Geophysical Research Abstracts
Vol. 12, EGU2010-3528, 2010
EGU General Assembly 2010

Two-phase flow numerical models for the formation of a Basal Magma Ocean

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In a recent paper Labrosse et al. (2007) have proposed that the sparse ultra low velocity zone observed at the base of the Earth's mantle, interpreted as patches of dense partial melt (Williams & Garnero, 1996), could be the vestiges of a basal magma ocean once overlying the core mantle boundary.

To investigate the physical mechanisms related to the formation of such a basal magma ocean, we have designed a two-phase flow model describing the early mantle of the Earth as a mixture of melt and viscously deforming solid matrix.

More specifically our model takes into account the compressibility of melt with depth and the melting of the matrix via a coupling source term. Because of its compressibility the melt eventually becomes denser than the surrounding matrix. Above this critical depth the dense melt is percolating upwards to form a magma ocean at the surface while symmetrically below this depth it is flowing downward to form a basal reservoir.

Physical and numerical characteristics of our model as well as preliminary results will be presented and discussed.

References:

Labrosse S., Hernlund J.W. and Coltice N., A crystallizing dense magma ocean at the base of the Earth's mantle, Nature, 450 (7171): 866-869, 2007

Williams Q. and Garnero E.J., Seismic evidence for partial melt at the base of the Earth's mantle, Science, 273:1528-1530, 1996