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Effects of hydraulic frac fluids and formation waters on groundwater microbial communities

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Shale gas is being considered as a complementary energy resource to other fossil fuels. Its exploitation requires using advanced drilling techniques and hydraulic stimulation (fracking). During fracking operations, large amounts of fluids (fresh water, proppants and chemicals) are injected at high pressures into the formations, to create fractures and fissures, and thus to release gas from the source rock into the wellbore. The injected fluid partly remains in the formation, while up to 40% flows back to the surface, together with reservoir waters, sometimes containing dissolved hydrocarbons, high salt concentrations, etc. The aim of our study was to investigate the potential impacts of frac or geogenic chemicals, frac fluid, formation water or flowback on groudnwater microbial communities.
Laboratory experiments under in situ conditions (i.e. at in situ temperature, high pressure) were conducted using groundwater samples from three different locations. Series of microcosms containing R2 broth medium or groundwater spiked with either single frac chemicals (including biocides), frac fluids, artificial reservoir water, NaCl, or different mixtures of reservoir water and frac fluid (to simulate flowback) were incubated in the dark. Controls included non-amended and non-inoculated microcosms. Classical microbiological methods and molecular analyses were used to assess changes in the microbial abundance, community structure and function in response to the different treatments. Microbial communities were quite halotolerant and their growth benefited from low concentrations of reservoir waters or salt, but they were negatively affected by higher concentrations of formation waters, salt, biocides or frac fluids. Changes on the microbial community structure could be detected by T-RFLP. Single frac components like guar gum or choline chloride were used as substrates, while others like triethanolamine or light oil distillate hydrogenated prevented microbial growth in groundwaters. Ongoing work will provide information on potential transformations of frac or geogenic chemicals by groundwater microbiota and their lifetime.