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Patterns of convection and surface expression of subsolidus convection within terrestrial planets and icy satellites

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Terrestrial planets and large icy satellites provide different environments where heat transfer by subsolidus convection may exhibit different geometries and lead to different surface expressions. The pattern of convection is driven by the energy sources. If only volumetric is present, convection is driven by the instability of the cold boundary layer where cold plumes form. If the bottom of the convective layer is maintained at a temperature much larger than its mean temperature, then plumes form at the hot boundary layer and migrate to the surface. Large planets such as Venus and Earth have big cores that have cooled very slowly after accretion and the Core-Mantle Bounday (CMB) is likely to be unstable. On the other hand, Mars' core cooled very quickly and the lack of temperature gradient at the CMB may have turned a convection pattern driven by hot plumes to a convection pattern driven by cold plumes. The large icy satellites of the giant planets provide another example where tidal heating may play an important role in the convective pattern. Whereas radiogenic heating and cooling can be considered as homogeneous internal heating sources, tidal heating is localized because it is very much viscosity dependent. Examples of these different convection models will be given as well as implications for the evolution of planets and satellites.