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Diffuse He degassing monitoring of the Tenerife North-western Rift Zone (NWRZ) volcano, Canary Islands

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Tenerife (2034 km²), the largest island of the Canary archipelago, is characterized by three volcanic rifts oriented NW-SE, NE-SW and N-S with a central volcanic complex, Las Cañadas Caldera, hosting Teide-Pico Viejo volcanoes. The North West volcanic Rift Zone (NWRZ, 72 km²) of Tenerife is one of the youngest and most active volcanic systems of the island, where two historical eruptions have occurred: Arenas Negras in 1706 and Chinyero in 1909. Diffuse degassing studies has become an important volcanic surveillance tool at those volcanic areas where visible manifestations of volcanic gases are absent, as in the case of NWRZ. Mapping soil gas emission along volcanic structures can provide a better understanding of the processes occurring at depth and allows monitoring the spatial distribution, magnitude and temporal evolution of the surface gas emissions. The geochemical properties of He, minimize the interaction of this noble gas on its movement toward the earth's surface, and make this gas an almost ideal geochemical indicator of changes occurring in the magmatic plumbing system of the volcano (Padrón et al., 2013, *Geology* 41(5):539–542). Since 2014, surface He emission surveys have been performed once a year as an additional geochemical tool to monitor the volcanic activity of NWRZ. At 345 sampling sites soil gas samples were collected at 40 cm depth and analyzed for He concentration within 24 hours by means of QMS, model Pfeiffer Omnistar 422. The soil helium concentration data were used to estimate the diffusive helium flux at each point, to construct spatial distribution maps by sequential Gaussian simulation and then to estimate the total helium emission in the NWRZ. Helium emission ranged between non-detected values up to 7.2 mgm⁻²d⁻¹, and the emission rate of the entire area was in the range ~1 – 45 kg d⁻¹. An increasing trend was observed in the period 2016-2018, showing a good temporal coincidence with a significant increase in seismic activity recorded in Tenerife. The promising results observed in the NWRZ and in other volcanic systems (Padrón et al., 2013) indicate that soil helium emission monitoring could be an excellent early warning geochemical precursory signal for future volcanic unrest.