U.S. DEPARTMENT OF
ENERGY

Office of
ENERGY EFFICIENCY &
RENEWABLE ENERGY

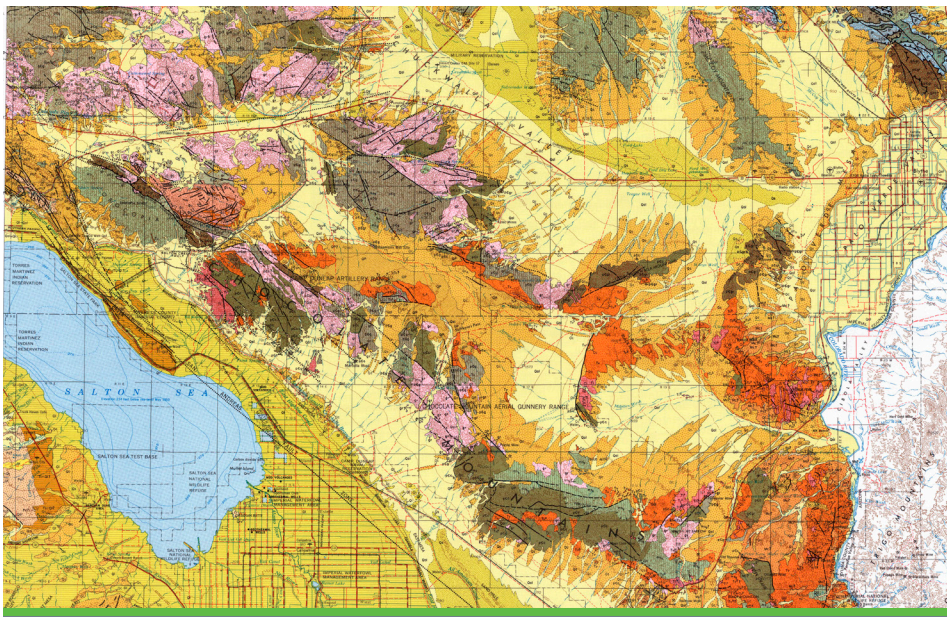
Identifying Geothermal Resources in Western United States

Using Aerial Surveys to Capture Critical Data to Support the Growth of Clean, Renewable Geothermal Energy

The U.S. Department of Energy's Geothermal Technologies Office (GTO) supports the transition to a clean energy economy by investing in projects, techniques, and tools to advance geothermal energy. GTO works in collaboration with national laboratories, federal agencies, state and local governments, and other partners to reduce risks and support the adoption of geothermal energy across the United States. According to U.S. Geological Survey (USGS) estimates, the western United States has more than 30 GWe of undiscovered conventional geothermal resources, which could power more than 20 million households. With little or no greenhouse gases and a very small environmental footprint, geothermal is already an important source of clean energy.

What Are Hydrothermal Resources?

Conventional hydrothermal resources, a type of geothermal resource, are reservoirs that naturally contain warm fluids or steam in porous and/or permeable rocks. Once brought to the surface, the geothermal fluid or steam can be used to generate electricity or used directly to heat homes and buildings. As a reliable, always-available power source, energy generated from geothermal resources can increase grid stability and reduce volatility, making it an important part of the diverse mix of clean energy sources.



Geologic map of Salton Sea region of California.
Credit: California Department of Conservation.

Where Are Geothermal Resources Found?

Geothermal energy is often found in the vicinity of geologic fault zones and may be evident at the surface as geysers or hot springs. In addition, naturally elevated heat flow is found across much of the western United States, including the Great Basin, making it a significant source of both identified and undiscovered geothermal resources. California and Nevada lead the nation in geothermal production, and there is significant untapped potential across the United States. Realizing this potential can help power many local communities and provide regional grid support.

How Do We Access Geothermal Energy?

Drilling wells is expensive—a single well, several thousand feet deep, can cost millions of dollars. A geothermal developer therefore needs to ensure a reasonable chance of success before committing to drilling a well. Gathering and analyzing geoscience data is a critical initial step. By doing so, researchers can better understand an area's geology and increase the chances of a successful well. Over the long term, lowering risk and improving drilling success for developers leads to greener, always-available geothermal energy for the community and region.

How is Geoscience Data Collected?

Geothermal reservoirs are largely undetectable above ground, but researchers have developed techniques to capture high-resolution data to identify areas with concealed geothermal resources and mineral deposits to support clean-energy production.

For example, high-resolution geophysical aeromagnetic surveys can be used to characterize surface and subsurface rock units and geologic structures by detecting and measuring anomalies in the Earth's magnetic field, which is affected by different rock formations.

Cessna-180 airplane specially modified for low-altitude geophysical surveys.
Photo credit: Michael Hobbs, EDCON-PRJ, Inc., Public domain.

Magnetometers are mounted on low-flying airplanes (or helicopters over rugged terrain) to measure distances and collect data on surface and near-surface geology. In coordination with the Federal Aviation Administration, experienced pilots fly in a grid pattern during daylight hours to collect data. Because the geophysical flights are conducted at lower altitudes, local communities are notified in advance about flight schedules.

