



Using carbon and hydrogen isotopic composition of hydrocarbons to decipher biodegradation effects in petroleum reservoirs

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Biodegradation of organic compounds goes along with an enrichment of the heavier stable isotopes in the residual fraction of the organic substrates. Therefore, carbon and hydrogen isotopic compositions of certain alkylbenzenes (BTEX), *n*-alkanes, chlorinated ethenes and MTBE were used to trace biodegradation in laboratory experiments(Meckenstock et al., 2004). Using the Rayleigh equation, the changes of isotopic composition and concentration are correlated by the isotope fractionation factor. This factor has to be determined for every compound in separate degradation experiments. With the knowledge of individual carbon isotope fractionation factors it was possible to quantify the amount and rate of biodegradation of individual light hydrocarbons in a contaminated aquifer from the carbon isotope ratios(Vieth et al., 2005). Recently, this approach, based on carbon isotopic composition of the light hydrocarbons, was verified by studying crude oil samples from the Gullfaks oil field, offshore Norway .(Vieth and Wilkes, 2005).

Evaluation of hydrogen isotope ratios of individual light hydrocarbons concerning quantification of biodegradation seems to be more complicated. In laboratory experiments, biodegradation of *n*-hexane, benzene, toluene and MTBE is related to an enrichment in deuterium and the concentration and isotope data fulfil the Rayleigh-equation. However, in petroleum reservoirs the evaluation of hydrogen isotope ratios in terms of biodegradation is difficult, for example due to isotope effects caused by maturation processes over geological timescales ...(Radke et al., 2005).

Within this presentation we will demonstrate how carbon and hydrogen isotope data of

light hydrocarbons can be used to decipher biodegradation processes within petroleum reservoirs.

Literature:

.Meckenstock R. U., Morasch B., Griebler C., and Richnow H. H. (2004) Stable isotope fractionation analysis as a tool to monitor biodegradation in contaminated aquifers. *J. Contam. Hydrol.* **75**, 215-255.

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