



## Geothermal Technologies Program

### ICEKAP 2004: A Collaborative Joint Geophysical Imaging Project at Krafla and IDDP

#### Project Summary

We propose a 2-part, go/no-go, field and laboratory study of a novel, Joint Geophysical Imaging (JGI), approach to subsurface fracture studies. The JGI approach refers to the inclusion of coincident, multiple-method geophysical observations in a single, combined inversion for structure and material properties. In this project, the JGI approach will be applied to fracture-network mapping, analysis, and monitoring in relation to Enhanced Geothermal Systems (EGS). The goal of the JGI technique is provide a subsurface image that can be used for the targeting of EGS wells, including those in supercritical fluid regimes. We are seeking both to: (I) collect and share coincident microearthquake (MEQ), magnetotelluric (MT), and other geophysical data from an EGS site and (II) complete a JGI analysis of these data aimed at defining and monitoring EGS-related conditions.

In Part (I) of our project, we propose a collaborative, cost-share JGI data collection effort at Icelandic EGS sites at Krafla and the first Icelandic Deep Drilling Project (IDDP) site on the Reykjanes Peninsula. An EGS injection test has been scheduled at Krafla for the summer of 2004. We propose to monitor this test and the surrounding area for microearthquakes, while at the same time collecting coincident MT and seismoelectric (SE) data sets. At the IDDP EGS site we will conduct a joint microearthquake monitoring and potential field profiling campaign. Both efforts will be aimed toward establishing the means whereby the subsurface conditions for EGS can be defined. Data will be shared and collaboratively analyzed.

In Part (II) - a go/no-go effort that will be based on the success of Part (I) - Duke proposes to complete a JGI analysis of the EGS data we have collected in Iceland. The aim of JGI analysis is the simultaneous combining of microearthquake and potential field data through a mathematical inversion procedure to obtain geologically constrained maps of hydrothermal systems and fractures. The inversion procedure uses evolutionary programming techniques that allow information on the geological setting to be used in defining reservoir characteristics and fluid-rich layer locations. The objective is to produce a map of subsurface zones that can be either targets for EGS drilling or monitoring. The practical goal is to lower the costs of geothermal energy by reducing drilling costs, thereby making geothermal more competitive.

Our project represents the cost-shared collaboration of geothermal exploration researchers at Duke, UNC, KenGen, and ISOR. A synergistic data analysis proposal is being submitted by UNC. Through ISOR our project has received promises of cost shared field support and cooperation in the timing of the Krafla injection test (pers.comm., K. Anrason). KenGen and the US IRIS consortium have made available a total of 40 MEQ recorders and 3 to 5 MT systems. Our collaboration includes the training of students and technicians in JGI field and laboratory methods, and, through Iceland and US-based geothermal studies, the transfer of the JGI technology to industry, both in the US and elsewhere.