Metal(loid) speciation and transformation by aerobic methanotrophs

Obulisamy Parthiba Karthikeyan

Thomas J. Smith

Shamsudeen Dandare

Kamaludeen Sara Parwin

Heetasmin Singh

Hui Xin Loh

Mark R. Cunningham

Paul Williams

Tim Nichol

Avudainayagam Subramanian

Kumarasamy Ramasamy

Deepak Kumaresan

Video Byte

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Abstract

Manufacturing and resources industries are critical drivers of economic progress, but they release large amounts of waste, threatening the health of surrounding ecosystems and nearby human communities. Inorganic pollutants like heavy metals and metalloids are especially problematic because they persist and bioaccumulate. However, specialized bacteria called methanotrophs can detoxify them using only methane as a carbon/energy source. Methanobactin peptides help these bacteria bind and reduce certain metal ions, such as copper. These bacteria can also reduce chromium, selenium, and mercury into less-toxic forms. Chromium is released from industries such as tanneries, but bacteria such as *Methylococcus capsulatus* can reduce this metal over a range of concentrations. Methanotrophs can also detoxify selenium, which is associated with mining, coal combustion, and electronic equipment production, and package it into useful nanoparticles. Furthermore, the bacteria can detoxify mercury, a pollutant arising largely from coal-fired industries and artisanal and small-scale gold mining. Numerous factors can affect methanotrophs' detoxification ability, and their real-world biotic interactions remain unclear. Nevertheless, the evidence suggests that these bacteria are potentially valuable bioremediation agents for multiple types of heavy metal(loid) pollution.