

Mantle dynamics during the Hadean

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Abstract. In the modern Earth, the mantle is slowly cooling with a peculiar style of convection involving rigid plates and continents at the surface. Several lines of evidence suggest that mantle dynamics must have been very different during the early stages of Earth's evolution, and particularly during the Hadean (the first 700Myrs of the history of the planet). The Hadean was the period during which the core has formed, the first continents and most of the atmosphere were extracted from the solid Earth. Until now, there is very little geological observation of old enough and abundant samples, or they are not yet fully described. As a consequence developing models for the dynamics of the mantle at this time is key, especially for the understanding of the thermochemical history of our planet.

I will first evaluate some of the consequences of accretion and core formation on the long-term evolution of the silicate Earth and show that pockets of melt existing at the core-mantle boundary are the last remnants of the earliest history of the planet. A basal magma ocean could have formed very early (Labrosse et al., Nature 450, 866-868, 2007), having fundamental thermal and chemical consequences.

I will then show that coupling hypothesis on the thermal history of the mantle and chemical modelling of the evolution of Xenon ratios, using radiogenic and fissionogenic isotopes only, can constrain the drastic changes in convection style over time.

These models underline the major decrease of the production of silicate melt at the end of the Hadean, modifying the mode of heat transfer towards a slow and sluggish solid-state convection for which melts have a little contribution on the global dynamics.