The Effect of H2O on the Anomalous Properties of Hydrous Rhyolitic Glass up to 3 GPa

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Since the observation of silicate melt properties at relevant P-T conditions remains challenging, silicate glasses have been commonly used as analogues for the study of melts within the Earth. Rhyolitic glasses are often found in the Earth's crust and, when present as glass inclusions, can contain up to 7 wt.% of water. In this study, we employ FTIR Spectroscopy and Brillouin Spectroscopy to study the properties of hydrous rhyolitic glass (5.69 wt.%) up to 3 GPa in a DAC. The acoustic velocities of almost all silicate glasses decrease with increasing pressure up to ~2 GPa. At ~2 GPa, a transition occurs after which the acoustic velocities increase with increasing pressure. The anomalous acoustic velocities in silicate glasses and the pressure at which the velocity transition occurs may be associated with the degree of polymerization in the glass. It has been shown that polymerization in silicate glasses increases with pressure, due to increasing coordination in Al and Si. However, the presence of water can also affect the polymerization of the glass. Water present in silicate glasses can exist as either molecular H_2O or as OH groups. The glass network is depolymerized with the incorporation of water as hydroxyl groups. Additionally, the speciation of water may change with pressure, which would further alter the polymerization of the glass with pressure. The speciation of water and its effect on glass polymerization, which will be calculated from FTIR spectra, can then be used to explain the anomalous acoustic wave velocities in hydrous rhyolitic glasses.