Geophysical Research Abstracts,
Vol. 11, EGU2009-5768, 2009
EGU General Assembly 2009


# Mechanical Anisotropy Development of a Two-Phase Composite Subject to Large Deformation

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Evolution of overall mechanical properties has been demonstrated in large strain deformation experiments. Strain softening is frequently employed in geodynamic simulations. In this paper, we quantify the structural and mechanical evolution of a two-phase composite rock subject to pure and simple shear. An inclusion-host type of geometry is assumed, we focus on the weak inclusion scenario and both materials obey a linear viscous behavior. Finite deformation leads to a shape preferred orientation development that results in an overall mechanical anisotropy. We derive the shape evolution model based on an analytical solution for an isolated elliptical inclusion embedded in an anisotropic host and subject to a uniform far field load. The presence of a strong anisotropy in the host leads to an enhanced inclusion stretching. A differential effective medium type of scheme predicting an overall anisotropic viscosity of a composite consisting of aligned elliptical inclusions is proposed and validated by finite element modeling. A comparison with an existing self-consistent averaging scheme is given and the new scheme is shown to provide an improved estimate of the effective normal and shear viscosity for high inclusion concentrations. The two models are combined into a final set of equations describing evolution of a two-phase rock under a shear. Hardening is predicted in pure shear. In simple shear, the hardening phase is followed by a pronounced softening after a shear strain of one, irrespective of inclusion concentration. Numerical simulations resolving evolution of inclusion-host systems under pure and simple shear demonstrate the high accuracy of our model prediction. The shape evolution model provides a sufficient approximation to the shape preferred orientation developing in an aggregate of interacting inclusions. Both in pure and simple shear, deformation localizes into conjugate trails of inclusions leading to formation of complex sigmoidal inclusion shapes.