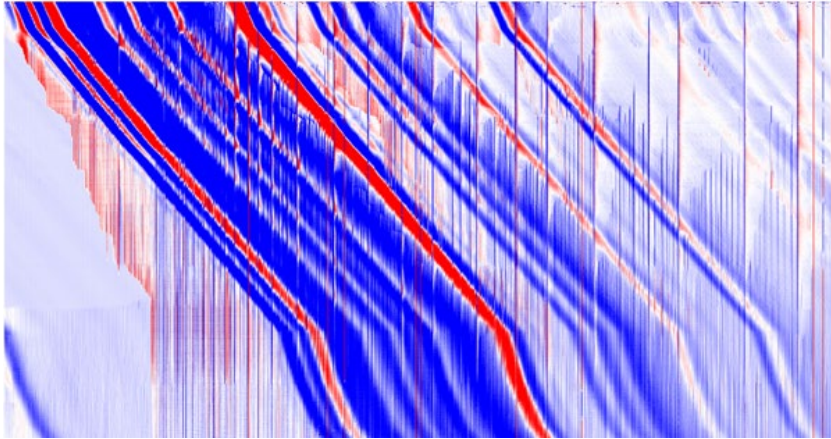


Turning Geothermal Injection Data into Results

High-Resolution DAS/DTS Confirms Targeted Reservoir Containment Across Multiple Cycles



DAS data enabled tracking injected fluid movement from the surface to the reservoir section.

Objectives

- Quantify the thermal response rate of geothermal reservoir intervals following injection through warm-back analysis.
- Optimize injection rates using step-rate testing and live downhole surveillance data.
- Use distributed acoustic sensing (DAS) and distributed temperature sensing (DTS) data to confirm injection distribution across perforated reservoir intervals, identify out-of-zone injection or crossflow, and assess well integrity.
- Characterize thermally induced fractures and reservoir behavior using high-resolution distributed temperature measurements.

Our Approach

- Planned an intervention-based capillary DAS/DTS fiber optic deployment by reviewing customer-provided well information and defining the surveillance requirements.
- Weatherford experts recommended the MARS™ Mature Asset Rejuvenation by Surveillance system, an advanced thru-tubing intervention and reservoir-intelligence system. Its unified sensors feature real-time DAS and DTS with complementary bottomhole (BHA) sensors for depth calibration and data correction.
- Confirmed well access using slickline intervention services before deploying fiber optics in the live geothermal producer.

LOCATION
Denmark

WELL TYPE
Geothermal

FORMATION

- Sedimentary rock
- Quartz-rich (arenite) gassum sandstone, fine-to-medium grained sandstone and minor shale interbeds
- Good porosity and permeability

PRODUCTS/SERVICES

- MARS system
- Slickline intervention services
- Capillary string services
- Casing collar locator
- Gamma ray sensor
- ProTherma pressure sensors
- ProTherma temperature sensors



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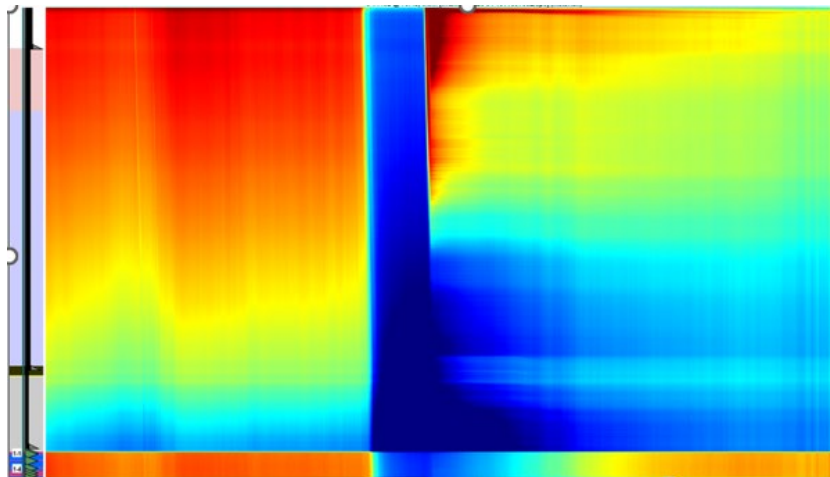
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Our Approach

- Acquired continuous real-time acoustic and temperature data from surface to total depth using single-mode and multimode fiber optic lines.
- Used bottomhole sensors deployed on the 1/4-in capillary DAS/DTS line, including a casing collar locator, gamma ray, ProTherma™ pressure sensors, and ProTherma™ temperature sensors.
- Combined Weatherford field surveillance expertise with capillary and slickline crews to execute the operation safely, collaboratively, and within operational requirements.

Value to Customer

- Completed a comprehensive one-week DAS/DTS survey across multiple cold- and hot-water injection cycles.
- Confirmed injection distribution along the target reservoir and verified that injected fluid remained confined within the intended interval.
- The one-week survey performance was faster than the time required for conventional noise logging and production logging tool deployment.
- Streamed MARS system data live to the customer's office for real-time analysis and decision-making.
- Provided a dataset that supported optimization of injection rates from the geothermal producing well to the downstream distribution plant, helping reduce cost and save time.
- Generated insight considered critical for optimizing existing wells and reservoirs and supporting the design of future geothermal wells.



DTS data illustrating hot- and cold-water injection cycles.

