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Compressibility of Fe-rich Pyroxene Glasses at High Pressure Derived from All-Optical Measurements of Refractive index and Absorption Coefficient

The density of silicate melts is essential for comprehensive modeling of the early Earth's evolution, when the Earth was largely composed of molten silicates encased in a magma ocean. However, fundamental insights into evolution of the density of melts with pressure are often experimentally inaccessible. Nevertheless, some experimental challenges might be overcome by using quenched glasses as structural proxies of their melts. Here we report on the compressibility of Fe-rich pyroxene glasses along the enstatite–ferrosilite compositional binary in the pressure range from 20 to 60 GPa. The compressibility was measured by a recently developed all-optical method in a diamond anvil cell and was inferred from the refractive indices and the absorption coefficients of the glasses under study. Further experiments at pressures of 0-20 GPa and 60-150 GPa will allow us to obtain an experimental model of the density of MgO-FeO-Fe₂O₃-SiO₂ glasses at the pressure conditions of the Earth's mantle.

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