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Density and structure of amorphous silicate at high pressure conditions

Petitgirard S.[1]*, Malfait W.J.[2], Kupenko I[3], Shale C.[4], Spiekermann G.[5], Weis C.[6], Sternemann C.[6], Sinmyo R.[7], Hennet L.[8], Wilke M.[5], and Rubie D.C.[1]

1-Bayerisches Geoinstitut, University of Bayreuth, Universitätsstrasse 30, Bayreuth, D-95447 Germany. 2-Empa, Dübendorf, Switzerland, 3- Institut fur Mineralogie, University of Munster, Germany 4-ESRF, Grenoble, France. 5-Univeristy of Potsdam, Germany 6- Fakultät Physik/DELTA, Technische Universität Dortmund, D-44221 Dortmund, Germany 7- ELSI, Tokyo Institute of Technology, Tokyo, Japan 8-CEMHTI, CNRS, Université d'Orléans, France.

*sylvain.petitgirard@uni-bayreuth.de

Modelling the formation and evolution of the deepest parts of the Earth through time requires the densities of solids and melts to be constrained. Other properties such as the structure and viscosity of high pressure melts are also needed to undersatnd the fate of deep mantle melts.

The main parameter controlling the entrainment or settlement of matter in the lowermost mantle and the possible deep magma ocean formation is the density contrast between solid and magma. To measure the density contrast between crystal and amorphous silicates, we have adapted the X-ray absorption method to the diamond anvil cell to enable density measurements of silicate glasses to be made to unprecedented conditions of high pressure [1]. We have consequently measured the densities of SiO_2 and $MgSiO_3$ glasses up to 90 and 127 GPa, respectively. We found that the glass and melts at CMB pressure can be as dense as their counterpart solids. Recently we extended the data to iron-bearing compsoition and we aim at forming a density model for amorphous silicate in the MgO-FeO-SiO_2 system. To understand the changes in the structure associated with such high densifictaion we measured the changes of the Si L-edge and O Kedge in SiO_2 glas sunder pressure by means of X-ray Raman scattering as well as X-ray diffraction up to 70 GPa. For both method the data are of unprecedented quality and reveal details about the atomic structure of amorphous silictae at deep mantle pressure conditions. These new data will bring a deeper knowledge of the structural, polymerization and viscosity changes of silciate magmas at lower mantle pressures.

[1] Petitgirard S. et al., 2015. PNAS 112, 14186-14190.