

Densification mechanisms of amorphous silicates at high pressure and temperature

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At modest pressures (<10 GPa), the main structural feature of silicate glasses and liquids is the interconnected network of SiO₄ tetrahedra. Depolymerized compositions (MgSiO₃ – Mg₂SiO₄ binary) have anomalously high proportions of interconnected SiO₄ tetrahedra compared to the predictions based on stoichiometry (NBO/T calculations). Polymerized silicate glasses (SiO₂-MgSiO₃ binary) exhibit anomalous volumetric and elastic properties at high pressure and room temperature. The unusual behavior of polymerized silicate glasses on compression, where the compressibility increases or is weakly pressure dependent, is consistent with densification being controlled by network flexibility, rather than the compression of interatomic bonds as exhibited in their crystalline counterparts. An outstanding question is what is the P-T-X range over which network flexibility controls densification. To this end, we will present combined *in situ* X-ray diffraction and microtomography datasets at elevated pressure and temperature in the Rotational Tomography Paris-Edinburgh Cell at Soleil synchrotron for a suite of silicate glasses spanning the SiO₂-MgSiO₄ binary. Simultaneous acquisition of X-ray diffraction on a large Q-range and 3D tomography were performed under extreme conditions, permitting direct comparison of density from volumetric measurements with changes in atomic structure. We use these results to investigate the role of network flexibility and polyamorphism in the anomalous high pressure behavior and whether the densification mechanisms that underlie the anomalous behavior in the glasses extends into the liquid state.