# Thermo-compositional evolution of solid mantle in contact with magma oceans: study with a phase change boundary condition

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After accretion and formation of the Earth, our planet went through at least one episode of magma ocean. When the temperature of this magma ocean decreases below liquidus and then solidus curves, it starts solidifying and solid mantle appears. Two different views of magma ocean crystallization can put the solid mantle growing below a magma ocean, or between two magma oceans. In this work we use the convection code StagYY to investigate the dynamics and thermo-compositional evolution of a solid mantle bounded at top, bottom, and top and bottom by magma oceans. Our setup is a solid mantle represented by 2D spherical annulus geometry and the magma oceans are parameterized as 0D objects at top and/or bottom boundaries. We make use of a new boundary condition that allows material to flow through the boundaries, and parameterization of fractional crystallization/melting processes at the boundaries. Our results show that the thermal evolution of solid part is strongly controlled by the presence of magma oceans above and below. Because material can now flow through the boundaries, different patters of convection arise depending on the timescale used for melting/crystallization processes. If this timescale is very short, we show that the extreme case of degree-1 mode of convection (translation) happens. Regarding compositional evolution, we show that solid part gets iron depleted, while magma oceans get enriched in iron. We also show the formation of a dense layer enriched in iron at the base of solid mantle.