

Particle size effects on Ni and Cr mobilization during ex situ mineral carbonation of ultramafic rocks

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The particle size is one of the key parameters affecting ex situ carbonation because the size reduction increases surface area and consequently the availability of reactive divalent cations [1]. This research investigates the effect of initial particle size on Ni and Cr mobilization during ex situ carbonation of partially serpentinized peridotite.

The studied serpentinized peridotite contained 2060 ppm of Ni and 2950 ppm of Cr. The majority of Ni was hosted in forsterite (~0,37 wt.% NiO) and constituted ~45% of the rock's modal composition. The highest Cr concentrations were measured in Fe-Cr spinels (~36 wt.% of Cr₂O₃).

The sample was ground to obtain three fractions of different particle size distributions: 250 µm – 125 µm, 125 µm – 50 µm, and < 50µm. The carbonation experiments were performed in the batch-type reactor at 185°C and 100 bar of *PCO*₂, using 20 g of the sample and 200 ml of ultrapure water. The specific surface area (SSA) of the studied rock was determined using the CO₂ adsorption method, which revealed minimal SSA variation from 17.0622 to 17.9458 m²×g⁻¹, with minimal differences between fractions and no clear correlation between SSA increase and grain size. However, the cation composition of post-experimental fluids reveals a noticeable trend. As particle size increases, the concentrations of Mg²⁺ and Si⁴⁺ in the fluid decrease. Furthermore, the concentrations of Cr and Ni remain below 0.1 mg/kg and 3 mg/kg, indicating minimal mobilization of these metals into the fluid.

In the next step of this project, the solid carbonation products will be analyzed to identify secondary phases that may act as sinks for Ni and Cr. This is a crucial aspect of the research, as it will help determine the optimal ultramafic rock particle size for maximizing CO₂ sequestration while minimizing the mobilization of metallic elements during carbonation.

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References:

[1]Santos & Van Gerven (2011), *Greenhouse Gases: Science and Technology*, 1(4), 287-293.