Geophysical Research Abstracts
Vol. 18, EGU2016-16744, 2016
EGU General Assembly 2016

Diffuse H_2 emission: a useful geochemical tool to monitor the volcanic activity at El Hierro volcano system

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The occurrence of interfering processes affecting reactive gases as CO_2 during its ascent from magmatic bodies or hydrothermal systems toward the surface environment hinders the interpretation of their enrichments in the soil atmosphere and fluxes for volcano monitoring purposes (Marini and Gambardella, 2005). These processes include gas scrubbing by ground-waters and interaction with rocks, decarbonatation processes, biogenic production, etc. Within the rest of the soil gases, particularly interest has been addressed to light and highly mobile gases. They offer important advantages for the detection of vertical permeability structures, because their interaction with the surrounding rocks or fluids during the ascent toward the surface is minimum. H_2 is one of the most abundant trace species in volcano-hydrothermal systems and is a key participant in many redox reactions occurring in the hydrothermal reservoir gas (Giggenbach, 1987). Although H_2 can be produced in soils by N_2-fixing and fertilizing bacteria, soils are considered nowadays as sinks of molecular hydrogen (Smith-Downey et al., 2006). Because of its chemical and physical characteristics, H_2 generated within the crust moves rapidly and escapes to the atmosphere. These characteristics make H_2 one of the best geochemical indicators of magmatic and geothermal activity at depth.

El Hierro is the youngest and the SW-most of the Canary Islands and the scenario of the last volcanic eruption of the archipelago, a submarine eruption that took place 2 km off the southern coast of the island from October 2011 to March 2012. Since at El Hierro Island there are not any surface geothermal manifestations (fumaroles, etc), we have focused our studies on soil degassing surveys. Here we show the results of soil H_2 emission surveys that have been carried out regularly since mid-2012. Soil gas samples were collected in $\sim$600 sites selected based on their accessibility and geological criteria. Soil gases were sampled at $\sim$40 cm depth using a metallic probe with a 60 cc hypodermic syringes and stored in 10 cc glass vials for later laboratory analysis by a VARIAN CP4900 micro-gas chromatograph. Soil H_2 concentration data were used to estimate the H_2 emission assuming a pure diffusive mechanism. The emission ranged between 12 and 25 kg d^{-1}, showing a good relationship with the seismic energy release during the period of study. However, spatial distribution of H_2 emission values did not show a clear relationship with main volcano-structures of El Hierro Island. H_2 emission studies are a promising volcano monitoring technique that might help to detect early warning signals of volcanic unrest in oceanic volcanic islands.

References

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