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Quantifying Carbon Sequestration Potential in Ultramafic Rocks at the Nikolai Ni-Cu-PGE Project, Alaska

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Magmatic Ni-Cu-PGE deposits hosted in mafic-ultramafic intrusions represent critical metal resources essential for the green energy transition. However, the carbon sequestration potential of the ultramafic host lithologies is currently not evaluated within exploration and resource assessment workflows. The Nikolai Project, located within the Wrangellia large igneous province of Alaska, contains dunite and wehrlite affected by variable degrees of serpentinization, providing an opportunity to assess ex situ CO₂ sequestration capacity through mineral carbonation.

Quantitative automated mineralogical analysis was applied to polished epoxy mounts prepared from coarse reject material to quantify modal abundances of Mg-bearing phases, including olivine and serpentine-group minerals. These analyses were conducted using scanning electron microscopy with energy-dispersive spectroscopy to document alteration textures, ore mineral associations, and the textural setting of Ni-Cu sulfides and platinum-group minerals. Based on the mineralogical information, whole-rock geochemical data were used to estimate mineral abundances in assay intervals through normative calculations. These estimated abundances of reactive Mg-bearing minerals were then used to calculate potential CO₂ uptake.

This study demonstrates that carbon sequestration potential in ultramafic-hosted magmatic Ni-Cu-PGE deposits can be evaluated at the exploration stage using integrated mineralogical and geochemical workflows. Incorporating estimates of mineral carbonation capacity into early technical assessments may provide critical information on the economic feasibility of implementing ex situ CO₂ sequestration technology in mining.