SUBSURFACE DRIP IRRIGATION AS A METHOD TO BENEFICIALLY USE COALBED METHANE PRODUCED WATER: INITIAL IMPACTS TO GROUNDWATER, SOIL WATER, AND SURFACE WATER

Mark A. Engle(1), Carleton Bern(2), Richard Healy (3), James Sams(4), John Zupancic(5), Karl Schroeder(4)

(1) Eastern Energy Resources Science Center, U.S. Geological Survey, Reston, Virginia
(2) Crustal Imaging and Characterization Science Center, U.S. Geological Survey, Denver, Colorado
(3) National Research Program, U.S. Geological Survey, Denver, Colorado
(4) National Energy Technology Lab, U.S. Dept. of Energy, Pittsburgh, Pennsylvania
(5) BeneTerra, LLC., Sheridan, Wyoming

Abstract:
Coalbed methane (CBM) currently accounts for >8% of US natural gas production. Compared to traditional sources, CBM co-produces large volumes of water. Of particular interest is CBM development in the Powder River Basin of Wyoming and Montana, the 2nd largest CBM production field in the US, where CBM produced waters exhibit low to moderate TDS and relatively high sodium-adsorption ratio (SAR) that could potentially impact the surface environment. Subsurface drip irrigation (SDI) is an emerging technology for beneficial use of pre-treated CBM waters (injectate) which are emitted into the root zone of an agricultural field to aid in irrigation. The method is designed to minimize environmental impacts by storing potentially detrimental salts in the vadose zone. Research objectives include tracking the transport and fate of the water and salts from the injected CBM produced waters at an SDI site on an alluvial terrace, adjacent to the Powder River, Johnson County, Wyoming. This research utilizes soil science, geochemical, and geophysical methods. Initial results from pre-SDI data collection and the first 6-months of post-SDI operation will be presented.

Substantial ranges in conductivity (2732-9830 µS/cm) and dominant cation chemistry (Ca-SO_4 to Na-SO_4) have been identified in pre-SDI analyses of groundwater samples from the site. Ratios of average composition of local ground water to injectate demonstrate that the injectate contains lower concentrations of most constituents except for Cr, Zn, and Tl (all below national water quality standards) but exhibits a higher SAR. Composition of soil water varies markedly with depth and between sites, suggesting large impacts from local controls, including ion exchange and equilibrium with gypsum and carbonates. Changes in chemical composition and specific conductivity along surface water transects adjacent to the site are minimal, suggesting that discharge to the Powder River from groundwater underlying the SDI fields is negligible.

Findings from this project provide a critical understanding of water and salt dynamics associated with SDI systems using CBM produced water. The information obtained can be used to improve SDI and other CBM produced water use/disposal technologies in order to minimize adverse impacts.

Key words: coalbed methane, coalbed natural gas, produced waters, subsurface drip irrigation, Powder River Basin