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Geochemical characterization of the Coda Terminal CO_2 storage site, Iceland

Martin Voigt and **Iwona Galeczka**
Carbfix, Iceland (Iwona.Monika.Galeczka@carbfix.com)

The Carbfix methodology has been demonstrated to be a safe and cost-effective approach to reduce the carbon dioxide (CO_2) emission into the atmosphere. The 2012 pilot study proved that 95% of the CO2 that was initially injected mineralized mainly as calcium carbonate in the shallow reservoir at 20-50 °C in less than two years. Followed by its successful outcome, the Carbfix methodology has been a foundation for many scaled-up CO_2 mineralization projects, e.g., the Coda Terminal, a cross-border carbon transport and storage hub in Iceland. The value chain of CO_2 includes: 1) capturing at industrial sites in Europe, 2) shipping to the Terminal in Iceland, 3) offloading and conditioning, 4) injection through a network of wells into the basaltic bedrock for subsequent 5) subsurface mineral storage. The Coda Terminal injections will be scaled-up stepwise, with a full annual injection capacity of 3 $MtCO_2$.

Several wells of varying depth have been drilled to explore and characterize the subsurface at the Coda Terminal storage site. The water collected from these wells show variable composition depending on their depth and location. Currently, the water from the main feed zone close to shore is saline with a conductivity of about 40000 µS/cm and a pH of about 8.4. In contrast, a well further away from shore shows low conductivity of about 100 µS/cm and is relatively alkaline (pH of 10.9). Shallow water supply wells are tapping the uppermost part of the Coda groundwater body with a conductivity of 100 µS/cm and a pH of about 9.0. The CO_2 concentration in these wells is within the range seen in groundwater in Iceland. The water in Coda reservoir shows no contamination of chosen halogen-containing alkanes and alkenes, aromatic carbohydrates, organic pesticides, and PAH. All are below the detection limit of the analytical methods used.

The results of the reaction path models carried out to assess the potential of CO_2 mineralization in Coda storage reservoir show that the predicted water chemical compositions and secondary mineralogies are similar to what has previously been observed during basalt weathering and its low temperature alteration. Mixing of the CO_2 injection water and the chemically variable reservoir water does not affect the overall chemical and mineralogical trends and mineralization efficiencies. The results of the simulations confirm high CO_2 mineralization potential with up to 100% of the injected CO_2 mineralized as calcite. However, the spatial and temporal evolution of this process has not been assessed in these models.