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Evolution of the thermally stratified layer in the outer core of Mercury

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Mercury's high core mass ratio means that its core evolution could have strong implications for its mantle dynamics, surface geology, and the generation of a dynamo. Radial contraction, present-day magnetic field, ancient crustal magnetisation, and early extensive volcanism are some of the observations that are controlled by the thermal evolution of Mercury's interior and therefore influenced by the core.

The low intensity and lack of small-scale variations in Mercury's present-day magnetic field can be explained by a convective liquid below a thermally stratified core layer where heat is transported conductively. Numerical studies confirmed the plausibility of a sub-adiabatic heat flow at the core-mantle boundary, giving rise to the thermally stratified layer. Investigating the conditions leading to the formation of the thermally stratified layer, and its evolution, is of crucial importance for our understanding of Mercury's geological and geophysical history.

We couple mantle and core thermal evolution to investigate the conditions under which the thermally stratified layer is formed in the liquid core, and to study the interactions between the core and the mantle. Events such as the cessation of convection in the mantle may strongly influence the core-mantle boundary heat flow and affect the thickness of the thermally stratified layer in the core. Our results highlight the importance of coupling mantle evolution with that of the core, taking into account processes such as melting in the mantle and solidification of an inner core, and the effects of a sub-adiabatic core-mantle boundary heat flow.