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Diffuse He degassing from Cumbre Vieja volcano, La Palma, Canary Islands

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Helium is considered as an ideal geochemical tracer due to its geochemical properties: chemical inertness, physical stability and practical insolubility in water under normal conditions. These characteristics, together with its high mobility on the crust, make the presence of helium anomalies on the surface environment of a volcanic system to be related to deep fluid migration controlled by volcano-tectonic features, also providing valuable information about the location and characteristics of the gas source and the fracturing of the crust. The recent results reported by Padrón et al. (2013) clearly show importance of helium emission studies for the prediction of major volcanic events and the importance of continuous monitoring of this gas in active volcanic regions. La Palma Island (708.32 km^2) is located at the northwestern end of the Canarian Archipelago. Subaerial volcanic activity on this island started $\sim$2.0 My ago and has taken place exclusively at the southern part in the last 123 ka. Cumbre Vieja volcano, the most active basaltic volcano of the Canary Islands, was built in this zone, including a main north-south rift area 20 km long and up to 1,950 m in elevation, with vents located also at the northwest and northeast. Padrón et al., (2012) showed that helium is mainly emitted along both N-S and N-W rift of Cumbre Vieja, being, therefore, zones of enhanced permeability for deep gas migration and preferential routes for degassing. This work represents a continuation of the results obtained by Padrón et al. (2012) until the year 2016. Each study covered the 220 km^2 of Cumbre Vieja with an average of 570 homogenously distributed sampling points. At each sampling site, soil gas samples were collected at 40 cm depth by withdrawing the gas aliquots into 60 cc hypodermic syringes. He content in the soil gases was analyzed by means of quadrupole mass spectrometry (QMS). Atmospheric gas was used periodically to calibrate the instrument. To estimate the helium emission rate at each sampling point, a pure diffusive model was applied following the Fick's law. Thus, assuming a pure diffusive mechanism, the helium emission was estimated between 18 and 38 kg d^{-1} in the studied period (2002-2016). Helium efflux contour maps were constructed using sequential Gaussian simulation (sGs) as interpolation method. In most of the surveys, helium enrichments in the soil layer with respect to the air concentration measured on Cumbre Vieja indicate a strong structural control in the degassing processes of the volcano and the excess helium seems to be emitted mainly along both N–S and N–W rifts of the volcano. This work reinforce the importance of performing helium emission studies as an important volcano monitoring technique that might help to detect early warning signals of volcanic unrest in oceanic volcanic islands.

References:

Padrón et al., (2012). Chem. Geol. 312–313, 138–147.

Padrón et al. (2013). Geology 41(5), 539–542.