

Newberry Volcano EGS Demonstration



Oregon Geothermal Working Group
Portland, Oregon
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ALTA ROCK
ENERGY INC



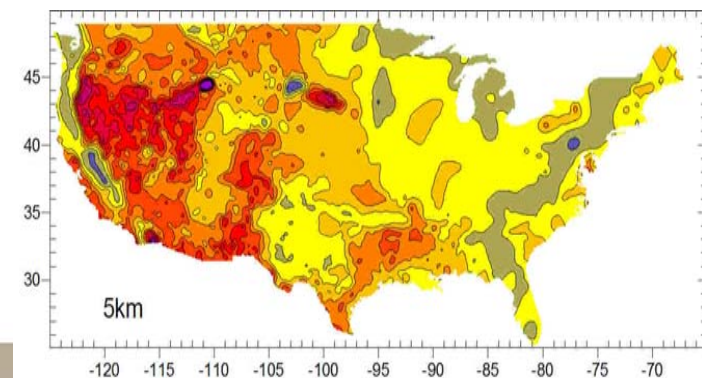
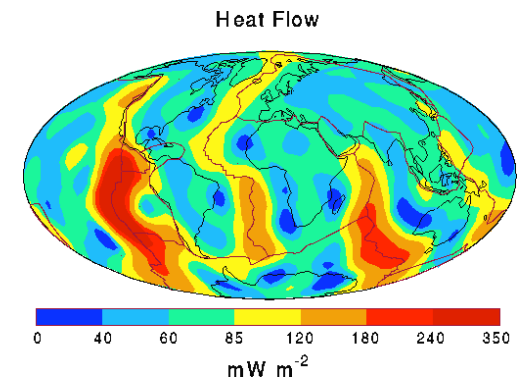
Newberry
Geothermal

Enhanced Geothermal Systems: The Future of Geothermal Energy

- **The Future of Geothermal Energy:** Impact of Enhanced Geothermal Systems (EGS) on the United States in the 21st Century
 - http://geothermal.inel.gov/publications/future_of_geothermal_energy.pdf
- Twelve-member panel lead by Dr. Jeff Tester through MIT
- Includes preliminary assessment of US resource
 - Enormous resource stored as heat in rock
 - Natural heat flow recharges stored heat

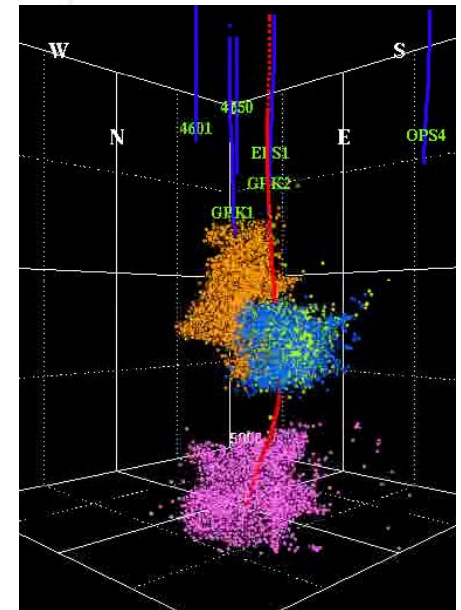
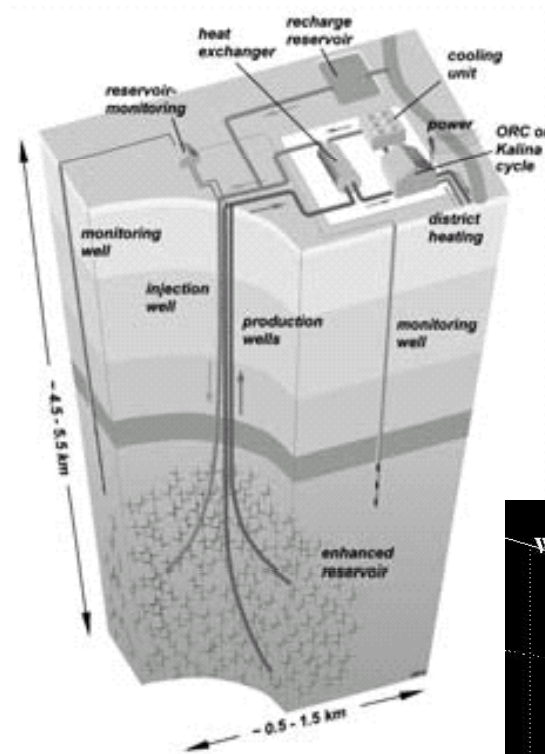
- **Conclusions**

