Position Specific Carbon Stable Isotope Ratios Analysis of Natural Gas by Microbial Oxidation and Chemical Cleavage

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Abstract

Compound Specific Isotope Analysis (CSIA) of natural gas was preformed as a routine analysis in petroleum explorations after Gas Chromatography – Combustion – Isotope Ratio Mass Spectrometer (GC-C-IRMS) commercialized(BAYLIS et al., 1994). The technology of CSIA can distinguish every component of the natural gas using gas chromatography method but limited by only providing average data of whole molecule so that can not discriminate isotope ratio of the specific carbon atom within the molecules. The oil exploration in Taiwan, natural gas is the major product in the historical drilling record. To obtain more knowledge from the limited resources, it could be extremely significant to deploy new methodologies for improving normal small alkane stable isotope analysis. Position Specific Isotope Analysis (PSIA) could be the alternative for the hydrocarbon analysis mediated by microbial activation and chemical degradation. It owns the advantage to provide intrinsic carbon stable isotope fingerprint of propane (C3), *n*-butane (C4) and *n*-pentane (C5) in natural gas.

The methodology was developed using several different methanotrophic bacteria or normal alkane utilized strains, such as *Methylococcus capslatus* (Bath), *Pseudomonas oleovorans* and *Pseudomonas putida* C8101, as the key components to hydroxylate *n*-alkane of natural gas(JOHNSON and HYMAN, 2006). All of the highlighted species exhibit the upstream carbon source fixing enzymes (soluble methane monooxygenase (sMMO), particulate methane monoxygenase (pMMO) and alkane monooxygenase (AMO)) and can oxidize C3, C4 and C5 regio-specifically with sole products.(HANSON and HANSON, 1996) After adjusting the $\delta^{13}C$ variation during isotope fractionation and kinetic isotope effect (KIE), rational designed KIE-free chemical cleavage was performed accordingly.(HUANG et al., 1999; HUANG et al., 2002) The whole PSIA methodology can provide 1‰ resolution in both methyl and methylene carbons of propane and *n*-butane, respectively, as well as the terminal carbon of *n*-pentane. Since alkane monooxygenase reveals C3-C16 oxidative activity, the applications for various regio-specific activation enzymes

exhibit great opportunities and potentials for the PSIA studies of normal hydrocarbon.

Reference

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