Newberry Geothermal

Validation of Innovative Exploration Technologies for Newberry Volcano

Davenport Newberry

May 19, 2010

Principal Investor: Albert F. Waibel
Columbia GeoScience & Davenport Newberry

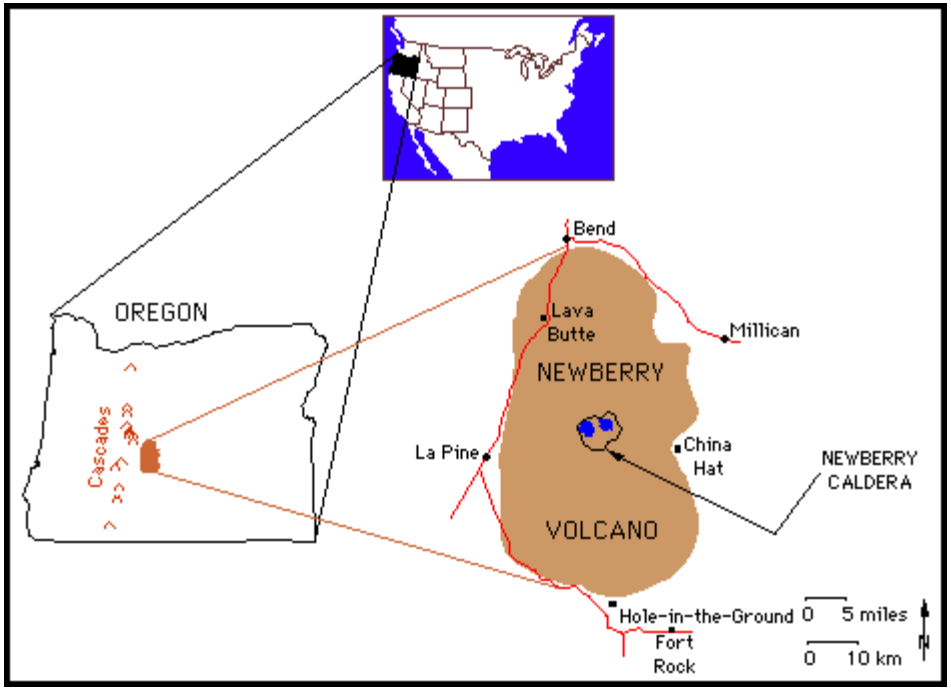
History of Newberry Exploration

- Cascade Range identified as a promising geothermal resource
- Exploration started in 1970's
  - Parties include USGS, GSI, Cal Energy and Davenport
- Challenges due to the blind resource characteristics of the terrain
  - Deep water table located below the topographic surface which results in the downward percolation of meteoric water through porous volcanic rock, effectively masking underlying geothermal resources
- In 1990, the National Volcanic Monument Act was signed into law

