Hydrotalcites as a carbon sink in serpentinites

C.C. TURVEY[1]*, S.A. WILSON[1], J.L. HAMILTON[1], J. MCCUTCHEON[2], A. BEINLICH[3,4], G.M. DIPPLE[4] AND G. SOUTHAM[2]

[1]School of Earth, Atmosphere & Environment, Monash University, Clayton, VIC 3800, Australia (*correspondence: connor.turvey@monash.edu)
[2]School of Earth Sciences, The University of Queensland, St Lucia, QLD 4072, Australia
[3]Department of Applied Geology, Curtin University, Bentley, WA 6102, Australia
[4]Department of Earth, Atmosphere and Ocean Sciences, The University of British Columbia, Vancouver, BC V6T 1Z4, Canada

Ultramafic mine tailings are being investigated for their potential to trap and store atmospheric CO_2. The anion exchange properties of hydrotalcite minerals, and their presence within many ultramafic mineral deposits, make them a potentially important resource for CO_2 sequestration. To this purpose we have investigated the formation mechanisms of pyroaurite $[Mg_6Fe^{3+}_2(CO_3)(OH)_{16}{\cdot}4H_2O]$ in the tailings of the derelict Woodsreef Chrysotile Mine, Australia.

Pyroaurite is known to be present at the surface of the tailings pile [1]; however, the depth to which it is present remains unknown. We have used Powder X-ray diffraction (XRD) and stable isotope analyses to determine the carbonate source and extent of pyroaurite formation from the surface down into the tailings material. Two structureless pattern fitting methods [2, 3] were used to quantify the abundance of pyroaurite in serpentine-rich samples taken from a suite of vertical profiles. Synthetic tailings were analysed alongside natural samples to determine the accuracy of both methods.

Pyroaurite occurs throughout the tailings with the highest abundances, 7-10 wt.% being found in the upper 15 cm of the tailings. The abundance decreases with depth, becoming undetectable below 70 cm, implying that pyroaurite is forming as a weathering product. Analyses show a preference for isotopically lighter carbon with $\delta^{13}C$ values between -7.5 ‰ and -2.5 ‰ (VPDB). Our preliminary studies suggest that this signature may reflect uptake of atmospheric CO_2 under carbon-limited conditions. Thus formation of pyroaurite may respresent an additional carbon sink to the hydrated Mg-carbonates found at Woodsreef and other ultramafic mines.

[1] Oskierski *et al*. (2013) *Cheml Geol* **358**, 156-169.
[2] Wilson *et al*. (2006) *Am Mineral* **91**, 1331-1341.
[3] Scarlett & Madsen (2006) *Powder Diffr* **21**, 278-284.