POTTER DRILLING
Drilling Technology for Clean Energy

Non-contact Drilling Technology for Geothermal Wells

CALIFORNIA ENERGY COMMISSION

PIER
PUBLIC INTEREST ENERGY RESEARCH
"Research Powers the Future"

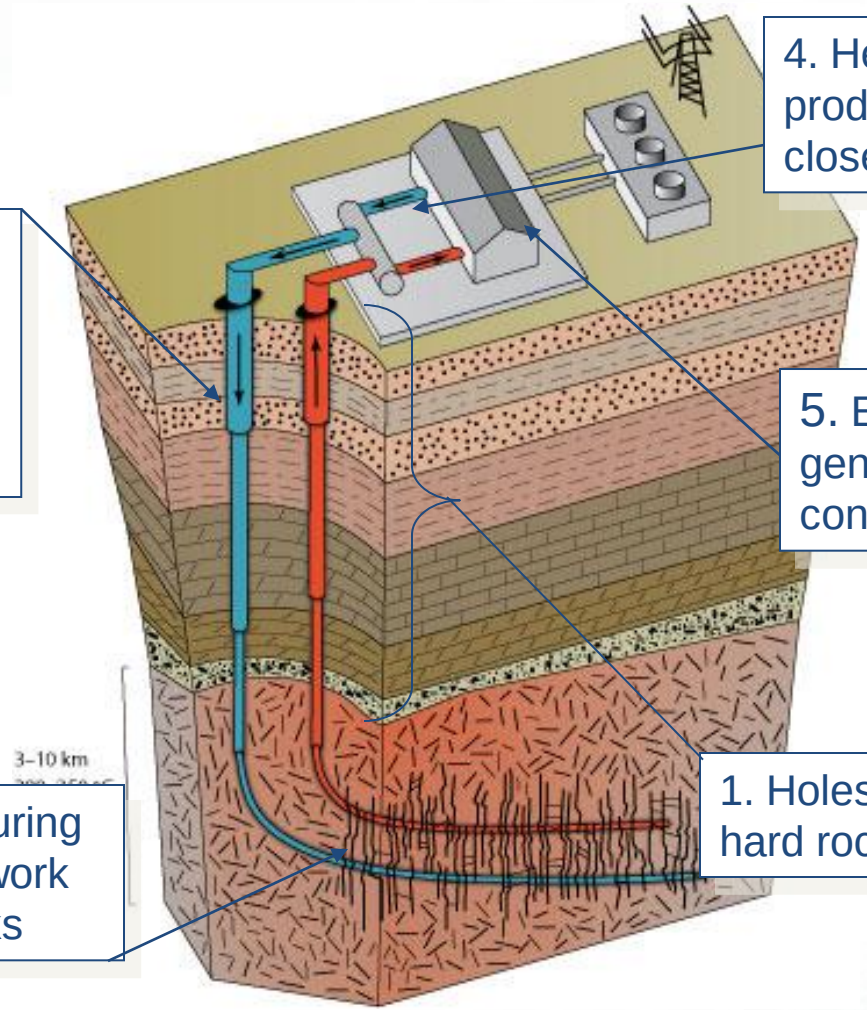
Potter Drilling

The Potter Method enables efficient, inexpensive wellbore enhancement and drilling in geothermal formations

- Hydrothermal spallation technology invented by MIT researchers and Bob Potter in 1995
- Company founded in 2004 (Jared Potter, and Bob Potter) to develop and commercialize downhole thermal spallation
- Located in Redwood City, CA with field test/demo site in Raymond, CA
- Partnered with leading geothermal and service companies
- Recipient of multiple DOE awards and industry accolades

Engineered Geothermal Systems (EGS)

