Field protocols for measuring rates of CO_2 influx into ultramafic rocks: A case study at the Sumas landslide, WA, US

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According to all climate projections by the IPCC, removal of carbon dioxide (CO_2) from the atmosphere is necessary to successfully limit global warming to 1.5°C above pre-industrial levels by 2100. Recent studies have observed CO_2 sequestration occuring passively in ultramafic mine tailings by the formation of hydrated magnesium-carbonate minerals. It has become increasingly valuable to measure the rates of CO_2 influx into ultramafic materials to validate this novel form of carbon capture utilization and storage.

A non-steady state soil gas flux chamber (LI-8100a, LI-COR Inc., Lincoln, NE) was used to measure CO_2 influx rates at the Sumas landslide in Washington, US. These chambers have been extensively used in agricultural, forest, and arctic environments to measure gas fluxes, but they have not previously been used to directly measure rates of CO_2 influx into ultramafic mine waste. The Sumas landslide is mineralogically and texturally comparable to ultramafic mine tailings, being dominantly composed of serpentinite that reacts readily at ambient conditions, making the landslide a good proof-of-concept case study.

With the removal of the carbonated material at the soil-atmosphere interface, the fresh serpentinized material showed consistent influxes of around -1.60 μmol m^{-2} s^{-1}. This is comparable to results observed through mineralogical analysis of hydrated magnesium-carbonate minerals by Wilson *et al. (2014)* at the Mount Keith Nickel Mine and Turvey *et al. (2018*) at the Woodsreef Chrysotile Mine. The similarities in mineral content, environmental conditions, and CO_2 fixation rates suggest that the landslide serves as a natural analog of ultramafic mine tailings. The study also demonstrates that soil gas flux chambers can be used effectively to measure CO_2 uptake rates in real time, and charcaterize their spatial distribution and temporal evolution at a site.