Anaerobic metabolism of organic compounds by hyperthermophilic microorganisms

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Abstract

From the time of their discovery in the early 1980's, hyperthermophilic microorganisms have been at the center of intense research to describe their diversity as well as the extreme geologic environments they inhabit. Although much has been learned about the metabolism of a select few pure culture isolates, very little is known about the great diversity of their metabolic potential, particularly *in situ*. Recent models for the fate of short-chain organic acids, and presumably aromatics and long-chain fatty acids, indicated that they must diffuse out of hydrothermal environments before being metabolized because no hyperthermophilic microorganisms in pure culture or in actual sediment or rock were known to utilize these substrates. In this study, the metabolism of the key fermentation product, acetate, as well as aromatic compounds was investigated in the hyperthermophilic microorganisms, *Ferroglobus placidus* and *Geoglobus ahangari*. In addition, the fate of ^{14}C-radiolabeld organic compounds was evaluated in hydrothermal sediments collected from a shallow marine vent on Vulcano, Italy. *F. placidus* and *G. ahangari* grew at 85°C in anaerobic medium with acetate as the sole electron donor and poorly crystalline Fe(III) oxide as the electron acceptor. Additionally, *F. placidus* was capable of using a variety of aromatic compounds as the sole electron donor for the reduction of Fe(III). In hydrothermal sediments from Vulcano, Italy, the radiolabeled acetate, palmitate, and glucose were completely oxidized to carbon dioxide coupled to sulfate reduction. Radiolabeled L-glutamate and benzoate were primarily oxidized to carbon dioxide, although incompletely. These results are the first indication that complex organic matter can be oxidized to carbon dioxide by hyperthermophilic microorganisms, and thus a complete carbon cycle may be modeled for hydrothermal systems. ^

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