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# Effects of Hydraulic Frac Fluids on Subsurface Microbial Communities in Gas Shales

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Shale gas is being considered as a complementary energy resource to coal or other fossil fuels. The exploitation of unconventional gas reservoirs requires the use of advanced drilling techniques and hydraulic stimulation (fracking). During fracking operations, large amounts of fluids (fresh water, proppants and chemical additives) are injected at high pressures into the formations, to produce fractures and fissures, and thus to release gas from the source rock into the wellbore. The injected fluids partly remain in the formation, while about 20 to 40% of the originally injected fluid flows back to the surface, together with formation waters, sometimes containing dissolved hydrocarbons, high salt concentrations, etc. The overall production operation will likely affect and be affected by subsurface microbial communities associated to the shale formations. On the one hand microbial activity (like growth, biofilm formation) can cause unwanted processes like corrosion, clogging, etc. On the other hand, the introduction of frac fluids could either enhance microbial growth or cause toxicity to the shale-associated microbial communities.
To investigate the potential impacts of changing environmental reservoir conditions, like temperature, salinity, oxgen content and pH, as well as the introduction of frac or geogenic chemicals on subsurface microbial communities, laboratory experiments under in situ conditions (i.e. high temperatures and pressures) are being conducted. Enrichment cultures with samples from several subsurface environments (e.g. shale and coal deposits, gas reservoirs, geothermal fluids) have been set up using a variety of carbon sources, including hydrocarbons and typical frac chemicals. Classical microbiological and molecular analysis are used to determine changes in the microbial abundance, community structure and function after the exposure to different single frac chemicals, “artificial” frac fluids or production waters. On the other hand, potential transformation reactions of frac or geogenic chemicals by subsurface microbiota and their lifetime are investigated.
In our “fracking simulation” experiments, an increasing number of hydrocarbon-degrading or halophilic microorganisms is to be expected after exposure of subsurface communities to artificial production waters. Whereas the introduction of freshwater and of easily biodegradable substrates might favor the proliferation of fast-growing generalistic heterotrophs in shale-associated communities. Nevertheless toxicity of some of the frac components cannot be excluded.