American Mineralogist, Volume 100, pages 1084–1092, 2015

## CHEMISTRY AND MINERALOGY OF EARTH'S MANTLE Ouantification of water in majoritic garnet

## SYLVIA-MONIQUE THOMAS<sup>1,\*</sup>, KATHRYN WILSON<sup>1</sup>, MONIKA KOCH-MÜLLER<sup>2</sup>, ERIK H. HAURI<sup>3</sup>, CATHERINE MCCAMMON<sup>4</sup>, STEVEN D. JACOBSEN<sup>5</sup>, JOHN LAZARZ<sup>5</sup>, DIETER RHEDE<sup>2</sup>, MINGHUA REN<sup>1</sup>, NEAL BLAIR<sup>5</sup>, AND STEPHAN LENZ<sup>2</sup>

<sup>1</sup>Department of Geoscience, University of Nevada Las Vegas, Las Vegas, Nevada 89154, U.S.A. <sup>2</sup>Helmholtz-Zentrum Potsdam, Deutsches GeoForschungsZentrum (GFZ), 14473 Potsdam, Germany <sup>3</sup>Department of Terrestrial Magnetism, Carnegie Institution of Washington, Washington, D.C. 20015, U.S.A. <sup>4</sup>Bayerisches Geoinstitut, Universität Bayreuth, 95440 Bayreuth, Germany <sup>5</sup>Department of Earth and Planetary Sciences, Northwestern University, Evanston, Illinois 60208, U.S.A.

## ABSTRACT

Majoritic garnet, characterized by an excess of silicon (>3 Si per formula unit), is considered one of the major phases of the Earth's transition zone from 410–660 km depth. Quantifying the H<sub>2</sub>O content of nominally anhydrous mantle minerals is necessary to evaluate their water storage capacity from experiments and modeling the Earth's deep water cycle. We present mineral-specific infrared absorption coefficients for the purpose of quantifying the amount of water incorporated into majorite as hydroxyl point defects. A suite of majoritic garnet samples with varying proportions of Si, Fe, Al, Cr, and H<sub>2</sub>O was synthesized at conditions of 18–19 GPa and 1500–1800 °C. Single-crystals were characterized using X-ray diffraction, electron microprobe analysis, secondary ion mass spectrometry (SIMS), IR, Raman, and Mössbauer spectroscopy. We utilize SIMS and Raman spectroscopy in combination with IR spectroscopy to provide IR absorption coefficients for water in majoritic garnets with the general mineral formula (Mg,Fe)<sub>3</sub>(Si,Mg,Fe,Al,Cr)<sub>2</sub>[SiO<sub>4</sub>]<sub>3</sub>. The IR absorption coefficient for majoritic garnet in the OH stretching region is frequency dependent and ranges from 10470 ± 3100 Lmol<sup>-1</sup>cm<sup>-2</sup> to 23 400 ± 2300 Lmol<sup>-1</sup>cm<sup>-2</sup>.

**Keywords:** IR spectroscopy, water in nominally anhydrous minerals, transition zone, integral molar absorption coefficient, SIMS, high pressure, Raman spectroscopy