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New approach for subsurface methanogenesis

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Quantitative understanding of microbially mediated methanogenesis is important in biogeochemistry for many reasons; Firstly, methanogenesis plays an important role in the carbon cycle on the Earth mediating a terminal process of organic matter degradation and a major metabolic process in anoxic sediments. Secondly, methane produced by methanogens results in methane hydrate formation which is a potential energy resource, while methane released to the atmosphere acts as a greenhouse gas. Thirdly, since methanogens are primitive organisms, clarification of their distribution and environmental factors controlling their activity provides better understanding of subsurface biosphere and environmental constraints for early life.

Although quantitative understanding of distribution and activity of methanogens is requisite for better understanding of methane biogeochemistry, available techniques are restricted to address this issue. Particularly, it is difficult to quantitatively detect a signal of modern methanogenesis from deep marine sediment cores where methanogenic activity is low and complex mixture of organic matter is accumulated during a geologic time scale. However, if function-specific compound directly involved in the methanogenic reaction can be quantified, we would be able to extract information about distribution and activities of methanogens in the marine sediments.

Recently we developed analysis of coenzyme F430. Since F430 catalyzes a terminal step of methanogenesis and possessed by all methanogens, it should be a good biomarker for methanogenesis. High sensitive detection of F430 by LC-MS/MS (sub-femto mol level) allows to detect F430 in marine sediment. We will present the developed methodology and application to sediment core samples.

Keywords: coenzyme F430, methanogenesis, LC-MS/MS, marine sediment