Geophysical Research Abstracts
Vol. 19, EGU2017-16192, 2017
EGU General Assembly 2017

Mechanical anisotropy and localisation during diffusion creep

John Wheeler
Liverpool University, Earth, Ocean and Ecological Sciences, Liverpool, United Kingdom (johnwh@liv.ac.uk)

It is well known that pressure solution (or the “dry” equivalent, diffusion creep) give rise to flow laws with grain size dependence. Localisation is thus described as resulting from grain size reduction. Here I show that there is an additional and marked dependence of strength on grain shape, using analytic and numerical models based on the same assumptions that are normally used for quantifying diffusion creep (e.g. negligible shear stress along grain boundaries). Mechanical anisotropy depends on grain shape, and for a model tessellation of a single grain shape, there exists a zero strength direction. In more complicated microstructures even a slight grain elongation parallel to the shear plane gives rise to a marked strength reduction. One digitized natural microstructure known to have been formed during diffusion creep gives an anisotropy of 16; other models predict factors of 100 or more. Numerical experiments show that shear bands sometimes develop but even if deformation is fairly uniform on a scale of (for example) 100 grains, drastic strength decrease may occur as grains become more elongate. This is a new type of geometric weakening which may influence localisation behavior throughout the Earth, from fault rocks to orogens through to the lower mantle.