

H₂O Activity in H₂O-N₂ Fluids at 10 kbar Measured by the Brucite-Periclase Equilibrium

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Nitrogen is commonly found in mineral fluid inclusions from various metamorphic settings. It also represents a major impurity in natural diamonds, which indicates its importance in the mantle-derived fluids. Thermodynamic mixing properties of N₂ in the aqueous fluids have, nonetheless, been poorly constrained by the experiments at high pressure. Here we present first experimental results constraining activity of H₂O, $a(\text{H}_2\text{O})$, in the H₂O-N₂ binary fluid mixtures at P=10 kbar, in the temperature and compositional ranges corresponding to 650-850 °C, X(N₂) from 0.05-0.5. Simple dehydration reaction: $\text{Mg}(\text{OH})_2 = \text{MgO} + \text{H}_2\text{O}$ (1) was used as a monitor of H₂O activity in the binary mixtures. Temperature depression of reaction (1) in the binary mixtures relative to its equilibrium position in pure H₂O, very well known from previous study (Aranovich and Newton, 1996), gives a direct measure of H₂O activity in the fluid. Experiments were done in a conventional piston-cylinder apparatus with NaCl pressure medium. Starting

solids were synthetic coarsely crystalline brucite and periclase mixed in a stoichiometric proportion. The H₂O and N₂ (latter as a reagent grade Cu₃N) were carefully weighed in to produce a desired starting X(N₂) composition of the fluid phase. Reaction progress was detected primarily by a weight loss method, supported by the optical and X-ray observations on the solid run products. Tightly converging brackets of the final fluid composition in equilibrium with the two-phase solid assemblage were obtained in the 200 °C temperature range. The resulting $a(\text{H}_2\text{O})$ values depart significantly from those predicted by the Raoult's law. Non-ideality in the binary system should be taken into account in the speciation calculations for the system H-O-N at high pressures.

Aranovich LY and Newton RC, *Contrib Mineral Petrol*, **127**, 261-271, (1997).