ONE Planet Doctoral Training Partnership

Natural Environment Research Council

**Project title:** The role of the soil microbiome in carbon sequestration and capture in soils amended with mineral wastes

**Ref: OP2432**

**Keywords:** soil microbiome, carbon sequestration, engineered soils, mineral wastes

**One Planet Research Theme:**
Climate & Climate Change ☒ | Earth System Processes ☒ | Anthropocene ☒ | Environmental Informatics ☒

**Lead Supervisor:**
Dr Angela Sherry, Northumbria University.

**Key Research Gaps and Questions:**

- What is the diversity and function of carbonate-precipitating microbes in soils amended with mineral wastes?
- Which microbial metabolisms induce carbonate precipitation in soils amended with mineral wastes?

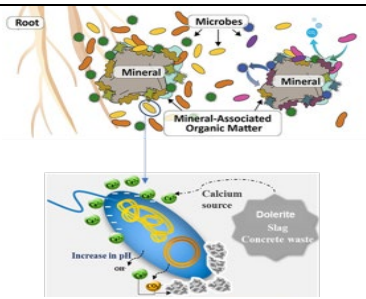


*Fig.1. Soil-microbe-mineral interactions during carbonate precipitation (modified from [6,7]).*

**Project Description:** Soil carbon sequestration is a vital requirement in mitigating climate change effects [1]. Natural and engineered soils (produced from mixes of mineral wastes e.g. crushed concrete from demolition waste, steel slag, basaltic quarry fines, or glacier rock 'flour'), have been recognised for their carbonate precipitation properties and contribution to carbon sequestration [2,3]. Microbial communities are key drivers of essential biogeochemical cycling in soils [4,5], inducing carbonate precipitation through a range of metabolic processes, e.g. photosynthesis, ureolysis and sulfate reduction, through either increasing pH or dissolved inorganic carbon (e.g. mineral wastes) [6,7]. However, the microbial processes leading to inorganic carbon capture in soils have yet to be defined and there is limited understanding of the full diversity of carbonate-precipitating microbes within the soil microbiome and their interactions. In this studentship, mineral waste-amended soil mesocosms will be studied alongside fields sites, using DNA-based molecular methods, to elucidate the role of the microbiome in carbonate precipitation in soils. Microbial diversity, functional genes and metabolic pathways will be determined alongside soil characteristics. Knowledge gained will contribute to understanding the role of the soil microbiome in carbon capture; land management practices related to soil stabilisation through precipitated carbon; circular economy through application of mineral wastes; and reduction in the environmental carbon cost of poor quality or low nutrient soils.

[1] IPCC (2019): Climate Change and Land Special Report https://www.ipcc.ch/srccl/ [2] Dietzen & Rosing., 2023 10.1016/j.ijggc.2023.103872 [3] Manning et al. 2013 10.1016/j.ijggc.2013.05.012 [4] Smercina et al., 2021 10.1093/femsec/fiab091 [5] Baveye et al., 2018 10.3389/fmicb.2018.01929 [6] Neurath et al., 2021 10.1021/acs.est.1c00300 [7] Song et al., 2022 10.1016/j.chemosphere.2021.133229

**Prerequisites:** Background in environmental science, microbiology or molecular biology. Some skills in bioinformatics are desirable. For more information, please contact Dr Angela Sherry (angela.sherry@northumbria.ac.uk).

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