**Thermal and chemical structure at the bottom of the lower mantle**

Ryuichi Nomura  
*Tokyo Institute of Technology*

---

**Solidus temperature of the lower mantle**

---

**Previous studies by x-ray diffraction methods**

---

**X-ray micro-CT methods**

BL47XU@SPring8  

- **Spatial resolution**  
  - ~70nm (for <100um sample)  
  - ~200nm (for >100um sample)  
- **X-ray energy**  
  - 7.8 keV (Fe K edge: 7.11 keV)

---

**Results**

- **142 GPa/3690 K**  
  - 7 keV  
  - 8 keV

- **151 GPa/3680 K**  
  - 7 keV  
  - 8 keV  
  - heated region

---

Iron-rich region in the hottest part
The lowermost mantle also contains smaller-scale heterogeneities, such as ultra-low velocity zones (ULVZs), which may be linked to subducted zones (ULVZs). Scattered seismic waves indicate that the velocity of the surrounding mantle is more than that of the surrounding mantle velocity provinces (LLSVPs), have sharp boundaries, and extend above the core-mantle boundary.

The newly documented LVZs exhibit distinct characteristics compared to the ULVZs. Sun et al. (2014) note that the LVZs are likely to arise from this depth.

Future work: melting temperature measurement

- Laser-heated diamond anvil cell (LH-DAC)
- Multi-anvil press

Temperature uncertainty: 3600(100) K

Conclusions and future works

- Solidus temperature of pyrolite: 3570(200) K @CMB
- Solidus temperature: 3570(200) K @CMB
- Mantle solidus: upper bound for geotherm

Melting criteria:
- Temperature jump with increasing laser power
13

0.6wt% hydrogen to make the “liquid” outer core

14

Temperature gradient in LH-DAC

Conclusions and future works

Thermal structure
- Solidus temperature of pyrolite 3570(200) K @CMB
  -> upper bound for T_{CMB}
- lower bound for core geotherm
  -> FeHx Tm only up to 20 GPa
  -> Tm in Fe-H-X system over 135 GPa is necessary

Chemical heterogeneities
< melting temperature of ancient crust, BIF, MORB and BMO residues