Methylmercury Production is Affected by Dissolved Organic Matter

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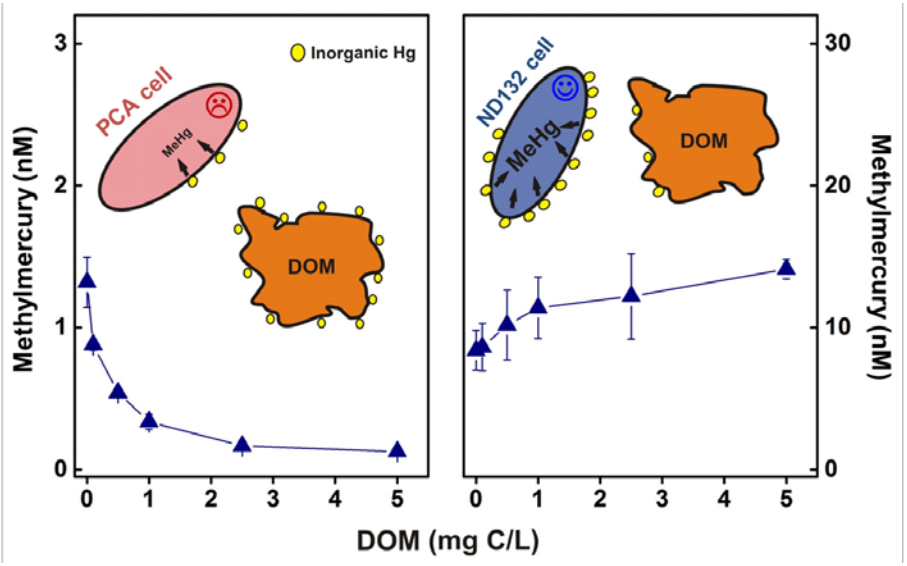
DOE Office of Science/Biological & Environmental Research

Objective

- Investigate the effects of natural dissolved organic matter (DOM) on Hg methylation by different bacterial strains



New Science

- We demonstrate that DOM can either inhibit Hg methylation by an iron-reducing bacterium *G. Sulfurreducens* PCA or enhance Hg methylation by a sulfate-reducing bacterium *D. desulfuricans* ND132
- DOM decreased Hg sorption by *G. sulfurreducens* PCA, but not by *D. desulfuricans* ND132 cells, demonstrating that ND132 has a higher affinity to sorb or take up Hg than the PCA strain
- We suggest that thiols in DOM likely played an essential role in affecting microbial strain-specific Hg uptake and methylation

Significance

- We show that DOM has opposing effects on Hg methylation by different bacterial strains and offer new insights into the role of DOM in methylmercury production in natural water and sediments

Zhao, L.; Chen, H.; Lu, X.; Lin, H.; Christensen, G. A.; Pierce, E. M.; Gu, B., Contrasting effects of dissolved organic matter on mercury methylation by *G. sulfurreducens* PCA and *D. desulfuricans* ND132. Environ. Sci. Technol. 2017. DOI: 10.1021/acs.est.7b02518.

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Natural dissolved organic matter (DOM) affects mercury (Hg) redox reactions and anaerobic microbial Hg methylation in the environment. Several studies have shown that DOM can enhance Hg methylation, especially under sulfidic conditions, whereas others show that DOM inhibits Hg methylation due to strong Hg-DOM complexation. In this study, we investigated and compared the effects of DOM on Hg methylation by an iron-reducing bacterium Geobacter sulfurreducens PCA and a sulfate-reducing bacterium Desulfovibrio desulfuricans ND132 under non-sulfidic conditions. The methylation experiment was performed with washed cells either in the absence or presence of DOM or glutathione, both of which form strong complexes with Hg via thiol-functional groups. DOM was found to greatly inhibit Hg methylation by G. Sulfurreducens PCA but enhance Hg methylation by D. desulfuricans ND132 cells with increasing DOM concentration. These strain-dependent opposing effects of DOM were also observed with glutathione, suggesting that thiols in DOM likely played an essential role in affecting microbial Hg uptake and methylation. Additionally, DOM and glutathione decreased Hg sorption by G. sulfurreducens PCA, but not by D. desulfuricans ND132 cells, demonstrating that ND132 has a higher affinity to sorb or take up Hg than the PCA strain. These observations indicate that DOM effects on Hg methylation are bacterial strain specific, depend on the DOM:Hg ratio or site-specific conditions, and may thus offer new insights into the role of DOM in methylmercury production in the environment.

Zhao, L.; Chen, H.; Lu, X.; Lin, H.; Christensen, G. A.; Pierce, E. M.; Gu, B., Contrasting effects of dissolved organic matter on mercury methylation by *G. sulfurreducens* PCA and *D. desulfuricans* ND132. Environ. Sci. Technol. 2017. DOI: 10.1021/acs.est.7b02518.