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CHANGING WHAT'S POSSIBLE

Geologic Hydrogen (Topics G & H)

PROJECT DESCRIPTIONS

Los Alamos National Laboratory – Los Alamos, NM

Geochemical and Hydromechanical Stimulation for Reaction Acceleration (GeoHydRA) of Serpentinization for In Situ Hydrogen Production - $1,300,000

Los Alamos National Laboratory (LANL) is developing a method to increase the production rate of stimulated hydrogen through promoting hierarchical cracks in reactant rock formations. The technical approach includes laboratory experiments and numerical modeling to combine and couple geochemistry, geomechanics, fracture mechanics, and porous media flow. The proposed work would enhance the injection design and fluid chemistry to ensure that hydrogen production rates do not decrease quickly over time, as prior laboratory experiments and numerical modeling have suggested.

Colorado School of Mines – Golden, CO

Geophysical Characterization and Site-Scale Real-Time Monitoring in Stimulated Hydrogen - $1,500,000

The Colorado School of Mines is developing real-time, efficient, and economical characterization and monitoring methods. Conventional monitoring techniques are too slow, sparse, and ill-tailored for measuring the mineralogical changes that produce hydrogen. Real-time feedback would enable the adjustment of stimulation parameters critical for maintaining hydrogen generation rate, which can change over the course of hours.

Lawrence Livermore National Laboratory – Livermore, CA

Enhanced Hydrogen Production from Subsurface Mineral Deposits by Organic Acids and Catalyst Stimulation with Novel Optical Fiber Monitoring (Fiber-OACS) - $1,000,000

Lawrence Livermore National Laboratory (LLNL) is developing chemical stimulants to increase the rate of hydrogen production by accelerating the breakdown of minerals. LLNL is targeting short-chain organic acids that can both break down minerals while also recovering other critical minerals. The team is also evaluating whether other transition metals could catalyze geologic hydrogen production.

Koloma Labs – Dublin, OH

Enhanced Hydrogen Production: An Empirically Validated Modelling Approach - $900,000

Koloma Labs is developing geochemical and microbial models to understand the processes that form hydrogen in novel rock systems. A combination of geochemical, geo-mechanical, and fluid transport models paired with an investigation of naturally occurring microbiology in hydrogen reservoirs seeks to reveal the feasibility of the widespread stimulation of geologic hydrogen in different rock systems.

Lawrence Berkeley National Laboratory – Berkeley, CA

Orange Hydrogen from Catalytic Low Temperature Serpentinization - $1,240,000

Lawrence Berkley National Laboratory is developing methods to understand the chemical mechanisms responsible for stimulating geologic hydrogen at low temperatures. Serpentinization rates are faster at higher temperatures, but the natural environment in future hypothetical geologic hydrogen production sites would have lower temperatures, meaning that reaction rates would not be as economical. The team is leveraging computation and experimental chemistry to determine how catalysts or other chemical approaches affect the formation of geologic hydrogen in low temperature environments.

Massachusetts Institute of Technology – Cambridge, MA

Towards Efficient Geological Hydrogen Production: Rate Determination, Control and Reactor Development - $1,300,000

Massachusetts Institute of Technology (MIT) is developing a laboratory reactor that will test many parameters and variables for geologic hydrogen production, such as temperature, pressure, and fluid composition. MIT's customized reactor would utilize artificial intelligence, allowing for rapid screening of different parameters that can affect stimulated hydrogen. Since one of the largest hurdles in pioneering geologic hydrogen stimulation is the slow reaction rate between rock and water, the team will focus on identifying methods to increase the rates, yields, and user control over the reaction.

Texas Tech University – Lubbock, TX

Enhanced Hydrogen Production through Chemo-Bio-Physical Stimulations – with a View to Pilot Development - $1,620,000

Texas Tech University is characterizing rock samples from mining sites with diverse lithologies to develop the chemical, biological, and physical means to stimulate geologic hydrogen across different types of iron-containing rocks. Testing will include studying the effects of metal ion catalysts and the effectiveness of biological stimulation methods on increasing the reaction rates of hydrogen production. The team will optimize the chemical, biological, and physical stimulation of hydrogen-generating rocks to maximize geologic hydrogen stimulation.

Eden GeoPower – Somerville, MA

Electric-Based Mechanical & Thermal Stimulation to Increase Geologic Hydrogen Reaction Rates in the Samail Ophiolite, Oman - $900,000

Eden GeoPower is developing a way to apply their electrical reservoir stimulation techniques to increase geologic hydrogen production through testing their stimulation methods on peridotite core samples from multiple sites to be selected in the Samail Ophiolite in Oman. The company's electrical stimulation method could produce significant surface area enhancement while also increasing the local temperature to promote reaction conditions suitable for hydrogen production. Experimentally testing how peridotite rock types respond to electrical stimulation could support identifying the optimal conditions and geologic formations for stimulation.

39 Alpha Research – Tempe, AZ

Enabling the Discovery of H_2 Producing Systems with Large-scale Chemical Cartography - $1,569,500

39 Alpha Research is developing a water-rock-gas modeling product for users to determine the hydrogen potential of drill sites and recommended stimulation techniques. The models will aggregate results of water-rock-gas systems to aid in predicting geologic hydrogen potential from naturally occurring and laboratory water-rock-gas systems across a diverse range of compositions and reaction conditions. The technology would help tie together laboratory-scale models with future studies on rock formations.

