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Molybdate inhibits mercury methylation of *Pseudodesulfovibrio hydrargyri* BerOc1 independently of sulfate-reducing metabolism

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Biogeochemical cycle of mercury (Hg) is driven by microorganisms that determine the production of one of its dangerous form, the neurotoxic methylmercury. In aquatic environments, anaerobic sulphate-reducing prokaryotes (SRP) are the main Hg methylators. The role of this microbial group on methylmercury production is usually determined using molybdate, as inhibitor of SRP [1-2]. The molybdate inhibition is thought to be linked to an intracellular decrease of ATP level due to the inactivation of the Sat, one of the enzymes involved in sulfate respiration. However, the mode of action of molybdate is still not well known. Here, two Hg methylators, the SRP *Pseudodesulfovibrio hydrargyri* BerOc1 and the non-SRP *Geobacter sulfurreducens* PCA, were used to evaluate the impact of molybdate on cell growth and Hg methylation. While PCA growth and methylation are not affected by molybdate, 1 mM of molybdate inhibits BerOc1 growth under sulfate respiration (50% inhibition) but also under fumarate respiration (complete inhibition). More surprisingly, Hg methylation of BerOc1 is totally inhibited at 0.1 mM of molybdate when grown under sulfate respiration with pyruvate as electron donor as well as fumarate respiration. At this concentration, a slight inhibition is observed when lactate is used for sulfate respiration. As molybdate is expected to reduce cellular ATP level, the lower Hg methylation observed with pyruvate could be the consequence of lower energy production. The expression of *hgcA* gene (involved in Hg methylation) is higher when exposed to molybdate in fumarate respiration as well as sulfate respiration when using lactate as electron donor, while the expression of *sat* gene is inhibited by molybdate in both sulfate respiration. The results indicate that the cellular response to molybdate in some SRP is variable and depends on the cellular metabolism. Since molybdate is widely used to evaluate the ecological role of SRP in Hg methylation process in ecosystems, the effects of molybdate seen on SRP metabolisms and Hg methylation in this study are valuable information that can shed light on the mechanisms of microbial Hg transformations in environmental studies.

[1] Biswas et al. BioMetals 2009, doi:10.1007/s10534-008-9198-8.

[2] Bouchet et al. Environ. Sci. Technol. 2018, doi:10.1021/acs.est.8b01885.