Japan Geoscience Union Meeting 2011
(May 22-27 2011 at Makuhari, Chiba, Japan)

SIT040-09 Room:104 Time:May 23 16:30-16:45

Viscosity of the D” layer inferred from the decay time of Chandler wobble and tidal deformation

Masao Nakada[1*], Shun-ichiro Karato[2]

[1]Kyushu University, [2]Yale University

Viscosity of the D” layer of the Earth’s mantle, the lowermost layer in the Earth’s mantle, plays an important role in the dynamics and evolution of the Earth. That is, its rheological properties control a number of important geodynamic and geochemical processes such as chemical interactions between the mantle and core and the nature of the observed ultralow-velocity regions in D” layer. However, inferring the viscosity of this region is difficult because of the lack of relevant geodynamic observations. A commonly used analysis of geophysical signals in terms of heterogeneity in seismic wave velocities suffers from major uncertainties in the velocity-to-density conversion factor, and the glacial rebound observations have little sensitivity to the viscosity of the D” layer. In this paper, we show that the decay time of Chandler wobble and semi-diurnal to 18.6 years tidal deformation combined with the constraints from the postglacial isostatic adjustment observations provide a strong constraint on the viscosity of this layer. The decay time of Chandler wobble (30-300 years) indicates the effective viscosity of the D” layer (~300 km thickness) to be 10^19-10^20 Pa s, and the tidal deformation with periods less than 20 years suggests the bottom of the D” layer (~100 km thickness) to be less than 10^18 Pa s. The viscosity structure may be consistent with the temperature distribution inferred from the double-crossing of seismic rays of the phase boundary between perovskite and post-perovskite. The results have a number of implications including the core-mantle interaction through small-scale convection and the interpretation of the ultralow velocity region in terms of partial melting.

Keywords: D” layer, viscosity, Chandler wobble, tidal deformation