Differences in the availability of Hg-thiol complexes to anaerobic bacteria

J.K. SCHAEFER, S.S. ROCKS AND F.M.M. MOREL

Dept of Geosciences, Princeton University, Princeton NJ 08544

One key factor controlling the production and accumulation of methylmercury in the environment is the speciation of Hg (II) available for uptake to methylating bacteria. Little is known about the mechanism of Hg (II) uptake and methylation in bacteria; however, Hg (II) uptake studies with *Geobacter sulfurreducens* suggest the involvement of an unknown facilitated transport mechanism with greater substrate specificity than observed in the sulfate-reducing bacterium, *Desulfovibrio desulfuricans* ND132. In short-term washed cell assays, *G. sulfurreducens* displayed enhanced Hg (II) uptake and methylation rates of specific Hg-thiol complexes (e.g. Hg-cysteine) at thiol concentrations found in the environment and released from the cells during growth. Cells were able to discriminate between related thiols (penicillamine and cysteine) which vary only on the thiol carbon, as observed by the lack of Hg (II) uptake and methylation of Hg-penicillamine complexes. In contrast, changes to the amino group of cysteine such as its removal (e.g. thioglycolate) or changes in chirality (L- vs D-form) did not affect Hg (II) methylation. Similar to *G. sulfurreducens*, the sulfate-reducing bacterium, *Desulfovibrio desulfuricans* ND132, showed a modest increase in the Hg (II) methylation rate in the presence of cysteine relative to sulfide-added controls. However, the uptake and methylation of these Hg-thiol complexes lacked the specificity displayed by *G. sulfurreducens*. The importance of these findings are further highlighted by the production and release of cysteine from growing cells of *G. sulfurreducens* which enhanced Hg (II) methylation in short term washed cell methylation assays. As a comparison, the iron-reducing bacterium, *Shewanella oneidensis* produced a compound only under anaerobic growth which significantly reduced Hg (II) availablility both to the parent strain as well as to *G. sulfurreducens*. These data suggest a facilitated uptake mechanism exists in both sulfate and iron-reducing bacteria with quite different patterns of specificity for Hg (II)-thiol complexes, and that cells can release thiols into the medium which can affect the speciation and availability of Hg (II). The possible mechanism (s) involved is an active area of research.

Biosignature analyses of two different types of granites by Raman spectroscopy

NADINE SCHÄFER[1]*, BURKHARD SCHMIDT[2] AND JOACHIM REITNER[1]

[1]Geoscience Center, Geobiology, University of Goettingen, Germany (*correspondence: nschaef1@gwdg.de) (jreitne@gwdg.de)

[2]Geoscience Center, Experimental & Applied Mineralogy, University of Goettingen, Germany (burkhard.schmidt@geo.uni-goettingen.de)

Raman spectroscopy belongs to the group of vibrational spectroscopy and is based on the fundamental vibrational motions of molecules, molecular ions and crystals. Therefore it is a powerful tool for the determination of both inorganic and organic matter. Furthermore Raman imaging gives the possibility of simultaneously collecting spectra from individual areas of the sample, so that the distribution of each material inside the sample can be visualized.

We performed Raman experiments for determining the mineralogical composition, as well as identifying organic remains inside the 'Äspö Diorite', Sweden. Samples were taken from a drill core obtained at 450 m depth in the Tunnel of Äspö (Äspö Hard Rock Laboratory). The main attention was directed at different fracture fillings with variable mineralogy and the associated phase boundaries, assuming a higher microbial activity at these sites. The organic remains could be further classified depending on their functional groups.

Furthermore with Raman imaging we were able to localize them mainly at the phase boundaries of fracture fillings inside the granitic structures. Additional investigations are underway to further characterize the organic signatures by linking them with associated groups of microorganisms.

For comparison we analyzed samples from the Triberg Granite (Black Forest, Germany). Most important are the differences in the type of organic remains. The Triberg granite contains various types of fracture fillings and it is known to contain fossilized fungal and bacteria remains [1].

[1] Reitner *et al*. (2006) In *Fungi in Biogeochemical Cycles* (ed. G.M. Gadd), pp.378–403. Cambridge University Press