

THE WATER CONTENT OF MANTLE GARNETS

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Garnets of crustal origin are known to commonly contain a hydrous component. We have investigated garnets of presumed mantle origin to determine whether they contain a hydrous component and what its structure is. Suites of garnet megacrysts from Colorado plateau diatremes (Green Knobs, Garnet Ridge) and the Wesselton kimberlite, South Africa, were found to commonly contain a structural hydrous component. The Colorado plateau samples range from 0.0 to 0.25 wt. % H₂O, and the Wesselton samples contain from 0.01 to 0.07 %. Concentrations were measured using P₂O₅ cell coulometry, H₂ gas manometry, and thermogravimetry. These were used to calibrate infrared integrated absorbance in the 3 um region, which is a more sensitive measure of total O-H content than the other analytical methods. Infrared absorbance patterns were also used to differentiate structural hydrous component from water contained in alteration and included phases. The structure of the hydrous component in these garnets appears to be the classic H₄O₄⁴⁻ = SiO₄⁴⁻, but other substitutions involving multiple hydroxides in close proximity cannot be ruled out. Molecular H₂O is ruled out by the absence of the diagnostic 1.9 um bend+stretch band in the near infrared. Profiles at 100 um intervals across these samples show flat concentration profiles, indicating equilibrium concentrations in individual garnets. The large range of water contents among samples appears to represent real differences in water fugacity at the point where the garnets equilibrated. These samples dehydrate in air in 4 hours at 1000°C. TG analysis shows weight loss beginning at 250°C and continuing to 1000°C. Garnets in eclogite nodules from South Africa and the Solomon Islands were also studied, but were either anhydrous or too badly altered to determine the content of structurally bound water. The high concentration of hydrous component in the Colorado Plateau samples is consistent with other indicators of high volatile content in that region of the mantle. The water content of mantle garnets may prove to be an accurate indicator of mantle water fugacities.