Lidar, on the other hand, is a light detection and ranging remote sensing method used by researchers. This technique transmits laser pulses to determine distancing, which can be used to develop detailed 3D models of surface topography.

The surveys collect the naturally occurring physical properties of the area, and as such there are no long-term effects from the data collection. Such data acquisition and associated geologic modeling efforts have been conducted across the country, with the USGS working to collect and make available data for the entire nation in the coming years.

How Is Data Collected In Nevada and California?

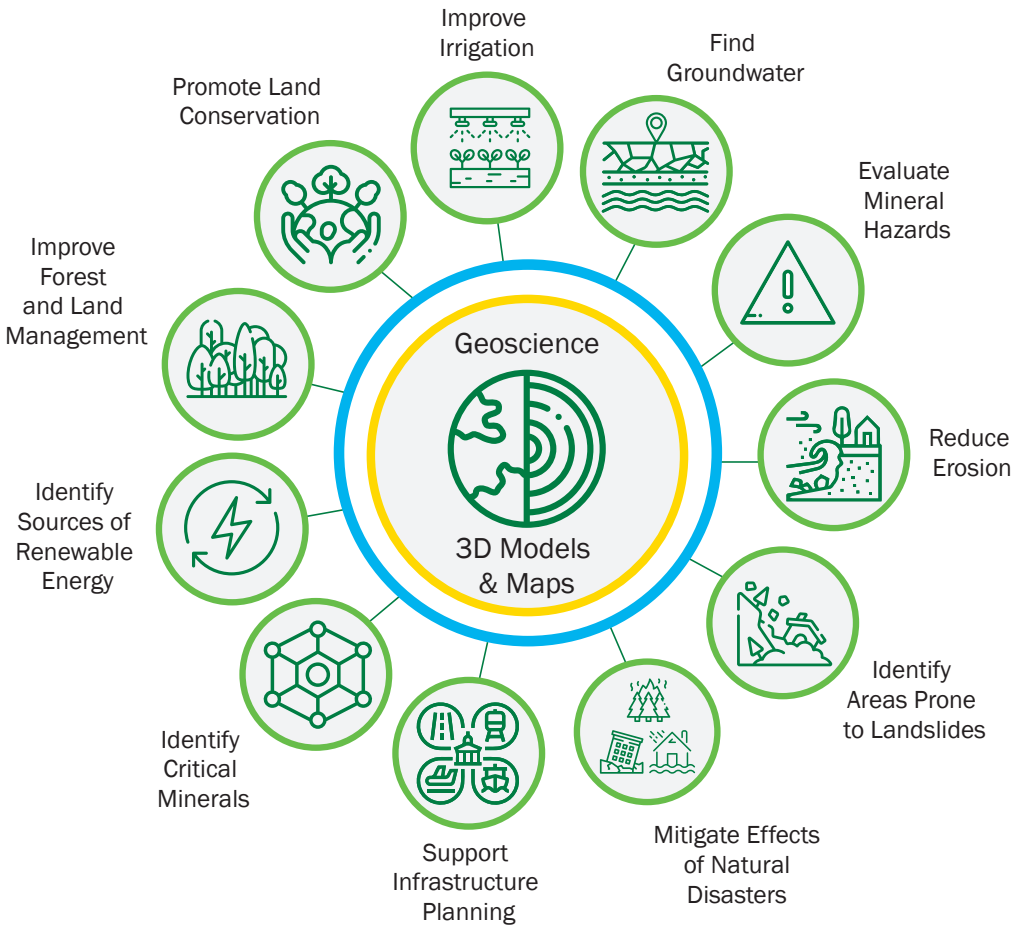
In western Nevada, the GeoDAWN (Geoscience Data Acquisition for Western Nevada) project, a joint effort between GTO, USGS, and other state and federal offices, collected airborne geophysical and lidar data for identifying undiscovered geothermal resources and critical mineral deposits. With sophisticated analysis, that data is also providing information about the origin and evolution of mineral, energy, and water resources, as well as geologic hazards.

Building off the success of GeoDAWN, GTO is planning to expand its efforts to other parts of the region. Future projects, such as GeoFlight: Salton Trough, will apply the techniques honed by GeoDAWN to the Salton Sea and other parts of southern California.

How Does Geoscience Data Benefit Your Community?

Though useful in geothermal energy development, this publicly available geoscience data has broad applications beyond geothermal. Your community can use the resulting 3D maps and models to characterize groundwater, improve irrigation, reduce erosion, identify areas prone to landslides, and evaluate mineral hazards such as asbestos and arsenic. Communities can also use the high-resolution natural resource data to mitigate the risks of natural disasters, like earthquakes, forest fires, and floods. Your community may even be able to use the data to support infrastructure and mineral resource planning, resulting in new job opportunities in a variety of fields. GTO aims to empower its stakeholders to use the data in any way that can benefit their communities. ■

The Many Uses of Geoscience Data



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