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Thermal evolution constraints on the interior of Mercury

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The thermal evolution of Mercury is strongly related to its interior structure and therefore can be used to put constraints on the interior, in particular on the inner core. Compressional deformation features on Mercury's surface indicate that Mercury has contracted during its thermal evolution by as much as 7 km. Contraction is mainly due to the secular cooling and the resulting growth of an inner core and provides insight into the existence, formation process and size of an inner core.

Recent measurements of Mercury's rotation and gravitational field strongly constrain the core size and density, but provide little information about a solid inner core. Both an entirely liquid core and a large solid inner core surrounded by a liquid outer part are consistent with those observations. The present-day global magnetic field could be generated by iron crystallisation at the inner core boundary, indicating the presence of a solid inner core, but could also be due to another crystallisation regime such as the iron snow, not necessarily requiring an inner core.

Here we use a coupled thermal evolution model of the core and mantle in order to study the interior structure of Mercury, particularly its inner core. We investigate the agreement of our models with geodesy data, contraction measurements, tides, and crust formation and assess whether they allow for dynamo action in the core.