Geophysical Research Abstracts
Vol. 14, EGU2012-13078, 2012
EGU General Assembly 2012

The role of thermal effect on mantle seismic anomalies from observations of GIA

P. Wu (1), H.S. Wang (2), and H. Steffen (1)

(1) University of Calgary, Dept. of Geoscience, Calgary, Canada (ppwu@ucalgary.ca), (2) Key Lab of Dynamic Geodesy, Institute of Geodesy & Geophysics, Chinese Academy of Science, Wuhan, China

Recent advance in seismic tomography reveals the structure inside the mantle. An outstanding issue is the role of thermal versus non-thermal (e.g. compositional, partial melting) contribution to seismic velocity anomalies. Here we use observations of Glacial Isostatic Adjustment (GIA), e.g. global relative sea level data, GRACE observations (with recent hydrology contributions removed) and GPS crustal uplift rates in combination with 3D GIA models to address this issue.

Both ICE-4G and ICE-5G models are tested, but ICE-4G gives much better overall fit to these observations. Also, several 1-D background viscosity profiles, with different viscosity contrast at 670 km depth have also been tested and the one that gives consistent results is model RF3 which has a moderate viscosity increase across 670 km. Lateral mantle viscosity variation is inferred from Ekstrom & Dziewonski's S20A seismic tomography model using a scaling law that includes both the effect of anharmonicity and anelasticity. Thermal contribution to seismic tomography appears as the beta factor in the scaling law. The values of beta in the upper mantle, shallow part of the lower mantle and the deep part of the lower mantle are allowed to be different and the solution space of the beta values is searched to find the best combination that gives the best fit to the GIA observations simultaneously.

The result of our best model (RF3 with lateral heterogeneity) shows that thermal effect increases from about 65% in the upper mantle to 80% in the shallow part of the lower mantle and to about 100% in the deep lower mantle above the D" layer. This is consistent with temperature excess in the lower mantle from high core heating. However, the uncertainty increases from $< 1\%$ in the upper mantle to 20% in the shallow lower mantle and is not very well constrained in the deep lower mantle.