First natural samples of ferropericlase from the lowermost mantle

M.G. KOPYLOVA AND P.C. HAYMAN

Department of Earth and Ocean Sciences, The University of British Columbia, Canada (mkopylov@eos.ubc.ca; phayman@eos.ubc.ca)

Recent high-P high-T experiments showed that ferropericlase (fPer) of the lowermost mantle (1700 - 2900 km) must be enriched in Fe because of the transition from high-spin to low-spin state of Fe at 70 GPa (Badro et al. 2003) or an equilibration with post-perovskite at P> 115 Gpa (Murakami et al., 2004). Such Fe-rich fPer has been found as inclusions in the lower mantle diamonds of Juina (Brazil). Juina fPer has significantly lower Mg-numbers (0.35-0.85) than lower mantle fPer from other locations globally (Mg#=0.70-0.95). Moreover, Juina fPer released from diamonds that do not contain upper mantle olivine polymorphs tends to be richer in Fe (Mg#=0.45-0.66) (Hayman et al., 2005). The extreme Fe enrichment in the fPer is not matched by a respective Fe enrichment in the coexisting MgSi-perovskite. These minerals show much lower distribution coefficients K_DFe^{2+} than those experimentally determined for P=24-30 GPa (McCammon et al., 2004). We propose that the Juina Fe-rich fPer formed in the lowermost mantle at depths greater than 1700 km. The fPer could be the low-spin Fe fPer that is produced experimentally and predicted theoretically, or the fPer equilibrated with post-perovskite at the base of the mantle.

References

Badro J, Fiquet G, Guyot F, Rueff J.P., Struzhkin V.V., Vanko G, and Monaco G (2003) *Science* 300:789-791.

Hayman, P. C., Kopylova M. G. and Kaminsky F. V. (2005). *Contrib.Miner.Petrol.*, accepted pending revisions

McCammon C.A., Stachel T, and Harris J.W. (2004). *Earth Planet Sci Lett* 222:435-449

Murakami M., Hirose K., Sata N., and Ohishi Y., (2004). *Eos Trans. AGU, 85(47), Fall Meet. Suppl.,* MR22A-01

Thermodynamics of the lowermost mantle

D. SUN[1], T.J. AHRENS[1] AND P.D. ASIMOW[2]

[1]Seismological Laboratory 252-21, California Institute of Technology, Pasadena, CA, (tja@caltech.edu)
[2]Division of Geological and Planetary Sciences, California Institute of Technology, Pasadena

Seismic observations of the region above the core mantle boundary (CMB), including Ultra-Low Velocity Zones (ULVZ) and D" discontinuities, and recent mineral physics data suggest the bottom of the mantle may be chemically heterogeneous, possibly, on account of the occurrence of the recently discovered post-perovskite ($CaIrO_3$) structure. Moreover, the large decrease in shear wave velocity in selected areas (ULVZ) in the lowermost 40 km of the mantle indicates the likely presence of partially molten material. To provide a complete petrologic and mineral physics model of this region, it is important to define both constituent material properties and phase equilibria including melting behavior. We expect to describe models that encompass the entire MgO-FeO-CaO-Al_2O_3-SiO_2 system and to define complete mineral physics equations of state, employing thermochemical data to obtain complete phase diagrams. Our mineral physics-based seismic models are to be obtained using global inversion methods. Initial model results are reported for the SiO_2-MgO system.

For the SiO_2 system, we modelled the high-pressure phase diagram over the TiO_2-, $CaCl_2$-, α-PbO_2-structure and liquid phase stability range. The high-pressure liquid SiO_2 has an EOS with: $\rho_0 = 4.05$ g/cm^3, K = 180 GPa, K′ = 6, $\gamma = 1.15$, q = 0.8, $C_v = 1.55$ J/K/g. The melting of $CaCl_2$ structure occurs at ~5000 K at 135 GPa. Also the α-PbO_2-structured SiO_2 EOS is described by : $\rho_0 = 4.18$ g/cm^3, K = 270 GPa, K′ = 3.6, $\gamma = 1.35$, q = 2.6, $C_{vm} = 1.215$ J/K/g, $\theta_0 = 1222$ K. Examination of the diamond anvil melting data for MgO yields the liquid EOS and a model melting curve. The melting point is ~5200K at 135 GPa. We also calculate the melting behavior of the binary SiO_2-MgO system. For $MgSiO_3$ composition the melting point at 135 GPa is ~5300 K, which combined with the above MgO data indicates melting temperatures of mantle composition at 135 GPa is ~4400 ± 400K.