AOGS 2006

Numerical Models of Mantle Plumes with both Upper-Mantle and Lower-Mantle Origins

DAVID YUEN[1], MASANORI CHARLEY KAMEYAMA[2], RADEK MATYSKA[3]

[1] *Univ. of Minnesota*

[2] *Earth Simulation Center*

[3] *Charles University*

Existing geophysical evidence from seismic tomography for mantle plumes reveals that this is indeed a multiscalephenomenon, with different depths of origins and horizontal extent. We willdiscuss the multiscale nature of mantle plumes within the context ofboth two-dimensional and three-dimensional Cartesian models . An importantconsideration is to have enough grid points along the vertical direction to resolve clearly the thermal boundary layer developed in the transition zone Our main focus here will be on the dynamical effects produced by variable mantle viscosity, depth- dependent thermal expansion coefficient, radiative thermal conductivity in the lower mantle, the spinel to perovskite phase transition separating the upper-lower mantle and the recently discovered post-perovskite phase change in the deep mantle. Both radiative thermal conductivity and the decreasing thermal expansivity can help to induce partially layered convection in the mantle and provoke the production of secondary mantle plumes from the transition zone. Large-scale upwellings in the lower mantle are induced by both the style of lower-mantle viscosity stratification and by radiative heat transfer. Intense viscous dissipation under the transition zone induces partially layered convection due to the formation of a low-viscosity layer under the spinel to perovskite phase change. We will also address the issues of the disparity in the timescales between the upper- and lower-mantle plumes, since they are dependent on the stratification of viscosity.