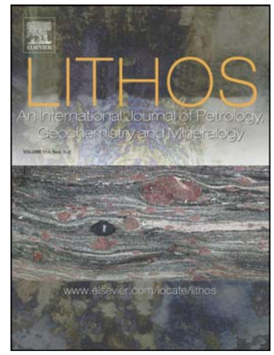

Radiogenic Heat Production in the Continental Crust

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Radiogenic Heat Production in the Continental Crust

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Abstract

The thermal structure and evolution of continents depend strongly on the amount and distribution of radioactive heat sources in the crust. Determining the contribution of crustal rocks beneath a superficial layer is a major challenge because heat production depends weakly on major element composition and physical properties such as seismic wavespeed and density. Enriched granitic intrusives that lie at the current erosion level have a large impact on the surface heat flux but little influence on temperatures in the deep crust. Many lower crustal rocks that are poor in heat producing elements are restites from ancient orogenic events, implying that enrichment of the upper crust was achieved at the expense of deeper crustal levels. For the same total heat production, concentrating heat sources in an upper layer acts to reduce temperatures in the lower crust, thereby allowing stabilization of the crust. The present-day structure of the crust is a consequence of orogeny and should not be adopted for thermal models of the orogenic event itself.

This review summarizes information extracted from large data sets on heat flow and heat production and provides estimates of crustal stratification and heat production in several geological provinces. Analysis of global and regional data sets reveals the absence of a positive correlation between surface heat flow and crustal thickness, showing that the average crustal heat production is not constant. Differences of heat flow between geological provinces are due in large part to changes of crustal structure and bulk composition. Collating values of the bulk crustal heat production in a few age intervals reveals a clear trend of decrease with increasing age. This trend can be accounted for by radioactive decay, indicating that thermal conditions at the time of crustal stabilization have not changed significantly. For the average crustal thickness of 40 km, Moho temperatures are near solidus values