

Measurements of vapor pressures of aqueous solutions using fused silica high-pressure optical cell

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Vapor pressure (VP) data of geologically and industrially important aqueous solutions containing one electrolyte are incomplete and those containing more electrolytes are lacking. In this study, we developed and tested methodologies for the acquisition of VP data of aqueous solutions, at temperatures (T 's) from 300°C up to near the critical T of pure H_2O using the high-pressure optical cells [1] and Linkam CAP500 heating-cooling stage. Typically, a section of ~18 cm-long solution of known composition was loaded into the fused silica capillary tube (0.67 mm OD, 0.30 mm ID and ~30 cm long) of the optical cell. The sample near the enclosed end of the tube was (1) placed on top of the heating-cooling stage and observed under a microscope with well controlled T 's ($\pm 0.5^\circ C$); (2) pressurized to a fixed P at room T using compressed CH_4 and then heated until a vapor phase was generated; and (3) cooled at a rate of $0.5^\circ C/min$. until the vapor phase disappeared at Th ; the P at Th is the VP of the solution. The P 's were continuously monitored with a Setra 204D P transducer (accurate to $\pm 0.14\%$). Because the sample solution was in a long capillary tube with a small ID, the molal concentration of the sample remained the same during experiment [2]. Our measured VP 's for pure H_2O and $NaCl$ aqueous solutions were consistently lower than most of the previous values, indicating either there was a systematic error in our experimental system or the presence of contaminating gases in the pressure vessels employed in previous works, including those for pure H_2O . If we used the VP 's of pure H_2O [3] to calibrate our experimental system, then our data agreed very well with those reported for $NaCl$ solutions [4] and our methodologies can be easily used for collecting VP data of more complicated and applicable aqueous solutions.

[1] Chou et al. (2005) In *Advances in High-Pressure Technology for Geophysical Applications*. Chapter 24, 475-485. Elsevier. [2] Applegarth et al. (2015) *Appl. Spectr.* **69**, 972-983. [3] <http://webbook.nist.gov/chemistry/> [4] Steele-MacInnis et al. (2012) *Comput. Geosci.* <http://dx.doi.org/10.1016/j.cageo.2012.01.0022>.