

Temperature dependence of CO₂ drawdown into ultramafic tailings

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Ultramafic materials react variably with carbon dioxide (CO₂) at Earth's surface conditions and can be used to mineralize and sequester this greenhouse gas. Here we assess the impact of temperature variation (4, 20, and 40 °C) on the rate of CO₂ mineralization in various ultramafic tailings and ores at ~100% relative humidity.

Replicate samples of six ultramafic ores or mine tailings, containing varying proportions of serpentine polymorphs, forsterite, brucite, and iowaite, were placed in flow-through reactors that continuously supplied humidified (~100% RH) laboratory air (0.042% CO₂). Subsamples of each material were collected from the 4, 20, and 40 °C experiments after 24 hours, 1 week, 1 month, and 3 months.

X-ray diffraction (XRD) results for both the pre- and post-carbonation samples show an increase in abundance of dypingite and a decrease in brucite content in variably serpentinized peridotites. The 003 peak of iowaite-pyroaurite shifted to smaller d-spacings, indicating chloride replacement by carbonates and a transition from a more iowaite-rich to pyroaurite-rich composition. Total Inorganic Carbon (TIC) measurements were used to determine the amount and rate of carbonation as a function of time, temperature, and mineralogy. The results of this study will help estimate the carbonation rates of mine tailings under different temperature conditions relevant to large-scale deployment of CO₂ mineralization at mines across Canada.