ACCELERATED DISSOLUTION OF CLAY AND DIATOM BY LAKE BAIKAL BACTERIAL ASSEMBLAGES

ŠTYRIAKOVÁ, I.,[1] LUXOVÁ, M.,[1] ŠTYRIAK, I.[2]

[1] Department of Mineral Biotechnologies, Institute of Geotechnics SAS [Oddelenie minerálnych biotechnológií, Ústav geotechniky SAV], Watsonova 45, Košice, 04353, Slovakia

[2] Institute of Animal Physiology SAS [Ústav fyziológie hospodárskych zvierat SAV], Šoltesovej 4–6, Košice, 04001, Slovakia

E-mail: bacil@saske.sk

Lake Baikal is the world's deepest and most voluminous lake. The sediment thickness reaches a maximum of approximately 8000 m. The attached bacteria were transported by the sedimentation of particles to the less favourable deep cold water of Lake Baikal, where microbial iron reduction is a major respiratory process in low-temperature sedimentary environments.

Temperature appears to be a dominant factor controlling extraction of Fe from clay minerals. The clays are more weathered during the diatom-rich intervals in agreement with warmer climate conditions (Fagel et al., 2002).

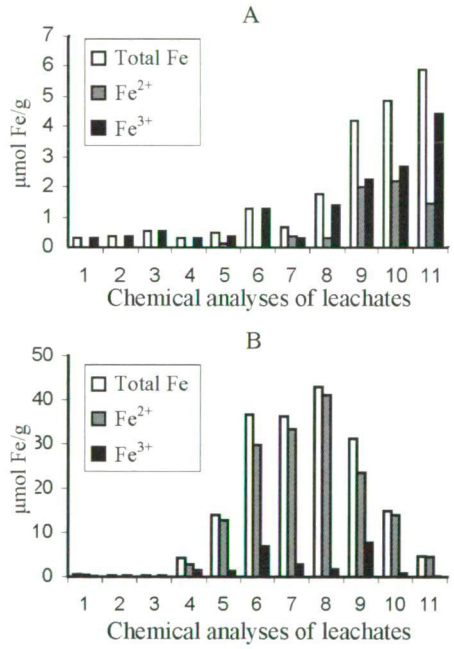

Fig. 1: Release of Fe from clay rich silicate samples during bacterial leaching A) at 4°C and B) at 22°C

The Fe extraction rate is five times lower at 4°C than at 22°C during bacterial leaching of clay (Fig. 1) and diatom rich samples from Lake Baikal. Bacterial activity in Fe reduction from clay rich samples was detected at 4°C later (in 8th leachate sampling) in comparison with cultivation at 22°C when bacterial activity was detected in fourth leachate sampling. The final Fe concentration at 4°C is not known yet because is already monitored. The highest concentration at Fe extraction was 43 µm Fe per gram of clay rich sediment sample and was obtained in 8th leachate sampling. The iron precipitation and formation of Fe mineral phases was observed.

Si extraction from diatom rich samples was also investigated. The silica release after diatom dissolution led to neoformation of clay minerals. It is possible to suggest on the basis of the results of our laboratory experiments how were clay minerals biotransformed during diatom-rich interval period in Lake Baikal.

In oligotrophic waters, microorganisms prefer to live as consortia in biofilms that form at rock–water interfaces (Brown et al., 1999). Lake Baikal is also oligotrophic. That is why it is not surprising that formation of exopolysaccharides in our samples at clay/medium interface, in which Fe was accumulated at 4°C in slime matrix-biofilm, was observed also in our laboratory experiments.

The original iron precipitate in biofilm was mostly in the form of ferrihydrite on the aerobic surface, and of siderite in the anaerobic part of the biofilm (Brown et al., 1999). In case of higher amount of available phosphorus also vivianite could be formed.

These observations confirm the important role of bacteria on biochemical weathering of silicates minerals. It seems that also the parameters such as temperature, formation of organic acids and CO_2 production can influence the biochemical destruction of silicates and bioformation of clay and iron minerals.

References

BROWN, D. A., SHERRIFF, B. L., SAWICKI, J. A., SPARLING, R. (1999): Geochimica et Cosmochimica Acta, **63/15**, 2163–2169.

FAGEL, N., BOSKI, T., LIKHOSHWAY, L., OBERHAENSLI, H. (2002): Palaeogeography, Palaeoclimatology, Palaeoecology, **193**, 159–179.