The effect of S on the glass transition temperature

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Water is the only volatile species which have been recognized to have a strong effect on glass transition temperature (Tg). The effect of sulfur volatile species (i.e. SO_4^{2-} or HS^-) on Tg is currently unknown.

We have measured Tg on a series of H_2O- S-bearing anorthite–diopside eutectic silicate glasses. Samples were synthesised under various pressure (100-500 MPa), temperature (1150-1450°C) and fO_2 conditions (NNO+2 to NNO-1). The glass S content goes up to 7519 ppm and H_2O content goes up to 5.3 wt.%. Tg was measured using Differential Scanning Calorimetry with 10-20 $K.min^{-1}$ as an heating rate.

At the highest H_2O content, the measured Tg is the lowest at 457±10°C whereas under volatile free conditions, the measured Tg is the highest at 758±13°C. The decrease in Tg with increasing H_2O content is consistent with previous works. The effect of S on Tg is almost inexistent or towards a slight decrease in Tg with increasing S content. This result appears in contradiction with recent spectroscopic work suggesting that S induced an increase in glass polymerization.

We explain this discrepancy by the fact that spectroscopic investigations on S-bearing silicate glasses might not reflect the true change in the glass network polymerization. Therefore spectroscopic studies on volatile-bearing (other than H_2O) silicate glasses cannot be used unambiguously as a proxy for the glass/melt physical properties.