CO_2 sequestration within mine wastes via weathering and mineralization

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Mining generates large quantities of mineral wastes and greenhouse gas emissions, thereby contributing to the increase in atmospheric carbon dioxide (CO_2). Enhanced weathering of these wastes and subsequent CO_2 mineralization has the potential to provide substantial greenhouse gas offsets [1,2]. Our approach begins with detailed analyses of mine wastes using a multitude of tools to gain information about their mineralogical, geochemical, and physical characteristics. The geochemical composition of mine wastes dictates CO_2 sequestration capacity, whereas the mineralogical composition and physical properties mainly influence reactivity. Batch leaches are coupled with inorganic carbon analyses to measure the release of magnesium and calcium from non-carbonate (desirable) and carbonate (undesirable) minerals present in mine wastes. This analysis allows us to predict the reactivity of mine wastes for CO_2 sequestration purposes and is akin to acid-base accounting methods that are widely employed for the prediction of acid rock drainage. Labour intensive mineralogical analyses have been used to quantify direct air capture of atmospheric CO_2 in ultramafic tailings from nickel and diamond mines [3,4]. As an alternative, we are utilizing long-term CO_2 flux chambers to directly measure the drawdown of atmospheric CO_2 resulting from mineral weathering. Enhanced weathering experiments using automated wetting and drying cycles are determining the extent of tailings dissolution and carbonate precipitation that may be achieved over months to years. Our ongoing research is examining the CO_2 sequestration potential within kimberlitic mine wastes at the Venetia diamond mine in South Africa with field pilots planned for the coming year [5]. This research is contributing towards developing CO_2 sequestration within mine wastes and enhanced weathering as a carbon dioxide removal strategy.

[1] Power *et al*. (2014), *Minerals* 4, 399-436. [2] Power *et al*. (2013), *Rev. Mineral. Geochem.* 77, 305-360. [3] Wilson *et al*. (2014), *Int. J. Greenh. Gas Con.* 25, 121-140. [4] Wilson *et al*. (2009), *Econ. Geol.* 104, 95-112. [5] Mervine *et al*., (2018) *Miner. Petrol.* 112 (Suppl 2), S755-S765.