*American Mineralogist, Volume 90, pages 1084–1091, 2005*

# Pressure and temperature-dependence of water solubility in Fe-free wadsleyite

**SYLVIE DEMOUCHY,[1,3,*] ETIENNE DELOULE,[2] DANIEL JAMES FROST,[1] AND HANS KEPPLER[3]**

[1]Bayerisches Geoinstitut, Universität Bayreuth, D-95440 Bayreuth, Germany
[2]Centre de Récherches Pétrographiques et Geochimiques, F-54501 Vandoeuvre-Lès-Nancy, France
[3]Institut für Geowissenschaften, D-72074 Tübingen, Germany

## ABSTRACT

The effects of temperature and pressure on water solubility in wadsleyite in the system MgO-$SiO_2$-$H_2O$ were investigated. Experiments were carried out using a 1000 ton multi-anvil press. One series of experiments was performed at a fixed pressure of 15 GPa and at various temperatures and in a second series the temperature was fixed at 1200 °C and pressure was varied from 13 to 18 GPa. The starting material was a mixture of oxides and hydroxides equivalent to the composition $Mg_2SiO_4$ + 5 wt% $H_2O$. Run products consisted of wadsleyite, quenched hydrous melt, and minor amounts of clinoenstatite. The water content of wadsleyite was quantified by ion probe. Results show that at 15 GPa, the water solubility in wadsleyite decreases significantly with increasing temperature from ~2.2 wt% $H_2O$ at 900 °C down to ~0.9 wt% $H_2O$ at 1400 °C; the corresponding Mg/Si ratios increase from 1.80 to 1.91 over this temperature range. This effect appears to be largely due to changes in the water activity in the coexisting melt. The partition coefficient of water between wadsleyite and coexisting melt is nearly independent of temperature with $D^{water}_{wadsleyite/melt} \approx 0.08$. No significant effect of pressure on water solubility was observed at 1200 °C. Our data suggest that the water storage capacity of wadsleyite in the transition zone is much lower than previously suggested. Together with previous results on ringwoodite, our data imply a strong decrease of the water partition coefficient between wadsleyite and ringwoodite with temperature. This decrease could have two important consequences: (1) The width of the 520 km discontinuity may vary strongly as a function of temperature. (2) During cooling of the Earth's mantle since the Hadean, water may have increasingly partitioned from the lower into the upper part of the transition zone.