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# Estimating compositions of natural ringwoodite in the heavily shocked Grove Mountains 052049 meteorite from Raman spectra

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## Abstract

A combined Raman spectroscopy and electron probe microanalysis study of the heavily shocked Grove Mountains (GRV) 052049 meteorite revealed the largest chemical fractionation of natural ringwoodite, and composition-dependent variation of the intensities and/or wavenumbers of Raman bands. With Fa content [atomic ratio of Fe/(Fe+Mg)] of ringwoodite varying from 27.8 to 81.6 mol%, the peak position of the single band around 290 $cm^{-1}$ (SB1), which relates to the $SiO_4$ translation mode, shifts from 296.0 to 284.6 $cm^{-1}$, and one of the doublets around 790 $cm^{-1}$ (DB1), which relates to the symmetric stretching of $SiO_4$, shifts from 796.3 to 782.7 $cm^{-1}$. In addition, the relative intensities of SB1 and the other band of the doublet around 840 $cm^{-1}$ (DB2), which relates to asymmetric stretching of $SiO_4$, increases with Fa content. Based on the paired Raman-EPMA data, single-peak and two-peak calibrations were established, which can be used to derive Fa contents of ringwoodite from the Raman spectra. The accuracy of Raman-derived Fa content of ringwoodite is better than ±5 mol%. The correlation of SB1 intensity with the Fa content of ringwoodite suggests that the vibration of SB1 is enhanced with the substitution of $Mg^{2+}$ by $Fe^{2+}$. The correlation between Raman spectra and the chemical composition of ringwoodite have potential applications in on-line measurement of high-pressure experiments and in situ mineralogical determination in future planetary explorations.

**Keywords:** Raman spectroscopy, ringwoodite, chemical compositions, shocked meteorite