Cities on Volcanoes 9
November 20-25, 2016
Puerto Varas, Chile
'Understanding volcanoes and society: the key for risk mitigation'

Volcanic soil gas 4He/CO2 ratio: a useful geochemical tool for eruption forecasting

Nemesio M. Pérez[1,2,3], María Asensio-Ramos[1], Eleazar Padrón[1,2,3], Gladys Melián[1,2,3], Pedro A. Hernández[1,2,3], Germán Padilla[1,2], José Barrancos[1,2], Fátima Rodríguez[1], Hirochika Sumino[1], Mar Alonso[1], and, David Calvo[1]

[1]Instituto Volcanológico de Canarias, Canary Islands, Spain

[2]Instituto Tecnológico y de Energías Renovables, Canary Islands, Spain

[3]Agencia Insular de la Energía de Tenerife, Canary Islands, Spain

[4]Dep. Basic Science, Graduate School of Arts and Sciences, Univ. Tokyo, Meguro-ku, Tokyo, Japan

Keywords: Canary Island, El Hierro, He/CO2 emission ratio, submarine eruption

Magmatic gases that percolate through volcano's porous flanks in a diffuse way disturb the chemical composition of soil gases at the surface environment of the volcano, generating enrichments of CO2, He, etc. He and CO2 have similar low solubility in silicate melts and their movement through the crust towards the surface is very different: CO2, which is a reactive gas, is affected by the occurrence of interfering processes, while interaction of He during its ascent is minimum. Their geochemical differences yield higher relative He/CO2 ratios in the fumarole gases than is actually present in the magma, but it decreases when the magma reservoir reaches enough pressure to generate incipient fracture systems approaching the eruption. In this work, we present quasi daily estimations of diffusive He through the whole surface of El Hierro, the youngest island of the Canarian archipelago, considering He emission data reported in the literature (Padrón et al., 2013. Geology), using the same procedure as for diffuse CO2 emission time series (Melián et al., 2014). After the occurrence of more than 11,000 seismic events, a shallow submarine eruption started south of El Hierro in October 12, 2011 and lasted 5 months. Two different emission peaks for He and CO2, with approximately the same delay between them (~23 days), were observed. The combination of both time series resulted in a drastic increase in the He/CO2 emission ratio of the island (up to 1.1×10-3) two weeks before the eruption onset. Additionally, a second significant He/CO2 emission peak (up to 5.5×10-4) was observed between 3 and 4 November, some days before the highest lava emission period. He/CO2 emission ratio time series during El Hierro submarine eruption presented here demonstrate the importance of its continuous monitoring in active volcanic regions, mainly in areas without visible manifestations of volcanic fluid discharges.