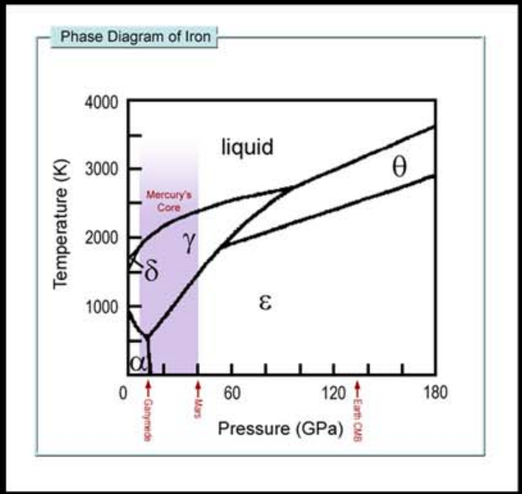
Mercury's Core

Planetary cores: Planet cores are composed of iron (Fe) plus other, smaller concentrations of other elements. The iron, being denser than rock, sinks to the center of the planet early when the planet's interior is very hot. This is called differentiation. If Mercury has a pure Fe core, it would have completely solidified. Evidence suggests this has not happened and that at least part of the core is still molten (liquid):

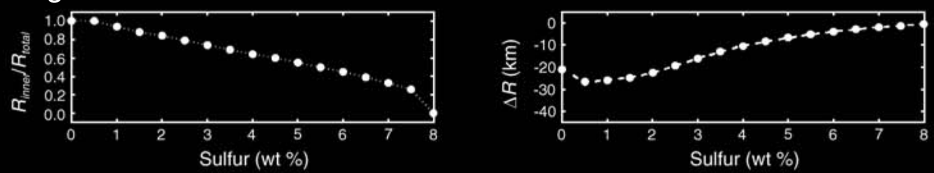
(1) The observed magnetic field, if the result of a core dynamo, requires liquid.

(2) The change in volume from freezing the Fe from liquid to solid would result in ~17 km of radial contraction, but the lobate scarps show only a few km of total radial contraction.

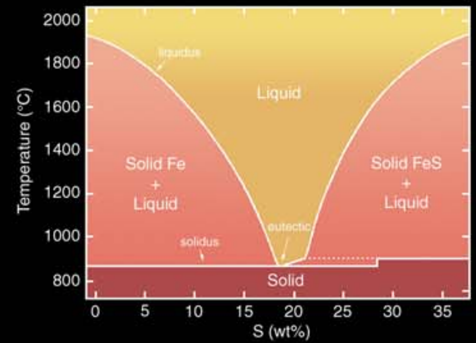
(3) Forced libration amplitude is larger than expected for an entirely solid core. Libration is a slight oscillitory back and forth motion in a planet's rotation. The observed libration can be explained if the mantle is decoupled from core, implying the core is not completely solid.



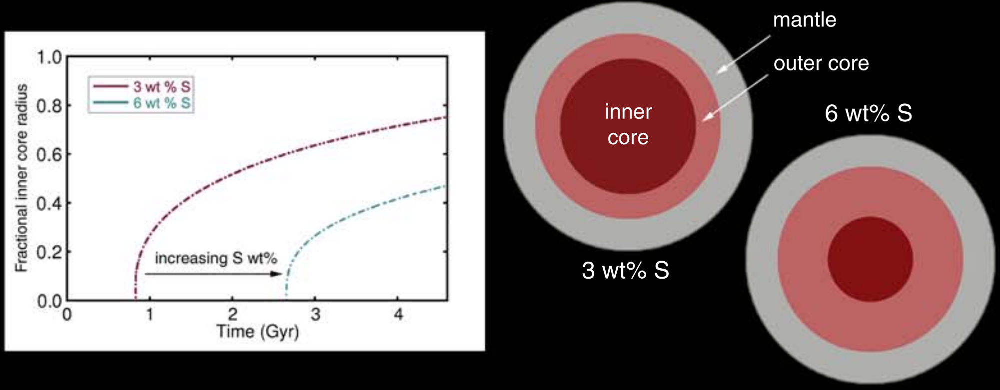
Phase diagram: This figure shows the phase of Fe given temperature and pressure. The range of pressures experienced by Mercury's core can be seen and roughly correspond to that of Mars due to similar core sizes, but lower pressure near the top due to is smaller overall size similar to the Jovian moon Ganymede. A pure Fe core would cool enough to completely feeze. The greek letters indicate different lattice configurations of solid Fe.



Contraction: Present-day inner core radial fraction for different amounts of core sulfur content and the resulting radial contraction ΔR. Smaller inner cores correspond to less contraction of the planet.



Sulfur: The relatively high abundance of sulfur (S) and its ability to partition into an Fe melt makes it a likely constituent in planetary cores. The inclusion of the element has a significant effect on the core structure due to the fact that it lowers the melting temperature (liquidus) of the core as the concentration increases from 0 wt% to the eutectic.



The influence of S can be seen in model results with 3 and 6 wt% S in the core. Increasing S delays inner core formation as it requires cooler temperatures resulting in a smaller present-day inner core.