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Long- and short-term temporal variations of the diffuse CO_2 emission from Timanfaya volcano, Lanzarote, Canary Islands

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Lanzarote Island is an emergent part of the East Canary Ridge and it is situated approximately 100 km from the NW coast of Morocco, covering an area of about 795km2. The largest historical eruption of the Canary Islands, Timanfaya, took place during 1730-36 in this island when long-term eruptions from a NE-SW-trending fissure formed the Montañas del Fuego. The last eruption at Lanzarote Island occurred during 1824, Tinguaton volcano, and produced a much smaller lava flow that reached the SW coast. At present, one of the most prominent phenomena at Timanfaya volcanic field is the high maintained superficial temperatures occurring in the area since the 1730 volcanic eruption. The maximum temperatures recorded in this zone are 605ºC, taken in a slightly inclined well 13 m deep. Since fumarolic activity is absent at the surface environment of Lanzarote, to study the diffuse CO_2 emission becomes an ideal geochemical tool for monitoring its volcanic activity. Soil CO_2 efflux surveys were conducted throughout Timanfaya volcanic field and surrounding areas during the summer periods of 2006, 2007, 2008, 2009, fall period of 2010 and winter, spring and summer periods of 2011 to investigate long and short-term temporal variations of the diffuse CO_2 emission from Timanfaya volcano. Soil CO_2 efflux surveys were undertaken at Timanfaya volcanic field always under stable weather conditions to minimize effects of meteorological conditions on the CO_2 at the soil atmosphere. Approximately 370-430 sampling sites were selected at the surface environment of Timanfaya to obtain an even distribution of the sampling points over the study area. The accumulation chamber method (Parkinson et al., 1981) was used to perform soil CO_2 efflux measurements in-situ by means of a portable non dispersive infrared (NDIR) CO_2 analyzer, which was interfaced to a hand size computer that runs data acquisition software. At each sampling site, soil temperature at 15 and 40cm depth was also measured by means of a thermocouple together with soil gas samples collected during the campaign of 2010 to evaluate the chemical and isotopic composition of soil gases. Diffuse CO_2 emission values have ranged between non detectable values to 34 g m-2 d-1, and most of the study area have shown relatively low values, around the detection limit of the instrument ($\sim$0,5 g m-2 d-1). Higher soil CO_2 diffuse emission values were observed where thermal anomalies occur, indicating a convective mechanism transport of gas from depth at these areas. Total CO_2 outputs of the study area have been estimated in the range 41-518 t d-1 during the study period. Long-term temporal variation on total CO_2 diffuse emission shows a peak recorded on winter 2011, suggesting a seasonal control on the CO_2 emission. As part of the volcanic surveillance program and to understand the dynamics of CO_2 diffuse emission at Timanfaya volcanic zone, an automatic geochemical station was installed in July 2010 to monitor the CO_2 emission and investigate the short-term temporal variation. Time series of soil CO_2 efflux shows also a close relationship with seasonal changes mainly due to rainfall.