Convective origin of the deep mantle roots of continents: evidence from variations in asthenospheric heat flow with the thickness of the continental lithosphere

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Geotherms and thickness of the unthinned continental lithosphere in various regions were determined from xenolith and diamond inclusion thermobarometry. This allow to demonstrate that the asthenospheric heat flow through the base of the continental lithosphere (q_a) strongly decrease from Late to Early Proterozoic belt (from LPB to EPB) and then some increase to the interior of the Archean craton (AC). Ages of LPB, EPB and AC correspond to Re-Os model ages of their lithospheric mantle. For example, q_a values in the Mozambique (Marsabit) and Tasman (SE Australia) LPBs are 19 and 28 mWm^{-2}, respectively. In southern Africa q_a values change from 10.9 mWm^{-2} to 11.3, 11.5 and 13.0 mWm^{-2} in the EPB (Gibeon), margin (N. Lesotho), periphery (Finsch) and interior (Kimberley) of the Kaapvaal AC, respectively. In North America q_a increases from EPB values of 10.0 mWm^{-2} (Williams, Montana) and 10.2 mWm^{-2} (Somerset Island) to 11.5 mWm^{-2} in the margin of the Wyoming AC (Sloan) and 12.0 mWm^{-2} in the interior of the Slave AC (Jericho). Such q_a variations is explained by movement of asthenospheric material, formerly cooled in oceanic environment. Because of thickness similarity LPB and adjacent old oceanic lithosphere (100-120 km) this material moves subhorizontally beneath them. In contrast, it sinks steeply under 170-180 km thick EPB lithosphere, forming cool root. Lower mantle heat is diverted by this root toward to the thinnest continental and oceanic lithosphere. Due to cool root it penetrates to the base of the AC lithosphere (Kaapvaal 220-270 km thick) in much lesser extent.