Geophysical Research Abstracts,
Vol. 10, EGU2008-A-08664, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-08664
EGU General Assembly 2008
© Author(s) 2008

The basal magma ocean

S. Labrosse (1), J. W. Hernlund (2) and N. Coltice (1)

(1) Laboratoire des sciences de la Terre, ENS Lyon, Université Lyon 1, France
(2) Department of Earth and Ocean Sciences, University of British Columbia, Canada

Presence of partial melting in the lowermost mantle has been proposed to explain the ultra low velocity zone. The cooling of the core necessary to have maintained the geodynamo for at least 3.2 Gyr implies a larger amount of melt in the past, that can be connected to an early magma ocean at the bottom of the mantle. The crystallisation of this basal magma ocean (BMO) leads to progressive enrichment in FeO in both the melt and the solid, leading to formation of dense piles at the bottom of the mantle.

This model provides a unique scenario to explain several geochemical observations, in addition to the geophysical observations already mentioned. Indeed, because we expect fractional crystallisation of the BMO, incompatible elements get gradually enriched in the liquid. If its initial mass is large enough, a significant fraction of Earth inventory can be trapped in this reservoir and, in particular, this can readily account for about 20–30% of the total amount of U, Th and K in the Earth. In addition, fractional crystallisation is able to produce isotopic signature and, for example, explain the systematic difference of Earth and chondrite in ^{142}Nd. The high density and low viscosity of this melt ensures that it cannot be entrained by convection in the solid mantle. The BMO is therefore the ideal hidden reservoir.

The incompatibility of Sm and Nd at the bottom of the mantle relies on the assumption of the liquidus phase being (Mg,Fe)-perovskite, not Ca-Perovskite (CaPv). This means that the progressive enrichment of the melt in Ca cannot have been large enough to reach the eutectic. At that point, CaPv crystals inherit the ^{142}Nd of the melt and, if entrained by convection in the solid mantle, they would produce a detectable signal at the surface. We can therefore delimit the range of acceptable phase diagrams for the basal magma ocean model to explain the Nd systematics.