Geophysical Research Abstracts
Vol. 17, EGU2015-14597, 2015
EGU General Assembly 2015

Mercury's thermal evolution and core crystallization regime

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Unlike the Earth, where the liquid core isentrope is less steep than the core melting temperature, at the lower pressures inside Mercury's core the isentrope can be steepper than the melting temperature. As a consequence, upon cooling, the isentrope may first cross the melting temperature near the core mantle boundary and produce iron-rich snow that sinks under gravity and produces buoyant upwellings of iron depleted fluid. Similar to bottom up crystallization, top down crystallization is expected to generate sufficient buoyancy flux to drive magnetic field generation by compositional convection.

In this study we model Mercury's thermal evolution by taking into account the formation of iron-rich snow to assess when the conditions for internally magnetic field can be satisfied. We employ a thermodynamic consistent description of the iron high pressure phase diagram and thermoelastic properties of iron alloys as well as the most recent data about the thermal conductivity of core materials.