Validation of Innovative Exploration Technologies for Newberry Volcano

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for

Davenport Newberry ("Davenport")

Relevance/Impact of Research

- Newberry Volcano is a blind resource location (no surface features such as hot springs, fumaroles, faults or surface geochemical sampling targets) and has a deep water table
- Test a combination of 8 new and traditional exploration techniques to identify and develop blind hot plutons and geothermal resources in young volcanic terra.
- Integrate new and existing data, identify target and validate by drilling an exploration well.
- Apex HiPoint conducted a 4-D passive seismic test using their patent pending LASEA (Low Amplitude Seismic Emission Analysis) technology
- Using the right combination of technologies will assist Davenport in locating hundreds of megawatts of potential geothermal resources at Newberry for use in future hydrothermal and EGS plants.
- This approach can be deployed in other areas (i.e. Cascade, Alaska and Aleutian Range) with similar geologic characteristics

Relevance/Impact of Research

- This project allowed for the systematic analysis by the scientific team to evaluate, find strengths and flaws, in the application and interpretation of each geophysical technique as a functioning contribution to the whole.

  The assumptions of interpretation and the data processing were re-evaluated in light of data from other techniques.

  Geology, Volcanology, Gravity, MT, Aeromagnetic, LIDAR, Seismic (LASEA), Well Data, Volcanic-Hosted Hydrothermal Mineral Deposits

  Markedly different understanding of the structure and history of Newberry Volcano

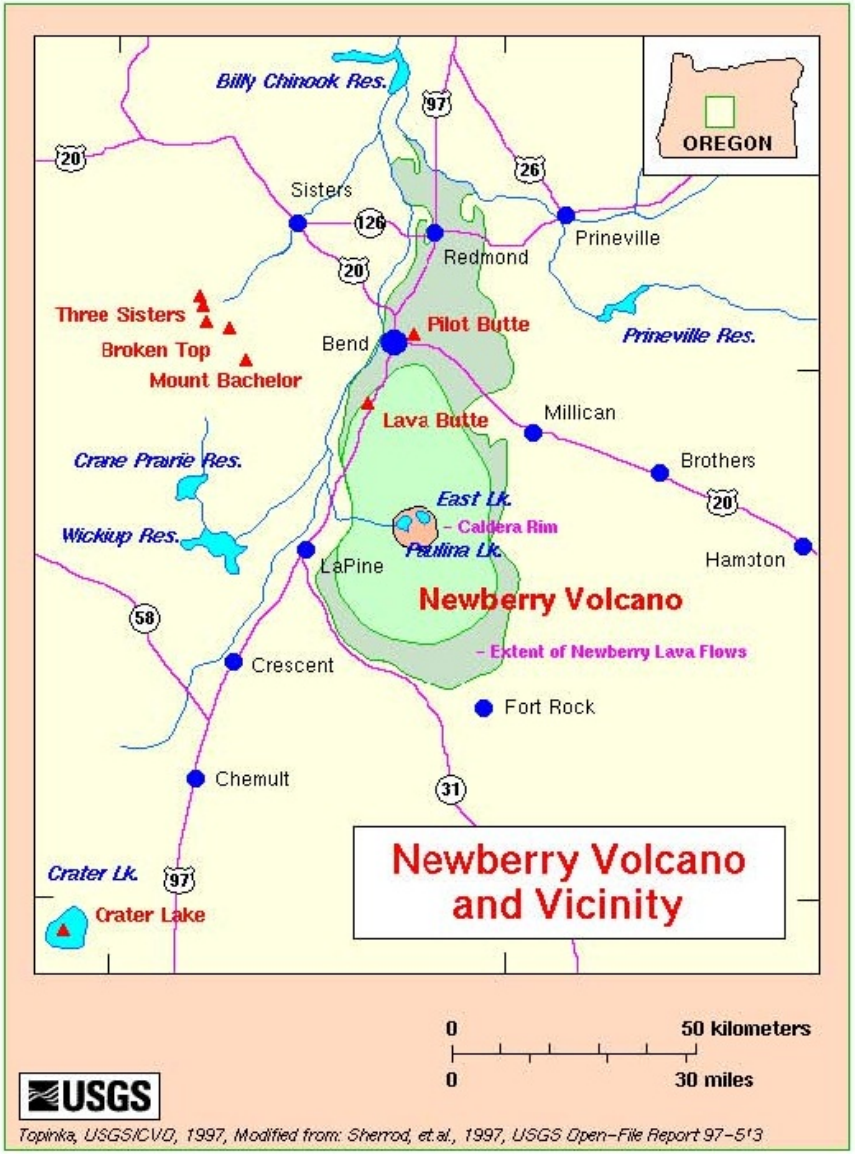
Relevance/Impact of Research

- Continued reprocessing MT data with Zonge: integration of MT, gravity, well logs and LIDAR producing a better understanding of hydrothermal targets and exploration strategies (Stanford Geothermal Workshop publication, 2013)

