Biogeochemical controls on methane formation in Cherokee Basin coalbeds

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Natural gas from unconventional reservoirs is an increasingly important energy source because natural gas is cleaner than coal and recent technological advances have made large resources available. Learning more about the basic controls on biogenic gas formation in these systems could add to these advantages by promoting development of strategies to enhance microbial methanogenesis and extend the productive life of commerical gas wells. In this study, we examine what geochemical factors influence the activity and composition of microbial communities in Cherokee Basin coalbeds. The basin exists largely in southeastern Kansas, USA, and contains numerous thin (<1 m thick) Pennsylvanian coalbeds of relatively low thermal maturity (0.5-0.7 %Ro), which have been developed for gas production. During November 2013, we collected gas, formation water, and microbe samples from 16 commerical gas wells. The wells we sampled range from 3 to 9 years old and produce 7760 L day^{-1} (=49 bw day^{-1}) and 1035 m^3 day^{-1} (37 Mcf day^{-1}) of water and gas, respectively, on average. Water and gas geochemistry show no significant correlations with production data. Water samples we collected are Na-Cl type with total dissolved solids ranging from 36,000 to 98,000 mg L^{-1}. Carbonate alkalinity ranged from 3.3 to 8.4 meq L^{-1}, values that are low relative to many unconventional gas reservoirs that contain biogenic gas. The chemical and isotopic composition of gas we sampled, however, is consistent with a predominantly biogenic origin. Gas samples consisted almost entirely of methane (CH_4 avg. 97%; wetness avg. 2638) and the δD and δ13C of methane averaged -222‰ VSMOW and -61‰ VPDB, respectively. Low-levels of ATP were detected in water from 12 of the 14 wells that were tested (ATP avg. 2 relative light units), indicating that active microbial populations exist in the coalbeds and may continue to generate methane. We are currently performing additional analyses on our samples using culturing, microscopy, and nucleic acid-based techniques. We expect those analyses will yield further insight into biogeochemical controls on methane formation in the coalbeds.