Geologic Hydrogen Research at Berkeley Lab

Earth & Environmental Sciences Area

BERKELEY LAB
EARTH & ENVIRONMENTAL SCIENCES

Experts at Berkeley Lab's Earth and Environmental Sciences Area are investigating ways to generate and store hydrogen underground— safely and affordably.

Energy opportunities through hydrogen geoscience

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Learn more

Hydrogen is a potent fuel that can be generated from water in ways that have low carbon emissions. The generation of hydrogen by the electrolysis of water, often called water splitting, could enable excess renewable energy to be stored as hydrogen at larger scales than batteries. The generation of hydrogen through a natural geologic process called serpentinization may provide a significant new energy resource that could be exploited or engineered. Our scientists are investigating how Earth systems can be managed to produce and store hydrogen for societal energy benefits. This fact sheet describes three compelling examples of our hydrogen geoscience research.

Accelerating reactions that generate geologic hydrogen

Geologic hydrogen generation occurs fastest in hot and deep environments that would be costly and commercially risky to access. Our scientists are studying methods to generate these reactions in cooler, shallower environments that would enable a huge volume of rock to be tapped for hydrogen production. They use quantum chemistry simulations and experiments to uncover mechanisms for accelerating hydrogen-producing reactions at these low temperatures, safely and affordably.

Highlighted Finding: Temperature may factor into pressure solution in a natural salt rock.

Manipulating rock fracture flow to extract geologic hydrogen

The successful engineering of geologic hydrogen production will require skillful approaches to introduce water into rock formations and enable water and hydrogen flow to the surface. Our scientists are developing fracture generation and flow approaches based on cyclic injection of fluids into geologic rock at different pressures, temperatures, and pH to control the extraction of hydrogen without inducing harmful seismicity.

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Highlighted Finding: Berkeley Lab scientists find that pore geometry and flow rate strongly influence the withdrawal of H2 from geologic environments.

Quantifying reactions for economical generation and storage

Many geologic and biologic processes could consume hydrogen following generation or storage. For example, microorganisms that are common in underground systems have the metabolic capacity to use hydrogen to gain energy for growth. Our scientists are seeking to develop the ability to predict the amount and rate of hydrogen consumption based on the chemical, mineral, and microbial composition of a subsurface system.

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Highlighted Finding: Berkeley Lab scientists found that changes in tension and compression on rocks can affect the velocity of and slow the rate of flux in a hydrocarbon reservoir in Kevin Done, Montana, helping to inform monitoring of fractured reservoirs.