

12.524 Problem Set 1: September 13, 2005; due September 21, 2005

The strength of the lithosphere:

1. What are the assumptions used to formulate the strength versus depth curves shown in Kohlstedt et al., 1995? How realistic are these assumptions for describing the deformation under Tibet? For describing the deformation at the outer rise of a bending oceanic slab? For boring a deep borehole (5-10) in a continental shield?
2. Make a list of the mechanisms of deformation of rocks, including brittle fracture mechanisms, frictional sliding, dislocation deformation, diffusional creep, pressure solution: give rough indications of how each mechanism responds to changes in temperature, strain rate, confining pressure (i.e. lithostatic pressure), and partial pressure (fugacity) of water. Indicate the regions of the Earth where each might be dominant.
3. Make a quantitative plot of the stress components in the x,y, and z directions as a function of depth (z) in the upper kilometer of a felsic crust, assuming that there is no extension in the x or y directions (i.e. the rocks are loaded by the overburden and they are rigidly constrained by the surrounding formations).