Supercritical CO2 boosts super optimism in sequestering greenhouse gas

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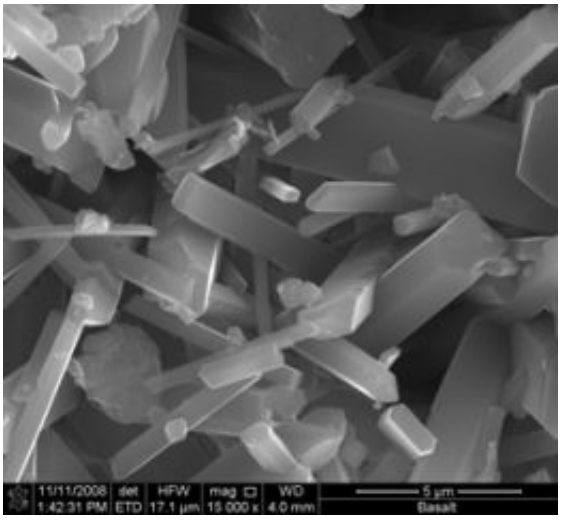

Shafts of calcite mineral grow rapidly on basalt after exposure to supercritical CO2 for 30 days. Use of dual beam focused ion beam scanning electron microscopy at the Environmental Molecular Sciences Laboratory helped capture the formation of the calcite. Image: PNNL

(PhysOrg.com) -- Scientists appear to have the rock-solid evidence that suggests carbon dioxide can be safely and permanently sequestered in deep, underground basalt rock formations, without risk of it eventually escaping to the atmosphere. The findings have potential implications for sequestering carbon in other reservoir systems as well.

Researchers at the Department of Energy's Pacific Northwest National

Laboratory have discovered key factors that show water-saturated liquid CO2, under conditions mimicking deep geologic settings, will plug cracks within the rock that otherwise might allow the hazardous greenhouse gas to escape.

"The implications of this discovery are far reaching," said PNNL scientist Pete McGrail. "Sufficient molecular water is apparently present in the supercritical CO2 phase to carry out multi-step reactions directly with minerals in the basalt. In essence, the carbon dioxide can self-seal undetected cracks or fissures that might allow the CO2 to migrate vertically to shallower depths."

Recently, McGrail exposed samples of basalt rock under high pressure to the two phases of CO2 that would exist after injecting it deep underground. The two phases include CO2-saturated water and water-saturated liquid CO2 or CO2 gas in a supercritical phase. Previous tests exposed basalt to CO2-saturated water, which forms over time as injected CO2 interacts with existing water in the porous and permeable basalt layers. However, these previous experiments ignored reactions to rock samples exposed to CO2 in a supercritical phase, which is dehydrated for transport by pipeline, but will absorb water from the surrounding basalt formation after injection.

McGrail presents his findings Tuesday, Nov. 18, at the 9th International Conference on Greenhouse Gas Technologies.

Scientists hoped the experiments would shed light on how both forms of CO2 might react with minerals found in the layers of basalt thousands of feet below the earth's surface, and if it would impact the speed in which the CO2 mineralized, thus affecting its stability.

McGrail's research, funded by the Department of Energy's Office of Fossil Energy and National Energy Technology Laboratory, revealed that

water-saturated liquid CO2 - CO2 gas in a supercritical phase - showed similar or even greater reactivity than observed for CO2-saturated water. The swift chemical reaction detected on metal and oxide surfaces, as well as the silicate surfaces found in basalt rock, were surprising and impressive according to McGrail.

Current reservoir simulation tools are quite sophisticated in their ability to model complex sets of heterogeneous reactions in aqueous media, but are presently incapable of treating similar reactions in the liquid or supercritical CO2 phase itself. McGrail suggests a need for development of significant new modeling capabilities to analyze the chemical reactivity of water dissolved in the dense CO2 phase.

"Although these initial experiments focused on basalt, the principles are not unique to basalts and would apply generally to other reservoir systems and caprocks," McGrail said.

He also noted that pilot-scale field injections will help validate these bench-scale findings.

Provided by PNNL