- **Sigma^3** (Apex HiPoint) completed final processing of the LASEA (Low Amplitude Seismic Emission Analysis) data on four wells

- The complete Davenport scientific team, including contractors, convened a multi-day meeting to discuss data and to share insights into their views of the volcano and to advance the multi-disciplinary strategy for geothermal exploration on the volcano.

Newberry Volcano Project Location



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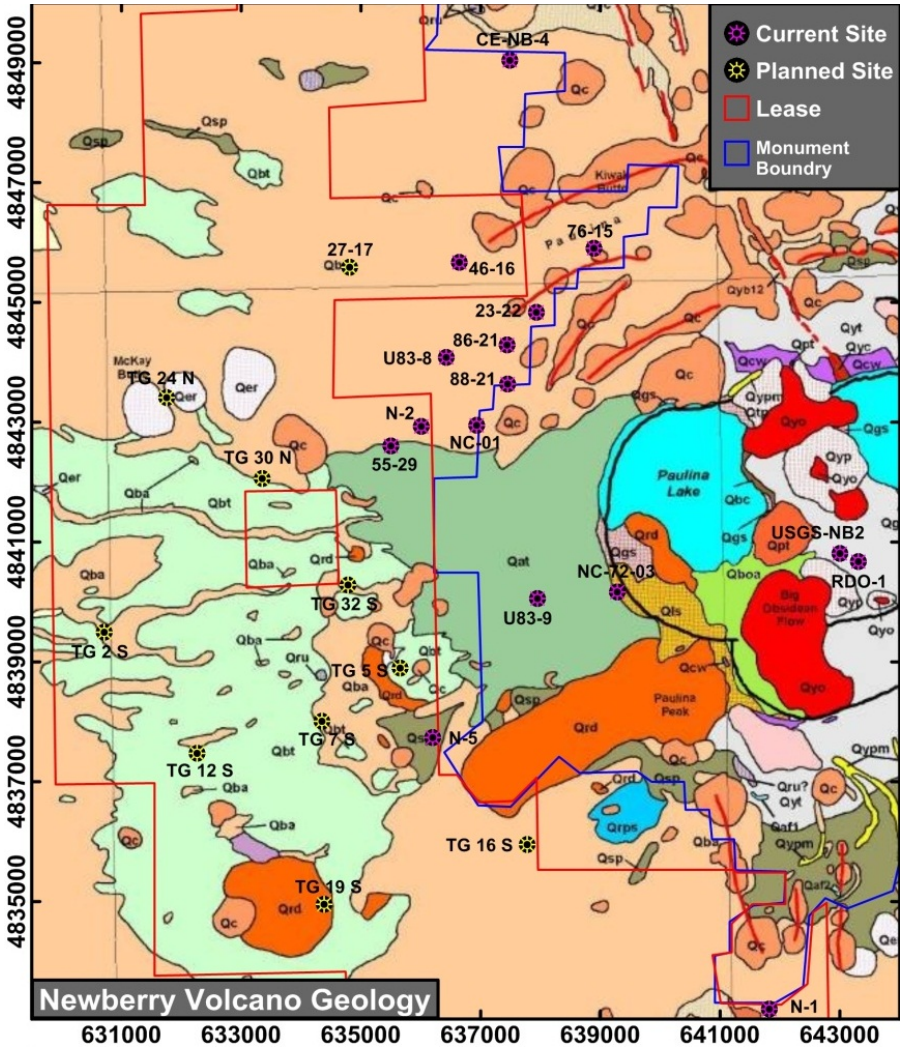
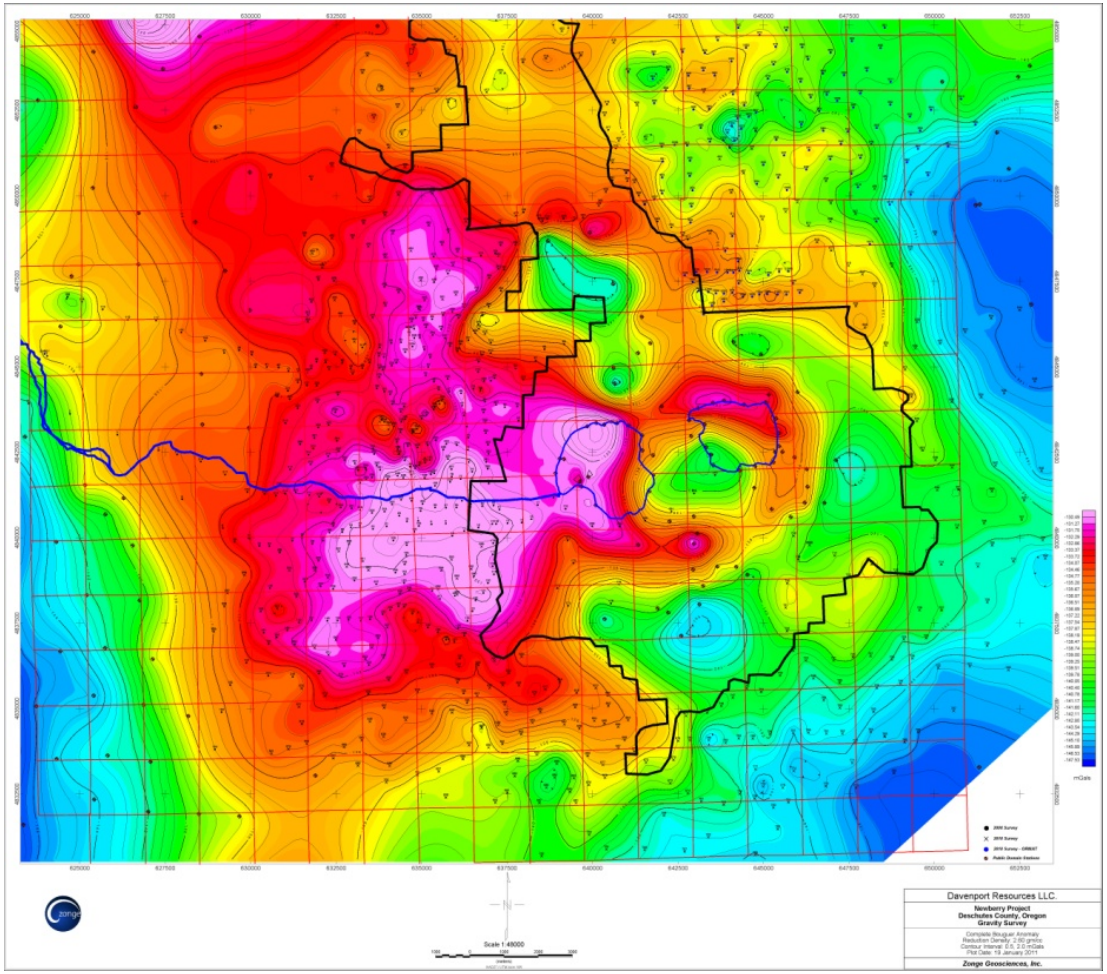
Geologic Map of Newberry



