

## Tracking the fate of nickel during Mg-carbonate mineral phase transformations: Implications for CO<sub>2</sub> storage

JESSICA HOOPER<sup>1</sup> AND ANNA HARRISON<sup>2</sup>

<sup>1</sup>Queen's University

<sup>2</sup>Géosciences Environnement Toulouse (GET) - CNRS

Presenting Author: 13jch7@queensu.ca

### Tracking the fate of nickel during Mg-carbonate mineral phase transformations: Implications for CO<sub>2</sub> storage

J.C. HOOPER<sup>1</sup>, A.L. HARRISON<sup>1</sup>

<sup>1</sup>Queen's University, Kingston, K7L 3N6, Canada  
(13jch7@queensu.ca, anna.harrison@queensu.ca)

Production of anthropogenic greenhouse gases such as CO<sub>2</sub> has been increasing substantially since the industrial revolution resulting in climate change [1]. Technologies to capture and store CO<sub>2</sub> are likely necessary to limit the temperature increase and reduce the harmful effects of climate change [1]. Carbon mineralization is a technology that can be used to offset CO<sub>2</sub> emissions by reacting CO<sub>2</sub> with silicate and hydroxide minerals and storing it in stable carbonate minerals [2]. Magnesium-rich mine tailings are a promising substrate because they are accessible at Earth's surface and react rapidly due to high surface areas [2]. However, dissolution of tailings during carbon mineralization could also release harmful trace metals (e.g. Ni, Cr). The hydrated Mg-carbonate mineral nesquehonite (MgCO<sub>3</sub>·3H<sub>2</sub>O) commonly forms in mine tailings but transforms to dypingite [Mg<sub>5</sub>(CO<sub>3</sub>)<sub>4</sub>(OH)<sub>2</sub>·~5H<sub>2</sub>O] and/or hydromagnesite [Mg<sub>5</sub>(CO<sub>3</sub>)<sub>4</sub>(OH)<sub>2</sub>·4H<sub>2</sub>O] over time. Nesquehonite was previously shown to sequester transition metals [3]; however, the fate of the metals during the subsequent phase transformations is unknown.

We examined the behaviour of nickel during the transformation of nesquehonite to dypingite and hydromagnesite. Experiments were conducted from 5 to 45°C over 2 to 12 weeks. Nesquehonite was placed in solutions with 1ppm Ni, and fluid and mineralogical compositions were tracked over time using inductively coupled plasma mass spectrometry, and X-ray diffraction. Nickel was rapidly removed from solution when nesquehonite was the only phase present. The rate at which nickel was removed from solution varied between temperatures, with removal to <0.5ppb occurring within 10h at 45°C and 120h at 35°C. Nickel remained in the solid phase throughout the subsequent mineral phase transformations, suggesting it is likely to remain sequestered in the solid despite dissolution and reprecipitation of the solid. Our results suggest that Ni mobility is likely limited during weathering of mine tailings for CO<sub>2</sub> removal, due to its incorporation into the solid phase.

[1] IPCC (2018)

[2] Power et al. (2013) *Reviews Min Geochem*, **77**, 305-360.

[3] Hamilton et al. (2016) *Int J GHG Control*, **55**, 73-81.