Geophysical Research Abstracts, Vol. 7, 08272, 2005
SRef-ID: 1607-7962/gra/EGU05-A-08272

Self-consistent formation of a low viscosity zone and it's relation to plate motion

U. Hansen (1) , C. Stein (1)
Institut fuer Geophysik, University Muenster, Germany

We have employed a three dimensional numerical model of mantle convection to study the conditions under which a Low viscosity zone (LVZ) can form. Rather than prescribing such a LVZ kinematically we have investigated which type of rheology leads selflconsistently to the formation of a LVZ. The numerical experiments reveal that neither a strong temperature dependence of the viscosity, nor a combined temperature and pressure dependence gives rise to a localized zone of low viscosity. Only if the temperature-dependence is combined with a stress-dependence of the viscosity a LVZ forms under appropriate conditions. Also for this combination a delicate balance of forces is required for a LVZ to form. A strongly dominating temperature-dependence leads to a formation of a stagnant lid on top of a strongly convecting interior, a prevailing stress-dependence mobilizes the surface, resembling almost convection in isovisous fluids. In neither case a LVZ is observed. An almost equal strength of the temperature - and the stress dependence is a prerequisite for the LVZ to form. Interestingly these are the same conditions under which plate-like motion has been observed, arguing for a strong coupling between the existence of a low viscosity zone and the appearance of selfconsistent plate-like motions.