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Amorphous Materials†

Determination of water content in silicate glasses using Raman spectrometry: Implications for the study of explosive volcanism

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Abstract

Raman spectroscopy can measure water concentrations of hydrous silicate glasses with several advantages such as: (1) high-spatial resolution of 1–2 μm^2; (2) non-destructive character; and (3) easy access, without any specific sample preparation or mounting techniques. The latter reasons render Raman highly suitable for studying natural products, such as volcanic pumice and scoriae fragments. Two spectral regions can be distinguished in Raman spectra of hydrated silicate glasses: a low-wavenumber region (15–1500 cm^{-1}), which corresponds to vibrations of the silicate network, and a high-wavenumber region (3100–3750 cm^{-1}), corresponding to the OH stretching vibrations of H_2O molecules and OH groups. Behrens et al. (2006) have published empirical equations relating the area ratio between these two regions and the water content. However, the proposed internal calibrations depend on chemical composition of the glasses. In this paper, we reinvestigated the previous procedures to improve the background subtraction. Our results allow us to present a more general and linear calibration. Water concentrations up to 13 wt% can be measured for a broad range of natural silicate melts, from basalts to rhyolite (40 up to 80 wt% SiO_2), using a single calibration curve with an absolute error of 0.2 wt%.

Keywords: Water, Raman spectroscopy, quantification, glass, melt, volcanic scorias