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The growth rate of the continental lithosphere: constraints from a global 1 deg x1 deg thermal model TC1 for the continents

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This study reports a new 1 deg x1 deg global thermal model TC1 for the continental upper mantle (Artemieva, Tectonophys., 2006), which is constrained primarily by heat flow data and tectono-thermal ages of continental lithospheňre complied on a 1 deg x1 deg grid. Geotherms for continental terranes of different ages (3.6 Ga to present) constrained by reliable data on borehole heat flow measurements (Artemieva and Mooney, JGR, 2001) are statistically analyzed as a function of age and show a strong linear correlation with r=0.98. The statistical age relationship of continental geotherms (z=0.04*t+93.6, where z is lithospheric thermal thickness in km and t is age in Ma) is used to estimate lithospheric temperatures in continental regions with no or low-quality heat flow data (ca. 60 per cent of the continents). Statistical analysis of continental geotherms reveals that thick (250-300 km) lithosphere is restricted solely to young Archean terranes (2.6-3.0 Ga), while in old Archean cratons (3.0-3.6 Ga) lithospheric roots do not extend deeper than 200-220 km. Growth models for the lithosphere, constrained by statistical relations between geological ages and lithospheric thermal thickness, do not reveal a peak in lithoňspheric volume at 2.6-2.7 Ga as expected from growth curves for juvenile crust. A pronounced peak in the rate of lithospheric growth (10-18 km3/year) at 2.1-1.7 Ga is the robust feature of the model; it well correlates with a peak in the growth of juvenile crust and with a consequent global extraction of massif-type anorthosites. It is proposed that large-scale variations in lithospheric thickness at cratonic margins and at paleoterrane boundaries control anorogenic magmatism.