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Microbial life associated with weathering of ultramafic rocks

F. L. Daae (1), L. Øvreås (1), T. Bjelland (1), I. Økland (2), I. Thorseth (2) and R. B. Pedersen (2)

(1) Department of Biology, Jahnebakken 5, 5020 Bergen, Norway, (2) Department of Earth Science, Allegaten 41, 5007 Bergen, Norway (frida.daae@bio.uib.no / Fax: +47 55589671 / Phone +47 55582663)

The microbial community associated with the weathering of ophiolite-hosted ultramafic rocks on the island Leka, Mid-Norway, has been studied. Microscopy, molecular analyses and culturing of the percolating alkaline groundwater and fracture-filling secondary minerals (e.g. magnesite $MgCO_3$, brucite $Mg(OH)_2$ show that this environment supports a rich endolitic microbial life. Groundwater collected from a 50 m deep borehole had higher pH, higher TOC, and lower cell number and colony forming units compared to groundwater from surface seepages. Molecular analyses and cultures obtained from the surface seeps showed bacteria affiliating with *Bacteriodetes*, and *alpha-*, *beta-*, and *gamma-Proteobacteria*. In groundwater from the borehole only sequences that affiliated with *beta-* and *gamma-Proteobacteria* were detected. Molecular analyses of relatively thick ($>$3 mm) fracture fillings from 15–20 cm beneath the rock surface revealed a rich microbial community, where sequences from microorganisms related to *Acidobacteria*, *Actinobacteria*, *Bacteriodetes*, *Cyanobacteria*, *Deinococcus*, *Planctomycetes*, *alpha-*, *beta-*, *gamma-Proteobacteria*, *Crenarchaeotae*, *Ascomycota* including lichens, and *Chlorophyta* were detected. Isolates from these fracture fillings were closest related to members of *Actinobacteria*, *Firmicutes*, *alpha* and *beta-Proteobacteria* and *Ascomycota*. In thin ($<$2 mm) fracture fillings from 20–160 cm beneath the rock surface, only sequences which related to prokaryotic organisms were detected. The closest relatives were uncultured clones belonging to *Crenarchaeota*, *Acidobacteria*, *Actinobacteria*, *Firmicutes*, *Nitrospirae*, and *alpha-*, *beta-* and *gamma-Proteobacteria*. Enrichments from these fracture fillings are not performed. The community composition indicates that the energy yielding processes in

the thick, 15-20 cm deep fracture fillings are driven both by photosynthesis and low-temperature water-rock interactions. In the thinner and/or deeper fracture fillings our findings of bacterial sequences with high similarity to hydrogen, iron- and manganese-oxidizing bacteria indicate that molecular hydrogen and reduced manganese and ferrous iron produced by low-temperature water-rock interactions are oxidized by these bacteria in energy yielding chemosynthetic processes. The results also show that the endolithic community is not reflected in the groundwater.