



The influence of partial melt and crust formation on the thermal evolution of terrestrial planets

D. Breuer

DLR Berlin, Institut für Planetenforschung, Germany, (doris.breuer@dlr.de)

The formation of the secondary crust of terrestrial planets is caused by partial melt in the silicate mantle, which then rises due to its lower density as compared to the solid mantle toward the surface. The melt generation and associated processes, however, are very complex and have a strong influence on the thermo-chemical evolution of a planet. The generation and recrystallization of melt tends to buffer temperature variations due to the consumption and the release of latent heat, respectively. The existence of partial melt reduces the viscosity and can therefore enhance the efficiency of planetary cooling. Partial melting in the mantle also results in buoyancy sources that can drive flow and cause further melting. However, a reduction of the viscosity is only given as long as all or part of the melt remains in retention with the mantle material. If melt separates from the mantle, the viscosity increases again to that of the solid material. The extraction of partial melt leaves behind a residuum that is more buoyant than its fertile parent material. This process can lead to the formation of a buoyant upper mantle, which can have a stabilizing effect on the mantle dynamics and prevents further the planet from cooling. In addition melt segregation results in a redistribution of radioactive elements. Radioactive heat sources are incompatible elements and enriched in the melt. If the enriched melt rises toward the surface the mantle becomes depleted in heat sources and a crust forms that is enriched in radioactive heat sources. When basaltic melt is extracted from the mantle and segregates to form the surface layer, heat is transported effectively toward the surface. The forming silicate crust, however, has in contrast to the underlying mantle a lower conductivity and tends to thermally isolate the mantle. In the present talk, I will discuss the various processes and effects on the thermal evolution of a planet in particular of a one-planet.