Demonstrated by Los Alamos National Laboratory in the 1980's



4. Heat is extracted from the produced water into a closed loop of working fluid

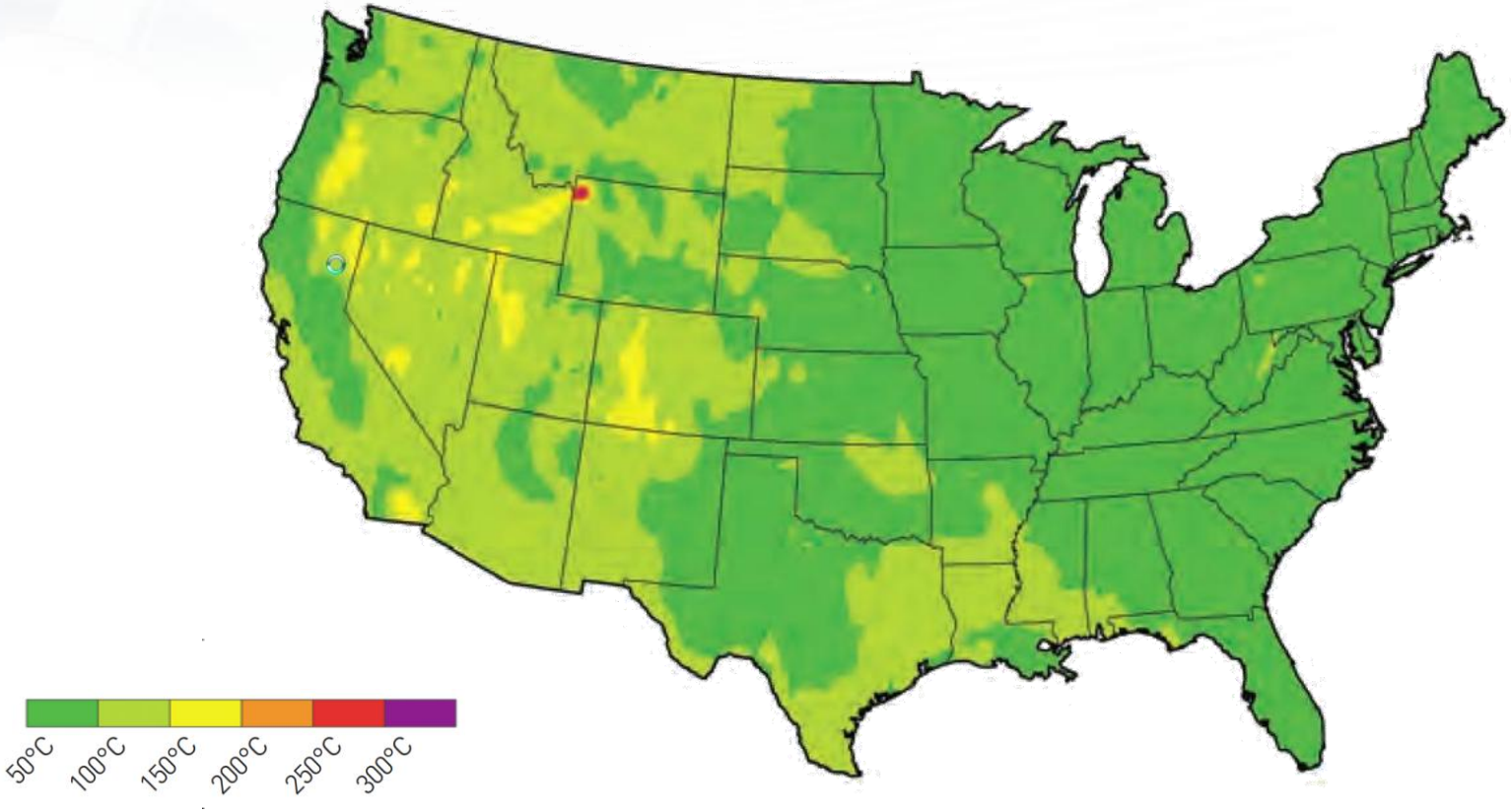
3. Water flows down the injection wells, returns up the production wells, and is re-circulated

