



Crump Geyser: High Precision Geophysics & Detailed Structural Exploration & Slim Well Drilling

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Validation of Innovative Exploration Technologies

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- **Timeline**

- Start Date: **March, 2010**
- Projected End Date: **May, 2011**
- Completed: **~5%**

- **Budget**

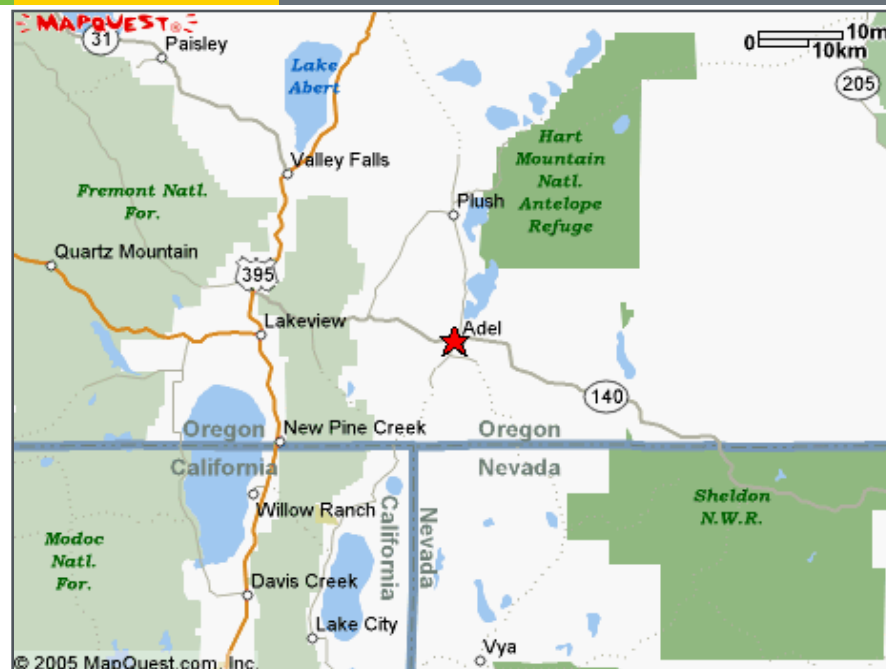
- Total project funding: **\$3,201,372**
- DOE share: **\$1,600,686**
- Awardee share: **\$1,600,686**
- Funding received in FY09: **\$0.00**
- Funding for FY10: **\$3,095,450.00**

- **Barriers**

- **No significant barriers exist.**
 - Transmission line in place.
 - All private lands, leasing and siting simplified.
 - Extensive geophysics and a sound scientific approach will increase the rate of development drilling success – helping to reduce the high up-front costs.

- **Partners**

- **USGS**
- **Sustainable Lake County Oregon**
- **South Central Oregon Economic Development District**



- Objectives:
 - Discover new 260F and 300F geothermal reservoirs in Oregon.
 - To demonstrate the application of high precision geophysics for well targeting.
 - Demonstrate a combined testing approach to Flowing Differential Self Potential (FDSP) and electrical tomography resistivity as a guide to exploration and development.
 - Demonstrate utility and benefits of sump-less drilling for a low environmental impact.
 - Create both short and long term employment through exploration, accelerated development timeline and operation.

Innovative geophysical approach designed to aide in the development of a detailed reservoir model to improve well targeting success throughout the development process.

If successful, this technique can be employed elsewhere in the region. Large regions of “unexplored” land with similar structural and geological settings in Oregon and Nevada.

- Apply high precision geophysics to define fault offsets.
 - Ground (ATV-towed) and Airborne Magnetics.
 - Precision Bouguer gravity.
 - Shallow seismic reflection/refraction.
 - Electrical resistivity tomography.
- Thermal gradient holes to confirm active hot fluid flow within fault network.
 - Sump-less drilling technique.
- Slim-holes to discover and test the reservoir.
 - Sump-less drilling technique.
 - FDSP survey to observe fluid flow patterns.
 - Electrical resistivity tomography.

- Major Milestones:
 - Completion of new geophysics and development of reservoir model. - ~20% complete. **Ultralight aeromag data collected.**
 - Drilled TG holes, collecting data and targeting slim-holes.
 - **GO/NO GO DECISION POINT**
 - Evaluation of project and likelihood of slim-holes identifying the resource.
 - Drill slim-holes.
 - Test slim-holes.
 - Review & Report. Analyze, synthesize and integrate all data and report on results.

