

Institut für Geophysik

Geophysikalisches Kolloquium
Wintersemester 2022/23

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Fluid Dynamics of Magma Ocean Solidification and Early Differentiation of the Earth's mantle

Giant impacts, core segregation and radiogenic decay can significantly melt terrestrial bodies early in the solar system, leading to the formation of magma oceans. The latter set the initial conditions for the long-term evolution of terrestrial planets. However, magma oceans remain poorly understood. Since the first magma ocean models proposed in the late 70s, magma ocean evolution is essentially described using 1D vertical models. This limitation is mostly due to the extreme convective vigor of a fully molten mantle that cannot be captured in direct fluid dynamics simulations. Consequently, most of our understanding of silicate mantle differentiation in magma ocean assume that a magma ocean is 1D.

Here, we go beyond these 1D approaches by using direct multiphase fluid dynamics simulations in 2D Cartesian geometry. Our focus is on the last stages of magma ocean solidification. We model mantle solidification from the point where the averaged mantle crystal fraction is above 50%. We use the new version of the code presented in Boukaré et al., (2017).

We will discuss two major findings. (1) Contrary to 1D models that show crystals forming at the intersection between liquidus and adiabat in the deep interior, our 2D models reveal that most of the solids form in cold thermal boundary layers, i.e. at the surface of the planet. (2) The formation of a basal magma ocean is inevitable if dense FeO-rich melts can segregate from the solids. The efficiency of solid-liquid phase separation controls the size of a primordial basal magma ocean as well as the degree of primordial mantle differentiation. These findings raise fundamental questions regarding the geochemical signatures of magma ocean solidification.

Das Kolloquium findet um **16:15 Uhr** als Zoom-Videokonferenz statt. Der Link dazu wird auf der Homepage und per eMail rechtzeitig mitgeteilt.

Alle an dem Thema Interessierten sind hierzu herzlich eingeladen.

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