Kolloquium:

Earth’s core formation and terrestrial magma oceans

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Earth’s iron core formed during planetary accretion and is hence inextricably linked to chemical and dynamic processes operating in a magma ocean. Accretionary impacts provide both material (e.g., Fe, Si) and energy (heat) that drive the growth of the core—and Earth as a whole—in part by sustaining a magma ocean near the surface. Geochemical models typically assume that chemical equilibration between silicate and core material occurs at a single pressure (P) and temperature (T), which is often associated with the middle of a magma ocean of predefined depth. However, the partitioning of moderately siderophile elements is strongly determined by P-T conditions that are known to evolve in time as a magma ocean cools and crystallises. Furthermore, degassing of a magma ocean produces a primary atmosphere that subsequently controls the cooling rate of the magma ocean. Therefore, constraining the conditions in a magma ocean as it cools and crystallises is critical for interpreting the bulk and trace element chemistry of Earth’s mantle and core—notably the mantle excess of siderophile elements. I will present a new framework for modelling Earth’s magma ocean and describe its application to understand Earth’s chemical reservoirs.

Figure 1: Earth began hot and molten, and within the magma ocean the earliest geochemical signatures of the mantle and core were established. Image credit: IPGP—Joël Dyon.