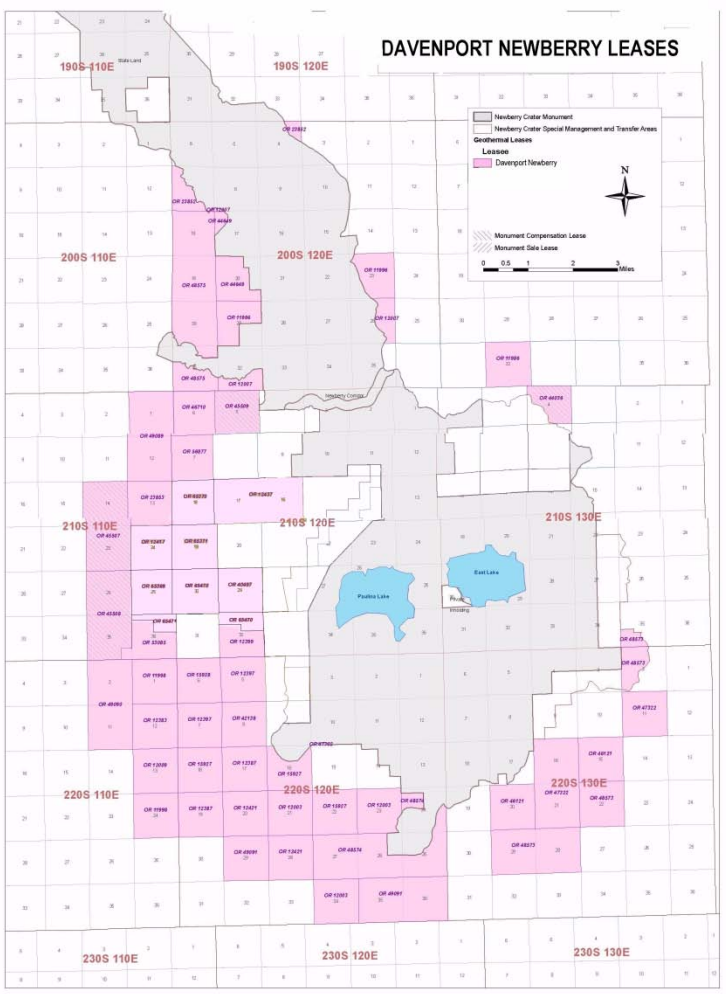
Recent History

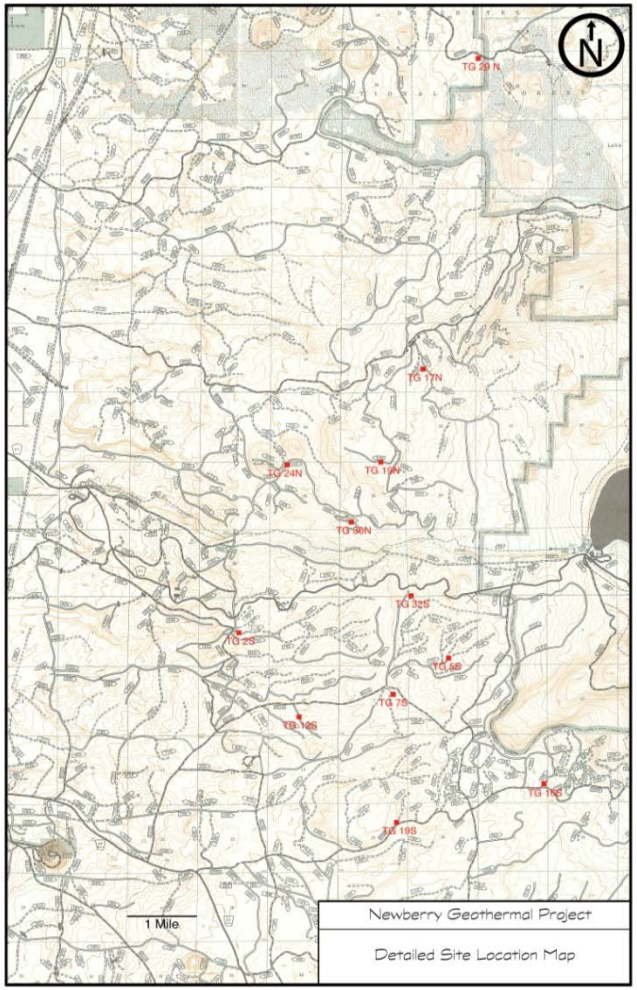
- Davenport conducted MT and gravity surveys
- Identified several interesting anomalies
- Drilled 2 deep wells on western flank of volcano
- Temperatures in excess of 600 F @ 10,000'

Project Location



Project Location





Objective

- Develop an innovative exploration strategy that will lead to the commercial development of geothermal energy at Newberry and other areas where a "Blind" ("no surface indications") geothermal system exists
- In particular, we will concentrate at Newberry volcano where a water table effectively hides underlying hot plutons and their associated geothermal systems
- Will use a combination of 7 cutting-edge and traditional technologies
- Plan to validate strategy by drilling a deep well to seek a commercial amount of geothermal resource

Technology Innovation and Validation

- Key is to effectively combine numerous exploration technologies to gather important data
- Once information is combined into 3-D models, a target drilling location will be determined
- Deep well capable of finding commercial quantities of geothermal resource will be drilled to validate methodology

Project Description and Implementation Plan

- Obtain necessary permits:
  - NEPA compliance (EA and FONSI issued)
  - Drilling permits from DOGAMI & BLM
- MT survey over 60 sq miles
- Gravity Survey over west flank
- Initially drill approximately six 700' wells with a rotary drill
- Perform innovative seismic detection analysis
- Continue drilling TG wells to 2500' to 3500' using a core drill

Project Description and Implementation Plan (cont.)

- Repeat drilling and testing for approximately 6 additional wells
- Analyze core samples for CO_2 degassing
- Conduct isotope analysis and other geochemical tests at SMU's lab
- Analyze structural / formations of cores
- Measure temperatures in wells
- 3-D modeling
- Recommend new drilling targets
- Validate with slim-hole drilling

More on Seismic Analysis

- APEX / Hipoint developed the technology for oil and gas industry to detect and map fluid flow (patent pending)
- Theory based on fluid movement creates low amplitude seismic waves over long time periods (several minutes to many hours) and can be identified
- Will install ten 3-component geophones in each well
- Continuous reading for 7 days at 2000 samples per second
- Uses cross correlation and Kirchhoff migration processing algorithm as opposed to timing delay between P-wave and S-wave arrivals
- Will plot 3-dimensional volume over time to map geothermal flow within fracture

Geothermal Resource Potential

- Sufficient indications exist from past exploration at Newberry
- Evidence suggests that exploration should continue westward
- Temperature extrapolations indicate that hundreds of MW's of energy exist on western flank (40 square miles)
- Promising location for generation plant
  - BPA interconnection study and wheeling contracts in place

Project Team & Resources

- Albert F. Waibel (Principal Investigator)
- Southern Methodist University
  - Dave Blackwell (geological advisory and model building)
  - Bob Gregory (geochemical analysis)
  - Graduate student (field analysis and research)
- APEX / Hipoint (seismic analysis)
- Zonge Engineering & Research (MT & gravity surveys)
- Western Water Development (drilling)
- TaylorNW (pad and road work)
- Davenport Newberry (management)

Timeline

- Mid- May 2010: commence pad construction
- Early June 2010: drilling commences
- Fall 2010: seismic analysis of first six wells
- Early 2011: drilling continues
- Summer 2011: additional seismic analysis
- Fall 2011: (maybe Spring 2012): finish drilling
- 2011 / 2012: modeling and report writing
- 2012 / 2013: validate with slim hole well drilling

Budget

- Total Project cost: $12.8 M
- DOE to provide $5 M
- Sponsor to provide $7.8 M
  - FY 10: $5.4 M
  - FY11: $3.7 M
  - FY12: $3.7 M