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Analytical techniques for volatiles: A case study using intermediate (andesitic) glasses

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ABSTRACT

Small-scale analyses of volatiles in minerals and glasses provide information on how volatiles influence high-temperature geologic processes and low-temperature alteration processes. Four techniques for determining the C-O-H volatile contents of andesitic glasses are compared: manometry, secondary ion mass spectrometry, micro-Fourier transform infrared spectroscopy, and a technique where the H_2O content is calculated using the difference between electron microprobe analysis totals and 100% sum. We present a method to determine the H content of a wide range of glass and mineral compositions using secondary ion mass spectrometry and a model for calibration factors. The extinction coefficients for H-O volatile contents in intermediate composition synthetic glasses are determined, and it is demonstrated that C-O speciation changes as total H_2O content increases, with molecular CO_2 decreasing, CO_3^{2-} increasing, and carbonate peak splitting increasing. For glasses with low H_2O content and oxy-substituted minerals, the methods of choice for volatile analysis are secondary ion mass spectrometry or micro-Fourier transform infrared spectroscopy.