

Accepted Manuscript

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PII: S0377-0273(16)30448-6

DOI: doi: [10.1016/j.jvolgeores.2017.01.023](https://doi.org/10.1016/j.jvolgeores.2017.01.023)

Reference: VOLGEO 6009

To appear in: *Journal of Volcanology and Geothermal Research*

Received date: 14 November 2016

Revised date: 27 January 2017

Accepted date: 28 January 2017

Please cite this article as: Marianna Cangemi, Paolo Madonia, Rocco Favara , Chemical characterisation of rainwater at Stromboli Island (Italy): The effect of post-depositional processes. The address for the corresponding author was captured as affiliation for all authors. Please check if appropriate. Volgeo(2017), doi: [10.1016/j.jvolgeores.2017.01.023](https://doi.org/10.1016/j.jvolgeores.2017.01.023)

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Chemical characterisation of rainwater at Stromboli Island (Italy): the effect of post-depositional processes

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Abstract

Volcanoes emit fluids and solid particles into the atmosphere that modify the chemical composition of natural precipitation. We have investigated the geochemistry of Stromboli's rainfall during the period from November 2014 to March 2016 using a network of a new type of sampler specifically designed for operations on volcanic islands. We found that most of the chemical modifications are due to processes occurring after the storage of rainwater in the sampling bottles. These processes include dissolution of volcanogenic soluble salts encrusting volcanic ash and a variable contribution of sea spray aerosol. Our data showed noticeably less scatter than has previously been achieved with a different sampling system that was more open to the atmosphere. This demonstrates the improved efficacy of the new sampler design. The data showed that post-depositional chemical alteration of rain samples dominates over processes occurring during droplet formation and precipitation. This has important implications for the calculation of fluxes of chemicals from rainfall in volcanic regions.

Keywords

Rainwater chemistry; sea spray; plume; volcanic ash; Stromboli; post-depositional processes.

1. Introduction

Volcanoes are important sources of gases, solid particles and aqueous acid droplets emitted at high temperature into the atmosphere (Cadle, 1980; Oppenheimer, 2003; Mather et al., 2003; Gerlach, 2004; Textor et al., 2004; Von Glasow et al., 2009). Atmospheric precipitations represent a significant mechanism for maintaining the balance between sources and sinks of particulate, providing a natural scavenging of the chemical dispersed into the atmosphere also in terms of acidification of water (González and Aristizábal, 2012). The interaction between volcanic activity and rain chemistry has been investigated worldwide, and among the others at Kilauea, Hawaii (Siegel et al. 1990; Scholl and Ingebritsen 1995), Soufriere Hills volcano, Monserrat (Edmonds et al. 2003), and in Italy at Mt Etna (Bellomo et al. 2003), Vulcano island (Liotta et al. 2006; Madonia and Liotta, 2010), Stromboli island (Bellomo et al., 2003; Liotta et al., 2006; Madonia et al., 2013), and Mt Vesuvius (Madonia and Liotta,

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