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C, H-Isotope Ratios of Indiana Coalbed Methane and Their Genetic Implications

Sedimentary basins containing low-rank coals have, until recently, not been targeted for coalbed gas exploration, primarily because the low thermal maturity was not expected to have generated sufficient thermogenic gas. However, the accelerated coalbed methane (CBM) development in the Powder River Basin has changed this perspective and initiated growing interest in the coalbed gas potential of less mature basins like the Illinois Basin. Limited information exists on the content and origin of gas in the Illinois Basin; therefore an adequate exploration model for CBM in this basin is lacking. This study addresses the origin of coalbed gas in Indiana based on carbon and hydrogen stable isotope ratios in methane. Gas samples were collected in Indiana from wells in Knox and Sullivan Counties. Several gas samples were collected from wells producing coalbed gas from the Seelyville coal at depths ranging from 350 to 475 ft. For comparison, samples were collected from wells producing gas from mine voids in the Springfield coal (423 ft. deep) and from a Pennsylvanian sandstone reservoir (850 ft. deep). Methane from the Seelyville coal has isotopic ratios ranging from $\delta^{13}C$ = -59 to -65.5 ‰, and from δD = -180 to -205 ‰. Methane in mine gas from Springfield coal has a $\delta^{13}C$ value of -60 ‰ and a δD value of -201 ‰. In contrast, methane from the sandstone reservoir is characterized by $\delta^{13}C$ = -52.5 ‰ and δD = -208 ‰. The overall ranges of $\delta^{13}C$ and δD values for coalbed methane suggest a dominantly biogenic/microbial mechanism of gas formation. On the other hand, methane from the sandstone reservoir is likely thermogenic in origin, with minor biogenic input.