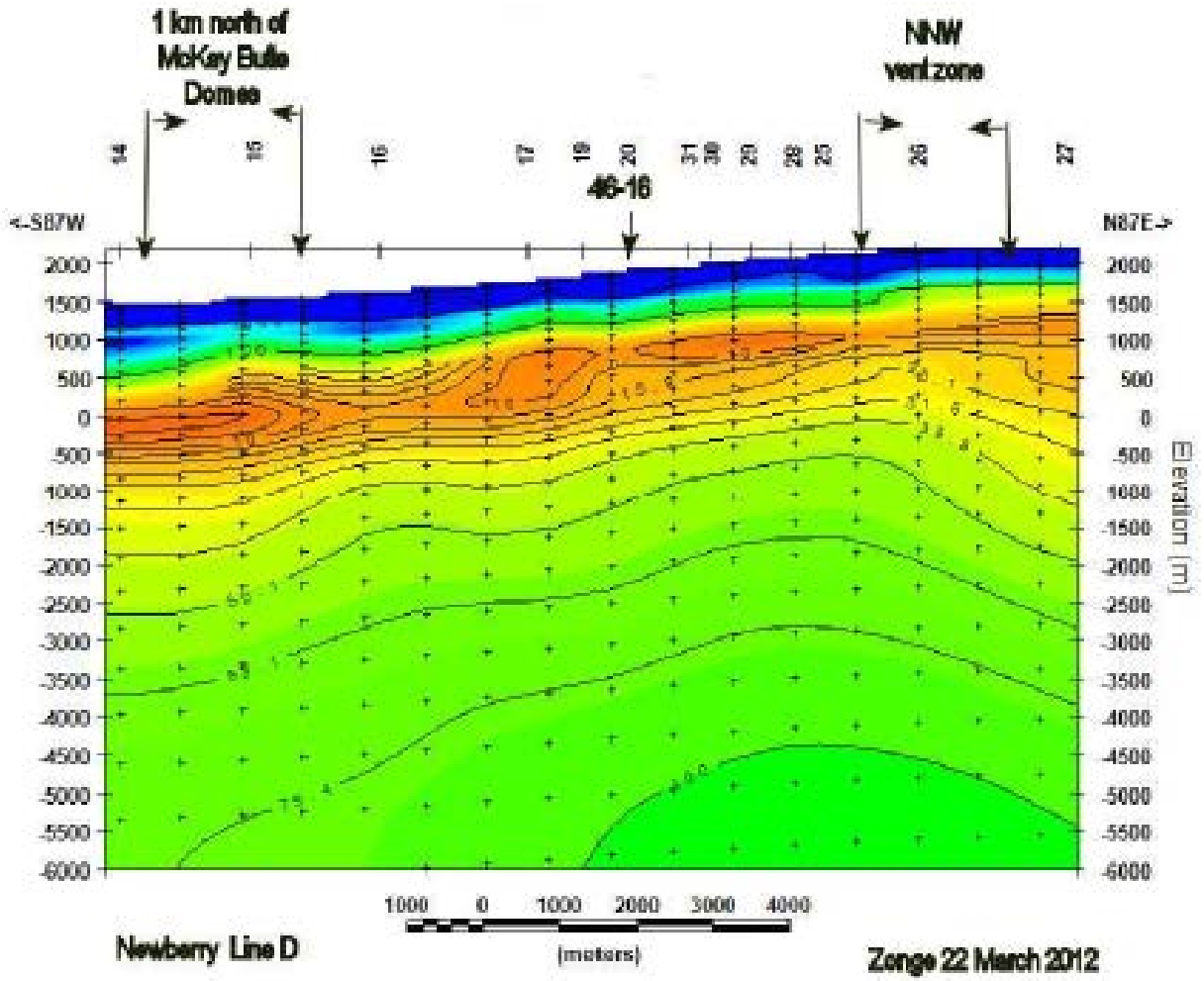
Qsp	Sedimentary and pyroclastic deposits (Pleistocene)
Qyo	Young obsidian flows of the caldera (Holocene)
Qboa	Deposits of Big Obsidian eruptive period (Holocene)
Qyt	Young rhyolitic tephra (Holocene and Pleistocene?)
Qyp	Pumice-cone and ring deposits of the caldera (Holocene and Pleistocene?)
Qrd	Rhyodacite domes and flows (Pleistocene)
Qat	Andesitic tuff (Pleistocene)
Qbt	Basaltic andesite lapilli tuff (Pleistocene)
Qer	Early rhyolite domes and flows (Pleistocene)
Qba	Basaltic andesite (Holocene? and Pleistocene)
Qc	Cinder cone and fissure-vent deposits (Holocene? and Pleistocene)

