

Geochemistry of Shale Gases From Around the World: Commonalities and Variations

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ABSTRACT

We collected and investigated published chemical data on >1,300 samples of gases recovered from shales in >20 basins in Argentina, Canada, China, France, Poland, Saudi Arabia and the USA. Most shale gases are relatively dry (average dryness $C1/(C1-C5)$ is 0.94) and contain nitrogen (average about 6%) and CO₂ (average about 2.5%). Methane has carbon isotopic composition $\delta^{13}C$ ranging from -70‰ to -24‰ and averaging around -42‰. Most shale gases have thermogenic origin, although gases from New Albany shale in the Illinois basin, Antrim shale in the Michigan basin, and Colorado shale in the Western Canada Sedimentary Basin have predominantly primary or secondary microbial origin. Isotopic reversal of the normal trend in carbon isotopic composition such that $\delta^{13}C$ of methane is larger than $\delta^{13}C$ of ethane is a common phenomenon observed in about 40% of studied samples. The vast majority of samples showing isotopic reversal have thermogenic origin and are very dry (ratio $C1/(C1-C5)$ exceeding 0.97 and averaging 0.99) suggesting that isotopic reversal is common among thermogenic gases with very high maturity. However, isotopic reversal of the normal trend in hydrogen isotopic composition such that δD of methane is larger than δD of ethane is observed among both thermogenic and microbial shale gases.