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A detailed soil gas physical-chemical survey for geothermal exploration at Tenerife, Canary Islands.

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There is no evidence of hydrothermal fluid discharges in the surficial environment of the Canary Islands, the only Spanish territory with potential high enthalpy geothermal resource, with the exception of the Teide fumaroles.

In 2011 and 2014 several geochemical and geophysical studies were carried out across 4 mining licenses on the island of Tenerife (Abeque, Berolo, Guayafanta, Garehagua) for geothermal exploration purposes. The geothermal exploration licenses known as Garehagua and Abeque, located on the south ridge and on the northwest ridge of the island of Tenerife respectively, showed the highest geothermal potential of the studied areas. It was decided to carry out several more detailed studies in the areas with the most significant anomalies to better characterize the potential for economic exploitation.

Three surface geochemical surveys each with an average measurement spacing of ~40 m were conducted, and allowed for a mesh resolution of 10 m x 10 m: a mesh size of a much higher spatial resolution than typical grids for surveys of potentially prospective or known geothermal areas. An area called "Madre del Agua", located in the northern zone of the Gareagua mining license was prioritised for attention due to i) observed geochemical anomalies at the soil surface; ii) the prominent low-resistivity structure interpreted as a clay alteration cap, and; iii) the positive correlation between thickness of clay alteration cap and helium emission. This study area covers ~0.7 km². The second area selected for detailed study is located inside the Abeque mining license. The spatial correlation between the helium enrichment and the endogenous CO₂ component of Abeque motivated the selection of this study area called "Abeque Detalle", which covers 0.8 km². The third study area called "Fuente del Valle" (0.6 km²) was motivated by the observation of significant values of helium anomalies in the Garehagua study area that were measured on the surface in the vertical of a bubbling of endogenous gases at depth, ~2,850 m from the entrance of the Fuente del Valle gallery.

The studies were completed from July to September 2018 (Madre del Agua and Abeque Detalle) and from January to March 2019 (Fuente del Valle). During the survey 1065 sampling sites were made, distributed among the three surveys: 362 points in Madre del Agua, 377 in Abeque Detalle

and 326 in Fuente del Valle. At each sampling site the soil CO₂ efflux and ²²²Rn activity were measured in-situ and He and H₂ were sampled at 40 cm depth and analysed in the lab. The spatial distribution of soil gases of the three study areas confirm the presence of relative enrichment of non-reactive and/or highly mobile gases in the soil gas atmosphere such as He and CO₂, that suggests the existence of a significant contribution of deep-seated gases.