Geochemical estimates of Earth's core heat content at the end of accretion

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The composition of Earth's mantle, when compared to experimentally determined partitioning coefficients, can be used to constrain the conditions of equilibration - pressure *P*, temperature *T*, and oxygen fugacity fO_2 - of the metal and silicates during core-mantle differentiation.
This places constraints on the thermal state of the planet during its accretion, and it is tempting to try to use these data to estimate the heat content of the core at the end of accretion.
To do so, we develop an analytical model of the thermal evolution of the metal phase during its descent through the solid mantle toward the growing core, taking into account compression heating, viscous dissipation heating, and heat exchange with the surrounding silicates. For each impact, the model takes as initial condition the pressure and temperature at the base of the magma ocean, and gives the temperature of the metal when it reaches the core. The growth of the planet results in additional pressure increase and compression heating of the core.
The thermal model is coupled to a Monte-Carlo inversion of the metal/silicates equilibration conditions (*P*, *T*, fO_2) in the course of accretion from the abundance of Ni, Co, V and Cr in the mantle, and provides an estimate of the core heat content at the end of accretion for each geochemically successful accretion.
The core heat content depends on the mean degree of metal-silicates equilibration, on the mode of metal/silicates separation in the mantle (diapirism, percolation, or dyking), but also very significantly on the shape of the equilibration conditions curve (equilibration *P* and *T* vs. fraction of Earth accreted).
We find that many accretion histories which are successful in reproducing the mantle composition yield a core that is colder than its current state.
Imposing that the temperature of the core at the end of accretion is higher than its current values therefore provides strong constraints on the accretion history.
In particular, we find that the core heat content depends significantly on the last stages of accretion

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