

Microbial gas in the Illinois Basin: Pennsylvanian coals versus Devonian/Mississippian shales

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Pennsylvanian high volatile bituminous coals and the Devonian/Mississippian New Albany shales along with their associated gases have been studied using petrological, geochemical, and isotopic techniques to determine gas origin, timing of gas generation, and controls on gas distribution. Our study used gas and co-produced water samples from commercial coalbed methane (CBM) and shale gas-producing wells in the eastern part of the Illinois Basin in Indiana. Gas compositional and isotopic data indicate that CBM from coals at depths of up to 213 m (700 feet) is predominantly of microbial origin and contains less than 1 percent by volume of thermogenic gas. Microbially generated CBM volumes show large variations across distances of hundreds of meters between and within individual coal seams, and no relationship exists between gas volumes and coal depth. We suggest that these variations are either related to microbial extent of methanogenesis or to the degree of preservation of the gas. This, in turn, suggests that cleat and fracture characteristics of coal have a strong influence on the CBM distribution. In the same area, gas from the New Albany Shale occurs at depths of up to 823 m (2700 feet) and ranges in origin from dominantly microbial to dominantly thermogenic. The origin of gas from the New Albany Shale is controlled by depth, maturity, and salinity of formation water. Deeper, more mature shales, associated with higher-salinity waters, contain thermogenic gas, whereas shallower, less mature and lower-salinity shales tend to host microbial gas. Organic carbon content and the micropore volume of the New Albany shales serve as excellent predictors for microbial or thermogenic gas contents as long as there is no gas leakage because of the presence of conducting faults or shallow depths.

Chlorite as a primary source of arsenic in groundwater aquifer sediments in Bengal delta

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Detrital chlorite in the arsenic polluted groundwater aquifer sediment of Sonargaon, Bangladesh, was examined to evaluate as a primary source of arsenic. The chlorite separated from the micaceous sandy aquifer sediment was Fe-rich chlorite, chamosite. Microbeam XRF analysis at Spring-8 revealed that arsenic was ubiquitously distributed in the chlorite. Although the chlorite contained goethite as an impurity mineral on the cleavage, a certain portion of the arsenic was included in the chlorite crystal. The concentration of arsenic was a few tens mg/kg. Based on the XAFS analysis at Spring-8, As (III):As (V) is close to 1:1. The arsenic concentration was too low to determine the space of this element in the crystal, those would occupy both of Si and Fe.

Naturally arsenic polluted groundwater along the Ganges-Bramaputra- Meghna river systems has been explained to be formed via dissolution of arsenic adsorbed iron (oxy)-hydroxides in association with reduction of the groundwater due to microbial activity in the aquifer. The solubility and adsorption-desorption affinity of iron (oxy)hydroxides would control the arsenic concentration of the groundwater corresponding to the redox condition of the aquifer, it is the secondary mechanism to determine the level of contamination. The primary mechanism of arsenic polluted groundwater must be chemical weathering of detrital chlorite and/or other arsenic bearing minerals in the aquifer promoted by the infiltration of surface water.