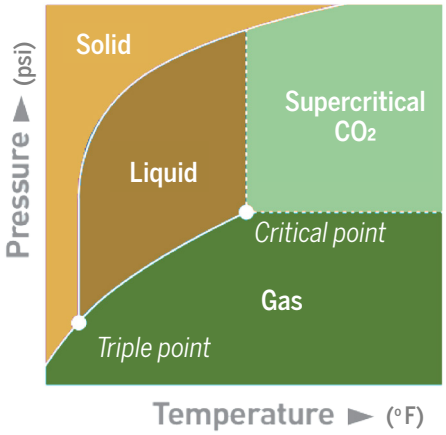
How is CO_2 stored in a geologic carbon storage system?

Critical temperature and pressure

CO_2 supercritical state

In a geological carbon storage system, CO_2 needs to be injected in a supercritical state, as this is the state it will be stored in in the storage reservoir. Supercritical CO_2 is a carbon dioxide held at or above its critical temperature (87.8 °F) and critical pressure (1070 PSI), also known as its critical point. In this state, CO_2 has properties of both a gas and a liquid. It is dense like a liquid but has the viscosity of a gas. This allows the CO_2 to take up less volume and flow more efficiently, which is beneficial for both transportation and storage (NETL, n.d.).



Phase diagram for CO_2.

Physical and chemical trapping

Trapping mechanisms

Physical and chemical trapping mechanisms can occur in the reservoir to securely store CO_2. The physical trapping mechanisms are structural and residual, and the chemical mechanisms are dissolution (or solubility) and mineral trapping (NETL, n.d.).

DID YOU KNOW?

Carbonic acid, H_2CO_3—the same weak acid created by dissolving CO_2 into saline reservoir water—is used in carbonated soft drinks. Once the bottle or can is opened, the pressure decreases and the H_2CO_3 decomposes, releasing CO_2 and making the drink fizz.

- **Structural trapping:** This occurs when the CO_2 is pumped into a reservoir and prevented from migrating upward by a seal or caprock (the same mechanism that keeps oil and gas contained underground).
- **Residual trapping:** This occurs when the CO_2 remains trapped in the pore space by capillary forces.

CURRENT SITUATION

Indiana is one of the top emitters of carbon dioxide (CO_2) in the country. Elevated levels of CO_2 in the atmosphere lead to changes in the Earth's climate. One practice being explored to help reduce CO_2 emissions is carbon sequestration. Geologic carbon sequestration is the process of capturing and storing CO_2 in underground rock formations. The publication "Carbon Sequestration in Indiana—a Brief Overview" in Vol. 7 of the *Indiana Journal of Earth Sciences* addresses many different aspects of carbon sequestration such as the necessary requirements, regulatory oversight, and the potential risks. The purpose of this document is to further explain some of the technical details of topics mentioned in the publication.

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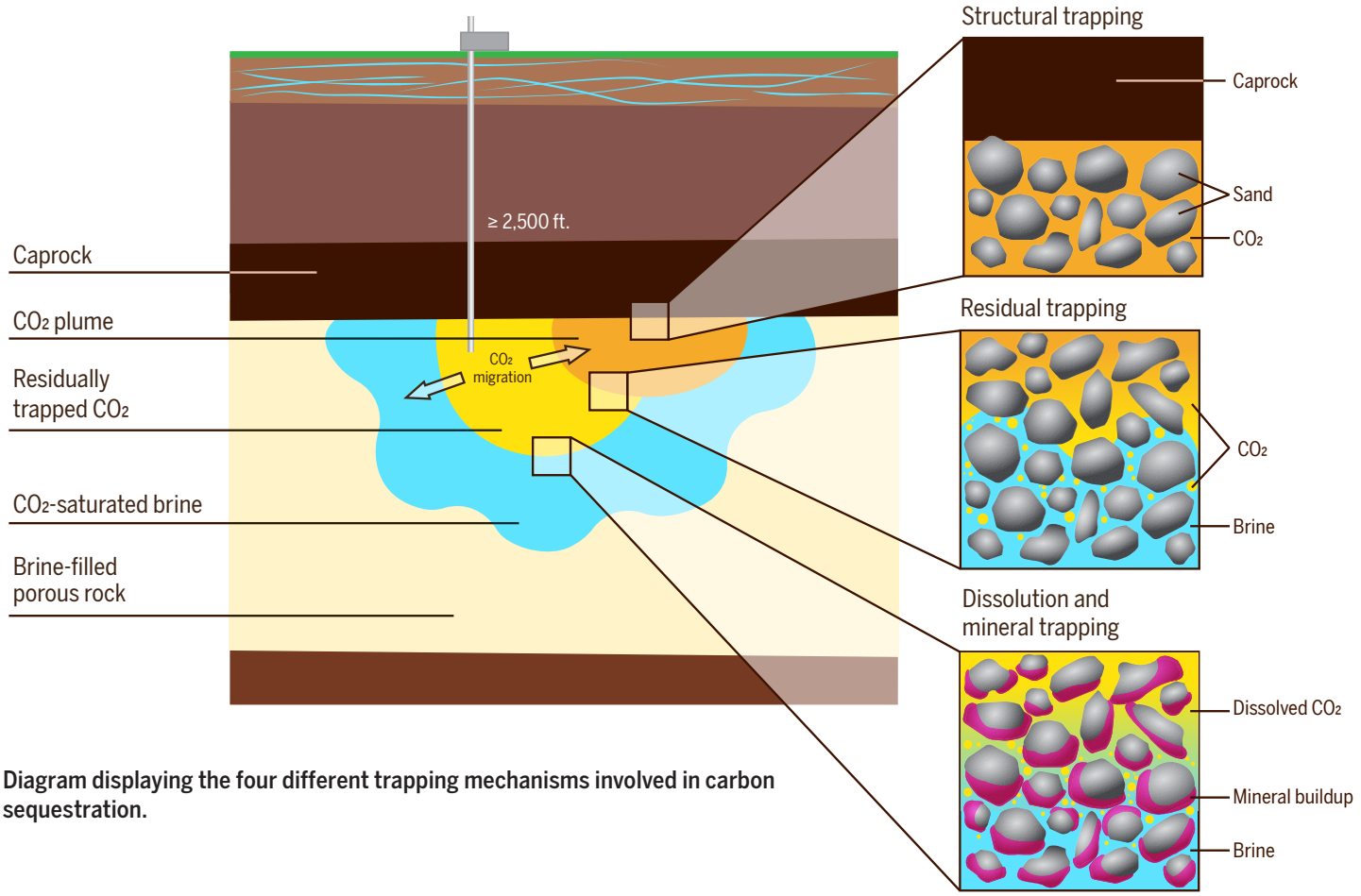

Diagram displaying the four different trapping mechanisms involved in carbon sequestration.

- **Dissolution/solubility trapping:** Over time, the CO_2 begins to dissolve into saline water in the reservoir.
- **Mineral trapping:** Once the CO_2 is dissolved into the saline reservoir water, it forms a weak acid (carbonic acid, H_2CO_3) and reacts with the surrounding rock, increasing the mineral saturation of the brine. Eventually, supersaturation will be reached and new carbonate minerals such as calcite, siderite, and dawsonite will precipitate out (Xu and others, 2003).

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