Microbial mineral and rock weathering in shale cliffs

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Diverse microbial communities contribute to active metal cycling and rock-mineral weathering proceses in shale rock. This has been demonstrated at various sites of shale rock coastal cliff surfaces in North Yorkshire, UK, where molecular and geological approaches have previously been used to study microbial shale weathering[1].

The work presented here used a combination of *in vitro* and *in situ* geomicrobiological methods to determine the role of microbes and the mechanisms they utilize to weather shale.

Microbial strains with the weathering phenotypes acid/siderophore/phosphotase production and Fe/Mn oxidation were isolated from ferromanganese deposits on weathered shale, using selective agar plate assays. Subsequent sequencing of the 16S/ITS regions of these strains yielded a characterized community of rock-mineral weathering species.

In vitro biogeochemical weathering experiments were established to determine the role of microbes in modifying elemental leaching rates from weathered shale, using ICP-OES to quantify concentrations of leached elements. Microbial iron oxidation was clearly identified, but leaching of other elements seemed unaffected by microbial activity.

Finally, SEM and fluorescence microscopy analysis of *in situ* and *in vitro* microcosms were used to explore microbial colonization, pitting, and etching on polished surfaces of albite, calcite, muscovite, pyrite and quartz, which are representative minerals of the shale rock studied in this work.

This work highlights the role of diverse microbial communities, including iron oxidizers, in shale weathering environments. The primary use of culture based work to identify key microbial players and rock weathering mechanisms in shale within the natural environment is an important step forward from previous, largely phylogenetic based studies.

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