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Monitoring diffuse CO_2 degassing in a monogenetic volcanic field during a quiescent period: the case of Timanfaya volcano (Lanzarote, Canary Islands, Spain)

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Lanzarote Island (795 km2) is an emergent part of the East Canary Ridge (ECR), which is a ca. 70-km-long, 65-km-wide, NNE-SSW linear volcanic structure off-shore Morocco. It is the easternmost island in the Canary Islands and it is situated approximately 100 km from the NW coast of Morocco, Africa. The island is elongated in NNE-SSW direction reflecting the trend of the ECR. From 1730 to 1736 Lanzarote suffered the longest eruption in historical times in the Canary Islands, the Timanfaya volcanic eruption, a basaltic-type eruption with tholeiitic tendencies, with more than 30 volcanic cones formed in different eruptive phases which covered 23% of the island. The last eruption at Lanzarote Island occurred during 1824, Tinguaton volcano, and produced a much smaller lava flow that reached the SW coast. Fumarolic activity is absent at the surface environment of Timanfaya, and therefore monitoring diffuse CO_2 efflux becomes a useful geochemical tool to monitor volcanic activity at this island. Since 1999, diffuse CO_2 emission surveys have been undertaken at Timanfaya and surrounding areas almost in a yearly basis following the accumulation chamber method. At each survey, between 370 and 430 sampling sites were selected to obtain a homogeneous distribution over an area of 252 km2. In September 2018 a new survey was carried out at Timanfaya volcanic system (TVF) with 411 sampling sites homogenously distributed along TVF always depending on logistic reasons. Soil CO_2 efflux values ranged from non-detectable to 8.2 g•m−2•d^{-1} with a maximum soil temperature of 154ºC measured at a depth of 40 cm. Statistical-graphical analysis of the data showed three different geochemical populations; background (B), intermediate (I) and peak (P), represented by 98.9%, 0.8% and 0.3% of the total data, respectively, with geometric means of 0.6, 4.9 and 5.3 g•m−2•d^{-1}, respectively. Higher CO_2 efflux values were measured at the north sector of the TVF where thermal anomalies occur, suggesting a convective mechanism transport of gas from depth at these areas. To quantify the diffuse CO_2 emission rate from the TVF, 100 sequential Gaussian simulations (sGs) were performed as interpolation method to construct soil CO_2 emission contour maps. The diffuse CO_2 emission rate for the studied area was estimated in 47.3 $\pm$ 4 t•d-1, value lower than the background average of CO_2 emission, estimated in 121.4 t d-1. This type of studies demonstrate the great utility of using diffuse CO_2 degassing as a useful geochemical method to contribute to volcanic monitoring programs in systems where there are no visible geothermal surface manifestations.