Anaerobic Isoprene-Degrading Microorganisms and their Impact on Microbial Methane Dynamics in Deep-Sea Carbonates and Eucalyptus-Leaf Sediments

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Abstract

Isoprene, a highly abundant biogenic volatile organic compound, has emerged as a crucial yet overlooked factor in addressing climate change. Despite its widespread production in all forms of life, comprehensive data on its global biogeochemical cycle remain scarce. Isoprene's reactivity in the atmosphere influences methane concentrations, with detrimental implications for climate, air quality, and health. Conversely, methane is abundant in marine and terrestrial subsurface environments, where deep-sea carbonates serve as hotspots for microorganisms performing anaerobic methane oxidation—an essential process in long-term methane storage and removal from the marine carbon cycle. Recent studies by Beckmann et al. (2020), Prouty et al. (2020) have shed light on novel metabolic pathways utilized by microbial communities in carbonates for methane oxidation. Similarly, in terrestrial environments, eucalyptus trees, as the highest emitters of isoprene, may harbor microorganisms capable of metabolizing isoprene alongside methane-oxidation and formation in eukalyptus leaf detritus. However, little is known about the fate of isoprene and the potential microbial communities involved in its metabolism within deep-sea carbonates and eucalyptus-leaf sediments, potentially impacting methane metabolism. Our study aims to unravel the anaerobic pathways of microbial isoprene degradation and investigate the effects of isoprene abundance and degradation on microbial methane production and oxidation. We detected anaerobic isoprene-degradation in deep-sea carbonates and terrestrial eukalyptus-leave sediments, where methane oxidation and methane formation was pronounced. Surprisingly, the presence of isoprene inhibited mcirobial methane-oxidation as well as methane-formation, suggesting an substantial impact of the presence of isoprene on methane cycling and storage. We are currently characterizing and isolating the microorganisms involved in the isoprene and methane metabolism in these enrichment cultures.

Keywords

Isoprene, Methane metabolism, Deep-sea carbonates

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Conflicts of interest

The authors have declared that no competing interests exist.

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