



## **Dynamics of diffuse carbon dioxide emissions from Cumbre Vieja volcano, La Palma, Canary Islands**

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La Palma Island, the fifth longest (706 km<sup>2</sup>) and the second in elevation (2,423 m asl) of the Canary Islands, is located at the northwestern extreme of the archipelago. Volcanic activity in the last 123 ka has taken place exclusively at the southern part of the island, where Cumbre Vieja volcano, the most active basaltic volcano in the Canaries, has been constructed. Cumbre Vieja includes a main north-south rift zone 20 km long up to 1,950 m in elevation, and covers 220 km<sup>2</sup> with vents located also at the northwest and northeast. Nowadays there are no visible gas emission from fumaroles or hot springs at Cumbre Vieja. For this reason, diffuse CO<sub>2</sub> degassing studies may provide important information about subsurface magma movement. Since diffuse CO<sub>2</sub> emission rate may increase extraordinarily before a volcanic eruption, it is very important to map surface CO<sub>2</sub> efflux anomalies and determine the total output of this gas prior to volcanic activity, in order to have a better understanding during future volcanic events.

This study report the results of 13 soil CO<sub>2</sub> efflux surveys at Cumbre Vieja volcano. The CO<sub>2</sub> efflux measurements were undertaken using the accumulation chamber method between 2001 and 2013 to constrain the total CO<sub>2</sub> output from the studied area and to evaluate occasional CO<sub>2</sub> efflux surveys as a volcanic surveillance tool for Cumbre Vieja. Soil CO<sub>2</sub> efflux values ranged from non-detectable up to 2,442 g m<sup>-2</sup> d<sup>-1</sup>, with the highest values observed in the south, where the last volcanic eruption took place (Teneguía, 1971). Isotopic analyses of soil gas carbon dioxide suggest an organic origin as the main contribution to the CO<sub>2</sub> efflux, with a very slight magmatic degassing being observed at the southern part of the volcano. Total CO<sub>2</sub> emission rates showed a high temporal variability, ranging between 320 and 1,544 t d<sup>-1</sup> and averaging 1,147 t d<sup>-1</sup> over the 220 km<sup>2</sup> region. Two significant increases in the CO<sub>2</sub> emission observed in 2011 and 2013, were likely caused by an enhanced magmatic endogenous contribution revealed by significant changes in the <sup>3</sup>He/<sup>4</sup>He ratio in a CO<sub>2</sub>-rich cold spring. The similarity observed in the estimates rates of diffuse CO<sub>2</sub> emission make them an effective surveillance tool for Cumbre Vieja volcano like it has been observed at other volcanic areas.