Geophysical Research Abstracts
Vol. 17, EGU2015-12754, 2015
EGU General Assembly 2015

Insights from fumarole gas geochemistry on the recent volcanic unrest of Pico do Fogo, Cape Verde

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

(1) Environmental Research Division, ITER, 38611 Granadilla de Abona, Tenerife, Canary Islands, SPAIN (gladys@iter.es), (2) Instituto Volcanológico de Canarias (INVOLCAN), 38400 Puerto de la Cruz, Tenerife, Canary Islands, SPAIN, (3) Observatório Vulcanológico de Cabo Verde (OVCV), Universidade de Cabo Verde (UniCV), Campus do Palmarejo, 279 Praia, Santiago Island, CABO VERDE, (4) Geochemical Research Center, Graduate School of Science, The University of Tokyo, Tokyo, JAPAN, (5) Departamento de Ciência e Tecnologia, Universidade de Cabo Verde (UniCV), Campus do Palmarejo, 279 Praia, Santiago Island, CABO VERDE , (6) Serviço Nacional de Protecção Civil (SNPC), ex Aeroporto Francisco Mendes, Praia, Santiago Island, CABO VERDE , (7) Centro de Vulcanologia e Avaliação de Riscos Geológicos (CVARG), Universidade dos Açores, 9500-321 Ponta Delgada, Açores, PORTUGAL

Fogo is a volcanic island of the Cape Verde archipelago and host at its center the active stratovolcano Pico do Fogo (2829 m.a.s.l.). On November 23, 2014 a new volcanic eruption started at the southwestern flank of Pico do Fogo, after 19 years of the last eruptive event. Since 2007, regular sampling and analysis of fumarole gas discharges from a fumarole (F1) has been performed in a yearly basis to monitor the chemical and isotopic gas composition. From 2008, fumarole gas sampling was also performed in a second fumarole (F2). During the period of study, outlet temperature in F1 has ranged between 62 to 159ºC, whereas the F2 has ranged between 295 and 344ºC. For determination of major gas species, fumarolic gases were collected in evacuated flasks containing a 5N NaOH solution. In addition, condensed steam and non-condensable gases (dry gas) were sampled by flowing the fumarolic gases through a water-cooled condenser. The isotopic composition of He (3He/4He) was determined on dry gas samples at the GRC of Tokyo University. Water vapor is by far the most abundant component, as shown by a gas/steam molar ratio between 0.08 and 0.48, followed by CO_2 (384,606 − 988,679 mmol/mol in the dry gas phase). The concentration of the other gases in the gas dry phase and expressed in [U+F06D]mol/mol: Stotal varies from 3,411 to 606,054, N2 from 835 to 84,672, H2 from 45.6 to 68,439, CH4 from 0 to 61,785, Cl from 4.9 to 1,729, CO from 0 to 1,396 and He from 4.4 to 617. The presence of O_2 in concentrations from 10.4 to 17,350 [U+F06D]mol/mol reflects minor air contamination either during sampling or storage, or naturally in the sampled vents. Carbon isotopic composition of Pico do Fogo fumarolic CO_2, expressed in d13C-CO_2 vs. VPDB notation, varied from −4.62 to −4.06 ‰ whereas 3He/4He data, expressed as R/RA, ranged from 5.70 to 8.81. In the classical He–Ar–N2 triangular diagram, most of samples plot between the He, air and ASW end members, showing compositions variably contaminated by air or by ASW. Few samples show a significant increase of the relative nitrogen content toward sediment composition. Gas geothermometry, based on chemical reactions related to measured gas species, indicate equilibrium temperatures between 240 to 504ºC using the H2/H_2O-CO/CO_2 geothermometer and between 240 to 638ºC using the CH4/CO_2-CO/CO_2 geothermometer. The chemical evolution of Pico do Fogo fumarolic gases coupled with the observed increase of CO_2 soil flux, suggests the occurrence of an important increase of convective heat flux and evidences an active magmatic degassing beneath the volcano before the eruption onset. H_2O/CO_2 and H_2O/St molar ratios showed an increasing trend towards the eruption onset, with higher values coinciding with the anomalous soil CO_2 emissions registered at the summit crater, November 2008 and March 2014, suggesting a heat pulse from the depth affected the hydrothermal reservoir before the eruption onset. This is corroborated by the sharp increase observed in the CO/CO_2 and H2/CO_2 molar ratios in November 2013 (one year before the eruption), the last one probably due by H_2O thermal dissociation. Early degassing of new gas-rich magma batch at depth is also explained by the observed increase on the He/CO_2 molar ratio, which showed two pulses in November 2008 to February 2011 and from November 2013 to March 2014, both also coinciding with two pulses on the soil CO_2 emission. These two pulses on the He content occurred together with an increase on the 3He/4He isotopic ratio, indicating the prevalence of a magmatic dominated component during these two periods. The observed changes in the chemical and isotopic composition of Pico do Fogo fumarolic gases have proved to be clear geochemical precursory signals of the volcanic unrest occurred before the eruption onset of Pico do Fogo volcano in November 23, 2014.