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Refractive Index Measurements on Hydrous Silicate Gel Under High Pressures

The chemical evolution of the primordial Earth during the transition from a molten to a solid state is largely controlled by density. The density contrast between the solid and liquid phases determines whether the crystallized particles sink or float. Geophysical observations of low-velocity zones, infer the existence of hydrous melt at the upper mantle transition, but experimental density measurements of hydrous silicate melt are limited to < 30 GPa [1]. In-situ density measurements of hydrous silicate melts under Earth's mantle conditions are extremely difficult to conduct because of the tiny sample size, melt chemical reactivity and lack of crystalline structure [2].
This study is part of the project Glass2Melt, which aims to develop a universal density model for silicate melts in the pressure range up to 135 GPa (i.e., across the pressure range of the entire mantle). To mitigate some of these challenges highlighted above, silicate melts rapid-quenched to glasses are used as proxy material to investigate the structural behavior and density at high pressure and room temperature conditions using a diamond anvil cell [3].
This study investigates the structural effect of volatiles (H2O and CO2) on silicate glasses. The all-optical determination of the refractive index and density of silicate glasses is carried out with a supercontinuum laser. Here I report on the evolution of the refractive index of hydrous silica gel (SiO2) up to ~ 65 GPa. Silica gel is an amorphous porous form of SiO2, which is structurally similar to silica glass [4], but can easily incorporate over 30 wt.% of H2O in its silicate structure [5]. Preliminary results show a reduction of the refractive index with water content at pressures > 30 GPa. Further investigations of glasses with a wide range of chemical compositions in the H2O –CO2 –Al2O3 –SiO2 –MgO –Na2O –CaO system are planned.

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