

LETTER

Densified glasses as structural proxies for high-pressure melts: Configurational compressibility of silicate melts retained in quenched and decompressed glasses

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ABSTRACT

The structures of high-pressure magmatic liquids have often been inferred from spectroscopic studies on quenched and decompressed glasses. However, it has not been completely verified whether the structures of quenched and decompressed glasses are representative of the structure of their corresponding liquids at the glass transition temperature and synthesis pressure. Here, we provide quantitative evidence for the retention of pressure-induced configurational changes upon isobaric quench and isothermal decompression for synthesis pressures up to 3.5 GPa. We use the degree of densification and elastic compressibility of permanently densified glasses, together with thermo-elastic data from the literature, to calculate the density of the melt at the glass transition temperature and synthesis pressure. The derived densities agree with those derived directly from the thermal equations of state of the melts. This observation indicates that, at least up to 3.5 GPa, the densified structure of the melt is preserved in the glass upon quenching and decompression; this validates past and future structural studies of high-pressure melts based on studies of quenched and decompressed glasses.

Keywords: Compressibility, silicate melts, relaxation, rhyolite, phonolite, basalt