

4.4.1 Detecting Fractures Using Technology at High Temperatures and Depths - Geothermal Ultrasonic Fracture Imager (GUF1)

Presentation Number: 015

Investigator: Patterson, Doug (Baker Hughes Oilfield Operations Incorporated)

Objectives: To develop an ultrasonic borehole televiewer that can operate at temperatures as high as 300 °C and in depths as great as 10,000 m.

Average Overall Score: 3.3/4.0

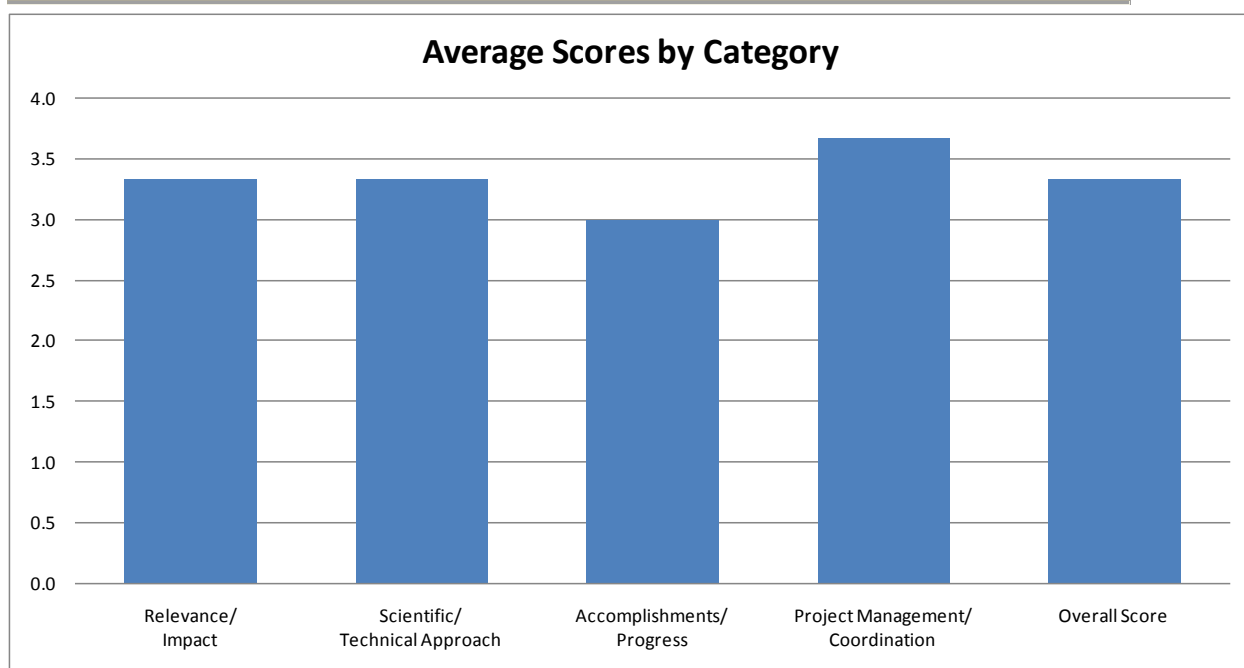


Figure 22: Detecting Fractures Using Technology at High Temperatures and Depths – Geothermal Ultrasonic Fracture Imager (GUF1)

4.4.1.1 Relevance/Impact of the Research

Ratings of Three-member Peer Review Panel: Outstanding (4), Good (3), Good (3)

Supporting comments:

- Knowledge of the size and location of fractures is extremely important in designing injector and/or producing zone placement. Visualization (by ultrasound) is one of the best ways to do this.
- Successful completion of this research would provide a tool for determining the location of fractures which is key to engineering or improving geothermal reservoirs.
- Success in developing EGS technology will depend on measuring the characteristics of fractures created in high-temperature rock formations. The proposed tool would contribute to that

understanding by identifying and measuring the width of fractures that intercept a borehole. This particular technology would not yield much information about fracture characteristics outside the borehole. However, some additional insight may be gained by comparing fracture detection data with data from different boreholes.

4.4.1.2 Scientific/Technical Approach

Ratings of Three-member Peer Review Panel: Outstanding (4), Good (3), Good (3)

Supporting comments:

- Ultrasonic imaging is probably the best way at present for visualizing fractures. The combination of external transducer / flasked electronics looks to have the best chance of success in the immediate future
- The research is focused on getting the sensing equipment to work at elevated temperatures and pressures similar to what one would encounter in a geothermal reservoir. Much of the work is being done in a lab, where sensitive equipment prohibits the simulation of actual well bore conditions -- things such as vibrations, salt concentration, lowering and raising the sensing equipment.
- The project begins by examining the basic issues, primarily the sensor material needed to survive the 300 °C contact with well bore fluids. Mechanical support of the sensor and electric connections at these temperatures also are critical. These components are tested separately, then together at the required temperature. Other system components can be protected from such high temperatures and will be upgraded later in the project. The principal investigator indicated during the presentation that pressure testing also will be accomplished, but was not clear where in the project timeline. In addition, this reviewer is concerned whether the various components will be subjected to simultaneous T and P conditions that would be found down-hole.

4.4.1.3 Accomplishments, Expected Outcomes and Progress

Ratings of Three-member Peer Review Panel: Good (3), Good (3), Good (3)

Supporting comments:

- Although it is in its relatively early days, the project appears to be on track. The project team is very experienced and they have access to good experimental facilities.
- This research appears to be on track.
- The research team seems to be well qualified, although little information on this subject was presented except for the degree levels of the researchers. The equipment and facilities used for work to date appear to be quite adequate. The progress, compared to cost expended is presented as being within the planning parameters. In general, the project seems to be about on track.

4.4.1.4 Project Management/Coordination

Ratings of Three-member Peer Review Panel: Outstanding (4), Outstanding (4), Good (3)

Supporting comments:

- The team has a good track record in the field. I liked the fact that they are already looking for field test facilities and partners. I also liked the idea that the televiewer is intended to be added to/integrated with an existing suite of logging tools (Nautilus Ultra). Although the rest of the tools do not yet have sufficient high-temperature capability this is obviously a future development target
- The presentation indicates a high level of cooperation.
- The project is well planned in terms of the phases, and a major decision point is identified at an appropriate place in the timeline.

4.4.1.5 Overall

Ratings of Three-member Peer Review Panel: Outstanding (4), Good (3), Good (3)

Supporting comments:

- Overall, a project directed to advancing our technology in an important field. The project has made good progress so far and the team has a good track record. I like the overall plan, looking ahead to integration with other instruments and towards field testing.
- This project appears to be a good investment.
- The early work appears to have met project milestones and to have achieved the desired results so far. If this project ultimately leads to a down-hole tool that can identify fracture intersections with boreholes in EGS systems, it should contribute successfully to the creation of high-temperature geothermal reservoirs for power production in impermeable igneous rocks.

4.4.1.6 PI Response

No response.