On the importance of compressibility in D"-layer dynamics

B. Schott[1], **D. A. Yuen**[2], **A. Braun**[1]

[1]*Department of Theoretical Geophysics, Utrecht University, POBox 80021, 3508 TA, Utrecht, Netherlands*
[2]*Deptartment of Geology and Geophysics and Minnesota Supercomputing Institute, University of Minnesota, Minneapolis, MN 55415-1227, USA*

The entrainment dynamics in the D"-layer are influenced by multitudinous factors, such as thermal and compositional buoyancy, and temperature- and composition-dependent viscosity. Here we are focusing on the effect of compositionally dependent viscosity on the mixing dynamics of the D"-layer, arising from the less viscous but denser D"-material. The marker method, with up to ten million markers, is used for portraying the fine scale features of the compositional components, D"-layer and lower mantle. The D"-layer has a higher density but a lower viscosity than the ambient lower mantle, as suggested by melting-point systematics. Results from a 2D-FD numerical model including the extended Boussinesq approximation, and therefore accounting for the compressibility of the mantle material, show that a D"-layer that is less viscous than the ambient mantle by 1.5 to 2.4 orders of magnitude, can NOT efficiently mix with the lower mantle, even though the buoyancy parameter is as low as Rrho = 0.2 to 0.3. This is in contrast to laboratory experiments, that overestimate the Rrho needed to stabilize the D"-layer at the CMB, when e.g. water is used to model convection. However, very small-scale Schlieren of D"-layer material are entrained into the lower mantle. These small-scale lower-mantle heterogeneities have been imaged with 1-D wavelets in order to delineate quantitatively the multiscale features. They may offer an explanation for small-amplitude seismic heterogeneity inferred by seismic scattering in the lower mantle. This particular type of mixing dynamics transforms to a kind of "lava lamp" mode, when mechanical heating is neglected and the buoyancy parameter is kept the same. Preliminary results suggest, that this is due to the convection velocities being overestimated, when adiabatic heating/cooling is not taken into account in the non-dissipative (Di=0) case.

Movies can be found at http://www.geo.uu.nl/∼bert/DDP