On the effects of planetary rotation on early Earth differentiation

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The crystallization of a terrestrial magma ocean is of key importance for the chemical structure of the Earth, the mantle evolution and the onset of plate tectonics. During the magma ocean phase, the Earth rotated very fast with a period between two and five hours. Due to the small magma viscosity, rotation probably had a profound effect on the early differentiation of the Earth. We investigate the influence of planetary rotation on magma ocean dynamics using a spherical shell model. At moderate rotation rate, crystals settle at the poles and are kept in suspension at mid-latitude, but accumulate in the bottom half at the equator. At faster rotation rate, all crystals accumulate in the equatorial region. All in all, our numerical experiments show that due to planetary rotation an inhomogeneous solidification of a terrestrial magma ocean with respect to time and latitude is very likely, favouring the development of large scale chemical heterogeneities.

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