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The Role of Thermal Effect on Mantle Seismic Anomalies under Laurentia and Fennoscandia from Observations of Glacial Isostatic Adjustment

Patrick Wu (1), Hansheng Wang (2), and Holger Steffen (3)

(1) University of Calgary, Geoscience, Calgary, Canada (ppwu@ucalgary.ca), (2) State Key Laboratory of Geodesy and Earth's Dynamics, Institute of Geodesy and Geophysics, Chinese Academy of Sciences, Wuhan 430077, China, (3) Lantmäteriet, Lantmäterigatan 2c 80182 Gävle Sweden

An outstanding issue in the study of seismic tomography 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), including global sea levels, observations from the Gravity Recovery and Climate Experiment (GRACE) satellite mission and GPS crustal uplift rates to show that thermal effect increases from about 65% in the upper mantle to about 75% 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 $\sim$10% in the upper mantle to $\sim$40% in the shallow lower mantle and is not well constrained in the deep lower mantle. The implication of large thermal contribution is that hot buoyant plumes can cause large viscosity reduction which may allow convection motion to occur easier even if the viscosity in the lower mantle is high.