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Diffuse H₂ emission: a useful geochemical tool to monitor the volcanic activity at El Hierro volcano system

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Because of its chemical and physical characteristics, H₂ moves easily through the crust and escapes to the atmosphere. It represents 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. For this reason, it is one of the best geochemical indicators of magmatic and geothermal activity at depth. The last volcanic eruption of the Canary Islands occurred in El Hierro, the youngest and the Southwestern most Island of the archipelago. The submarine eruption took place 2 km off its southern coast from October 2011 to March 2012. Since no surface geothermal manifestations (fumaroles, etc.) are present at the island, our studies have been focused on soil degassing surveys. Here we present the results of soil H₂ emission surveys that have been regularly performed since mid-2012. Soil gas samples were collected at 601 sites, selected on the base of their accessibility and geological criteria, at ~40 cm depth using a metallic probe with a 60 cc hypodermic syringes and stored in 10 cc glass vials for later determination of H₂ concentration in a Varian CP4900 micro-gas chromatograph. Assuming a pure diffusive mechanism, the H₂ emission was estimated between 12 and 25 kg d⁻¹, showing a good relationship with the seismic energy release during the period of study. H₂ efflux contour maps were constructed using sequential Gaussian simulation (sGs) as interpolation method, observing that, however, spatial distribution of H₂ emission values did not show a clear connection with main volcano-structures of the island. This work demonstrates the importance of performing H₂ emission studies as a promising volcano monitoring technique that might help to detect early warning signals of volcanic unrest in oceanic volcanic islands.