geoconvention
Calgary • Canada • May 15-17 2023

Distributed Acoustic Sensing Analysis in the FORGE Geothermal Case Study

Dr. Naimeh Riazi
University of Calgary

Summary

Geothermal resources are considered as one of main solutions to transit to a zero-emissions sustainable energy future. The continuous geophysical characterization using Fiber-optic distributed acoustic sensing (DAS) technique optimizes efficiency of fractured high temperature, high-pressure crystalline reservoir. The Utah Frontier Observatory for Research in Geothermal Energy (FORGE) site in Utah is a field laboratory which uses Enhanced Geothermal Systems (EGS) to develop and improve commercial power production on a large scale. FORGE provides a great opportunity for researchers to test ideas and methods with the open access repository of geothermal data.

The multi-stage horizontal well technology is used in EGS for the exploitation of geothermal resources from the low permeability rocks. Characterizing and monitoring of ESG due to high-temperature environments is not feasible by conventional methods. Fiber-optic distributed acoustic sensing (DAS) is a feasible and emerging tool to monitor microseismicity and induced seismicity during reservoir stimulation along hydraulic fracturing stimulations. DAS microseismic processing is applied in the selected FORGE dataset, including the application of various denoising techniques. The results of this study demonstrate that fiber-optic DAS analysis can improve deep geothermal reservoir characterization and imaging.

Introduction

The primary focus of the EGS Forge project is to develop a novel stimulation technology capable of efficiently generating engineered fractures in hot rock formations. The project aims to enhance the effectiveness and cost-efficiency of EGS systems, while also demonstrating their commercial feasibility. Ultimately, the EGS Forge project seeks to establish a reliable and affordable geothermal energy source that can power homes, businesses, and industries. Given its renewable nature and minimal greenhouse gas emissions, geothermal energy has the potential to play a vital role in reducing carbon emissions and mitigating the effects of climate change.

Distributed Acoustic Sensing (DAS) is valuable in geothermal energy because it can monitor fluid flow in subsurface reservoirs, locate and evaluate fractures, and track changes in the reservoir over time. By providing real-time information about geothermal systems, DAS technology can help operators optimize their production.

At the FORGE geothermal site, it is crucial to monitor microseismicity (-2 magnitude detection limits) in order to detect fractures that form during the injection of cold water. Pinpointing the location of these events accurately is important because these fractures will ultimately facilitate the process of generating geothermal energy by heating the injected water. The western Utah

region is prone to seismic activity caused by tectonic activity, so the advanced seismic network at Utah FORGE also monitors natural earthquake activity in the area. Figure 1 illustrates the seismic monitoring infrastructure at the FORGE site, which includes seismometers deployed to depths exceeding 3000 feet in vertical wells surrounding the bottom of the deviated injection well. Additionally, a geophone and accelerometer are permanently installed at the bottom of well 68-32, and well 78-32 is equipped with a distributed acoustic sensor (Moore et al , 2021&UTAHFORGE website).

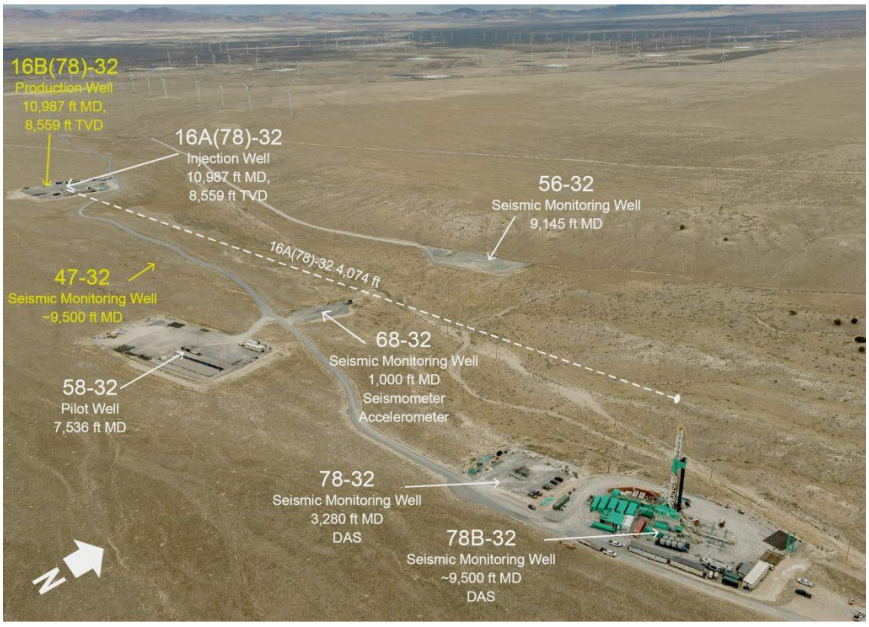

Figure 1. seismic monitoring infrastructure at the FORGE site (Moore et al 2021).

References

Moore, J., Simmons, S., McLennan, J., Pankow, K., Xing, P., Jones, C., Finnela, A., Wannamaker, P. and Podgorney, R., 2021. Current Activities at the Utah Frontier Observatory for Research in Geothermal Energy (FORGE): A Laboratory for Characterizing, Creating and Sustaining Enhanced Geothermal Systems. GRC Transactions, 45, pp.802-813.