ONE Planet Doctoral Training Partnership

Natural Environment Research Council

Project title: Transformative Potential of Self-Healing Mechanisms for Carbon Sequestration in Geo-Infrastructures

Ref: OP244

Keywords: Resilient Infrastructure, Self-Healing Mechanisms, Carbon Capture, Sustainable Geo-Infrastructure

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

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Key Research Gaps and Questions:
1. What is the influence of biological processes on the continuous processes of CO_2 sequestration through atmospheric weathering of silicates and the formation of carbonate minerals in geo-infrastructures, and how can this understanding be leveraged to advance our efforts towards achieving a net-zero carbon future?
2. How can the integration of microbial self-healing mechanisms into geo-infrastructures contribute to the development of resilient and sustainable solutions for carbon sequestration, bridging the current knowledge gap in climate-resilient infrastructure engineering?

Project Description: The global infrastructure industry faces an unprecedented challenge in meeting the needs of a growing population while addressing climate change and the vulnerability of existing infrastructure. Climate-related geo-hazards such as flooding, subsidence, erosion, and landslides are becoming increasingly concerning due to the changing climate. This presents an urgent demand for resilient infrastructure solutions, further accentuated by the global imperative to achieve net-zero carbon emissions by 2050.
In light of these challenges, this proposed PhD project aims to explore the transformative potential of self-healing mechanisms in the context of carbon sequestration within geo-infrastructures. This project will advance our understanding of the capabilities of self-healing mechanisms, particularly microbial self-healing, and their carbon sequestration potential in bioengineered soil applications. By integrating self-healing principles into geo-infrastructures, we seek to develop longer-lasting and low-maintenance structures, ultimately reducing maintenance costs and contributing to sustainable economic growth. This project will employ state-of-the-art experimental research techniques in microbiology, materials science, geotechnical engineering and soil science to investigate the influenced of biological processes on the continuous processes of CO_2 sequestration through the athmospheric weathering of silicates and the formation of carbonate minerals.
This project holds the potential to revolutionize the field of geo-infrastructure engineering by offering innovative and sustainable solutions for carbon capture and sequestration. Through rigorous research, experimentation, and collaboration, we aim to contribute to a more resilient and environmentally responsible built environment, aligning with global efforts to combat climate change and achieve a net-zero carbon future.

Prerequisites: Essential: Background in Soil Science or Related field, Experimental Research Skills, Strong Communication Skills, Adaptability and Creativity, Project Management, Interdisciplinary Collaboration. Desirable: Geochemistry Expertise, Microbiology Expertise, Materials Science Knowledge, Data Analysis and Modelling, Environmental Science and Climate Change Knowledge.

For more information, please contact Dr Bruna Lopes (bruna.lopes@newcastle.ac.uk).

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