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Microbial communities in the weathering zone—implications for oxidative weathering

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Carbon is stored in sedimentary rocks as petrogenic organic carbon (OC_{petro}) and carbonates on timescales of millions of years. When sedimentary rocks are exposed to the atmosphere through orogeneses and erosion, a suite of physical, chemical and biotic processes occur during oxidative weathering, and result in carbon exchanges with the atmosphere. Previous studies have focused on quantifying the rates of geochemical reactions and net carbon dioxide (CO_2) transfers, showing that oxidative weathering in sedimentary rocks likely acts as a positive feedback to rising temperatures on geological time scales [1]. However, the unknown role of microbiology in these processes has remained largely unexplored, despite their ability to catalyse reactions via enzymes and their capacity to assimilate OC_{petro} [2].

We quantified microbial biomass in sedimentary rocks known to display temperature-sensitive CO_2 emissions to explore whether the role of microorganisms should be further investigated to improve our mechanistic understanding of oxidative weathering and its kinetics. Rock samples were collected every three months over the course of a year at the Draix-Bléone Critical Zone Observatory, France to assess seasonal changes in microbial biomass and community assemblage. The samples were stored at –80^{o}C within 24 hours of collection, and subsequently analysed for the abundance and composition of phospholipid fatty acids, and sequenced for 16s RNA. Preliminary results from a second field site in the Swiss Alps—where the OC_{petro} content is an order of magnitude higher than in Draix—enabled us to further explore the role of lithology on microbially-mediated weathering processes. Our work brings us one step closer to understanding the links between microbial biomass, microbial community composition, carbon fluxes and environmental parameters, including temperature.

[1] Soulet, Hilton, Garnett, *et al.* (2021) *Nature Geosciscience* **14**, 665–671

[2] Petsch, Eglinton, Edwards (2001) Science **292**, 1127-1131