Discussion on designing a plasticity benchmark experiment

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Deformation of the lithosphere is characterised by elastic, non-linear viscous and plastic material behaviour. The representation of this complex rheology is a challenge for numerical models of tectonic processes and it is important, therefore, to test rheology assumptions and implementations. A comparison of results run with different codes for a well-defined and constrained setup may help to establish code-independent results and improve codes by learning from any differences. Mantle convection codes, for example, can be validated against the results of convection benchmarks [Blanckenbach et al. 1989; Van Keken et al. 1997]. Recent initiatives also exist for code testing and comparisons for models of the thermal structure and dynamics of subduction zones [Schmeling et al. 2005; van Keken et al. 2003] However, no comparison exists to date of Earth science codes for plasticity implementations.

We propose to design a tectonic Mohr-Coulomb plasticity experiment for comparing results of different numerical codes. The experiment should be (1) simple, (2) implement the same plasticity law, (3) use prescribed resolution and time step sizes, and (4) yield unambiguous quantitative numbers for comparison. During the workshop we will discuss possible experiments, including, but not limited to: (1) Circular inclusion in pure or simple shear [Schmid and Podladchikov 2003]; (2) GeoMod2004 viscous-plastic extension but with free basal slip [Buiter et al. in press]; (3) Compressional and extensional wedges [Zhao et al. 1986; Xiao et al. 1991] (4) Horizontal inward translation of a retaining wall [Roscoe 1970]; (5) 0D and 1D shear [Vermeer 1990].

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