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# Influence of specific mineralogy on accelerated weathering and mineral carbonation potential

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Accelerated mineral carbonation can be employed to sequester $CO_2$ in carbonate minerals [1]. In this study, three different ultramafic residues or rocks were used for column acid leaching experiments to study the influence of mineralogy on mineral carbonation potential. Processed kimberlite residues from Gahcho Kué mine (GK, NWT, Canada) and two serpentinite rock samples from the Record Ridge project (RRP1 and RRP2, BC, Canada) were treated with 16.6 mL 0.12 M HCl daily for 28 days.

GK residues contain lizardite, saponite, phlogopite, albite, orthoclase, augite, a low amount of calcite (1.4 wt%) and no brucite. Both serpentinite rock samples are rich in lizardite and forsterite, with RRP1 containing similar amounts of both minerals and RRP2 dominated by lizardite with minor (<10 wt%) forsterite. Neither RRP sample contains calcite and both contain minor brucite. These mineralogical contrasts resulted in very different leachate compositions. pH values in leachates from GK columns were always >7.0 throughout the 28 days while pH values in leachates from RRP1 columns were always <2.2. pH values in leachates from RRP2 columns varied between 0.6 and 9.2 as preferential flow paths opened and closed. Calcite dissolution in GK columns accounted for 29.8% of the leached Ca while augite, tremolite and saponite provided the rest of the Ca in solution. Clay minerals provided the Mg leached from GK and RRP columns. In the case of GK, this equates to an estimated $CO_2$ offset potential of 7.8% of the mine's annual greenhouse gas emissions [2]. Leachates from RRP1 and RRP2 show a low concentration of Ca leached from tremolite, with an extraction efficiency of 11.1% and 10.8%. A total of 3.6%, 1.8% and 3.0% of the Mg was leached from the GK, RRP1 and RRP2 columns, respectively, with the highest extractions obtained from lizardite and saponite-rich samples and the lowest extraction obtained from the forsterite-rich sample. Our results show that the specific mineralogy of each ultramafic rock type, and even each ultramafic facies, plays a critical role in carbonation potential.

[1] Wilson, S.A. et al. (2006), Am Mineral 91: 1331-1341.

[2] Mervine, E.M. et al. (2018), Mineralogy and Petrology 112:755-765.