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Surface geothermal exploration at Tenerife (Canary Islands) by means of soil gas He and H2 surveys

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The Canary Islands archipelago is located 100 km away from the African North-West coast. It is composed of seven islands, which are distributed from East to West and they are different in shape and composition. However, the archipelago clearly presents magmatic features which begun in the early Tertiary period. The volcanism of the Canary Islands is characterized by alkaline sodium magmatism, subsaturated in SiO_2. It is usual feature the presence of rocks of intermediate composition like Trachites and Phonolites, not frequent in oceanic islands. Tenerife, which is extended ≈ 2000 km2 long and 3718 m height over the sea level, is the biggest island within the archipelago. This island shows evident geothermal surface manifestations (Teide volcano fumaroles), where gas composition indicates that steam derives from a mature liquid dominated geothermal reservoir with temperatures in the range of 250-300ºC. But with the exception of the Teide volcano fumaroles, there is not any evidence of hydrothermal fluid discharges in the surficial environment of the Canary Islands, which becomes diffuse degassing surveys an important geochemical tool for geothermal exploration purposes. In the early 2000s, several geochemical and geophysical studies were carried out in different promising areas of Tenerife. The present study shows the results of an intensive detail soil gas helium (He) and hydrogen (H2) survey develop in a specific area of the south of the island where some geochemical anomalies matched with a thinning of the 'clay alteration cap' detected with MT campaigns, since diffuse He and H2 degassing have been previous applied to reveal hidden geothermal resources (Rodríguez et al. 2015). Soil gas samples were collected at 362 sites selected with a homogeneous spatial distribution in the study area (0.7 km2) from July to August 2018, with an average distance between sites of ≈ 40 m. At each sampling site, soil gas samples were collected at 40 cm depth using a metallic probe with a 60 cc hypodermic syringe and stored in 10 cc glass vials for later laboratory analysis. The soil He concentrations were analyzed by means of a quadrupole mass spectrometer (QMS; Pfeiffer Omnistar 422) and the soil H2 concentrations by a micro-gas chromatograph (microGC; VARIAN CP4900). In the case of helium, values are given using the ΔHe notation: [ΔHe = [He]soil atmosphere – [He]air = 5240 ppb]. ΔHe values measured on the soil atmosphere ranged from typical atmospheric values up to 20460 ppb, with an average of 805 ppb. Soil H2 concentrations measured ranged from typical atmospheric values (≈ 0.5 ppm) up to 13.22 ppm with an average value of 0.9 ppm. The main ΔHe anomalies were located at the south sectors of the study area and H2 concentration showed up as multiple isolated anomalies. The soil He and H2 degassing surveys are a great tool in the first step of the reconnaissance phase and delimitation of geothermal reservoirs in order to take an advance in the understanding of geothermal resources that might exist in the subsurface.

References:
Rodríguez et al., 2015. Surv Geophys, 36(3