5. Electrical power is generated using conventional turbines

1. Holes are drilled deep in hot, hard rock such as granites

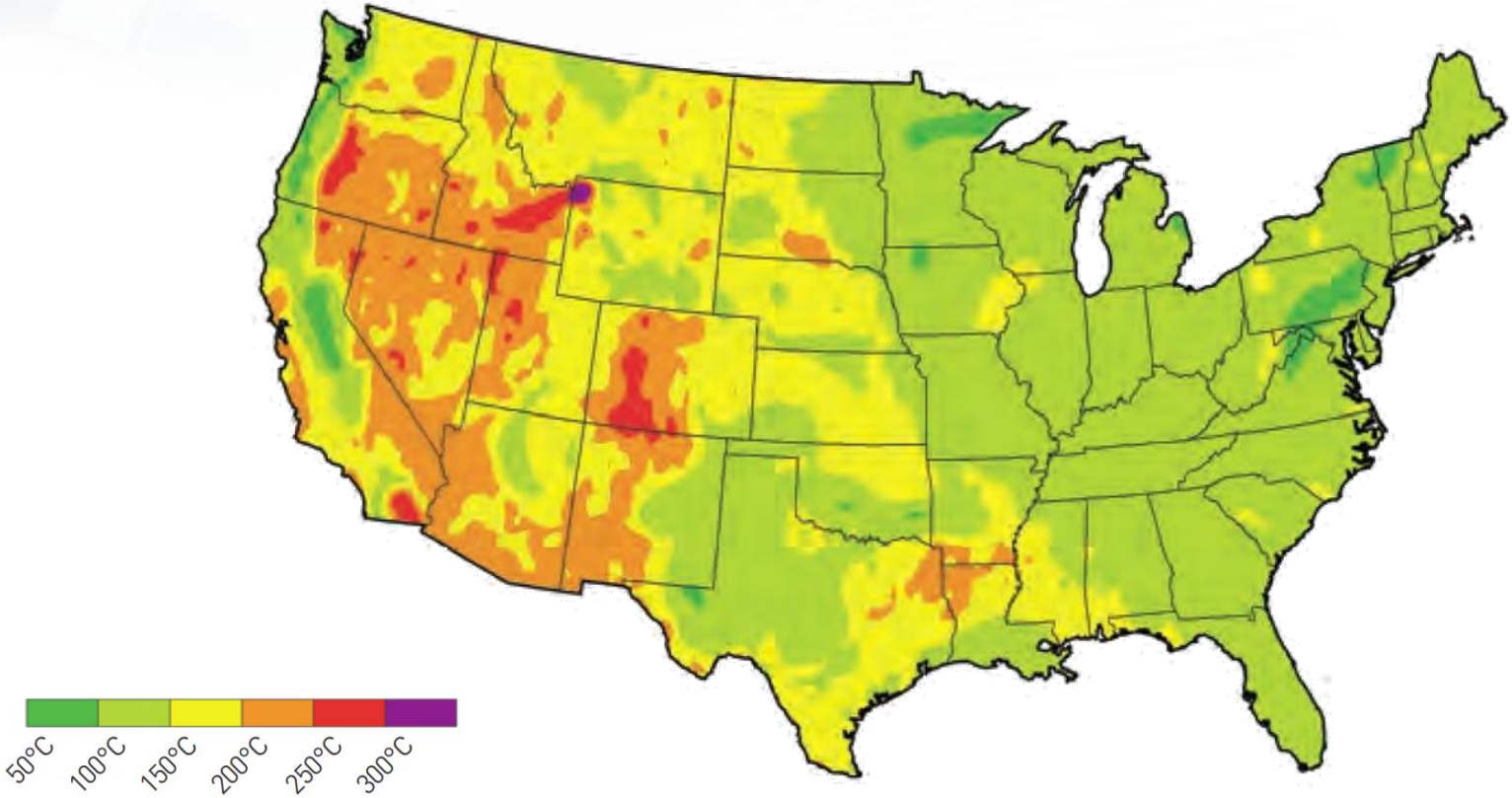
2. Standard hydro-fracturing technology creates network of cracks in the hot rocks

