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The continental lithosphere: reconciling thermal, seismic, and petrologic data

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Abstract

The goal of the present study is to extract non-thermal signal from seismic tomography models in order to distinguish compositional variations in the continental lithosphere and to examine if geochemical and petrologic constraints on global-scale compositional variations in the mantle are consistent with modern geophysical data. In the lithospheric mantle of the continents, seismic velocity variations of a non-thermal origin (calculated from global Vs seismic tomography data (*Grand, 2002; Shapiro and Ritzwoller, 2002)* and lithospheric temperatures (*Artemieva & Mooney, 2001*)) show strong correlation with tectono-thermal ages and with regional variations in lithospheric thickness constrained by surface heat flow data and seismic velocities. In agreement with xenolith data, strong positive velocity anomalies of non-thermal origin (attributed to mantle depletion) are clearly seen for all of the cratons; their amplitude, however, varies laterally and decreases with depth, reflecting either a peripheral growth of the cratons in Proterozoic or their peripheral reworking. These cratonic regions where kimberlite magmas erupted show only weakly positive compositional velocity anomalies, atypical for the "intact" cratonic mantle. A reduction in the amplitude of compositional velocity anomalies in kimberlite provinces is interpreted to result from metasomatic enrichment (prior or during kimberlite emplacement) of the cratonic mantle, implying that xenolith data maybe non-representative of the "intact" cratonic mantle.