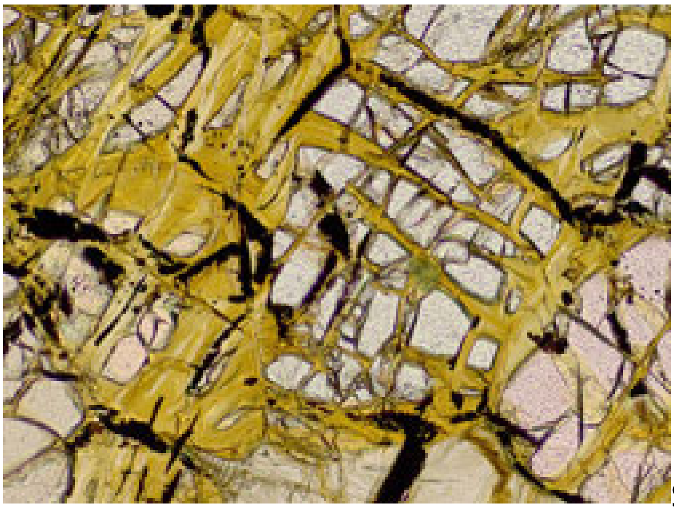
Scientists discover quick recipe for producing hydrogen

Scientists in Lyon, a French city famed for its cuisine, have discovered a quick-cook recipe for copious volumes of hydrogen (H_2).

The breakthrough suggests a better way of producing the hydrogen that propels rockets and energizes battery-like fuel cells. In a few decades, it could even help the world meet key energy needs—without carbon emissions contributing to the greenhouse effect and climate change.

It also has profound implications for the abundance and distribution of life, helping explain astonishingly widespread microbial communities that dine on hydrogen deep beneath the continents and seafloor.

Describing how to greatly speed up nature's process for producing hydrogen will be a highlight among many presentations by Deep Carbon Observatory (DCO) experts at the American Geophysical Union's annual Fall Meeting in San Francisco Dec. 9 to 13 (for DCO scientist presentations at AGU [1]).

Muriel Andreani, Isabelle Daniel, and Marion Pollet-Villard of Univ. Claude Bernard Lyon discovered the quick recipe for producing hydrogen:

In a microscopic high-pressure cooker called a diamond anvil cell (within a tiny space about as wide as a pencil lead), combine ingredients: aluminum oxide, water, and the mineral olivine. Set at 200 to 300 C and 2 kilobars pressure—comparable to conditions found at twice the depth of the deepest ocean. Cook for 24 hours. And voilà.

Daniel explains that when water meets the ubiquitous mineral olivine under pressure, the rock reacts with oxygen (O) atoms from the H_2O, transforming olivine into another mineral, serpentine—characterized by a scaly, green-brown surface appearance like snake skin. The process also leaves hydrogen (H_2) molecules divorced from their marriage with oxygen atoms in water.

Finding the reaction completed in the micro space overnight instead of over months as expected left the scientists amazed. The experiments produced H_2 some 7 to 50 times faster than the natural "serpentinization" of olivine.

Says Jesse Ausubel of The Rockefeller Univ. and a DCO founder: "Scaling this up to meet global energy needs in a carbon-free way would probably require 50 years. But a growing market for hydrogen in fuel cells could help pull the process into the market."

Adds Dr. Daniel, until now it has been a scientific mystery how the rock + water + pressure formula produces enough hydrogen to support such an abundance of chemical-loving microbial and other forms of life abounding in the hostile environments of the deep.

"We believe the serpentinization process may be underway on many planetary bodies—notably Mars."

Meanwhile, the genetic makeup of Earth's deep microbial life is being revealed through DCO research underway by Matt Schrenk of Michigan State Univ. and many other associates.

At AGU, they will report the results of deep sampling from opposite sides of the world, revealing enigmatic evidence of a deep subterranean microbe network.

Says Dr. Schrenk: "It is easy to understand how birds or fish might be similar oceans apart, but it challenges the imagination to think of nearly identical microbes 16,000 km apart from each other in the cracks of hard rock at extreme depths, pressures, and temperatures."

Among other major AGU presentations, DCO investigators will introduce a new model that offers new insights into water / rock interactions at extreme pressures 150 km or more below surface, well into Earth's upper mantle. To now, most models have been limited to 15 km, one-tenth the depth.

Dr. Dimitri Sverjensky's work, accepted for publication by the Elsevier journal Geochimica et Cosmochimica Acta, is expected to revolutionize understanding of deep Earth water chemistry and its impacts on subsurface processes as diverse as diamond formation; hydrogen accumulation; the transport of diverse carbon-, nitrogen- and sulfur-laden species in the mantle; serpentinization; mantle degassing; and the origin of Earth's atmosphere.

The $500 million global DCO collaboration is led by Dr. Robert Hazen, a Senior Staff Scientist at the Carnegie Institution of Washington.

Says Hazen: "Bringing together experts in microbes, volcanoes, the micro-structure of rocks and minerals, fluid movements, and more is novel. Typically these experts don’t connect with each other. Integrating such diversity in a single scientific endeavor is producing insights unavailable until the DCO.”

Source: Deep Carbon Observatory [2]

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