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Diffuse Hydrogen (H2) emissions from the summit crater of Pico do Fogo before the 2014-15 eruption, Cape Verde

Samara Dionis (1), Eleazar Padrón (1,2), Gladys V. Melián (1,2), María Asensio-Ramos (1), Paulo Fernandes (3,4), José Barrancos (1,2), Fátima Rodríguez (1), Germán Padilla (1,2), David Calvo (1), Pedro A. Hernández (1,2), Sónia Silva (4,5), Jeremias Cabral (6), Zuleyka Bandomo (3), José Manuel Pereira (4,5), Helio Semedo (7), Nemesio M. Pérez (1,2)

(1) Instituto Volcanológico de Canarias (INVOLCAN), 38400 Puerto de la Cruz, Tenerife, Canary Islands, SPAIN (sdionis@iter.es), (2) Environmental Research Division, ITER, 38611 Granadilla de Abona, Tenerife, Canary Islands, SPAIN, (3) Laboratorio de Engenharia Civil (LEC), Tira Chapéu - Zona Industrial, Praia, Santiago Island, CAPE VERDE, (4) Observatório Vulcanológico de Cabo Verde (OVCV), Universidade de Cabo Verde (UniCV), Campus do Palmarejo, 279 Praia, Santiago Island, CAPE VERDE, (5) Departamento de Ciência e Tecnologia, Universidade de Cabo Verde (UniCV), Campus do Palmarejo, 279 Praia, Santiago Island, CAPE VERDE, (6) Centro de Vulcanologia e Avaliação de Riscos Geológicos (CVARG), Universidade dos Açores, 9500-321 Ponta Delgada, Açores, PORTUGAL, (7) Serviço Nacional de Protecção Civil (SNPC), ex Aeroporto Francisco Mendes, Praia, Santiago Island, CAPE VERDE

Pico do Fogo is an active stratovolcano rising 2,829 m above sea level, situated in Fogo Island (476 km2), Cape Verde. Pico do Fogo has a long eruptive history with about 30 eruptions since its discovery ($\sim$1500 AD). On November 23, 2014 a new volcanic eruption started at the southwestern flank of the volcano after 19 years of the last eruptive event on 1995. Diffuse hydrogen (H2) emission from the summit crater of Pico do Fogo has been regularly estimated since 2007 to improve the geochemical monitoring program for the volcano surveillance. H2 is one of the most abundant trace species in volcano-hydrothermal systems and is a key participant in many redox reactions occurring in the volcano-hydrothermal reservoir. Because of its chemical and physical characteristics, H2 moves rapidly though the crust and escapes to the atmosphere. These characteristics make H2 an excellent tracer for processes that occurs in the volcano-hydrothermal systems. The first published data on diffuse H2 degassing rate from Pico do Fogo volcano (37.3 $\pm$ 11.3 kg d-1) is related to a field work performed on February 2010 (Dionis et al., 2015).

A total of seven diffuse H2 degassing surveys have been carried out during the period 2007-2014. Soil gas H2 concentration measured at 40 cm depth, allowed the computation of its emission rate in about 50 sampling sites selected in the surface environment of Pico do Fogo summit crater (0.14 km2). Both advective (convective) and diffuse components were estimated. The sampling sites were selected to cover homogeneously the study area, allowing the computation of the total H2 emission by sequential Gaussian simulation (sGs). During the study period diffuse H2 emission rate ranged between 2.9 and 163.6 kg d-1. On February 2010, it was observed the first relatively high diffuse H2 emission value which suggests the occurrence of an increase in the heat flow. However, higher observed diffuse H2 emission values than February 2010 were detected on April 2013 (75.1 $\pm$ 30.7 kg d-1) and March 2014 (163.6 $\pm$ 76.2 kg d-1), suggesting a second much more energetic heat-transfer process caused by a magmatic intrusion that triggered the eruption of November 23, 2014. Since relatively high H2 concentrations in volcanic gases are usually related to temperature dependent gas–water–rock interactions (Tassi et al. 2013), the increase on diffuse H2 emission observed at the surface environment of summit crater could have been produced at the root of the hydrothermal system of Pico do Fogo by interaction of ascending magmatic fluids with liquid water. These geochemical precursory signals evidence the importance use of monitoring diffuse H2 emission as an excellent early indicator of volcanic unrest.

Dionis et al. (2015), Bull. Volcanol., in press; Tassi et al., (2013) Bull. Volcanol. DOI 10.1007/s00445-013-0711-8