Degradation of naphthalene and phenanthrene in contaminated marine sediments under sulfate reducing conditions

Lory Ann Hayes, *University of Massachusetts Amherst*

Abstract

This research examined the environmental fate of two polycyclic aromatic hydrocarbons (PAHs), naphthalene and phenanthrene, under *in situ*, sulfate-reducing conditions, and the composition of the microbial community associated with rapid anaerobic naphthalene degradation in marine sediment. ^ In sediments from Boston Harbor, Tampa Bay and San Diego Bay, a positive correlation was observed between rates of anaerobic PAH mineralization and the degree of *in situ* PAH contamination. Mineralization was inhibited by molybdate suggesting that sulfate-reducers were involved in the anaerobic PAH degradation. When relatively pristine sediments from San Diego Bay that lacked the capacity for anaerobic PAH oxidation were exposed to high concentrations of naphthalene they developed a potential for naphthalene degradation that was comparable to that in sediments that had a history of PAH contamination. Enumeration of naphthalene oxidizers indicated that the increase in potential for naphthalene degradation was associated with an increase in naphthalene degrading microorganisms. These results demonstrate that the potential for anaerobic PAH degradation exists in geographically diverse locations and is greater in sediments with a history of PAH exposure. In addition, these results suggest that many marine harbor sediments contain microorganisms capable of anaerobically oxidizing PAHs under sulfate-reducing conditions. Furthermore, pristine sediments can develop the ability to anaerobically oxidize PAHs upon exposure to the compounds. ^ The actual degradation of the *in situ* pools of PAHs was determined in petroleum-contaminated sediments incubated under strict anaerobic conditions. Over time there was a significant loss of some *in situ* PAH pools in live sediments, but not in sediments inhibited with poison or molybdate. This demonstrated for the first time that *in situ* pools of some PAHs in petroleum-contaminated marine sediments are degraded under sulfate-reducing conditions. ^ Analysis of bacteria in PAH-degrading enrichment cultures and the naphthalene-amended sediments revealed the presence of microorganisms which together with a closely related sulfate-reducing naphthalene-degrading isolate and other hydrocarbon degraders form a distinct phylogenetic group within the δ-Proteobacteria. These results demonstrate that the potential for PAH degradation under sulfate-reducing conditions is greater than previously considered. Therefore, if PAH inputs into marine sediments are reduced, the sediments may be capable of self-purification even under anaerobic conditions. ^

Subject Area

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