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Structural Relaxation of Isostatically Compressed Sodium-Borate Glass

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The short- and intermediate-range structures and thus properties of glasses can be modified by subjecting them to sufficiently high pressure. However, the relaxation behavior of such compressed glasses upon subsequent heat-treatment at ambient pressure is poorly understood. Relaxation studies of compressed glasses could shed light on the relations between certain structural features and the macroscopic glass properties. In this work, we address this issue by performing ^{11}B and ^{23}Na NMR, Raman, and density measurements on a sodium-borate glass, which has first been isostatically compressed at 1 GPa at the glass transition temperature (T_g) and then annealed at ambient pressure at various times and temperatures around T_g. In general, the isostatically compressed glass gradually returns to its state prior to compression upon annealing at ambient pressure. As expected, the rate of relaxation increases with increasing annealing temperature. The structural analysis reveals strong correlations between density and both short- and intermediate-range structural features. We thus find that density and the pressure-induced change in boron coordination from BO_3 to BO_4 relax on a similar timescale, in contrast to recent findings on an analogous composition.