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Subsurface CO_2 mineral storage in the Patardzueli Basin, Georgia

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To address the need for large-scale, secure, and local carbon sequestration solutions in Eastern Europe and Central Asia, a mineral carbon storage pilot program was initiated by Block Energy in the Patardzeuli Basin, Georgia. This former petroleum reservoir, extending approximately 24 km by 4 km, offers a significant geological target for mineralization. The mineral carbon storage capacity within the Middle Eocene volcanoclastic rocks of the Patardzeuli Basin is estimated at 43 to 182 million tons of CO_2, while the broader Georgian Katari Basin presents a theoretical capacity ranging from 2 to 8.7 gigatons.

As a first step toward unlocking this capacity, a field-scale pilot was conducted involving the injection of 130 tons of water dissolved CO_2, together with 3 kg of sodium fluorescein (Na-F) tracer. The water used in the injection was originally from the target Middle Eocene rocks to avoid potential comparability issues. The injection targeted the fractured Middle Eocene formation 2–3 km below the surface. This 800 m thick unit is comprised of approximately 50% plagioclase, 20% chlorite, 8% quartz, and significant concentrations of zeolite and clay minerals. Reservoir temperature at the bottom of the injection well is approximately 110 °C. Prior to injection, formation fluids exhibited a pH of 8.3 (at 25 °C) and were slightly supersaturated with respect to calcite, and near to equilibrium with respect to quartz, albite, and diaspore.

Subsurface fluid monitoring was conducted via four wells located 200 to 600 m from the injection site. The Na-F tracer was detected in the closest monitoring well, indicating the arrival of the CO_2-charged injection water, within four weeks. Yet the concentrations of dissolved CO_2 and all major dissolved elements changed negligibly. This suggests that the injected carbon was fixed into solid mineral phases within the 4-weeks. We attribute the rapid mineralization to the presence of Ca-bearing zeolite minerals. These minerals have been shown in recent laboratory studies to facilitate the rapid release of calcium in the presence of dissolved CO_2, leading to the precipitation of stable carbonate minerals at accelerated rates (Alqahtani et al., 2025).

Reference:

Alqahtani et al., 2025. Sci. Reports 15, 958.