Geophysical Research Abstracts
Vol. 12, EGU2010-7106, 2010
EGU General Assembly 2010


# Melting curve of the deep mantle applied to properties of early magma ocean and actual core-mantle boundary

Denis Andrault (1), Giacomo Lo Nigro (1), Nathalie Bolfan-Casanova (1), Mohamed A. Bouhifd (1), Gaston Garbarino (2), and Mohamed Mezouar (2)

(1) Laboratoire Magmas et Volcans, Université Blaise Pascal, Clermont-Ferrand, France, (2) European Synchrotron Radiation Facility, Grenoble, France

Our planet experienced partial melting early in its history as a consequence of energy release due to accretion. Partial mantle melting could still happen today in the lowermost mantle. Occurrence of melting is primordial for the chemical segregation between the different Earth's reservoirs and for the dynamics of the whole planet. Melting of iron-alloys is relatively easy to achieve, but the silicated mantle happens to be more refractory.

We investigated experimentally melting properties of two starting material, forsterite and chondritic-mantle, at pressures ranging from 25 to 140 GPa, using laser-heated diamond anvil cell coupled with synchrotron radiation. We show that partial melting in the lowermost mantle, as suggested by seismology on the basis of the ultra-low velocity zones (ULVZ), requires temperatures above 4200 K at the core-mantle boundary. At low pressures, our curve plots significantly lower than previous reports. Compared to recent estimates of mantle geotherm, while this temperature remains possible if the Earth's core is very hot, it is more likely that ULVZs correspond to high concentration of incompatible elements driven down to the D"-layer by subducting slabs or extracted out from the outer core.

When our chondritic melting curve is coupled with recent isentropic temperature profiles for a magma ocean, we obtain a correlation between magma ocean depth and the potential temperature (Tp) at its surface; an ocean depth of 1000 km (equivalent to ∼40 GPa) corresponds to Tp=2000 K, which happens to be significantly hotter than the estimated surface temperature of a sustained magma ocean. It emphasizes the importance of a lid at the magma ocean surface at an epoch as early as that of core-mantle segregation.