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Monitoring of diffuse CO₂ degassing at NERZ, NWRZ and NSRZ volcanic systems of Tenerife, Canary Islands

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One of the main volcano-structural and geomorphological feature in Tenerife (2,034 km²) is the triple rift system, formed by aligned of hundreds of monogenetic eruptive products of shield basaltic volcanism. At the intersection of this triple rift system rises the Teide-Pico Viejo volcanic complex. These volcanic rifts are considered as active volcanic edifices. The North East volcanic Rift Zone (NERZ, 210 km²) form a main NE-SW structure. The North West volcanic Rift Zone (NWRZ, 72 km²) is oriented in NW-SE direction and the North South volcanic Rift Zone (NSRZ, 325 km²) comprises a more scattered area on the south of these monogenetic cones. The most recent eruptive activity of Tenerife has taken place in these rift systems. NERZ host the fissural eruption of Arafo-Fasnia-Siete Fuentes (1704-1705). NWRZ host two historical eruptions: Arenas Negras in 1706 and Chinyero in 1909. Recently the eruption of Boca Cangrejo (1492) has been added to the historical register through ¹⁴C dating. NSRZ does not host historical volcanism, although it is recent, up to 10,000 years old.

In order to provide a multidisciplinary approach to monitor potential volcanic activity changes at the NERZ, NWRZ and NSRZ, diffuse CO₂ emission surveys have been undertaken since 2000, in general in a yearly basis, but with a higher frequency when seismic swarms have occurred in and around NWRZ volcano. Each study area for NERZ, NWRZ and NSRZ comprises hundreds of sampling sites homogenously distributed. Soil CO₂ efflux measurements at each sampling site were conducted at the surface environment by means of a portable non-dispersive infrared spectrophotometer (NDIR) LICOR Li820 following the accumulation chamber method. To quantify the CO₂ emission rate from the NERZ, NWRZ and NSRZ a sequential Gaussian simulation (sGs) was used as interpolation method.

The diffuse CO₂ emission rate for the NERZ ranged from 532 up to 2823 t d⁻¹ between 2001 and 2020, with the highest value measured in 2020. In the case of NWRZ, the diffuse CO₂ emission rate ranged from 52 up to 867 t d⁻¹ between 2000 and 2020, with the highest value measured in one of the surveys of 2005. Finally, and for NSRZ, the diffuse CO₂ emission rate ranged from 78 up to 819 t d⁻¹ between 2002 and 2020, with the highest value measured in 2019. The temporal evolution of diffuse CO₂ emission at the NERZ, NWRZ and NSRZ shows a nice and clear relationship with the

volcanic seismicity in and around Tenerife Island, which started to take place from the end of 2016. The good temporal correlation between the volcanic seismicity and the increase trend observed in the time series of diffuse CO₂ emission rates at NERZ, NWRZ and NSRZ is also coincident with the observed increase of diffuse CO₂ emission rate at the summit crater of Teide. This work demonstrates the importance of performing soil CO₂ efflux surveys at active rift systems in volcanic oceanic islands as an effective geochemical monitoring tool.