

GEOPHYSICAL AND GEOCHEMICAL CONSTRAINTS ON THE COMPOSITIONAL HETEROGENEITY OF THE UPPER MANTLE

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Constraints on the seismic velocity and thermal structure of the upper mantle indicate the existence of a root zone extending to a depth on the order of 400 km beneath the ancient shields which translates coherently with the continents in the course of plate motions. This root zone (tectosphere) is characterized by high seismic velocities, low temperatures and superadiabatic thermal gradients. Chemical gradients within the upper mantle are necessary to stabilize this zone against advective disruption. The nature of these chemical differences is indicated by peridotite xenoliths from kimberlite pipes, which suggest a strong depletion of the subcontinental mantle in the garnet forming components. Density calculations based on realistic mineralogies show that the inferred gradients in garnet depletion are in quantitative agreement with the geophysical model.

Root zone - no finite strength
depleted in volatiles
low Fe/Mg
lower T
low vol

near depletion of major elements
enrichment of minor elements