Resource vs. Depth



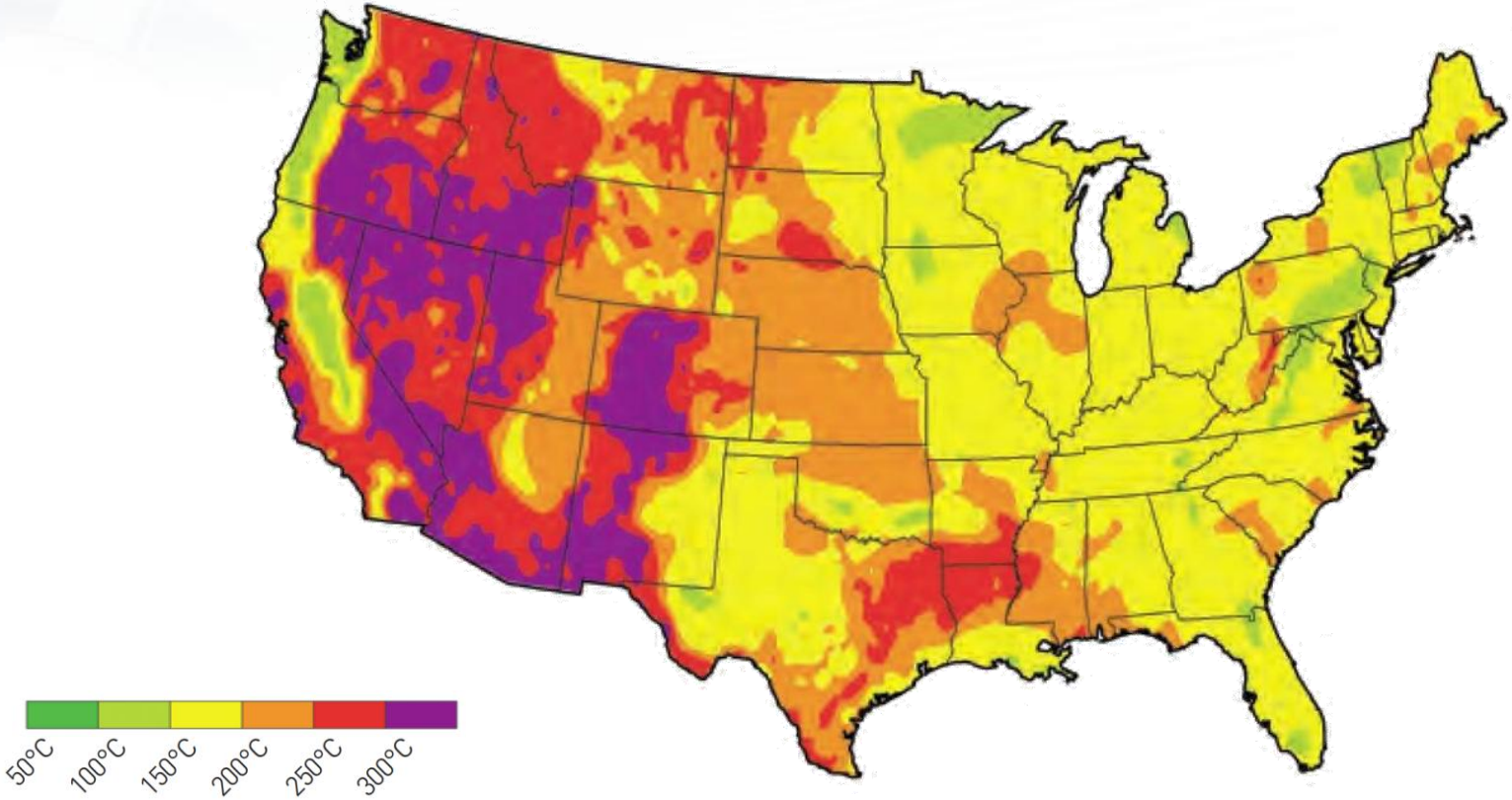
3.5 km: EGS only viable in select locations

Resource vs. Depth



6.5 km: EGS available throughout western U.S.

