

Un-mixing messages: finding meaning in volcanic gases

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Volcanic gases contain a wealth of information about eruptive processes and subsurface plumbing. We record these gas emissions as signals captured through remote sensing, in situ instrumentation, or laboratory analyses of samples. A measurement at the surface, however, is not solely a representation of the exsolution of volatiles and magmatic processes. Modification can occur, for example, through interaction of magmatic gas with rock, water, or air. The analytical techniques we use may further affect our data or interpretations. Thus, collection and interpretation of volcanic gas data requires the context of the volcanic setting and our own measurement methods.

We will consider approaches to, and challenges in, 'un-mixing' the messages contained in volcanic gas data, with examples as follows: (1) Isolating magmatic processes through time-frequency analyses of multi-parametric gas measurements. In this example, analyses of time-series gas data, obtained by Fourier transform infrared spectroscopy, allow us to distinguish solubility and redox controls on magmatic degassing at Erebus lava lake, Antarctica. (2) Illustrating how spatial analyses of volcanic gases can reveal subsurface environmental interactions between magmatic gas and the volcanic edifice. This case study centres on direct sampling and laboratory analyses of emissions from the ice caves and warm ground areas of Erebus volcano. (3) Discussing how choices of instrumentation and retrieval methods can affect gas measurements, with examples from ultraviolet camera research at Sabancaya, Peru, and Yasur, Vanuatu. We will see that despite these challenges, with awareness of context and appropriate use, gas measurements remain a powerful tool for qualitative and quantitative understanding of volcanic processes.