



Low cost soil CO₂ efflux monitoring network for the volcanic surveillance of Cumbre Vieja volcano, La Palma, Canary Islands

Lucía Sáez-Gabarrón (1), Jessica L. Palmer (2), Rachael Haughton (3), Cecilia Amonte (1,4), María Cordero (1), Jesica Hopson-Safatli (1), Silvia Rayo-Mato (1,5), Mar Alonso (1,5), Violeta T. Albertos-Blanchard (1), Fátima Rodríguez (1), Eleazar Padrón (1,4,5), María Asensio-Ramos (1), Marta García-Merino (1), Nemesio M. Pérez (1,4,5)

(1) Instituto Volcanológico de Canarias (INVOLCAN), 38320 La Laguna, Tenerife, Canary Islands, Spain (nperez@iter.es), (2) School of Geographical and Earth Sciences, University of Glasgow, Glasgow G12 8QQ, U.K., (3) The Science Department, The Open university, Milton Keynes, MK7 6AA, U.K., (4) Agencia Insular de la Energía de Tenerife (AIET), 38600 Granadilla de Abona, Tenerife, Canary Islands, Spain, (5) Instituto Tecnológico y de Energías Renovables (ITER), 38600 Granadilla de Abona, Tenerife, Canary Islands, Spain

La Palma Island (708.32 km²) is located at the northwestern end of the Canarian Archipelago. Subaerial volcanic activity on La Palma started ~2.0 My ago and has taken place exclusively at the southern part of the island in the last 123 ka, where Cumbre Vieja volcano, the most active basaltic volcano in the Canaries, has been constructed. On 7-9 and 13-14 of October 2017 two intense seismic swarm occurred beneath Cumbre Vieja. Seismological and geochemical evidences linked the seismic swarm to a deep-seated magmatic intrusion. In the last 20 years, there has been considerable interest in the study of diffuse degassing as a powerful tool in volcano monitoring programs. Diffuse degassing studies are even more important volcanic surveillance tool at those volcanic areas where visible manifestations of volcanic gases are absent, such as Cumbre Vieja. Historically, soil gas and diffuse degassing surveys in volcanic environments have focused mainly on CO₂ because it is, after water vapor, the most abundant gas dissolved in magma. One of the most popular methods used to determine CO₂ fluxes in soil sciences is based on the absorption of CO₂ through an alkaline medium, followed by titration analysis. In October 2017, a network of 21 closed static chambers was installed, covering Cumbre Vieja volcano with volcanic surveillance porpoises. 50 cc of 1N KOH solution is placed inside the chamber to absorb the CO₂ released from the soil. The solution is replaced weekly analyzed at the laboratory by titration. Results are expressed as weekly integrated CO₂ efflux values. The CO₂ efflux values ranged from 1.7 to 15.6 g•m⁻²•d⁻¹, with an average value of 7.4 g•m⁻²•d⁻¹ for the entire Cumbre Vieja volcano. Stations showing highest values (> 13 g•m⁻²•d⁻¹) are located at the southern end of Cumbre Vieja where the most recent volcanic eruption took place and on the northwest flank of this volcanic system. Soil gas samples were weekly sampled on the head space of the closed chambers to analyze the chemical and isotopic composition of CO₂. Collected gas samples can be considered as CO₂-enriched air, showing concentrations of CO₂ in the range 305-158,211 ppmV, with an average value of 2,237 ppmV. The highest values of CO₂ concentration coincided with those stations that showed the highest CO₂ efflux values. Regarding to the CO₂ isotopic composition, expressed as [U+F064] [U+F031] [U+F033] C-CO₂, most of the stations exhibited CO₂ composed by different mixing degrees between atmospheric and biogenic CO₂ with slight contributions of deep-seated CO₂, with values ranged from mean values of -2.40‰ to -29.0‰ and an average value of -19.4‰. Three stations located along the southern most part of the NS rift of Cumbre Vieja volcano showed values with a strong deep-seated CO₂ contribution, occurring at the same time that the observed increase on the diffuse CO₂ emission along the Cumbre Vieja measured by the accumulation chamber method. The methodology presented here represents an inexpensive method that might help to detect early warning signals of future unrest episodes at Cumbre Vieja.