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Helium and carbon dioxide diffuse emissions from Cumbre Vieja volcano,

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La Palma island (730 Km^2) is the northwestern most island of the Canarian archipelago. Cumbre Vieja volcano (220 Km^2) is the result of the volcanic activity in the southern part of the island during the last 1 Ma. Six historical eruptions have occurred at Cumbre Vieja, with the most recent one taking place in 1971 at the extreme south of this volcano (Teneguía volcano). Three major volcanic rift-zones trending N-S, NW-SE and NE-SW constitute Cumbre Vieja's major structural features. Since fumarolic activity is absent at the surface environment of Cumbre Vieja volcano, to study the spatial distribution of soil CO_2 efflux becomes an ideal geochemical tool for monitoring volcanic activity. However, CO_2 efflux can be strongly affected by atmospheric parameters and biologic activity in the soil. Helium is an ideal geochemical gas tracer because it is chemically inert, physically stable and sparingly soluble in water under ambient conditions. The aim of this study is to compare and evaluate the use of diffuse CO_2 and helium degassing systematic for monitoring the volcanic activity of Cumbre Vieja. During the summers of 2002, 2003 and 2004, soil CO_2 efflux and He surveys were performed under ideal weather conditions (no wind and sunny) at Cumbre Vieja volcano. Diffuse CO_2 efflux and soil gas helium content were measured in approximately 600 observation sites. Soil CO_2 efflux measurements were performed in-situ by means of a portable NDIR sensor LICOR-800 according to the accumulation chamber method. At each point soil gas samples were collected at 40 cm deep using a metallic probe and stored in vacutainers by means of water displacement technique. Soil gas samples were analyzed for ^{4}He concentration by means of a QMS Omnistar 422 within 24 hours after sampling. For all this study, CO_2 efflux values ranged from negligible values to 1900 g m^2 d^{-1} and ΔHe values (ΔHe = $He_{soil atmosphere}$

- He_{air}) ranged from -1170 to 6689 ppbV. CO_2 efflux and ΔHe contour maps were constructed using kriging as interpolation method. CO_2 efflux contour maps show the following features: (1) most of the studied area showed CO_2 efflux values bellow 5 g m^2 d^{-1}, (2) relatively high CO_2 degassing rates (>10 g m^2 d^{-1}) were mainly identified along the three rift-zones and (3), the highest degassing rates (>1500 g m^2 d^{-1}) were identified at Teneguía volcano. Spatial distribution of ΔHe at the surface environment showed the following features: (1) most of the studied area showed ΔHe values bellow 1000 ppbV and (2) spatial distribution of anomalous ΔHe values (>1800 ppbV) were mainly identified along the upper part of N-S rift of Cumbre Vieja. During this study and mainly in 2004, an extension on the soil ΔHe anomalies along the NW rift has been observed together with the appearance of ΔHe anomalous values (>2000 ppbV) in 2004 at the southern most part of Cumbre vieja where Teneguía volcano is located. Soil ΔHe distribution at the surface environment of Cumbre Vieja indicate that a deep contribution for the diffuse degassing is structurally controlled and occurs along the N-S rift. Otherwise, diffuse CO_2 anomalies did not show a clear spatial relation with the structural features of Cumbre Vieja indicating the usefulness of soil He surveys to evaluate the contribution of deep sources in volcanic areas.