

Mechanical properties and thermal behavior of hydrous glasses

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The lecture focuses on the impact of hydration on the mechanical properties and the thermal behavior of various oxide glasses including silicate, borosilicate and borate compositions. Glasses with a total water content up to 20 mol% H₂O were prepared under wet condition of melting using an external pressure of 5 kbar. Firstly, an insight into their structure and related water speciation will be given, followed by an analysis on water-induced changes in viscosity and sub-T_g relaxation. The central approach of studying mechanical properties of hydrous glasses is to trigger a situation of having water species (hydroxyl groups and water molecules) already dissolved in the glass structure and to confront them with environmental water molecules reacting at their surfaces. Thus, the contributions of dissolved water and humidity on elastic constants, hardness, crack formation and propagation will be highlighted in the central part of the lecture by reviewing mechanical tests that were conducted in vacuum, dry nitrogen gas and ambient air.