Geophysical Research Abstracts
Vol. 21, EGU2019-14198, 2019
EGU General Assembly 2019

Geophysical signature of shallow thermal anomalies in the volcanic area of Timanfaya (Canary Islands, Spain)

Jose Arnoso (1,7), David Gomez-Ortiz (2), Isabel Blanco-Montenegro (3,7), Tomás Martin-Crespo (2), Mercedes Solla (4), Fuensanta G. Montesinos (5,7), Emilio Vélez (1,7), and Nieves Sánchez (6)

(1) Instituto de Geociencias (CSIC-UCM), Madrid, Spain (arnoso@ucm.es), (2) Dpt. de Biología y Geología, Física y Química Inorgánica, ESCET, Universidad Rey Juan Carlos, Madrid, Spain (david.gomez@urjc.es), (3) Dpt. de Física. EPS, Universidad de Burgos, Burgos, Spain (iblanco@ubu.es), (4) Defense University Center, Spanish Naval Academy, Pontevedra, Spain (merchisolla@cud.uvigo.es), (5) Facultad de Ciencias Matemáticas, Universidad Complutense, Madrid, Spain (fuensanta.gonzalez@mat.ucm.es), (6) Spanish Geological Survey, Unit of Canary Islands, Las Palmas de Gran Canaria, Spain (n.sanchez@igme.es), (7) Research Group 'Geodesia', Universidad Complutense, Madrid, Spain

Hydrothermal systems caused by convective circulation of brines at high temperature have been extensively studied by means of different geophysical methods, mainly electric and electromagnetic surveys. The location of low resistivity anomalies is then associated with the presence of the hydrothermal brines. However, hot dry rock geothermal systems are less common and, consequently, the application of near surface geophysical techniques is scarcer. In addition to this, the geophysical signature is different from convective hydrothermal systems due to its very low fluid content being vapour the dominant phase.

The southwestern part of Lanzarote Island (Canary Islands) comprises the Timanfaya volcanic area, characterized by a hot dry rock geothermal system. Ground temperatures ranging from 250 to 605ºC have been recorded at shallow (<70 m) depths. They are associated with discrete areas of emanating gases mainly composed by N2 (95–98%) and very low amounts of CO_2 (0.5–1%). A few of these geothermal areas are well known as they are located inside Timanfaya National Park, but the exact location of some others remains uncertain. The aim of this study is to characterize the geophysical signature of the high ground temperature areas using a combination of three different non-destructive near surface geophysical techniques: ground penetrating radar (GPR), electromagnetic induction (EM) and magnetic anomalies.

A GPR profile obtained through a geothermal anomaly has revealed that the stronger reflections can be correlated to the location of the highest ground temperatures. Moreover, when the same GPR profile was repeated three years later, subtle variations of the GPR signal intensity were observed, suggesting that the ground temperature shows temporal variations. On the other hand, the inversion of electromagnetic data obtained along a profile coincident with the GPR line, imaged a high resistivity anomaly area in good agreement with the location of the highest ground temperatures. It is remarkable that the electrical signature of the hot dry rock geothermal anomaly is exactly the opposite than the observed for the convective hydrothermal ones. Regarding the magnetic anomalies, when the data are reduced to the pole, a low magnetic anomaly is located just above the geothermal anomaly. Therefore, the geophysical signature of the area with the highest ground temperatures is characterized by a combination of strong GPR reflections, high resistivity values and low magnetic anomalies.

Considering this geophysical signature, four additional geothermal areas were located close to the previous one. Consequently, we propose a combination of the three near surface geophysical methods as a useful tool to identify the presence of shallow geothermal areas inside hot dry rock systems, as well as to monitor their seasonal variability.