# Melting curve of the lowermost Earth's mantle

D. ANDRAULT[1], G. LO NIGRO[1], N. BOLFAN-CASANOVA[1], M.A. BOUHIFD[1], G. GARBARINO[2] AND M. MEZOUAR[2]

[1]Université Blaise Pascal, Clermont-Ferrand, France
[2]European Synchrotron Radiation Facility, Grenoble, France

Partial melting of the Earth's deep mantle probably occurred at different stages of its formation as a consequence of meteoritic impacts and seismology suggests that it could even continues today at the core-mantle boundary. Melts are important because they dominate the chemical evolution of the different Earth's reservoirs and more generally the dynamics of the whole planet.

Previous works report melting relations in the uppermost lower mantle region, using the multi-anvil press [1, 2]. On the other hand, the pyrolite solidus was determined up to 65 GPa using optical observations in the laser-heated diamond anvil cell (LH-DAC) [3]. Finally, the melting temperature of $(Mg, Fe)_2SiO_4$ olivine is documented at core-mantle boundary (CMB) conditions by shock wave experiments [4]. Solely based on these reports, experimental data remain too sparse to draw a definite melting curve for the lower mantle in the relevant 25-135 GPa pressure range.

We reinvestigated melting properties of lower mantle materials by means of *in situ* angle dispersive X-ray diffraction measurements in the LH-DAC at the ESRF [5]. Experiments were performed in an extended P-T range for two starting materials: forsterite and a glass with chondrite composition. In both cases, the aim was to determine the onset of melting, and thus the pseudo-eutectic melting temperatures as a function of pressure. Melting was evidenced from major changes of diffraction figures on the image plate.

In this work, we show that temperatures higher than 4000 K are necessary for melting mean mantle at the 135 GPa pressure found at the core mantle boundary (CMB). Such temperature is sigificantly higher than most of estimations of the geotherms. Therefore, partial melting at the CMB is likely to indicate the presence of additional elements depressing the solidus, such as water or an anomalous concentration of K, Na, etc.

[1] Ito *et al. PEPI*, **143–144**, 397 (2004). [2] Ohtani *et al. PEPI* **100**, 97 (1997). [3] Zerr *et al*. Science **281**, 243 (1998). [4] Holland & Ahrens, Science **275**, 1623 (1997). [5] Schultz *et al*. HPR **25**, 71 (2005)

# Experimental evidence for perovskite and post-Pv coexistence throughout the whole D’ region

D. ANDRAULT[1], M. MUÑOZ[2], N. BOLFAN-CASANOVA[1], N. GUIGNOT[3], J.-P. PERRILLAT[4], G. AQUILANTI[4] AND S. PASCARELLI[4]

[1]Université Blaise Pascal, Clermont-Ferrand, France
[2]Université Joseph Fourier, Grenoble, France
[3]Synchrotron SOLEIL, Gif-sur-Yvette, France
[4]European Synchrotron Radiation Facility, Grenoble, France

Since the phase diagram for (Fe, Al)-bearing $MgSiO_3$ compositions at the P-T conditions of the core-mantle boundary remains ambiguous, we investigated the Fe distribution among the silicate perovskite (Pv) and post-perovskite (PPv) polymorphs using tandem synchrotron analyses of X-ray diffraction and X-ray absorption spectroscopy. We performed measurements at the Fe-Kedge of the partitioning of iron between Pv and PPv up to more than 150 GPa after annealing at about 3300 K. We obtain a unique solution for $K_{Fe}^{Pv/PPv}$ of 4.2 (± 0.5). Our results evidence that the two silicates should coexist over the whole D″ region, with the main post-perovskite phase being largely depleted in Fe compared to the perovskite.

As Fe and Al have a dominant effect on the phase diagram, these new results challenge recent determinations of the temperature profile in the lowermost mantle based on the Clapeyron slope of the Pv to PPv transition for *pure* $MgSiO_3$ composition. Also, it appears clear that variations in the molar fractions of perovskite and post-perovskite phases should be expected radially or laterally in the D′ region in relation with thermal or compositional heterogeneities. This can help explaining the seismological anomalies observed for this mantle region. Finally, we predict a significant increase of the FeO activity in the D″ region, which should greatly affect the chemical exchange between mantle and core.