



Compositional Variations in the Continental Mantle Constrained by Geophysical Data

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The study seeks to examine if geochemical constraints on global-scale compositional variations in the mantle are consistent with modern geophysical data. Compositional variations in lithospheric mantle are reflected in densities and seismic velocities as measured in laboratory studies of mantle xenoliths and should be present in global seismic tomography and gravity models. However, large-scale compositional variations in the mantle reflected in seismic tomography models and mantle gravity anomalies are substantially masked by temperature anomalies. The goal of the present study is to extract non-thermal signal from seismic and gravity models in order to distinguish compositional variations in the continental lithosphere. In accord with laboratory studies which indicate strong T-dependence of seismic velocity, thermal model for the continental upper mantle constrained by surface heat flow data (Artemieva & Mooney, 2001) outlines the same regions of thick continental lithosphere as seismic tomography model of Shapiro and Ritzwoller (2002). However, T-variations alone are sufficient to explain seismic Vs only in ca. 50% of continental regions. In cratonic lithosphere, compositional anomalies due to Fe-depletion can explain the misfit between seismic Vs and theoretical Vs (the latter was calculated from mantle temperatures based on experimental data on T-dependence of seismic parameters). In regions of active tectonics, partial melts and/or fluids are likely to affect Vs. The gravity model (after the effect of thermal expansion being excluded from Bouguer gravity data, Kaban et al., 2003) reveals compositional density anomalies in continental lithospheric mantle, which are not always correlated with seismic constraints on compositional variations in the mantle or regional variations in lithospheric thickness. The discrepancies between seismic and gravity compositional constraints are caused by different dependencies of Vs and density on compositional variations and reflect processes of lithosphere formation and its later tectono-magmatic modification.