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# Advances in monitoring carbon dioxide exchange between the atmosphere and mine waste derived from ultramafic-hosted mineral deposits; a pilot study at Cassiar, B.C.

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Removal of carbon dioxide ($CO_2$) from the atmosphere is necessary to limit global warming to below 2°C. Here we demonstrate real-time monitoring of $CO_2$ fluxes for quantification of accelerated $CO_2$ uptake by mine tailings manipulated for the purpose of $CO_2$ removal. $CO_2$ fluxes were measured over 12 days at a closed asbestos mine in the Cassiar Mountains of Northern British Columbia using eddy covariance (EC) and dynamic closed chambers (DCC). Ultramafic-hosted ore deposits present ideal terrains for comparing abiotic $CO_2$ fluxes measured by EC and DCC due their mineral homogeneity and flat topography. Baseline $CO_2$ uptake rates of 0.17 g C $m^{-2}$ $d^{-1}$ were measured on the surficial tailings using DCC and indicated that very little carbon sequestration was occurring in the undisturbed tailings due to age and prolonged exposure to the atmosphere. A 50 m x 80 m area was reworked by removing 1 to 2 m of tailings, exposing buried material containing more alkaline porewater and facilitating the ingress of $CO_2$ into the tailings. This removal resulted in an average uptake flux of 1.00 g C $m^{-2}$ $d^{-1}$ over the following 48 hours as the alkaline porewater equilibrated with atmospheric $CO_2$[1]. After 48 hours the uptake flux stabilized at an average value of 0.64 g C $m^{-2}$ $d^{-1}$, which was sustained over the remaining 10 days. After filtering the EC fluxes for friction velocity threshold, stationarity, and wind direction, half-hourly fluxes were strongly correlated ($R^2$ = 0.83) with DCC measurements indicating spatial homogeneity at the site. Results demonstrate that EC and DCC can be used in tandem to monitor and validate accelerated $CO_2$ uptake by ultramafic mine tailings.

1. Bea, S. A., Wilson, S. A., Mayer, K. U., Dipple, G. M., Power, I. M., & Gamazo, P. (2012). Reactive transport modeling of natural carbon sequestration in ultramafic mine tailings. *Vadose Zone Journal*, *11*(2), vzj2011.0053. https://doi.org/10.2136/vzj2011.0053