GEOTHERMAL SERVICES

CGG

Supporting the transition to a lower-carbon future

Understand and de-risk geothermal prospects, from exploration to production, with multi-disciplinary geoscience data, technology and expertise.

CGG's dedicated Geothermal Science group offers worldwide, multi-disciplinary geoscience data, technology and expertise to understand and de-risk geothermal prospects, from exploration to production. With a track record of over 150 targeted projects and two global resource assessments over the last two decades, we leverage significant exploration experience to provide valuable intelligence in global data and analytics, resource assessment, multi-physics imaging reservoir characterization, production and monitoring.

Meet geothermal challenges with confidence, from exploration to production, with our comprehensive services and products:

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Data analytics	Global data integration, analytics and interpretation
Resource exploration and assessment	From global to prospect scale
Geothermal reservoir characterization	Characterization, reservoir monitoring and 3D and thermal modeling
Geothermal value chain analysis	Including combined heat and power, cascade use, and co-production of critical elements and fresh water
Multi-spectral satellite monitoring	Satellite surface deformation monitoring, mapping and spectral analysis
Geomechanics	Comprehensive well and geomechanical studies, drilling prognosis and drilling analysis
Multi-physics and seismic design	Imaging, inversion and interpretation
Repurposed seismic	Seismic noise reduction, integration, reprocessing of 2D and 3D data and quantitative interpretation and characterization of seismic for geothermal
Data transformation	Dedicated team of specialists skilled in machine-learning-enabled digitalization, extraction and classification
GeoVerse™ multi-client products	Including Global Geothermal Resource Assessment, Global Lithium in Geothermal Brines and Lithium and Geothermal in Oilfield Brines studies (in progress)
Seismic exploration and monitoring solutions	High-precision sensors, pressure/temperature gauges and distributed acoustic sensing (DAS) systems from Sercel

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Seismic information and machine learning for geothermal prospect evaluation

By integrating high-end seismic imaging technology within reservoir quantitative workflows, CGG provides detailed geothermal prospect evaluations that range from de-risking geothermal wells and production behavior using high-resolution fault area identification to improving geothermal quantitative interpretation in areas where reliable well information is limited or even absent.

CGG has a proven track record in providing this expertise in complex areas such as the Upper Rhine Graben in France where state-of-the-art survey design and data imaging have provided key information for the interpretation of fault networks in deep crystalline rocks and the construction of a structural model that informed new production well trajectories.

In sedimentary strata lacking well information and high-resolution seismic data, the use of deep neural networks driven by rock physics knowledge has demonstrated the value of re-using legacy seismic data with often limited coverage in estimating key reservoir properties. Such advanced neural networks were successfully applied to seismic data across a carbonate geothermal reservoir located in the Dogger formation north-east of Paris with the main objective of characterizing the extent of porous and permeable layers.
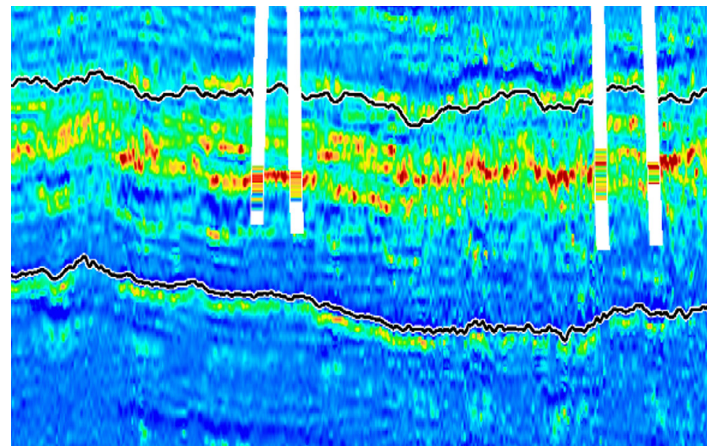

Geothermal reservoir seismic characterization with physics-guided deep neural networks (http://dx.doi.org/10.1190/tle40100751.1).

Rock physics data can be extracted and made analytics-ready using public and private digital and digitized well databases using our machine learning-enabled data transformation and classification capabilities. These data, along with multi-physics expertise, can then be used to classify and characterize existing and reprocessed seismic data for geothermal purposes.

Level up to 3D for complete geothermal Earth Modeling

Multiphysics Imaging brings together CGG's electromagnetics and gravity-magnetics software development and interpretation groups, a global team of geophysical and geological experts in data processing, depth inversion modeling and interpretation.

