A new mechanistic model of pressure solution creep

RENCHAO LU[1,2*], OLAF KOLDITZ[1,2], HAIBING SHAO[1,3]

[1]Helmholtz Centre for Environmental Research-UFZ, Leipzig, Germany (*correspondence: renchao.lu@ufz.de)
[2]Technische Universität Dresden, Dresden, Germany
[3]Technische Universität Bergakademie Freiberg, Freiberg, Germany

Overburden pressure that acts upon layers of sediment causes physiochemical changes and hence deformation of the strata over geological time scales. Specifically, in the presence of pore waters, mineral dissolution over the contacts between grains is enhanced due to stress concentration. Substantial dissolved components then migrate into the pores outside the contacts under the overwhelming concentration gradient. With the concentration enrichment in the pores, secondary precipitates may be formed and deposited over the free surfaces of grains. In this course, stress-enhanced dissolution and precipitation cause permanent changes on surface topography in a fashion of pore volume reduction and contact area expansion. Such a chemically-induced deformation process is called pressure solution creep. This work aims at developing a new mechanistic model of pressure solution creep [1] which is built upon an extended reaction rate law [2,3] in combination with the classical thermodynamic model [4-7]. The present mechanistic model is allowed to describe attenuation behavior of dissolution enhancement over the contacts due to stress transfer across the expanding contacts and concentration build-up in the interlayer of absorbed water. In addition, this mechanistic model indicates that chemical compaction equilibrium arises from concentration build-up in the interlayer, having no relevence to the latent heat of fusion.

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