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Carbon stable isotopic composition of soil gas CO_2 for surface geothermal exploration in Gran Canaria, Canary Islands

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The subaerial volcanic/magmatic history of Gran Canaria (1560 km^2), the third largest island of Canarian archipelago, started 15-16 Ma ago and the last constructive phase started in the late Pliocene. This last phase is restricted to the northern part of the island and has continued until the present. The island is approximately circular in shape and rises to an altitude of approximately 1949 meters above sea level (Pico de las Nieves). This configuration led to the formation of a set of deep radial ravines and canyons. In the last 20 years, there has been considerable interest in the study of diffuse degassing as a powerful tool in volcano monitoring and geothermal exploration studies. Historically, soil gas and diffuse degassing surveys in volcanic environments have focused mainly on CO_2 because it is, after water vapor, the most abundant gas dissolved in magma. The results showed in this work where measured in the framework of a geothermal exploration project of Gran Canaria island, aimed to enhance the knowledge on the possible existence of high enthalpy geothermal resources in the island. Geochemical techniques are particularly useful in the early stages of geothermal exploration research and even more when, as the case of Gran Canaria, there are no obvious geothermal manifestations in the surface environment. In this study we are showing the first results of a soil CO_2 survey carried out during June-November, 2017, with the aim to help to identify the possible existence of permeable portions of deep-seated actively degassing geothermal reservoirs through the study of the contribution of volcano-hydrothermal CO_2 in the diffuse degassing in the study area. The soil CO_2 concentration and isotopic composition have been measured at 3,000 observation sites homogeneously distributed in the NE zone of Gran Canaria. Soil gas samples were collected at of 40 cm depth using a stainless steel probe and stored in glass vials for a later analysis in the laboratory by a micro-GC VARIAN CP4900 and by a Thermo Finnigan MAT 253 isotope ratio mass spectrometer (IRMS). The CO_2 isotopic composition, expressed as δ^{13}C-CO_2 showed the contribution of three different end-members: biogenic, atmospheric and deep-seated CO_2, defined by isotopic compositions of -24, -8 and -3 ‰ vs. VPDB, respectively, and CO_2 concentration of 100%, 0.04% and 100% respectively. The results indicate that most of de sampling sites exhibited CO_2 composed by different mixtures between atmospheric and biogenic CO_2 with slight inputs of deep-seated CO_2, with a mean values of -16.5‰ the maximum and the minimum being -4.2‰ and -28.0‰ respectively. These results can help to identify the possible existence of actively degassing geothermal reservoirs, particularly where the interpretation and application of geophysical data is difficult.