In-house algorithm and software development has produced the comprehensive range of industry-leading solutions—continuously maintained, upgraded and expanded—that drive both Multiphysics Imaging service projects and are licensed to companies and professionals across the Natural Resource E&P market.
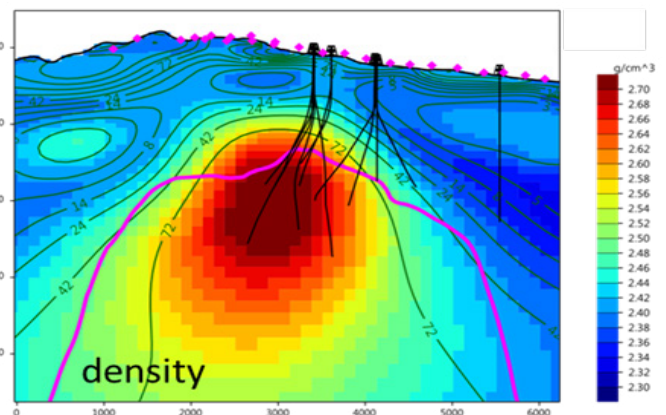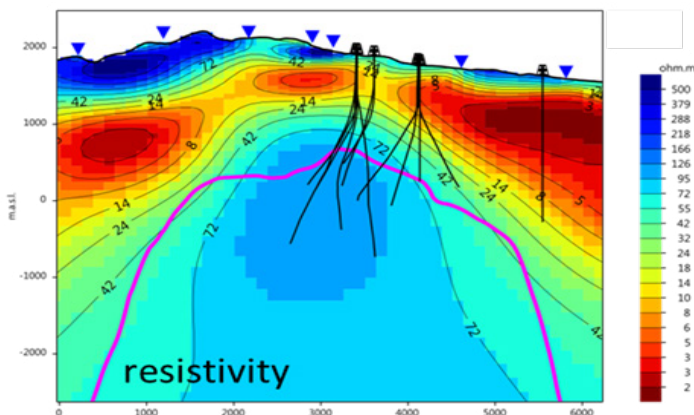
Generate high-quality 3D visualization of your reservoirs with our industry-leading interactive platform, Geotools.

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Sercel offers a comprehensive range of design and equipment solutions for the geothermal market

High-precision equipment is provided in both onshore and offshore environments, for better characterization, evaluation, and monitoring of geothermal stimulation and production, as well as stable technology solutions, products, and associated services, starting with design assistance and pilot survey execution to installation, maintenance, and upgrades of installed equipment.
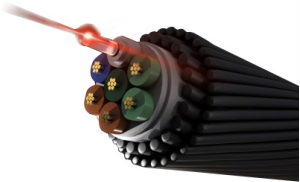
Variable business models allow adaptation to customer needs and project-specific requirements. Working with CGG and other partners provides options for integrated and turnkey solutions, unique in the industry.

WiNGNT
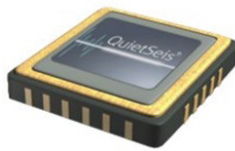
QuietSeis®

DAS

GeoWave® II

Sercel equipment for geothermal applications includes:

- Geophone-based **SlimWave** system—Slim diameter (43-mm OD) system with up to 24 three-component shuttles can be installed either on wireline or on tubing or behind the casing. The **SlimWave** system has industry-leading vector fidelity, sensitivity and field-proven reliability for short- and long-term installation and has been successfully used on many geothermal projects

- Geophone-based **GeoWave II** system—High-temperature, high-pressure system with up to 120 three-component shuttles installed either on wireline, on tubing or behind the casing. The **GeoWave II** system has industry-leading vector fidelity, sensitivity and field-proven reliability for short- and long-term installation for harsh environments

- **WiNG** nodal acquisition system. A fully integrated nodal land acquisition system designed with a single data collection platform to manage operations more easily and efficiently. This new nodal solution integrates Sercel's best performing and most sensitive broadband sensor ever, **QuietSeis®**, to acquire high-precision seismic data

- **Q-SERIES** pressure and temperature permanent gauges—Q-series gauges provide the most accurate and reliable surveillance, with Sercel-GRC's proprietary quartz transducer technology paired with a finely tuned oscillator circuit to offer superior accuracy, higher sensitivity, faster response and minimal drift over time

- **DAS** systems—Installed either on wireline, on tubing or behind the casing, this range of fit-for-purpose cables can be used for a variety of uses and installations, including options of enhanced sensitivity fibers. The systems are connected on the surface to industry-leading recording systems, allowing high-resolution, high-fidelity, real-time data stream with integrated quality control features

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SEE THINGS DIFFERENTLY

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