

PVTx properties of H₂O-NaCl fluids from acoustic measurements in the diamond anvil cell

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Saline-rich aqueous fluids play an important role in metamorphic reactions and chemical transport in a wide range of geological processes. This includes magma generation in the mantle wedge, ore deposit formation and hydrothermal alteration in seafloor. Prerequisite for a quantitative treatment of phase equilibria related to such processes is a knowledge of the thermodynamic properties of complex aqueous fluids at geologically relevant pressures and temperatures.

H₂O-NaCl mixtures represent good analogs for deep geological fluids but experimental data on its thermodynamic properties at high P-T conditions remains scarce. For instances, equations of state (EoS) for H₂O commonly used to predict thermodynamic properties at high pressures rely heavily on extrapolation of sparse low-pressure experimental data (< 1 GPa) [1] and molecular dynamic calculations [2, 3].

In this contribution, we present PVTx properties of H₂O-NaCl mixtures (0, 5.5 and 15 wt% NaCl) up to 400 °C and 7 GPa obtained from sound velocity measurements in the diamond anvil cell using Brillouin scattering spectroscopy. Inverted volumetric properties are compared with available data in literature. The EoS obtained from this work are further used to evaluate the P-T dependence of thermodynamic properties of H₂O-NaCl binary fluids, including thermal expansion coefficients, isothermal and adiabatic compressibilities and heat capacities. The results are combined with previous experimental and theoretical EoS of H₂O-NaCl mixtures [4] to provide an internally consistent dataset for the thermodynamical properties of the most relevant aqueous systems involved in fluid-mediated processes in the Earth's crust and mantle.

[1] Wagner, W. & Pruss, A. (2002) *J. Phys. Chem. Ref. Data* **31**, 387–535. [2] Belonoshko, A. & Saxena, S.K. (1991) *Geochim. Cosmochim. Acta* **55**, 381-387. [3] Brodholt, J. & Wood, B. (1993) *J. Geophys. Res.* **98**, 519-536. [4] Driesner, T. (2007) *Geochim. Cosmochim. Acta* **71**, 4902-4919.

Thermal and Uranium-series isotope constraints on the rate and depth of silicic magma genesis

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Uranium-series isotopes provide important limits on the timescale of magma differentiation and this can be used to constrain where in the crust and silicic magmas acquire their geochemical characteristics. Timescales of differentiation can be inferred from the observed co-variations of U-series disequilibria with differentiation indexes. When crustal assimilation of secular equilibrium material is involved, inferred timescales will generally decrease. In turn, they will increase if periodical recharge (> 20 wt. % relative volume) of the magma body occurs. If crustal assimilation and magma recharge occur concurrently, inferred timescales for differentiation can be similar to that of closed system differentiation. We illustrate the approach with data from Mt St Helens which suggest that dacitic compositions are produced in ~ 2,000 yr. Combining this with recent evidence for an important role for amphibole fractionation suggests that differentiation of a ~ 10km³ magma body at this volcanic centre occurs at 8-10 km depth in the crust.