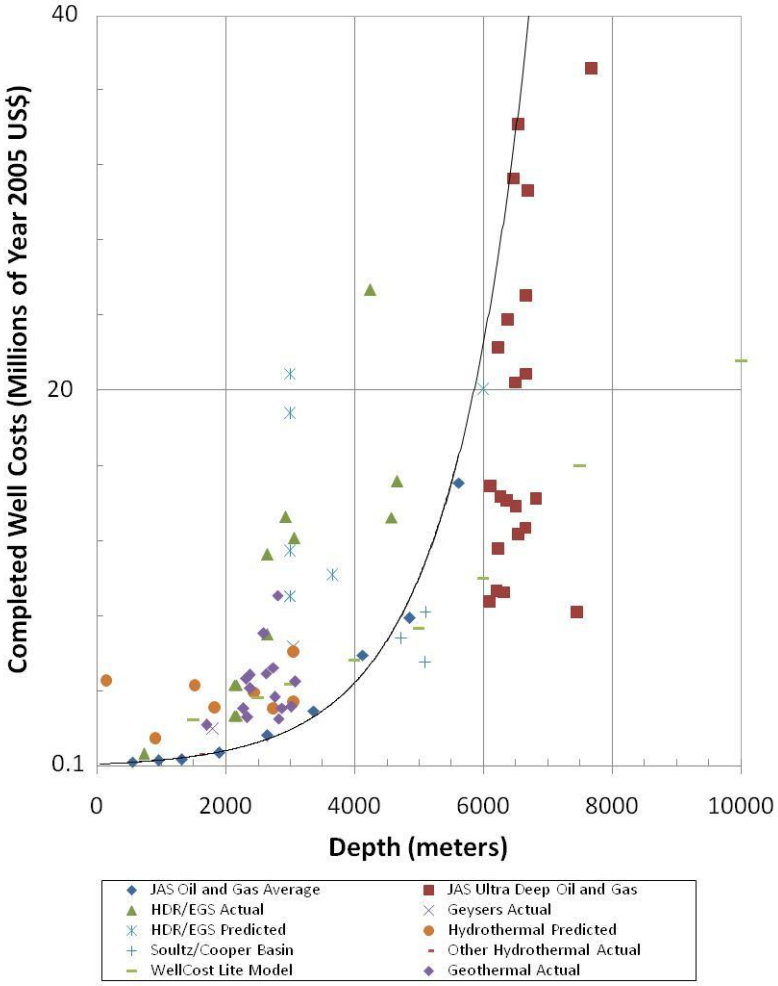
Resource vs. Depth



10 km: EGS available throughout U.S. and the world

Well Costs vs. Depth

- Cost of oil and gas wells increase exponentially with depth
- Geothermal wells cost more than oil and gas wells
  - Larger diameters
  - Harder rock
  - Higher temperatures
- There is a need for a less expensive way to produce these wells

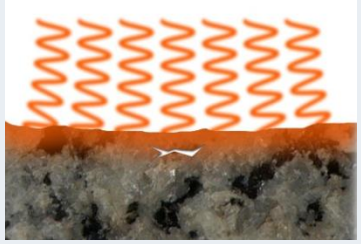


Adapted from Augustine et. al, A Comparison of Geothermal with Oil and Gas Well Drilling Costs, Thirty-First Workshop on Geothermal Reservoir Engineering, Stanford, CA, January 30-February 1, 2006. SGP-TR-179

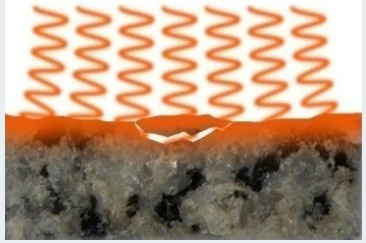
The Potter Method

The Potter Method removes hard rock using Thermal Spallation

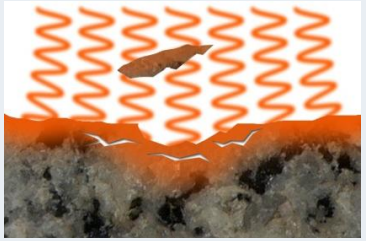
1. **Intense heat** creates high stress at the rock surface



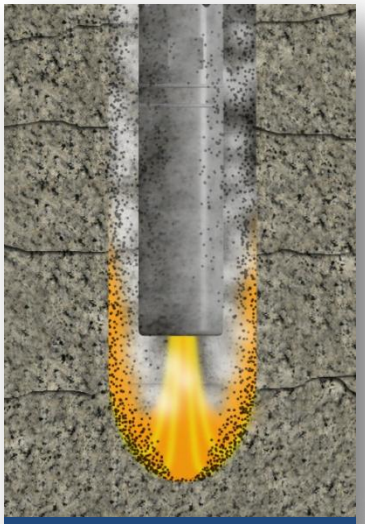
2. **Micro-fractures initiate** at flaws or between mineral grains