Gravity Map

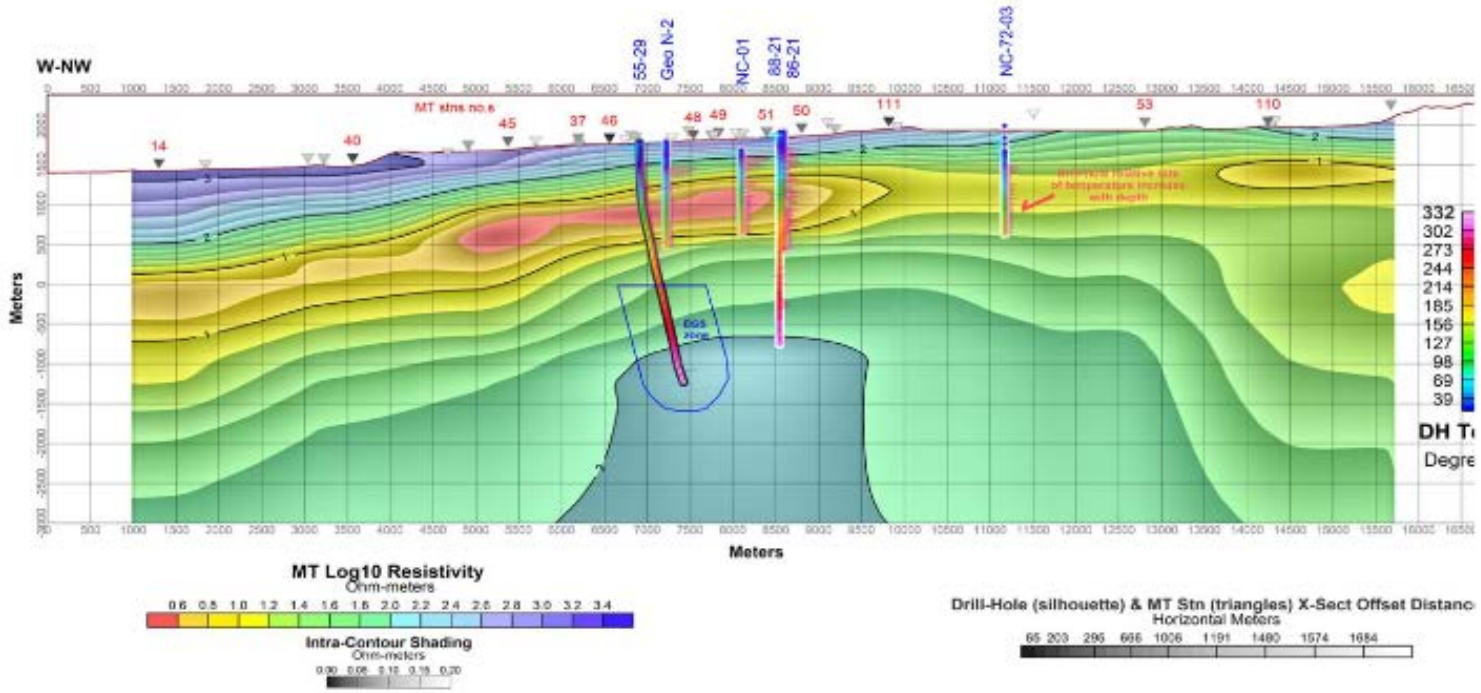


Complete Bouguer Anomaly with a reduction density value of 2.60 gm/cc.
East Lake, Paulina Lake and Paulina Creek are shown in blue. The Monument boundary is outlined in black.

Scientific Approach (cont.)

