Effects of Earth's rotation on the early evolution of a terrestrial magma ocean

C. MAAS[1]* AND U. HANSEN[1]

[1]Institute for Geophysics, University of Muenster, Germany (*correspondence: christian.maas@uni-muenster.de)

Like Moon or Mars, Earth experienced one or several deep magma oceans of global extent in a later stage of its accretion. The crystallization of these magma oceans is of key importance for the chemical structure of Earth, the mantle evolution and the onset of plate tectonics. Due to the fast rotation of early Earth and small magma viscosity, rotation probably had a profound effect on differentiation processes. For example, [1] propose that the distribution of heterogeneities like the two large low shear velocity provinces (LLSVP) at the core mantle boundary is influenced by rotational dynamics of early Earth. Further [2] suggest that the LLSVP's are very long-living anomalies, probably reaching back to the time of differentiation and solidification of Earth. However, nearly all previous studies neglected the effects of rotation.

In our work a strong influence of rotation as well as of latitude on the differentiation processes in an early magma ocean is revealed. We show that crystal settling in an early stage of magma ocean crystallization crucially depends on latitude as well as on rotational strength and crystal density. Due to rotation an asymmetrically differentiated mantle could possibly develop after magma ocean solidification, with strong effects on mantle composition. Further we show that rotation could explain the development of a basal magma ocean [3] and the formation of chemical heterogeneities at the core mantle boundary. These heterogeneities in the deep early mantle would have a profound effect and could control the planform of mantle convection and the geometry of plate motions at the surface [4].

[1] Dziewonski et al. (2010) *EPSL* **299**, 69-79. [2] Garnero and McNamara (2008) *Science* **320**, 626-628. [3] Labrosse et al. (2007) *Nature* **450**, 866-869. [4] Trim et al. (2014) *EPSL* **405**, 1-14.