- EGS technically feasible now
- Best resources economic today
- Resource extends across US
- 50 GW EGS possible by 2050 with no federal investment
- 100 GW potential by 2050 with ~\$350mm federal investment



Enhanced Geothermal Systems

- Fractures are created (or enhanced) by hydroshearing of injection well basement rock
- Fractures are mapped using geophysical methods
- Production wells are drilled into mapped fracture network
- Cold water is circulated into injection well fractures, heated by the rock and returned to the surface through production wells
- Heat is extracted from circulating water for use in power generation

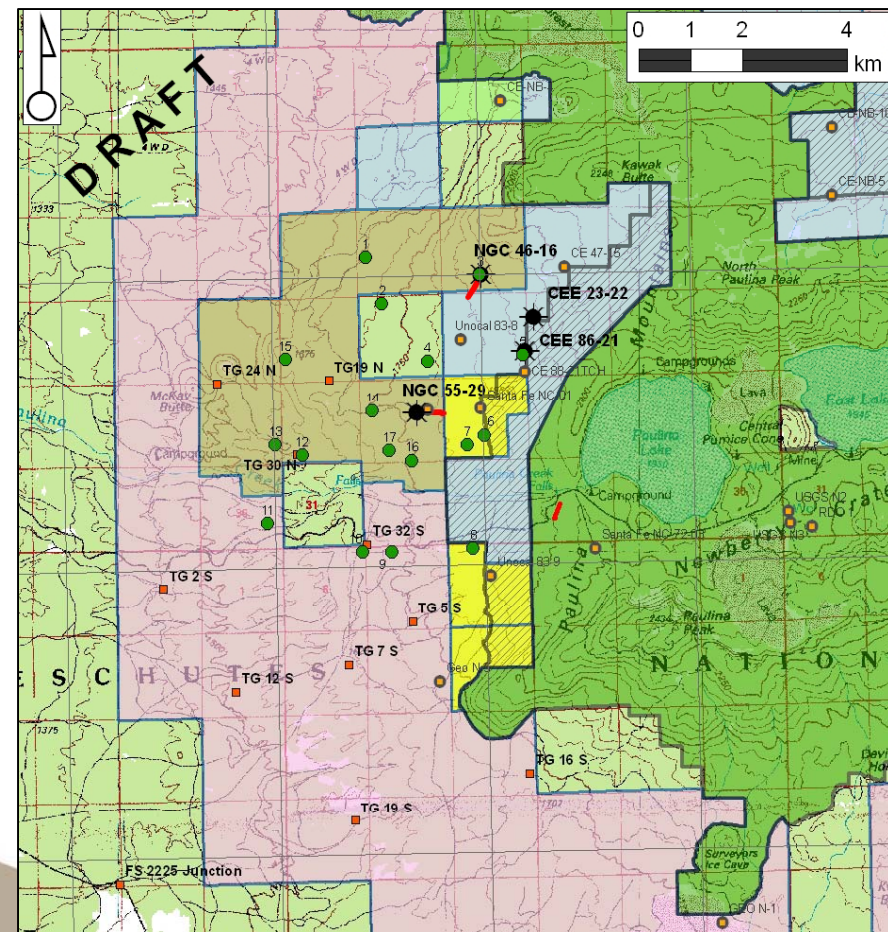
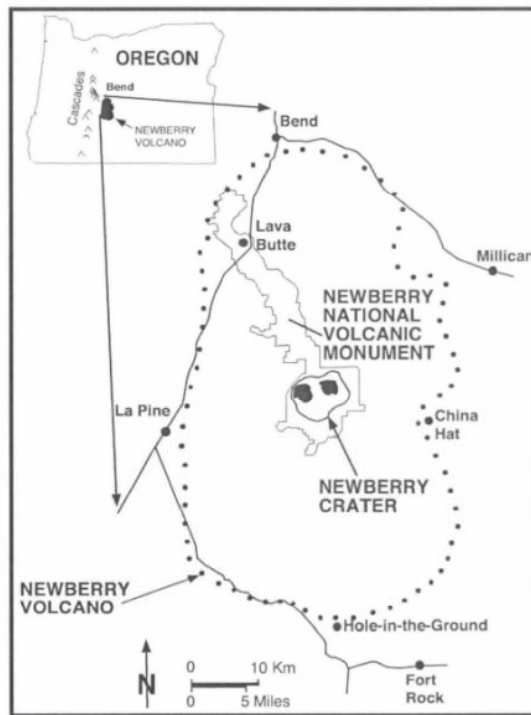


