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Mg-carbonate minerals trap potentially toxic trace metals and CO₂ at Woodsreef Mine, New South Wales

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Carbon mineralisation has been recognised as a safe and long-term means of trapping and storing CO₂ within mineral structures. The stockpiles of reactive, finely pulverised mine tailings produced by ultramafic-hosted mines are ideal settings in which to observe and promote carbonation. This can be achieved by reaction of Mg-rich waste minerals with atmospheric or industrial CO₂. Consequently, there has been much interest in enhancing the rate of natural weathering processes at mine sites.

We have recently (October 2015) deployed the first ever field-scale experiments to accelerate CO₂ sequestration by enhanced weathering at the Woodsreef Chrysotile Mine in NSW, Australia. Mine tailings commonly contain significant concentrations of potentially toxic metals (e.g., Cr, Co, Cu, Ni), found within the crystal structures of Mg-silicates, sulfides, oxides and metal alloys. Because our field trial involves leaching tailings with acidic solutions, which may enhance metal mobility, it was crucial that we first understand the ultimate fate of trace metals during enhanced weathering.

Synchrotron X-ray fluorescence mapping indicated that recently precipitated (since 1983) carbonate minerals are sequestering first-row transition metals (i.e., Cr, Ni, Mn, Co, Cu) trace metals, likely via substitution for Mg, within their crystal structures. This demonstrates that accelerated carbonation of metal-rich industrial wastes or mine tailings, such as those at Woodsreef Mine, is unlikely to generate metalliferous drainage and will not pose an environmental risk.

Keywords

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