Geophysical Research Abstracts,
Vol. 10, EGU2008-A-08719, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-08719
EGU General Assembly 2008

The continental lithosphere: reconciling thermal, seismic, and petrologic data (a European example)

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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 constraints on global-scale compositional variations in the mantle are consistent with modern geophysical data. A set of profiles through the lithospheric mantle of Europe down to a 200 km depth constrained by 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)) clearly indicates strong vertical and lateral heterogeneity (non-thermal in origin) of the European lithosphere. The anomalies show strong correlation with tectono-thermal ages and with regional tectonics. In agreement with global xenolith data, strong positive velocity anomalies on non-thermal origin (attributed to mantle depletion) are clearly seen for the cratonic part of the continent; their amplitude, however, varies laterally and reduces with depth. Similar pattern has been calculated for other cratons of the world and reflects either a peripheral growth of the cratons in Proterozoic or their peripheral reworking. Cratonic regions, where kimberlite magmas erupted, show only weakly positive compositional velocity anomalies, atypical for the "intact" cratonic mantle, which are interpreted to result from metasomatic enrichment of the cratonic mantle. This implies that mantle-derived xenoliths maybe non-representative of the "intact" cratonic mantle.