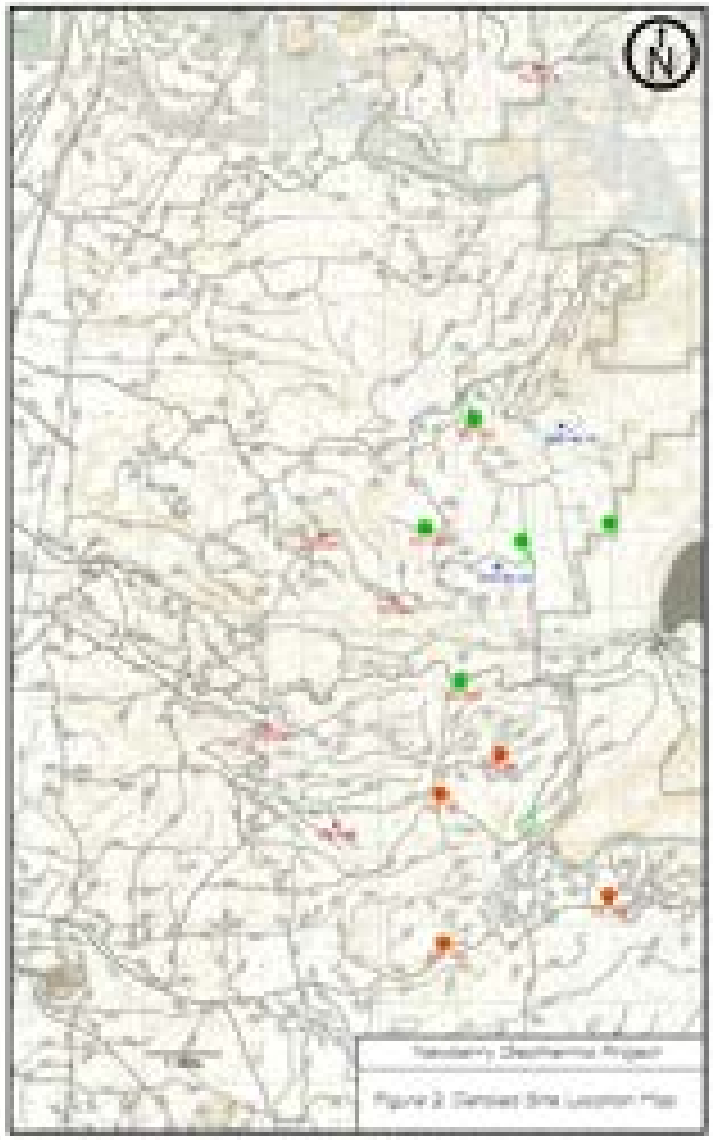


Scientific Approach (cont.)



Scientific Approach (cont.)

- **Location of Sigma 3 LASEA seismic study**



Dominant Microseismic Pattern

Episodic signal pattern due to:

-Fluid movement along structure.

-Micro-structural movement.

-Signal reflection from distal sources, reflected along a linear structure.

Accomplishments, Results and Progress

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Original Planned Milestone/ Technical Accomplishment	Actual Milestone/Technical Accomplishment	Date Completed
Complete Temperature gradient holes	Only shallow cased portions were completed	
Complete Microseismic surveys	Completed southern 4-hole survey	Dec. 2012
Complete MT data processing	Completed MT data processing	Nov. 2012
Complete Microseismic data processing	Completed Microseismic data processing	Dec. 2012
Scientific Team Collaboration	Scientific Team Collaboration	Apr.-Sept.-Dec. 2012
Well Cuttings Chem-Petrography	Well Cuttings Chem-Petrography	ongoing
Publication,	Publication, GRC Trans.	Oct. 2012
Public Outreach	Meetings, Field Trip, Univ. Lectures	Mar-Apr-June-Aug 2012
Temperature	Measured Temp. in shallow cased wells	Aug. 2012

Project Management Data Sharing

- All data are shared with the Alta Rock EGS sister project.
- MT and other data have been shared with Oregon State Univ. geophysical team conducting research on Newberry Volcano.
- Partial data has been given to the DOE Geothermal Data Repository. As the program progresses and after analysis and integration of data is completed, additional data will be provided to DOE

Future Directions

- Davenport Newberry is now administered by Alta Rock Energy.
- Davenport anticipates the cumulative results of this program will facilitate identification of deep geothermal exploration drill targets.
- Davenport is applying the new integrated model to plan next-step actions in the vicinity of well 46-16 (with hydrothermal intersects) and to plan step-out exploration beyond the western flank of the volcano.
- Davenport's short term (summer 2013) priority is to complete the microseismic survey in the northern well set.
- Continue Publications and University and Public outreach.

Summary Comments

- DONOT Rely on Kneejerk interpretations of data.
- Integrate all aspects of geology into the combined interpretation of data for each unique location.
- Exploration is teamwork.
- Changes in commodities and the economy can trump best intentions.
- *A priori* logic can lead to bankrupt companies.

Project Management

Federal Share	Cost Share	Planned Expenses to Date	Actual Expenses to Date	Value of Work Completed to Date	Funding needed to Complete Work
1,399,269	1,532,057	10,132,664	2,931,269	30%	7,434,883

Active communication with stakeholders, communities, government agencies and various organizations

- Public meetings, annual public field trip, open office, newsletters, team meetings, Geothermal Resources Council meeting presentation and publication, SMU lectures

Coordination with BLM and USFS schedules and restraints

Coordination / sharing information with EGS demo project

- Providing full technical data base, supervision, public relations, permitting, scheduling

Managing delays

- Economics of Renewable Energy vs. Natural Gas