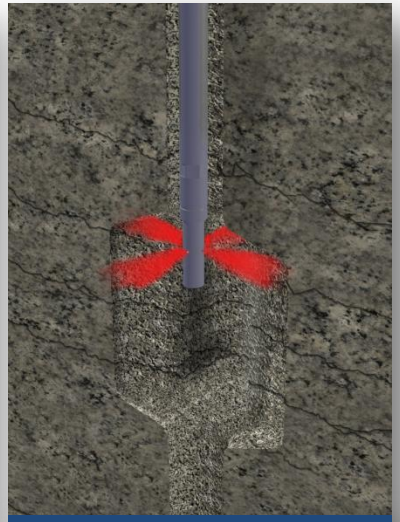
3. To relieve stress, **spall is ejected**, exposing fresh surface



Provides effective hard rock excavation tools



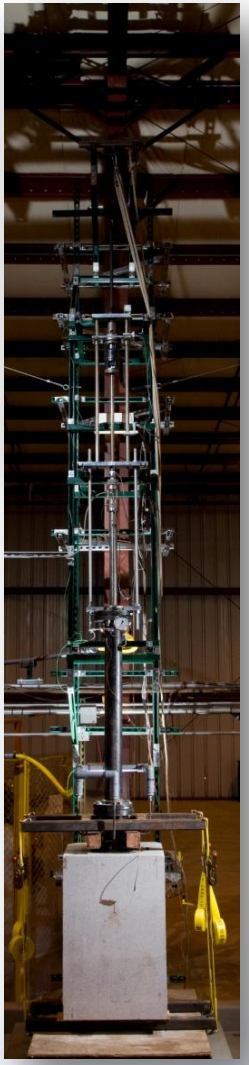
Drilling



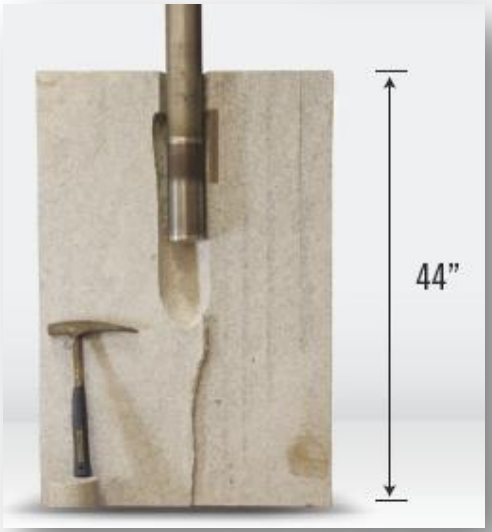
Well Enhancement

Staged Development Approach

- **Stage I: Lab Development**
  - Proof of concept
  - Simulated to depths of 7,000’
  - Optimization of process conditions
  - 1” diameter hole



- **Stage II: Surface Testing**
  - Drilling at shallow conditions
  - Slim hole capabilities
  - 4” diameter hole



Stage III: Shallow Field Testing

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- **Objectives**
  - Demonstrate thermal spallation drilling in the field.
  - Determine potential of thermal spallation to accelerate the commercial deployment of EGS as a domestic energy resource.
- **Budget**
  - Total funding: $3,218,943
  - DOE share: $1,874,103
  - CEC share: $380,000
  - Awardee share: $964,840

Accomplishments, Results and Progress

- ☑ Robust and reliable BHA
- ☑ Able to generate continuous, high temperature steam downhole
- ☑ Customized control and data acquisition software system
- ☑ ROP up to 15ft/hr with pathway to 30ft/hr
- ☑ Able to drill up to a 12” diameter hole with 3.5” diameter tool
- ☑ Surface system collecting and separating spalls continuously
- ☑ 12 jobs preserved and 4 jobs created (Mech Eng, Coiled Tubing Tech, Welder, Admin)
- ☑ Awards: Cleantech Global 100, Always On’s Top 100, Greentech Media Top 50
- ☑ Presentation at 2010 GRC meeting in Sacramento (Wideman et al., 2010)

Next Steps

- Demonstrate continuous drilling at 30 ft/h to 1000 ft
- Adjust parameters to work in air-filled boreholes
- Adapt process for less spallable rock
- Development of Well Enhancement through slotting
- Defined pathway to commercial products
  - Geothermal well enhancement
  - Exploratory drilling
  - Deep drilling for EGS

Acknowledgments

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