Geophysical Research Abstracts
Vol. 19, EGU2017-5565, 2017
EGU General Assembly 2017


# Effect of planetary rotation on the differentiation of a terrestrial magma ocean in spherical geometry

Ulrich Hansen and Christian Maas
Münster University, Inst. für Geophysik, Münster, Germany (hansen@earth.uni-muenster.de)

About 4.5 billion years ago the early Earth experienced several giant impacts that lead to one or more deep terrestrial magma oceans of global extent. The crystallization of these vigorously convecting magma oceans is of key importance for the chemical structure of the Earth, the subsequent mantle evolution as well as for the initial conditions for the onset of plate tectonics. Due to the fast planetary rotation of the early Earth and the small magma viscosity, rotation probably had a profound effect on early differentiation processes and could for example influence the presence and distribution of chemical heterogeneities in the Earth's mantle [e.g. Matyska et al., 1994, Garnero and McNamara, 2008].
Previous work in Cartesian geometry revealed a strong influence of rotation as well as of latitude on the crystal settling in a terrestrial magma ocean [Maas and Hansen, 2015]. Based on the preceding study we developed a spherical shell model that allows to study crystal settling in-between pole and equator as well as the migration of crystals between these regions. Further we included centrifugal forces on the crystals, which significantly affect the lateral and radial distribution of the crystals. Depending on the strength of rotation the particles accumulate at mid-latitude or at the equator. At high rotation rates the dynamics of fluid and particles are dominated by jet-like motions in longitudinal direction that have different directions on northern and southern hemisphere. All in all the first numerical experiments in spherical geometry agree with Maas and Hansen [2015] that the crystal distribution crucially depends on latitude, rotational strength and crystal density.

References

E. J. Garnero and A. K. McNamara. Structure and dynamics of earth's lower mantle. Science, 320(5876):626-628, 2008.
C. Maas and U. Hansen. Eff
ects of earth's rotation on the early di
erentiation of a terrestrial magma ocean. Journal of Geophysical Research: Solid Earth, 120(11):7508-7525, 2015.
C. Matyska, J. Moser, and D. A. Yuen. The potential influence of radiative heat transfer on the formation of megaplumes in the lower mantle. Earth and Planetary Science Letters, 125(1):255-266, 1994.