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Geothermal Technologies Program

Fracture Characterization – Medicine Lake

PREDICTING FRACTURE CHARACTERISTICS IN VOLCANIC ENVIRONMENTS AS A GUIDE TO LOCATING ENHANCED GEOTHERMAL SYSTEM RESERVOIRS

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PROJECT SUMMARY

The identification and characterization of geothermal targets for EGS development is required to meet DOE's goal of 40,000 megawatts. Few areas contain the potential for the rapid growth that will be needed. The most attractive candidate regions are the Cascade Range, with its numerous active volcanic systems, and the Salton Trough. Deep drilling at several sites within the Cascade Range where surface manifestations are only weakly developed has demonstrated that extensive areas of hot rock lie beneath its volcanic features. Most of these wells have encountered low permeability rocks suitable for the development of large EGS reservoirs. Despite its potential, the province is underdeveloped, poorly explored, and inadequately understood. This project addresses the techniques required for locating and developing of EGS reservoirs in complex volcanic terrains.

Hydrofracturing is currently the best technique for forming EGS reservoirs. The permeability enhancement that can be achieved is dependant on the characteristics of the natural fracture networks and the stress distributions. In volcanic terrains, local stress distributions reflect the interactions of regional tectonic stresses with stresses induced by magmatic activity and increasing overburden thickness. Heterogeneities in rock lithologies and rheologies, hydrothermal alteration and temperature further influence fracture characteristics and fluid flow. Because drilling accounts for a major percentage of EGS development costs, the best means of reducing costs is to reduce the number of wells drilled. Better methods for targeting wells and improving well productivities are needed. The goal of this investigation is to develop and test predictive methods for extrapolating stress distributions and fracture characteristics obtained from isolated well bore measurements to areas where subsurface data is not available. An integrated approach that combines fracture and rock property data with numerical simulations is proposed. Improving reservoir performance addresses Objective 1 of the solicitation: "Increase the identified economically-viable domestic geothermal resources to 40,000 megawatts". A reduction in the number of wells will lead directly to a decrease in the price of electricity (Objective 2 of the solicitation).

This study will initially focus on the Glass Mountain geothermal area, located on Medicine Lake Volcano in northern California. This area was selected by the Calpine Corp. and the DOE for EGS development. It represents the best site for testing the proposed techniques because an extensive collection of cores, cuttings and geological, geochemical and geophysical data is available for evaluating subsurface conditions. The well samples will be used to determine the characteristics of the fracture systems, their origins, and the factors that control their ability to transmit fluids. In-situ stress distributions will be calculated from measurements made on the core samples. A structural model of the area will be developed from these data. The model will be used to calculate stresses, fracture types and fracture distributions. Work performed on this project will represent a cooperative effort between EGI and the Calpine Corp. Dr. J. Moore will act as the Principal Investigator. Mr. J. Hulen and Dr. Michal Nemčok will serve as Co-Principal Investigators.