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Volcanic fluxes of water from Mount Etna and Stromboli (Italy): measurements and implications

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Water is usually the main volatile species dissolved in magmas and the prevalent component of volcanic gas emissions, as water vapour. It thus has well known key influences on magma rheological properties and the dynamics of volcanic eruptions. In contrast, its emission rate from volcanoes has rarely been measured directly and remains poorly constrained, at both local and global scales. In addition, water in volcanic emissions can have a complex origin as either surface or recycled waters can mix with truly mantle-derived H_2O. Here I present unpublished data for water emission rates from two very active basaltic volcanoes, Mount Etna and Stromboli (Italy), and discuss their implications. Water contents and fluxes were directly measured in plume emissions of the two volcanoes, using different methodologies onboard of a laboratory-aircraft [1]. Water concentrations were measured both in volcanic plumes and the outer normal atmosphere, either continuously (infrared spectroscopy, relative humidity sensing) or/and after cumulative sampling (weighed permeation tubes). The net supply of volcanic water was determined by subtracting the atmospheric background from the plume concentration. Water fluxes were then obtained in reference to the SO_2 flux measured from the aircraft with UV absorption spectroscopy (COSPEC). The results demonstrate a much stronger water emission from Mount Etna than Stromboli, in agreement with a higher magma supply rate and gas discharge at Etna. However, at both volcanoes the measured water fluxes significantly exceed the purely magmatic discharge that is expected from the magma supply rate and the degassed mass fraction of H_2O constrained by melt inclusion data [2-5]. Such a discrepancy can be explained by (i) partial entrainment of atmospheric water vapour into the initially hot and buoyant volcanic plume, which can be assessed reasonably well, but also (ii) the vaporisation of meteoric groundwater present in the volcanic piles or even in their

crustal basement (hydrothermal systems). As illustrated in the case of Etna, the potential magmatic and meteoric contributions can tentatively be evaluated from mass balance calculations and available D/H isotopic data [6,7]. Moreover, the mass and heat flows associated with H_2O emission can be compared interestingly with the other (seismic, magmatic) modes of energy release from the volcano. The measured water fluxes from Etna and Stromboli basaltic volcanoes will be compared to those measured at a few other volcanoes and to current flux estimates for global volcanism.

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