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Universal calibration of Raman spectroscopy for the analysis of volatiles in glasses of variable composition

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The amount and distribution of volatiles (water, carbon dioxide ...) in magmas represent key parameters for the understanding of magma processes and dynamics within volcanic plumbing systems. Micro-Raman spectroscopy is an excellent technique for accurate determination of volatile contents in magmas, as it combines several advantages. The technique is non-destructive and requires minimal sample preparation before the analysis. Its high lateral and in-depth spatial resolution is crucial for the study of small objects and samples that are chemically and texturally heterogeneous at the small scale (microns). Moreover, the high confocality allows analysis of sample regions not exposed to the surface and 3D mapping.

We present a universal calibration of Raman spectroscopy for quantification of volatiles in silicate glasses. The proposed method is based on internal calibration, i.e. on the correlation between the glass water content and the ratio between the areas of the water and silicate Raman bands. Synthetic glasses with variable major element compositions (basaltic, andesitic, rhyolitic, dacitic ..) bearing different H_2O (up to $\sim$7 wt%) and CO_2 contents are used as standard glasses. Natural silicate glasses, mainly in the form of melt inclusions, are used to test the goodness of the proposed method.

In addition to quantification of volatiles in glass, in bubble-bearing melt inclusions we perform micro-Raman spectroscopy investigation of gas-bearing bubbles for accurate determination of total volatile contents in melt inclusions.