University of Texas at Austin – Austin, TX

Sustainable H_2 Production from Abiotic Catalyst-Enhanced Stimulation of Iron-Rich Rocks - $1,700,000

The University of Texas at Austin is investigating effective and economical catalyst-enhanced reaction mechanisms to spur geologic hydrogen production. The team will analyze reaction catalysts that exist naturally in iron-rich rock, including nickel and platinum group elements, that could increase serpentinization reaction rates and lower the required reaction temperatures. The study will evaluate the most likely regions for geologic hydrogen production in North America, including mafic basalts in the Midcontinent Rift system, which have the potential to be a large source of geologic hydrogen.

New England Research – White River Junction, VT

Accelerated Mechanical Promotion (AMP) of Serpentinization for Hydrogen Production - $1,500,000

New England Research is developing a method for environmentally safe self-propagating fractures to stimulate geologic hydrogen. The team will monitor the creation of fracture networks and how fractures can propagate within a rock under a variety of physical or mechanical stimuli. Optimizing the self-propagating fractures can dramatically increase reaction rates in iron-rich host rocks to produce economic amounts of hydrogen.

Lawrence Berkeley National Laboratory – Berkeley, CA

Cyclic Injection for Commercial Seismic-Safe Geologic H_2 Production (CyclicGeoH_2) - $2,000,000

Lawrence Berkley National Laboratory is developing a cyclic injection strategy to create fractures, stimulate geologic hydrogen production, and ultimately transport the produced hydrogen back to the surface. The approach involves multiscale numerical modeling, laboratory tests, and field characterization to develop and test the proposed technology using rock samples from Montana and other sites. Through high pressure, high temperature testing, the system will be optimized for hydrogen flow and maximum extraction.

University of Southern California – Los Angeles, CA

Multiscale Characterization, Transport, and Mechanics for Enhanced H_2 Recovery and Reservoir Management - $1,000,000

The University of Southern California is developing geologic hydrogen production and extraction techniques by utilizing industrial oil and gas methods. The proposed technology would be a modified version of the Huff-n-Puff process, which is practiced for shale gas recovery. Multiple process scenarios would be used to optimize the generation, accumulation, and extraction of geologic hydrogen. Laboratory studies on rock cores would be explored over multiple length scales and modeling would be used to determine how large-scale reservoirs will interact with this production method.

University of Texas at Austin – Austin, TX

Foam-Assisted Enhanced Hydrogen Recovery (EHR) - $1,000,000

The University of Texas at Austin is developing a foam injection approach to extract geologic hydrogen. Conventional fluids like water or steam may present challenges for extracting hydrogen because of the insolubility of the hydrogen gas and bubbles being trapped. Instead, the injected foam sweeps, captures, and extracts clustered hydrogen bubbles from mineral surfaces to enable higher recovery efficiency and transport. The project team will design, synthesize, and characterize foam compositions for optimal stability and hydrogen uptake behavior in the reservoir.

Eden GeoPower – Somerville, MA

Engineered Geologic Hydrogen Battery for Long-Term Energy Storage - $500,000

Eden GeoPower is developing a subsurface battery technology that takes advantage of the reversible chemical reactions of iron in ubiquitous iron-rich geologic formations. The subsurface battery would operate as a long-duration energy storage solution by utilizing excess grid energy to reduce spent iron into usable iron for multiple cycles of hydrogen production.

Texas A&M Engineering Experiment Station – College Station, Texas

ULTRA-H_2: Reservoir Management of Natural Hydrogen from Ultramafic Rocks - $1,500,000

Texas A&M Engineering Experiment Station is developing a method using modeling and experimentation to determine the behavior of a large-scale geologic hydrogen reservoir based on laboratory-scale data. The proposed approach would combine established reservoir characterization, exploitation, and management methodologies. Using laboratory investigations of a range of temperatures, pressures, and chemicals associated with field site rock cores, the team will develop models that can predict how to maximize extracted geologic hydrogen and minimize losses.

New Mexico Institute of Mining and Technology – Socorro, NM

Subsurface Engineering Solutions and Management for Sustainable In-Situ Hydrogen Production and Economic Extraction - $1,200,000

New Mexico Institute of Mining and Technology is developing subsurface engineering approaches for geologic hydrogen reservoir management, including ways to mitigate the risk of induced seismicity and hydrogen leakage. In addition to conducting laboratory experiments to explore hydrogen generation rates and transport using steam, the team will test methods to minimize rock volume expansion and to identify ecological indicators of hydrogen leakage. These technologies could predict, model, and prevent harmful side effects associated with enhanced stimulation of hydrogen generating mineralogical processes.

Pennsylvania State University – University Park, PA

Developing an Integrated Technology for Subsurface Hydrogen Harvesting through Reservoir Creation and Management - $1,100,000

Pennsylvania State University is developing a method to extract hydrogen using carbon dioxide to deliver reactants to the subsurface and recover hydrogen. The approach would create a hydrogen reservoir by using carbon dioxide mineralization and would improve long-term hydrogen yield. The team will focus on controlling the hydrogen production from a geologic reservoir through carbon dioxide fracturing and mineralization to create or form new surfaces. Artificial reservoirs combined with biological stimulation could result in a unique and highly controlled system of geologic hydrogen management.