



Stability of hydrous ringwoodite in the $(\text{Mg}_1\text{Fe}_1)\text{SiO}_4 - \text{H}_2\text{O}$ system

G. Ganskow, F. Langenhorst and D. Frost

Bayerisches Geoinstitut, University of Bayreuth, Bayreuth, Germany
(geertje.ganskow@uni-bayreuth.de / Fax: +49 921-553769)

High-pressure experiments revealed that nominally anhydrous magnesium-rich ringwoodite and wadsleyite can accommodate up to 2-3 wt% H_2O , suggesting that the transition zone of Earth has an enormous water storage capacity. For more iron-rich compositions in the $(\text{Mg},\text{Fe})_2\text{SiO}_4$ system, it is however less known about the solubility and incorporation mechanism of H_2O and its effect on phase stabilities.

Therefore, we have conducted a series of multi anvil experiments in the $(\text{Mg}_1\text{Fe}_1)\text{SiO}_4 - \text{H}_2\text{O}$ system. First experiments cover a wide pressure range from 6 to 23 GPa at variable temperatures between 500°C and 1150°C . A powder starting material with a nominal Fo50 composition was prepared by mixing the following starting materials: $2 \text{Mg}(\text{OH})_2 + \text{Fe}_2\text{SiO}_4 + \text{SiO}_2$. Recovered samples were examined using electron microprobe (EPMA), analytical transmission electron microscopy (TEM), RAMAN and FTIR spectroscopy.

Phase identification reveals ringwoodite as dominant mineral phase under various experimental run conditions (15-18 GPa and $750^\circ - 1150^\circ\text{C}$). The three phase assemblage Ringwoodite (rw) + Magnesiowüstite (mw) + Stishovite (st) was observed at 18 GPa and 1150°C , which is located at lower pressure than predicted in the water-free $(\text{Fe}_1\text{Mg}_1)\text{SiO}_4$ system. FTIR spectroscopy measurements show that ringwoodite (15 GPa, 1150°C) with a nominal Fo50 composition incorporates 0.28 wt% H_2O , which is an order of magnitude lower than the water content of endmember Mg_2SiO_4 ringwoodite. The incorporation mechanism of H_2O into the ringwoodite structure was approached by measuring Fe L_{32} electron energy loss spectra, revealing that iron is

purely ferrous. Thus, it is likely that the water is accommodated by the common substitution mechanism, which involves the replacement of Mg^{2+} or Fe^{2+} by 2H^+ .

Our results suggest that the uptake of water in ringwoodite is considerably reduced for iron-rich compositions. This implies that the water storage capacity of the Martian transition zone is eventually lower than that of Earth. The addition of water to the $(\text{Fe}_1\text{Mg}_1)\text{SiO}_4$ system has also the effect to stabilize the three-phase assemblage $\text{rw} + \text{mw} + \text{st}$ at lower pressure. Thus the mineralogical structure of Mars would be distinctly different than currently assumed, if the Martian mantle were a water-bearing.