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Alkaline traps network to monitor soil CO_2 efflux weekly measurements for the volcanic surveillance at Tenerife, Canary Islands

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Tenerife (2,304 km2), the largest of the Canary Islands, has developed a central volcanic complex (Cañadas edifice), that started to grow about 3.5 My ago. Coeval with the construction of the Cañadas edifice, shield basaltic volcanism continued until the present along three rift zones oriented NW–SE, NE–SW and NS (hereinafter referred as NW, NE and NS respectively). Main volcanic historical activity has occurred along de NW and NE rift-zones. Uprising of deep-seated gases occurs along the aforementioned volcanic structures causing diffuse emissions at the surface environment of the rift-zones. In the last 20 years, there has been considerable interest in the study of diffuse degassing as a powerful tool in volcano monitoring programs, an important monitoring task mainly at those volcanic areas where visible manifestations of volcanic gases are absent. Soil gas and diffuse degassing surveys have been focused in CO_2 because it is, after water vapor, the most abundant gas dissolved in magma. One of the most inexpensive methods to determine CO_2 fluxes is based in the absorption of CO_2 through an alkaline medium, followed by titration analysis. In the summer of 2016, a network of 31 closed static chambers was installed, covering the three main structural zones of Tenerife (NE, NW and NS) as well as Cañadas caldera with volcanic surveillance porpoises. 50 cc of 1N KOH solution is placed inside the chamber to absorb the CO_2 released from the soil. The solution is replaced weekly and the trapped CO_2 is then analyzed at the laboratory by titration. Results are expressed as weekly integrated CO_2 efflux values. The CO_2 efflux values ranged from 2.7 to 12.5 g•m-2•d-1, with average values of 8.2 g•m-2•d-1 for the NE rift-zone, from 3.1 to 10.9 g•m-2•d-1, with average value of 6.3 g•m-2•d-1 for the NW rift-zone, and from 2.3 to 10.9 g•m-2•d-1, with average value of 6.3 g•m-2•d-1 for NS rift-zone. In the case of Cañadas caldera, values ranged from 1.1 to 8.0 g•m-2•d-1, with average value of 5.0 g•m-2•d-1. The most significant CO_2 efflux values were observed at the NE rift-zone, with a maximum value of 12.5 g•m-2•d-1. Soil gas samples were weekly sampled on the head space of the closed chambers to analyze the chemical and isotopic composition of CO_2. The gas is considered as CO_2-enriched air, showing concentrations of CO_2 in the range 355-22,448 ppmV, with average values of 4,959 ppmV, 1,274 ppmV, 1,465 ppmV and 609 ppmV for the NE, NW, NS rift-zones, and Cañadas caldera, respectively. The CO_2 isotopic composition indicates that most of the sampling sites exhibited CO_2 composed by different mixing degrees between atmospheric and biogenic CO_2 with slight inputs of deep-seated CO_2, with mean values of -21.4‰ -14.1‰ -16.6‰ and -11.9‰ for the NE, NW, NS rift-zones, and Cañadas caldera, respectively. The methodology presented here represents an inexpensive method that might help to detect early warning signals of future unrest episodes in Tenerife.