Position-specific isotope composition of natural gas hydrocarbons: recent insights and future prospects

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Hydrocarbons are the main consistuent of natural gas and their isotope composition (^{2}H, ^{13}C) provide useful information about their formation. Recently a variety of methods have been developed aiming at determining position-specific (terminal vs central position) isotope composition of short-chain hydrocarbons [1][2][3].

Here we review the data obtained so far from the on-line pyrolysis of C_{3+} hydrocarbons [3]. The method allows the determination of $\delta^{13}C$ value for each position of propane, *i*-butane and *n*-butane in a single run. We applied this approach to lab simulation experiments and bacterial cultures, as well as to natural samples of various origins. We notably show that:

(i) Thermogenic and abiotic hydrocarbons have clearly distinguished position-specific ^{13}C signatures: while for thermogenic hydrocarbons CH_3 positions are depleted in ^{13}C, it is the opposite for abiotic hydrocarbons. These data are consistent with models of hydrocarbon formations [4].

(ii) Anaerobic bacterial oxidation of hydrocarbons leads to specific ^{13}C-enrichment on the central position of hydrocarbons. This signature is different from a thermogenic one and provides a way to detect bacterial oxidation of hydrocarbons in natural gas basins. Thus, we clearly show that natural gas samples from Michigan basin and Southern Ontario have been degraded by bacterial oxidation.

On the whole, position-specific isotope analysis of hydrocarbons helps refining the information regarding formation and alteration of natural gas hydrcarbons, making it a particularly interesting tool for the exploration of fossil fuel energy resources.

[1] Piasecki et al., **2016** GCA *v188* p58[2] Gao et al., **2016** Chem Geol. *v435*, p1 [3] Gilbert et al., **2016** GCA *v177*, p205 [4] Suda et al., **2017** GCA *v206*, p201