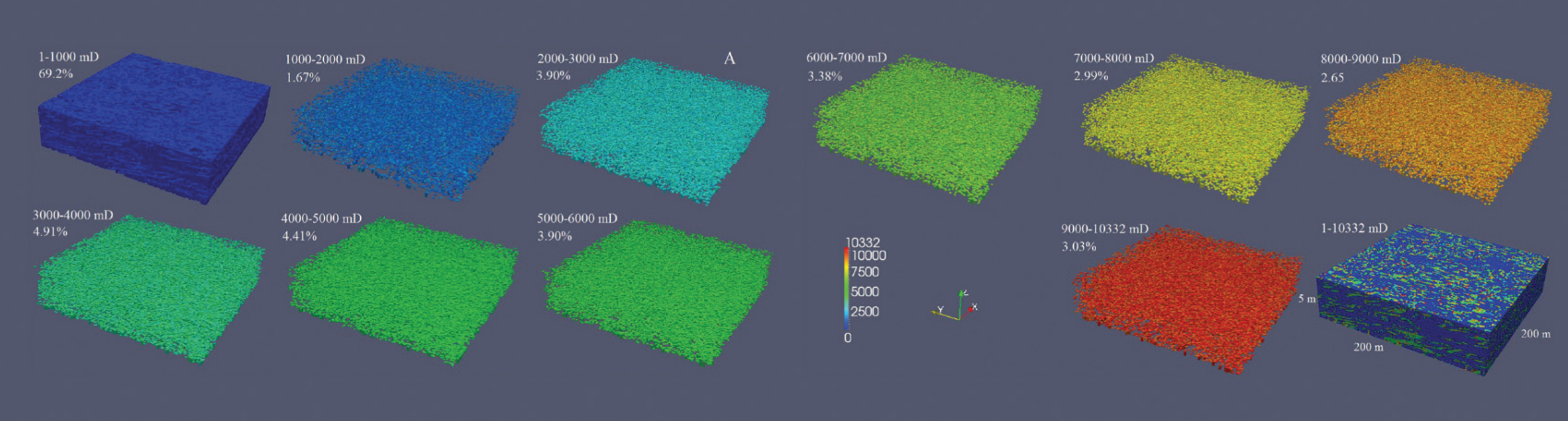

Carbon Injection

Ritzi, Gershenzon analyze safety of underground CO_2 sequestration

The Department of Energy supports pilot projects and basic research that evaluate the feasibility of capturing carbon dioxide created by industrial processes and power plants and injecting it into deep geologic formations for permanent storage, known as geo-sequestration.

This is part of evaluating strategies for reducing atmospheric emissions and mitigating accumulation of greenhouse gasses.

Robert Ritzi, Ph.D., Naum Gershenzon, Ph.D., and David Dominic, Ph.D., from Wright State University are studying the movement of CO_2 in the earth's subsurface to help inform this process for the Department of Energy and environmental industries.

In geo-sequestration, CO_2 is injected into underground reservoirs as a supercritical fluid, a substance with pressure and temperature above the liquid and gas phase separation point. After injection, it rises under buoyant forces. At the top of most reservoirs where CO_2 injection occurs is an impermeable seal or cap rock, which traps CO_2 until it dissolves or mineralizes. The integrity of the seal could be compromised by an undetected fault or fracture in the cap rock, so industry professionals look for additional mechanisms for trapping the CO_2. A number of candidate CO_2 reservoirs comprise sedimentary rock laid down by ancient rivers.

"It's not a new idea, but there is need for scientific qualification—what happens," Gershenzon said. "We want to be sure that this CO_2 will never affect groundwater and never goes back into the atmosphere."

Through three-dimensional models and flow simulations run through the Ohio Supercomputer Center, the researchers are showing that differences in the size of grains within this type of sedimentary rock cause capillary trapping of the CO_2 before it ever reaches the cap rock, providing added insurance that the CO_2 is permanently stored.

"What our research is showing is that the plume is being almost entirely, if not entirely, trapped by this residual trapping process in the reservoir, and the carbon dioxide is getting trapped even before it makes it to the seal, so that's a good thing," Ritzi said.

Their research has relevance in other areas. Facing an incessant demand for oil, the United States has recovered much of its easily accessible with traditional gravity drainage methods. To extract more oil, water and CO_2 are injected into oil reservoirs to sweep oil to the production well, in a process known as enhanced oil recovery, or EOR. The Wright State reservoir simulations are illuminating how formations in sedimentary rock affect flow patterns during EOR, providing insight into optimal strategies for improving oil recovery. A CO_2 sweep could end by leaving the injected CO_2 underground for permanent storage. •

(Above) Hydraulic properties of reservoirs vary with different sediment types and have highly non-linear relationships with the amount of water and oil saturation, requiring high performance computing to help solve the problem.

Project Lead: Robert Ritzi, Ph.D., Wright State University
Research Title: High performance computing to understand multiphase flow and capillary trapping processes in multiscaled and hierarchical sedimentary reservoirs
Funding Source: U.S. Department of Energy
Website: wright.edu/~robert.ritzi/research.html