American Mineralogist, Volume 82, pages 549–556, 1997

The solubility of H_2O in phonolitic melts

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ABSTRACT

We have calibrated the IR spectroscopic technique for measurement of H_2O dissolved in phonolitic glasses as hydroxyl and H_2O molecules using manometric and weight-loss methods. The resulting molar absorptivity coefficients are $1.25^{+0.33}_{0.22}$ (for absorbance due to OH^- at 4500 cm^{-1}) and $1.10^{+0.12}_{-0.10}$ (for absorbance due to molecular H_2O at 5200 cm^{-1}). These values are similar to those previously determined for hydrous jadeitic glasses. We have applied our calibration to a new set of solubility experiments in which H_2O and a natural phonolitic glass were equilibrated at near-liquidus temperatures (85–973 °C) and pressures of 191–1500 bars for periods of 38–272 h. We used a regular solution model to develop an equation of state for the solubility of H_2O in phonolitic melts. Our experimental results demonstrate that H_2O solubility is appreciably higher in phonolitic melts compared with basaltic and rhyolitic melts at the same pressures and near-liquidus temperatures; e.g., the solubility of H_2O at 1000 bars is 4.9 wt% in phonolitic melt (850 °C), 4 wt% in rhyolitic (850 °C), and 3.2 wt% in basaltic (1200 °C) melts. The calculated partial molar volume of dissolved H_2O in phonolitic melt (8.5 ± 2.5 cm^3/mol) falls between that determined by similar methods for rhyolitic and basaltic melts, but we note that the significance of this number is unknown because speciation changes during quenching are not sufficiently well characterized.