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Diffuse CO_2 and H2S degassing from the summit crater of Pico do Fogo

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Pico do Fogo volcano is the youngest and most active volcano of the Cape Verde archipelago and rises over 2,800 m above sea level. It is located to the east of the Bordiera semicircular escarpment at Fogo Island and is capped by a 500-m-wide, 150-m-deep summit crater. Soil gas geochemical surveys in volcanic areas are useful tool to identify changes in volcanic activity related to magmatic processes. Among these studies, to monitor spatial and secular variations of soil CO_2 and H2S effluxes pattern can provide important information about the state of activity of the volcanic system. CO_2 has been one of the most studied gases in volcanic environments. Many studies have shown that significant amounts of CO_2 are released to the atmosphere by quiescent volcanoes and geothermal systems through soil diffuse degassing. Since the emission rate of diffuse CO_2 can increase dramatically prior to an eruption (e.g., Hernández et al. 2001a; Carapezza et al. 2004), efforts have to be made to obtain a CO_2 flux baseline for a given volcanic system. However, and mainly due to analytical limitations, very few works on diffuse H2S emission have been carried out at volcanic-hydrothermal areas. With the aim of improving the geochemical surveillance program of Pico do Fogo, periodic soil degassing surveys have been performed at the summit crater of this volcano, focusing on the diffuse CO_2 and H2S emissions. Temporal and spatial variations of CO_2 and H2S efflux have been used to improve the knowledge about the degassing processed and their relationships with the volcanic activity. Each diffuse CO_2 and H2S survey has been carried out following the accumulation chamber method at 40-65 sites homogeneously distributed at Pico do Fogo summit crater covering an area of about 0.142 km2. Soil CO_2 and H2S efflux distribution maps were constructed following a Sequential Gaussian Simulation (sGs) in order to distinguish areas with anomalous CO_2 and H2S emission rates and to compute the total gas emission from the studied area. The total diffuse CO_2 output released to atmosphere was estimated in the range 30-339 t/d for the period of study. Furthermore, the total H2S output was estimated in the range 2.4-68.3 Kg/d during the same period of study. Highest CO_2 and H2S efflux values were measured in an around western flank of the crater where the most evident fumarolic activity occurs. The 1999 survey was performed 4 years after the last eruption at Fogo (April 1995), and an emission rate of 918 $\pm$ 409 t•d-1 was estimated. This value was followed by a drastic decrease in the CO_2 and H2S emission rates during the survey performed in May 2007. In the last survey (April 2012), CO_2 emission rate was estimated on 186 $\pm$ 34 t•d-1, which is still bellow the higher limit observed in 1999 whereas estimated H2S emission rate was 15 $\pm$ 10.8 Kg•d-1. This observed decreasing trend on diffuse CO_2 emission from the summit crater of Fogo seems to be related to its eruptive cycle. Following the evolutionary model of gas release from volcanoes described by Notsu et al., (2006), Fogo is at present within an inter-eruptive phase. Evolution in the magma degasification processes from deep sources can explain the observed temporal change in the diffuse CO_2 emission. Diffuse soil degassing in volcanic areas releases high amount of gases and its monitoring can be helpful for the mitigation of volcanic risk at Fogo Island.