

# Melting processes at the core mantle boundary

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Partial melting has been proposed to explain mantle regions with ultralow seismic velocities (ULVZs) near the core-mantle boundary [1]. To test this hypothesis, we first constructed the solidus curve of a natural fertile peridotite between 36 and 140 gigapascals using laser-heated diamond anvil cells. In our experiments, melting at core-mantle boundary pressures occurs around  $4100 \pm 150$  K, which is a value that can match estimated mantle geotherms. Similar results were found for a chondritic mantle [2] whereas much lower pyrolitic melting temperatures were recently proposed from textural and chemical characterizations of quenched samples [3].

We also investigated the melting properties of natural mid-ocean ridge basalt (MORB) up to core–mantle boundary (CMB) pressures. At CMB pressure (135 GPa), we obtain a MORB solidus temperature of  $3950 \pm 150$  K. If our solidus temperatures are in good agreement with recent results proposed for a similar composition [4], the textural and chemical characterizations of our recovered samples made by analytical transmission electron microscope indicate that  $\text{CaSiO}_3$  perovskite (CaPv) is the liquidus phase in the entire pressure range up to CMB. The partial melt composition is enriched in FeO, which suggests that such partial melts could be gravitationally stable at the core mantle boundary.

Our observations are also corroborated by calculations made using a self-consistent thermodynamic database for the MgO-FeO-SiO<sub>2</sub> system from 20 GPa to 140 GPa built using published chemical potentials for solids, liquid MgO and SiO<sub>2</sub>, and a standard state chemical potential for liquid FeO and mixing relations derived from various indirect observations. These observations and calculations provide a first step towards a consistent thermodynamic modelling of the crystallization sequence of the magma ocean, which shows that the existence of a dense iron rich and fusible layer above the CMB at the end of the crystallization is plausible [5], which is in contradiction with the conclusions drawn in [4].

[1] Williams & Garnero (1996) *Science* **273**, 1528. [2] Andrault et al. (2011), *EPSL* **304**, 251. [3] Nomura et al. (2014) *Science* **343**, 522. [4] Andrault et al. (2014) *Science* **344**, 892. [5] Boukaré et al (2015) *J.Geophys. Res*, submitted.