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Microbial Processes and Natural Gas Accumulations

Barry Jay Katz
Chevron Energy Technology Company, Houston, TX

Microbial processes are responsible for the formation, alteration, and destruction of natural gas accumulations. Biogenic or bacterial gas accumulations may be quite significant and may account for 30% or more of the global natural gas resource-base and may dominate in individual basins. Furthermore, the resource estimate does not effectively account for the contribution of mixed biogenic-thermogenic gases, which appear to be quite common and may only be effectively assessed if wet gas components (C_{2+}) are present.

Biogenic gas accumulations form through multiple pathways, including fermentation and carbonate reduction, and may be derived from both sedimentary organic matter and pre-existing oil accumulations. Independent of pathway or source, multiple "steps" appear to be involved with bacterial communities required to breakdown the large macromolecules into something that the methanogens can effectively utilize as an energy source. Although biogenic gas accumulations are typically considered as dry (i.e., depleted in C_{2+} components) there is clear evidence that ethane may also form through bacterial processes. Just as with the methane, biogenic ethane is isotopically light. Numerous authors have provided guidance on the conditions that favor biogenic gas formation and accumulation including: an anoxic setting, high rates of sedimentation, formation of early traps, low temperatures, and limited availability of sulfate.

Gas accumulations may also be biodegraded. Biodegradation results in the preferential removal of C_{3-5} *n*-alkanes, leaving isotopically heavy residuals of these compounds. Ethane is resistant to biodegradation. At more advanced levels of biodegradation the wet gas components are removed yielding a dry gas. As with the biodegradation of oil, the biodegradation of a gas accumulation results in a reduction of the resource base. The isotopic compositional changes induced by bacterial alteration of gas accumulations can often complicate their interpretation suggesting more advanced levels of thermal maturity.