

Water effects on the anharmonic properties of forsterite

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ABSTRACT

To quantify the effects of hydration on anharmonicity of olivine thermodynamics, we have measured in situ Raman spectra of an extremely hydrous forsterite with 4500 ppm (wt) H₂O at temperatures up to 1273 K. All the Raman modes in hydrous forsterite shift linearly to lower wavenumbers with increasing temperature. The calculated isobaric mode Grünesien parameters related to SiO₄ internal stretching and bending vibrations are much lower than lattice vibrations. Additionally, compared with anhydrous forsterite, except for the modes at 919, 858, and 227 cm⁻¹, water greatly reduces the isobaric mode Grüneisen parameters of the Raman modes in forsterite. Water also has a large effect on the anharmonic parameters related to lattice vibrations, whereas it has little effect on the anharmonic parameters related to SiO₄ internal stretching and bending vibrations. Those results have the implications to the variations of local structure with temperature and estimation of water effects on the thermodynamics of forsterite.

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