Geophysical Research Abstracts, Vol. 7, 05936, 2005
SRef-ID: 1607-7962/gra/EGU05-A-05936

Moderate core cooling: no need for core radioactivity?

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Radioactivity in the Earth's core has recently been invoked to explain simultaneously the generation of the magnetic field and the growth of the inner core at an appropriate rate and to its present size. Although the possibility of a potassium heat source in the core has been debated for a long time, its presence would complicate geochemical interpretations of other aspects of the Earth.

The need for the extra heat source derives in part from thermal history calculations in which the heat lost from the core was much greater in the past than at present (up to 80 TW, compared with estimates of 2.5-6 TW at present [Buffett, *Geophys. Res. Lett.* **29**, 1566, 2002; Nimmo et al., *Geophys. J. Int.* **156**, 363, 2004]). These thermal histories contrast with earlier versions in which the early core heat flux was less than a factor of two greater than at present [Davies, *Geophys. J. Int.* **115**, 132, 1993]. The discrepancy arises because of different parameterisations of how the mantle cools the core. In particular the recent thermal histories use the viscosity at the mid-temperature of the thermal boundary layer, whereas the Davies version used the viscosity at the highest temperature, at the core. It is argued that the latter parameterisation is more appropriate for hot thermal boundary layers, the former having been derived from the context of cool thermal boundary layers.

Thus the estimates of past high heat flows from the core do not seem to be justified. According to Nimmo et al., the more appropriate thermal history, in which core heat loss was never greater than about twice the present value, may remove the need for radioactivity in the core.