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Upper mantle temperatures and composition in the Fennoscandian Shield: implications for rheology

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We applied data on kimberlite-hosted mantle xenoliths from Lahtojoki, Kaavi, in eastern Finland for thermal, rheological, and seismic velocity modeling of the lithospheric mantle in the central part of the Fennoscandian Shield. Petrographic evidence for decrepitated fluid inclusions in olivine of lherzolite and harzburgite xenoliths indicate the presence of fluids in the upper mantle. Our data and models suggest that the thermal and rheological lithosphere is very thick (230-250 km), contains small amounts of fluids, and follows wet (but not fluid-saturated) olivine rheology. The lithospheric part of the mantle where heat transfer is mainly conductive and which does not participate in convection, changes into a mechanical asthenosphere in a solid state. Mantle viscosity shows a weak minimum at the mechanical lithosphere-asthenosphere boundary. The lithosphere-asthenosphere transition does not require partial melting, and very probably there is no partial melt-bearing asthenosphere beneath the lithosphere at all.