EGS Demonstration

- American Reinvestment and Recovery Act
 - Grant FOA Number DE-PS36-09GO99019 for Enhanced Geothermal Systems Demonstrations
- AltaRock awarded \$25m to demonstrate EGS technology at Newberry KGRA
 - Susan Petty, AltaRock founder, CTO and Principal Investigator
 - Will Osborn, AltaRock Project Manager
 - Doug Perry, Davenport President
- In association with
 - Davenport Newberry Holdings LLC
 - University of Oregon
 - Energy and Geoscience Institute (University of Utah)
 - U.S. Geological Survey
 - Temple University
 - Texas A&M
 - Lawrence Berkeley National Laboratory
- Currently negotiating award with Department of Energy
- Expect project initiation April 2010

Project Location

- Northwest flank of Newberry Volcano, Deschutes Co, OR
- Outside western boundary of Monument



Pre-Stimulation 2010-2011

- Public Outreach
 - Multimedia presentation of project plan
 - Permitting and planning meetings
 - Public interaction through various media outlets
- Permitting
 - Groundwater use
 - Surface MSA installation and monitoring (complete)
 - Strong motion sensors
 - Underground injection
 - MSA calibration
 - Subsurface MSA sensors and telemetry
 - Induced seismicity and Seismic Hazards Evaluation
 - Environmental Assessment
 - Stimulation
 - Testing



Pine Mountain SMS Site

Pre-Stimulation 2010-2011

- Pre-Stimulation
 - Site and wellbore readiness
 - Site preparation
 - Sump, well pad, roads
 - Water wells
- Stimulation Plan
 - Geoscience review, lab studies, LiDAR
 - Initial Microseismic Array (“MSA”) design, install, monitor
 - Injection well
 - Integrity test
 - Pre-stimulation injectivity
 - Geophysical logs

Injection Well Stimulation Spring-Summer 2011

- Preparation for Stimulation
 - Ongoing site maintenance
 - Materials procurement
 - Installation of subsurface sensors and telemetry
- Injection Well Stimulation
 - Rig mobilization
 - Wellhead installation
 - First stimulation
 - Zone isolation
 - Additional stimulations and tracer injection
- Flow test
 - Mass flow, temperature, pressure
 - Well bore surveys
 - Chemical composition and tracer recovery
- Production well drilling plan

First Production Well Fall 2011-Spring 2012

- Drill First Production Well
- Geophysical well logs
- Connectivity test
 - Pump groundwater into injector
 - Flow test production well
 - Mass flow, temperature, pressure
 - Well bore surveys
 - Chemical composition and tracer recovery
 - Injection makeup water
- Recirculate groundwater to injector
- Stimulate production well, if needed
 - Repeat flow test
- Update numerical model and evaluate productivity
- Plan second production well



Second Production Well Spring-Fall 2012

- Drill Second Production Well
- Geophysical well logs
- Multi-Well Connectivity test
 - Pump groundwater into injector
 - Flow test both production wells simultaneously
 - Mass flow, temperature, pressure
 - Well bore surveys
 - Chemical composition and tracer recovery
 - Injection makeup water
- Recirculate groundwater to injector
- Stimulate production well, if needed
 - Repeat connectivity test

Conceptual Modeling and Long-Term Monitoring

- Long-term monitoring
- Update numerical model and evaluate resource potential
- Develop conceptual models
 - Long-term test facility
 - Wellfield expansion
 - Power plan design
- Project Reports
 - Drilling, stimulation and test results
 - Reservoir performance
 - Peer-reviewed publications
 - Data posting to national public database

