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Measuring the degree of “nanotilisation” of volcanic glasses and their implications for volcanic processes

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Iron is a fundamental component of natural silicate melts and glasses and its structural role in magmas can drastically affect the melt’s rheology. It has recently been shown that iron may crystallize out of the magma to form nanolites, effectively depleting the residual melt of iron and bringing forth changes in melt structure and viscosity. This, in turn, influences magmatic and volcanic processes such as degassing and eruptive style.
To date, the identification and characterization of nanolites in volcanic eruptive products largely relied on laborious and costly analytical techniques such as transmission electron microscopy. Raman spectroscopy has only recently been demonstrated as a fast and cheap tool for the investigation of glass nanoheterogeneity.
Here we present a series of spectra of synthetic, nanolite bearing, glasses spanning basaltic to peralkaline rhyolitic compositions acquired using three standard laser wavelengths used in Raman Spectroscopy (red, green and blue). We investigate the effect of laser wavelength on the ability to detect the degree of glass “nanolitization”. The results show that a peak located at ∼970 cm-1 is directly related to presence of ferric iron in the glass structure, whereas a peak at ∼ 690 cm-1, which is not related to any spectral feature of the glass structure, reveals the presence of iron-bearing nanolites. We present a new index termed N# (“nanolitization” index) to rate the degree of “nanotilization”. This will enable different laboratories to compare results obtained from melts and glasses and explore the nanoheterogeneity of experimental and volcanic products. We further present preliminary data of Raman studies on natural volcanic glasses and discuss the implications of nanolitization for volcanic processes.