Geophysical Research Abstracts,
Vol. 11, EGU2009-13553, 2009
EGU General Assembly 2009

The role of a high viscosity hill in the lower mantle on the fate of subducting slabs

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A survey of global tomography models displays the common features of the accumulation of cold material in the mid and lower part of the lower mantle, as already put forth previously. This feature shows dynamical influences on the radial component of the slabs penetrating into the lower mantle. Recent convergent evidences have revived the idea proposed originally by Ricard and Wuming (1991) of a high viscosity zone in the mid lower-mantle, at depths from around 1800 to2000 km. These evidences include inversion of geoid and post-glocial rebound data(Mitrovica and Forte, 2001), molecular dynamics simulations (Ito and Toiumi, 2007), current rotational data inversions from GRACE mission (Peltier et al, 2008), and ab initio density functional models (Wentzcovitch et al, 2009). We investigate here the fate of the subducting slabs by simulating the subduction of plates with several widths and several lengths and their interaction with the a viscosity hill with several cup-size dimensions and peak values. In order to investigate more deeply into this problem, we employ a recently developed approach which is a Multipole-accelerated Boundary Element Method (FMM-BEM) for modeling global-scale spherical geodynamics, which allows for the simulation of a subducting plate at unprecedented small spatial resolutions, 50 km in lateral resolution, which has never been reached before in a 3-D spherical shell (Morra et al, 2007). This approach had been already exploited in order to show how a very wide (9000km) homogeneous plate will shorten at depths, typical of the lower mantle when encountering a viscosity hill at depths of the mid-lower mantle, displaying a bend of the type (1) described above and folding in the plate center (Morra et al, 2008). We analyze more in general the radial characterization of the subduction of plates into the lower mantle and how different kinds of viscosity profiles influences the pattern of plate morphologies and the rate of accumulation of cold material as a function of depth.