

# Dehydration of dacitic glasses near the glass transition

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To further our understanding of the driving force for volcanic eruptions – the degassing of volatile-rich melts – an experimental study on the dehydration of dacitic glasses has been conducted. While most studies focused on water diffusion in melts at higher temperatures, we chose temperatures near the glass transition temperature (609 – 852 K). Experiments were conducted in a horizontal tube furnace in air. We used infrared spectroscopy to characterize initial water speciation and total water contents (1.42 – 5.28 wt%) of the glasses and Raman spectroscopy to measure depth profiles near the glass surface. This allowed us to determine total water contents near the surface on the micrometer scale, showing a non-zero surface concentration which decreases with time. This is in agreement with the assumption that part of the total water (i.e. structurally bound OH) can be considered immobile when modelling diffusion, but also shows that the reaction rate of the interconversion of OH groups to more mobile molecular water ( $\text{H}_2\text{O} + \text{O} = 2\text{OH}$ ) at such high viscosities is too sluggish to achieve equilibrium concentration on the time scale of our experiments. Consequently, single profiles are in good agreement with error function, but the apparent water diffusivity becomes time-dependent and slows down with progressing dehydration. By adopting the numerical model of Coumans et al. (2020), which considers the reaction kinetics of OH conversion, to our case, we can reproduce our observations.

Our study shows that the efficiency of water release at these conditions is significantly lower than predicted by previously proposed diffusion models and magma fragmentation is a more complicated process, for which it is necessary to also consider the kinetic reaction rate for the interconversion of water species.

Coumans, J. P., et al. (2020). "An experimentally-validated numerical model of diffusion and speciation of water in rhyolitic silicate melt." *Geochimica et Cosmochimica Acta* **276**: 219-238.