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Geomicrobiological insights from contrasting shallow geothermal aquifers

DRUHI VAID[1,2], NATALI H BECERRA[1,2], KEVIN G TAYLOR[2] AND SOPHIE L NIXON[1,2]

[1]Manchester Institute of Biotechnology
[2]Department of Earth and Environmental Sciences

Geothermal resources provide several benefits, including natural heat energy, large-scale seasonal energy storage, combined cooling and heating, and a steady, low carbon supply [1]. Their widespread utilisation could help reduce carbon emissions, thereby facilitating compliance with 2050 net zero targets, and contribute to UK's self-sufficiency and energy security [2]. However, concerns over environmental impact of geothermal systems remain a key barrier to adoption [3]. The associated risks lead to higher costs, sustaining reliance on higher carbon alternatives. Hence, there is a need to determine and quantify the environmental impacts and response of geothermal heat storage systems. This work studied two potential key heat storage aquifer systems in the UK: the Triassic Sherwood Sandstone and the Cretaceous Chalk. These aquifers represent contrasting lithologies and flow characteristics, with the Sherwood Sandstone largely dominated by matrix (pore-space) flow, and the Chalk dominated by fracture flow and dual porosity behaviour [4]. Groundwater samples from both aquifers were collected at varying borehole volumes and timepoints for characterisation. The biogeochemical analyses included anion/cation concentrations, total organic carbon, and on-site pH, temperature, and dissolved oxygen measurements. In addition, biomass from these samples was concentrated and genomic DNA extracted for sequencing to assess the diversity (16S rRNA gene sequencing) and functional potential (metagenomics) of baseline communities. Results showed clear geochemical and microbial differences between the aquifers, likely reflecting lithological contrasts. Across sampling volumes, only minor differences in geochemistry and microbial composition were observed. Biomass yields varied largely with sampling timepoints. Notably, including an iron-flocculation step during DNA extraction (usually aimed at retaining viromes [5]) revealed distinct microbial communities not seen with the standard extraction protocol. Ongoing work focuses on identifying the functional potential of these communities, particularly for sulfide production and well-clogging processes that could impact geothermal system performance.

References:

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