Hydrocarbons in Groundwater Overlying the Eagle Ford, Fayetteville, and Haynesville Shale Unconventional Oil and Gas Production Areas, USA

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Water wells in aquifers overlying the Eagle Ford, Fayetteville, and Haynesville Shale hydrocarbon production areas were sampled for chemical, isotopic, gas, and groundwater-age tracers to investigate the occurrence and sources of selected hydrocarbons in groundwater. Methane isotopes and hydrocarbon gas compositions indicate most of the methane in the wells was biogenic and produced by the CO_2 reduction pathway, not from thermogenic shale gas. Two samples contained methane from the fermentation pathway that could be associated with hydrocarbon degradation based on their co-occurrence with hydrocarbons such as ethylbenzene, butane, and methyl tert-butyl ether.

Benzene was detected at low concentrations (<0.15 µg/L), but at relatively high frequencies (2.4–13.3%), in the study areas. $^{3}H/^{3}He$, SF_6, and ^{14}C were used to estimate mean groundwater ages and evaluate whether benzene was from surface or subsurface sources. Eight of nine samples containing benzene had mean groundwater ages >2,500 years, indicating the benzene was from subsurface sources. One sample from the Fayetteville study area contained benzene that could be from a surface release associated with hydrocaron production activities based on its mean age (10±2.4 years) and proximity to hydrocarbon wells. Overall, mean groundwater travel times from recharge areas to drinking-water wells were mostly >30 years, indicating timescales of decades or longer may be needed to fully assess the effects of potential surface releases of hydrocarbons on the wells.