Surface diffuse degassing monitoring of the Tenerife Northeastern Rift Zone (NERZ) volcano, Canary Islands

Lucía Sáez-Gabarrón1, Jazlyn Beeck2, Sian Reilly3, Mar Alonso1,4, Víctor Ortega-Ramos1, Eleazar Padrón1,4,5, Gladys V. Melián1,4,5, Fátima Rodríguez1, Pedro A. Hernández1,4,5, and Nemesio M. Pérez1,4,5

1Instituto Volcánológico de Canarias (INVOLCAN), 38240 La Laguna, Tenerife, Canary Islands, Spain (lucia.saez.beca@iter.es)
2Department of Geology and Atmospheric Sciences, Iowa State University, Ames, IA 50011, U.S.A.
3School of Earth & Environmental Sciences, University of St. Andrews, St. Andrews, KY16 9AJ, U.K.
4Instituto Tecnológico y de Energías Renovables (ITER), 38611 Granadilla de Abona, Tenerife, Canary Islands, Spain
5Agencia Insular de la Energía de Tenerife (AIE), 38611 Granadilla de Abona, Tenerife, Canary Islands, Spain

The North East Rift volcanic Zone (NERZ) of Tenerife Island is one of the three volcanic rift-zones of the island, oriented NW-SE (NWRZ), NE-SW (NERZ) and a more scattered area on the south (NSRZ). From a volcano-structural point of view, NERZ is more complex than NW or NS rifts due the existence of Pedro Gil stratovolcano that broke the main NE-SW structure. Pedro Gil Caldera was formed 0.8 Ma ago by a vertical collapse of this stratovolcano. The most recent eruptive activity along the NERZ took place during 1704 and 1705 along a 13 km of fissural eruption of Arafo-Fasnia-Siete Fuentes. Diffuse CO₂ efflux surveys have been undertaken in a yearly basis since 2001 in order to provide a multidisciplinary approach to monitor potential volcanic activity changes at the NERZ. The aim of this study is to report the results of the last soil CO₂ efflux survey undertaken in summer 2019, with 639 measuring sites homogeneously distributed in an area of 210 km². In-situ measurements of CO₂ efflux from the surface environment of NERZ were performed by means of a portable non-dispersive infrared spectrophotometer (NDIR) following the accumulation chamber method. Soil CO₂ efflux contour maps were constructed to identify spatio-temporal anomalies and to quantify the total CO₂ emission using the sequential Gaussian simulation (sGs) interpolation method. The CO₂ efflux values ranged from non-detectable (0.5 g m⁻² d⁻¹) up to 72.3 g m⁻² d⁻¹, with an average value of 10.9 g m⁻² d⁻¹. Statistical-graphical analysis of the 2019 data show two different geochemical populations; background (B) and peak (P) represented by 70.4% and 1.9% of the total data, respectively. The geometric means of the B and P populations are 0.4 and 4.3 g m⁻² d⁻¹, respectively. The diffuse CO₂ emission rate was estimated in 2,205 t d⁻¹. Studying the long-term variations on the diffuse CO₂ emission since 2001, two main pulses are identified: one in 2007 and a second one sustained over time between 2014 and 2019. Enhanced endogenous contributions of deep-seated CO₂ might have been responsible for the higher CO₂ emissions values observed during those pulses. The 2014-2019 pulse appears to be related to the seismic activity that started taking place in Tenerife at the end of 2016. This study denotes the importance of soil CO₂ efflux surveys at the NERZ volcano of Tenerife Island as an effective volcanic monitoring tool.