Investigation of biogenic chelators, microenvironments and weathering processes in soil

ENGY AHMED* AND SARA HOLMSTRÖM

Department of Geological Sciences, Stockholm University, Stockholm, Sweden
(*Correspondence: engy.ahmed@geo.su.se)

The interplay between geology and biology has shaped the Earth during billions of years. Microbe-mineral interactions are prime examples of this interplay and underscore the importance of microorganisms in making Earth a suitable environment for all forms of life. The present study addresses how the composition and distribution of biogenic chelators (siderophores) differ with regard to soil horizon and mineral type *in situ*, what siderophore type soil microorganisms produce under laboratory conditions and what role microbial surface attachment plays in mineral weathering reactions.

Podzol, the third most abundant soil in Europe, was chosen for a field experiment, where three mineral types (apatite, biotite and oligoclase) were inserted in the organic, eluvial and upper illuvial soil horizons. The study started with an investigation of the siderophore composition in the bulk soil profile and on the mineral surfaces, which was followed by a study of the siderophore producing capabilities of microorganisms isolated from the soil profile under laboratory conditions. Subsequently, a study was done on the impact of microbial surface attachment on biotite dissolution.

The major findings were that the concentration of hydroxamate siderophores in the soil attached to the mineral surfaces was greater than those in the surrounding bulk soil, indicating that the minerals stimulate the microbial communities attached to their surfaces to produce more siderophores than the microorganisms in the bulk soil. Each mineral had a unique assemblage of hydroxamate siderophores that makes the mineral type one of the main factors affecting siderophore composition in the natural environment. Siderophore production varied between the microbial species originating from different soil horizons, suggesting that the metabolic properties of microbes in deep soil horizons function differently from those at upper soil horizons. Microbial surface attachment enhanced the biotite dissolution, showing that attached microbes have a greater influence than free living populations on weathering reactions in soil. In conclusion, our findings reflected that the complicated relationship between microorganisms and mineral surfaces reinforces the central theme of biogeochemistry that the mineral controls the biological activity in natural environments.