- Technical Accomplishments To Date:
 - USGS ATV-towed ground magnetic and precision gravity;
 - Partially completed studies.
 - Full datasets to be acquired July 2010.
 - Detailed Aeromagnetic Survey; Edcon-Prj.
 - Currently under full review and interpretation by NGP and USGS.
 - Initial review indicates good data quality, identification of key structural features
 - Follow-up seismic will provide additional context and depth calibration.



- Planned Accomplishments:

- Complete shallow seismic study. Results are expected to help calibrate interpreted depth of the aeromagnetic data, and provide additional insight on faulted basalt formations.

- Complete TG drilling. Results are expected to provide an representative view of the thermal signature of the reservoir, and correlate well with geophysical/geological indicators of the reservoir.

- Drill slim-holes. Expectation of initial drilling is the successful completion of the wells in unfamiliar drilling conditions, and the intersection of the resource at depth.

- Test slim-holes. Expected to demonstrate the viability of commercial production rates and temperatures. FDSP and resistivity tomography will provide additional insight into the structural nature of the reservoir, which will guide subsequent development well targeting.

- Project Management Plan: Nevada Geothermal Power
 - Resources: Using internal resources to manage and meet project timeline goals efficiently.
 - Experienced management and staff.
 - Using in-house resources, materials and supplies wherever possible.
 - Utilizing USGS technical expertise for data analysis and scientific planning/approach.
 - Timelines: Continuously updated as the project progresses.
 - Budgeting: Detailed budgets and spending plans have been developed. Are frequently checked against reality.
 - Funds: Expenditures carefully monitored and recorded and we are requesting reimbursements from DOE on a monthly basis.

- Project Management Plan: Schedule
 - Geophysics:
 - Preliminary USGS Work: Summer 2009
 - Aeromag Survey: March 2010
 - Seismic Reflection Survey: May/June 2010
 - Follow up USGS Work: Summer 2010
 - TG drilling: Spring/Summer 2010
 - Project review & reporting: Summer 2010
 - Slim-hole drilling: Summer/Fall 2010
 - Slim-hole testing: Fall/Winter 2010
 - Project review, data integration and reporting: Spring 2011
 - Scheduling will somewhat revolve around field conditions.
 - Coordination with the natural flood cycle, and the rancher's irrigation needs (water supply & ground conditions).

- Strategy: Short Term
 - To complete the remainder of geophysics work as soon as possible.
 - Timeline affected by field/ground conditions.
 - Thorough analysis of prior/preexisting data to ensure subsequent activities are carried out with the best possible chance for success
 - Not rushing or pushing the timeline – putting scientific/results goals ahead of time-based goals.
 - Successful thermal gradient drilling operations.
 - Confirm targets and complete drilling operations.

- Strategy: Long Term
 - Develop a thorough reservoir model. Evaluate G/NG
 - Integration of all data acquired to date.
 - Technical discussions and review
 - In-house & with USGS
 - Target slim-holes
 - Drill slim-holes.
 - Drill slim-holes
 - During optimal field conditions
 - Avoiding flood-irrigated areas.
 - Coordinate with ranchers on water supply availability.
 - Test slim-holes.
 - Test during dry season – reduce interpretation complexity.
 - Access to more areas for installing FDSP setup.

- Strategy: Long Term
 - Integrate data
 - Expand and modify reservoir model
 - Final analysis and reporting

- Further down the road:
 - Ultimate measure of this project will be a fully developed geothermal power plant.

 - If successful, this project will lead directly into development well drilling and reservoir planning for the future power plant, commencing as soon as practical.

- **Crump Geyser: Warner Valley, South-Central Oregon:**
 - High precision detailed geophysics.
 - Thermal gradient well drilling
 - Slim-hole drilling.
 - Well testing & FDSP
 - Innovative scientific and low-impact drilling approach
 - Great density of low-cost, high-value geophysical data.
 - Sump-less drilling technique: environmentally friendly.
 - Started **March 2010**. To be completed in **May 2011**.
 - Total project cost of **\$3,201,372 (50% cost share)**.
 - **Partners: USGS; Sustainable Lake County Oregon; SCOEDD**