That CO2 warming the world -- lock it in a rock

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Sometime next month, on the steaming fringes of an Icelandic volcano, an international team of scientists will begin pumping "seltzer water" into a deep hole, producing a brew that will lock away carbon dioxide forever.

Chemically disposing of CO2, the chief greenhouse gas blamed for global warming, is a kind of 21st-century alchemy that researchers and governments have hoped for to slow or halt climate change.

The American and Icelandic designers of the "CarbFix" experiment will be capitalizing on a feature of the basalt rock underpinning 90 percent of Iceland: It is a highly reactive material that will combine its calcium with a carbon dioxide solution to form limestone -- permanent, harmless limestone.

The researchers caution that their upcoming 6-to-12-month test could fall short of expectations, and warn against looking for a climate "fix" from CarbFix any year soon.

In fact, one of the objectives of the project, whose main sponsors are Reykjavik's city-owned utility and U.S. and Icelandic universities, is to train young scientists for years of work to come.

A scientific overseer of CarbFix -- the man, as it happens, who also is credited with coining the term "global warming" four decades ago -- says the world's failure to heed those early warnings, to rein in greenhouse-gas emissions from coal, gasoline and other fossil fuels, is driving scientists to drastic approaches.

"Whether we do it in the next 50 years, or the 50 years after that, we're going to have to store carbon dioxide," Columbia University's Wallace S. Broecker said in an interview in New York.

The world is already storing some carbon dioxide. As a byproduct of Norway's natural gas production, for example, it is being pumped into a sandstone reservoir beneath the North Sea.

But people worry that such stowed-away gas could someday escape, while carbon dioxide transformed into stone would not.

The experimental transformation will take place below the dramatic landscape of this place 29 kilometers (18 miles) southeast of Reykjavik, Iceland's capital. On an undulating, mossy moor and surrounding volcanic hills, where the last eruption occurred 2,000 years ago, Reykjavik Energy operates a huge, 5-year-old geothermal power plant, drawing on 30 wells tapping into the superheated steam below, steam laden with carbon dioxide and hydrogen sulfide.

CarbFix will first separate out those two gases, and the CO2 will be piped 3 kilometers (2 miles) to the injection well, to combine with water pumped from elsewhere.

That carbonated water -- seltzer -- will be injected down the well, where the pressure of the pumped water, by a depth of 500 meters (1,600 feet), will completely dissolve the CO2 bubbles, forming carbonic acid.

"The acid's very corrosive, so it starts to attack the rocks," explained University of Iceland geologist Sigurdur Reynir Gislason, CarbFix's chief scientist.

The basalt rock -- ancient lava flows -- is porous, up to 30 percent open space filled with water. The carbonic acid will be pushed out into those pores, and over time will react with the basalt's calcium to form calcium carbonate, or limestone.

CarbFix's designers, in effect, are radically speeding up the natural process called weathering, in which weak carbonic acid in rainwater transforms rock minerals over geologic time scales.

The CarbFix team, beginning work in 2007, had to overcome engineering challenges, particularly in the inventive design and operation of the gas separation plant. They have applied for U.S. and Icelandic patents for that and for the injection well technique.

They plan to inject up to 2,000 tons of carbon dioxide over 6 to 12 months and then follow how far the solution is spreading via tracer elements and monitoring wells. Eventually they plan to drill into the rock to take a core sampling.

"It will take months and years to test how well it has spread," Reykjavik Energy's Bergur Sigfusson, project technical manager, said as he guided two AP journalists through the step-by-step process over the rolling green terrain of the Hengill volcano.

The team's greatest concern is that carbon "mineralization" may happen too quickly.

"If it reacts too fast, then that will clog up the system," Sigfusson explained. Quick formation of calcium carbonate would block too many paths through the basalt for the solution to spread.

If it works on a large scale, scientists say, carbon mineralization has a limitless potential, since huge basalt deposits are common -- in Siberia, India, Brazil and elsewhere. One formation lies beneath the U.S. northwest, where the U.S. Pacific Northwest National Laboratory plans an experiment similar to CarbFix.

The long-term challenge then becomes capturing the carbon dioxide, and building the infrastructure to deliver it to the right places.

At a basic level, the CarbFix process might at least allow geothermal plants worldwide to neutralize their carbon emissions. At another level, "you'd line up the coal-fired power plants where the basalt is," said Gislason. Their CO2 then could be locked away permanently as rock, rather than stored in underground cavities as now generally conceived.

But ultimately "my vision for carbon capture and storage is offshore, below the sea. The whole ocean floor is basalt below the sediments," said Swiss geochemist and CarbFix manager Juerg Matter, who works with Broecker at Columbia's Lamont-Doherty Earth Observatory.

That futuristic vision would likely require technology to take carbon dioxide from the atmosphere itself -- perhaps via millions of chemically treated vanes standing in the wind, a technique being investigated. Such units could be located offshore, with the captured CO2 piped to basalt below, Matter said.

In Gislason's Reykjavik university laboratories, young scientists are already conducting experiments with seawater and basalt, "and they're very promising," the chief scientist said.

"In 10, 20, 30 years' time, if climate change gets very drastic, then we are going to need solutions like this," he said of CarbFix. "We are going to need solutions 'yesterday.'"

Reykjavik Energy has supplied almost half the $10 million spent thus far on CarbFix. Other funding comes from the two universities, France's National Center of Scientific Research, the U.S. Energy Department, the European Union and Scandinavian sources.