Using GIS tools for the Play Fairway Analysis in geothermal exploration

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The Canary Islands archipelago, due to their recent volcanism, are the only Spanish territory with high enthalpy geothermal resources. However, there is no evidence in the islands of endogenous fluids manifestations with the exception of the Teide fumaroles, in Tenerife. Although some efforts have been made to investigate the geothermal resources from the 1970s to the 1990s and later during the past decade, the final goal has not yet been achieved, which is to locate and define the size, shape and structure of the geothermal resource, and determine their characteristics and capacity to produce energy (Rodríguez et al. 2015). For this reason it is extremely important to use new tools that allow a better understanding of the geothermal resource. In this work we describe a probabilistic evaluation of the geothermal potential of the island of Tenerife using Geographical Information Systems (GIS) through a collection of geological, geophysical and geochemical data.

The Play Fairway Analysis (PFA) was used, as illustrated by Lautze et al. (2017) in a similar study for an environment having similar characteristics: the Hawaiian Archipelago. The PFA approach consists of joining information coming from multidisciplinary datasets within a probabilistic framework. Basically, the probabilities related to the presence of heat (H), fluids (F) and permeability (P) are computed quantitatively from the starting datasets and combined to obtain the probability of presence of geothermal resources and its confidence.

In the present study this probabilistic method have been implemented using GIS geoprocessing tools and raster image analysis using geological (Holocene vents, volcano-tectonic structures), geophysical (seismicity, resistivity data, gravity data) and geochemical (hydrogeochemistry, soil gas emission and geochemistry, etc...).

The main result of this work is a cartographic set that allow showing the areas of Tenerife with the greatest potential for geothermal exploration. Furthermore, using the statistical framework of PFA analysis, we obtained also confidence intervals on the retrieved probability maps.