Hydrogen solubility in Al-rich stishovite and water transport to the lower mantle.

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Stishovite is an important phase in subducting oceanic crust. The postgarnet assemblage from a precursor eclogite lithology contains up to 25% stishovite at pressures above 25 GPa. This stishovite may contain up to 4 wt.% Al_2O_3 [1]. Several studies showed that alumina-bearing stishovite contains up to 850 ppm H_2O [e.g. 2-3].

We measured hydrogen solubility in stishovite synthesized at 20 GPa and 1400-1800°C from several starting materials ranging from SiO_2+nH_2O to SiO_2:$Al(OH)_3$=3:1.

FTIR spectra of Al-rich stishovite (Fig.) show major bands at 3111-3126 cm^{-1}, with the wavenumber increasing as H content increases, and several minor bands at 2662-2668, 3312, 3320, and 3351 cm^{-1} (Fig.). H_2O contents of Al-free stishovite are 60-130 ppm using the calibration of [4]. The maximum H_2O content of stishovite (4.4 wt.% Al_2O_3) synthesized at 1400°C is 0.29±0.02 wt.%. The H_2O content of stishovite with 6.1 wt.% Al_2O_3 (synthesized at 1800°C) is 0.24±0.03 wt.%.

Here we report the highest H_2O concentrations in stishovite and confirm it as one of the key phases for transporting water to the deep Earth's mantle.

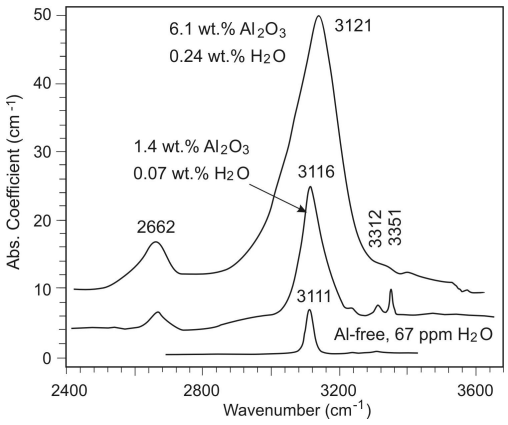

Figure: Examples of polarized FTIR spectra of stishovite.

References

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