Geophysical Research Abstracts
Vol. 18, EGU2016-10876, 2016
EGU General Assembly 2016

Estimating the Prospectivity of Geothermal Resources Using the Concept of Hydrogeologic Windows

Jeffrey Bielicki (1,2), David Blackwell (2), Dylan Harp (3), Satish Karra (3), Richard Kelley (3), Shari Kelley (4), Richard Middleton (3), Mark Person (4), Glenn Sutula (5), and James Witcher (6)

(1) The Ohio State University; Civil, Environmental, and Geodetic Engineering, Columbus OH, United States (bielicki.2@osu.edu), (2) Southern Methodist University; Dallas TX, United States, (3) Los Alamos National Laboratory; Livermore CA, United States, (4) New Mexico Institute of Mining and Technology; Socorro NM, United States, (5) The Ohio State University; Environmental Science Graduate Program, Columbus OH, United States, (6) Witcher and Associates; Las Cruces NM, United States

In this Geothermal Play Fairways Analysis project we sought to develop new ways to analyze geologic, geochemical, and geophysical data to reduce the risk and increase the prospects of successful geothermal exploration and development. We collected, organized, and analyzed data from southwest New Mexico in the context of an integrated framework that combines the data for various signatures of a geothermal resource into a cohesive analysis of the presence of heat, fluid, and permeability. We incorporated data on structural characteristics (earthquakes, geophysical logs, fault location and age, basement depth), topographic and water table elevations, conservative ion concentrations, and thermal information (heat flow, bottom hole temperature, discharge temperature, and basement heat generation). These data were combined to create maps that indicate structural analysis, slope, geothermometry, and heat. We also mapped discharge areas (to constrain elevations where groundwater may be discharged through modern thermal springs or paleo-thermal springs) and subcrops: possible erosionally- or structurally-controlled breaches in regional-scale aquitards that form the basis of our hydrogeologic windows concept. These two maps were particularly useful in identifying known geothermal systems and narrowing the search for unknown geothermal prospects.

We further refined the "prospectivity" of the areas within the subcrops and discharge areas by developing and applying a new method for spatial association analysis to data on known and inferred faults, earthquakes, geochemical thermometers, and heat flow. This new methodology determines the relationships of the location and magnitudes of observations of these data with known geothermal sites. The results of each of the six spatial association analyses were weighted between 0 and 1 and summed to produce a prospectivity score between 0 and 6, with 6 indicating highest geothermal potential. The mean value of prospectivity for all regions with positive prospectivity inside subcrops and discharge areas was 1.83 (standard deviation = 0.75), whereas this mean prospectivity for known geothermal sites was 3.07 (standard deviation = 0.90). These results suggest that our prospectivity analysis using our integrated framework and the hydrogeologic windows concept is useful for identifying known and potential geothermal resources. The prospectivity approach also substantially reduces the number of known geothermal resources per km2 (from 0.004 at prospectivity > 0 to 0.016 at prospectivity > 3), suggesting that limiting an exploration area to regions with high prospectivity scores could reduce exploration costs. Comparing this method to more simplistic methods revealed that this method consistently had a higher density of resources in the top quintile for prospectivity. Using our prospectivity map, we identified nine sites for further data collection and analysis: Rincon, Lordsburg, Mud Springs, Gillis Hot Well, Goodsight, Cliff-Riverside, Rio Salado/Lucero, and the Northern Little Florida Mountains.