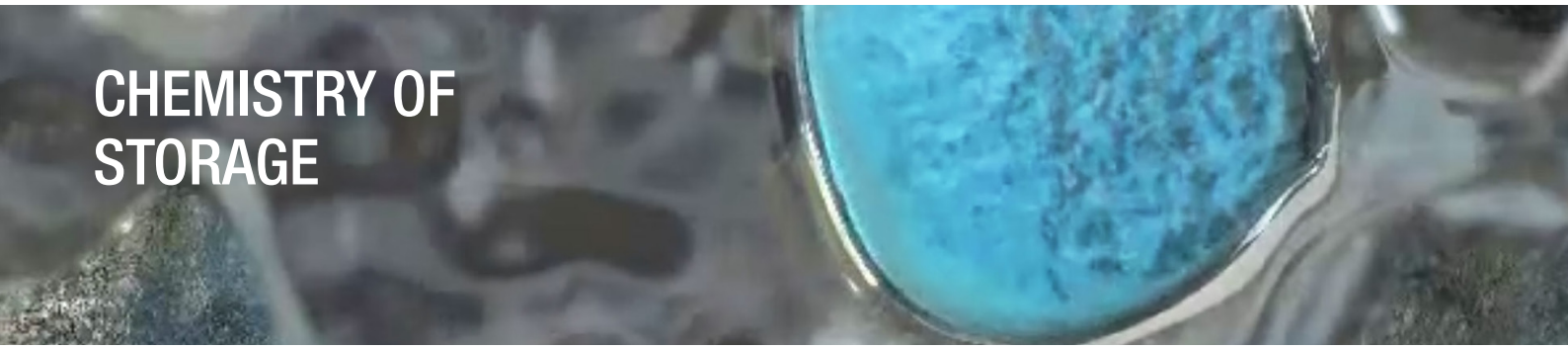


CHEMISTRY OF STORAGE

CO_2 is not dissolved in formation water immediately after it is injected. As it is supercritical, it is less dense than the formation water and so it rises upwards. There are several mechanisms that can ensure the gas is permanently stored.

Residual trapping

The CO_2 plume migrates with the formation waters which generally have low flow velocities (typically less than 10 cm/year). At the tail of the CO_2 plume, the concentration of the CO_2 falls and it becomes trapped by capillary pressure from the water in the pore spaces between the rock. Over time, this residually trapped CO_2 can dissolve into the formation water.

Solubility trapping

The solubility of CO_2 in water increases with increasing pressure and decreases with increasing temperature

and increasing water salinity. As some CO_2 dissolves in water, the water becomes denser, and begins to sink

downwards. This leads to convective mixing of the formation water with the CO_2, increasing the amount of CO_2

dissolved in the formation water.

Aqueous CO_2 will form carbonic acid, a weak acid, in the reaction

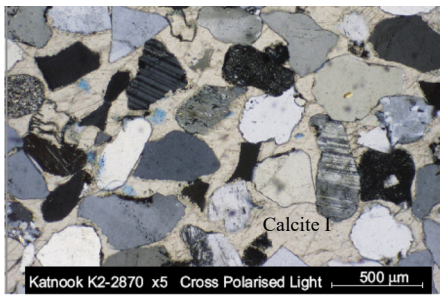
$$CO_2 + H_2O \leftrightarrow H_2CO_3 \leftrightarrow HCO_{3^-} + H^+ \leftrightarrow CO_{2^-} + {}_2H^+$$

This is the reaction that occurs in carbonated soft drinks and soda water.

Mineral trapping

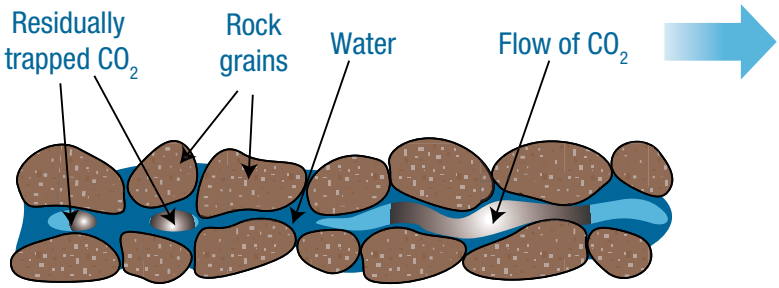
When dissolved CO_2 reacts with the reservoir rock, carbonate minerals can form and precipitate, trapping CO_2 in the most stable form. While there is some reaction in the early years of storage, the time line for this trapping mechanism is generally over thousands of years. The potential to form these minerals depends on the composition of the reservoir rock (eg the presence of aluminosilicates), the temperature and pressure of the rock, the chemical composition of the water, the water/rock contact area and the rate of fluid flow through the rock.

One mineral which can be formed is calcite (calcium carbonate) in the following reaction:



$$CaAl_2Si_2O_8 + H_2O + CO_2 \rightarrow CaCO_3 + Al_2Si_2O_5(OH)_4$$

(anorthite) (calcite) (kaolinite)



The tail of the carbon dioxide plume is snapped off and trapped residually

CO2CRC Limited
11 – 15 Argyle Place South
Carlton VIC 3053 Australia
+61 3 8595 9600
info@co2crc.com.au
www.co2crc.com.au
@CCS_Research

Last updated 22 July 2020