Graz 2014
PANGEO AUSTRIA 2014	Graz, 14. September 2014 – 19. September 2014		

Rotated objects under high-strain simple shear

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We compare pinch-and-swell objects, which have been subjected to layer parallel shear deformation (winged inclusions) with other rotated objects (delta clasts, rolling structures). Delta clasts and rolling structures are similar structures, which develop due to rotation of an object like a clast but the recrystallized wings or marker horizons in the host rock matrix remain quasi-stationary in the far-field during deformation. We used a high-resolution mechanical finite element model (milamin.sourceforge.net), which allows us to model finite strains up to $\gamma = 40$. The model results suggest markedly different mechanical evolution for winged inclusions compared to delta clasts and rolling structures. During the initial stages of formation winged inclusions are mirror geometries of sigmoidal objects and therefore miss-interpretations will lead to a wrong shear sense. During high-shear strain, winged inclusions consist of a pulsating faster rotating core and thinning tails that experience differential slower rotation. In contrast, delta clasts and rolling structures have stationary wings and a rotating core. The viscosity ratio, the power-law exponent and the shape of core and wings of the rotating object have a significant influence on the rotation rate. If the tails are rotating, they are subject to ptygmatic folding when they rotate through the field of instantaneous shortening and may unfold again in the field of instantaneous stretching. Therefore rotated objects like winged inclusions, delta clasts or rolling structures record almost no information about the finite strain history of the structures.