Influence of subsurface microbial communities on unconventional natural gas development

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Subsurface unconventional natural gas (UNG) resources, e.g., shale gas and coalbed methane (CBM), contain ~ 42% of worldwide gas reserves. Development of these resources is of high importance as they play a key role in the clean energy future and there is a high level of concern about the environmental impacts of UNG production. Recent research has focused on characterizing the microbial ecology of UNG systems in order to assess the effects of subsurface microbial communities on natural gas development. Microorganisms are typically thought to negatively impact energy production through well souring or corrosion, but subsurface microbial populations can also play an important role in enhancing UNG resources. In this talk I will highlight what is known about shale and CBM microbial ecology and our recent findings on microbial impacts on the geochemistry of shale gas systems and enhanced CBM.

Shale gas development has expanded rapidly in the past decade due to the advancement of new hydraulic fracturing technologies. The process results in large volumes of produced water returning to the surface, containing a mixture of injected fluid and formation water. Despite the addition of biocides during fracturing, microbial communities are recovered over the lifetime of a gas-producing well with diversity decreasing in parallel with increasing salinity and Ra and Ba concentrations. Halophilic, anaerobic fermentative *Halanaerobium* species typically dominate at the later stages of production. We recovered novel *Halanaerobium* strains from Pennsylvania shale gas wells and are studying their potential to degrade organic fracturing fluid additives, and to contribute to well souring and barite dissolution. These processes could have important implications for disposal or spills of wastes associated with shale gas production.

Microbial communities in CBM reservoirs are of particular importance for resource recovery as these subsurface communities can be exploited to convert coal to methane, thereby enhancing UNG reserves. We show that subsurface microbial communities in unproductive coals can be successfully stimulated to convert coal to methane via the addition of organic compounds that shift communty structure towards hydrocarbon degrading and methanogenic populations. Microbial populations in shale may be good targets for similar enhancement strategies.