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Recent Developments in Stable Isotope Geochemistry of Light Hydrocarbons

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Light hydrocarbon gases ($C_1 - C_5$) are some of the most ubiquitous fluids within the Earth with different sources, transport-degradation processes, and sinks. Major formation mechanisms of these light hydrocarbons include microbial, thermogenic, and abiogenic. The compositions and bulk isotope ratios ($^2H/^1H$ and $^{13}C/^{12}C$) of light hydrocarbons have been extensively utilized to investigate their origins and alteration pathways. Most natural compounds, including light hydrocarbons, are composed of a set of diverse isotopic molecules that differ in the number of isotopic substitutions (isotopologues) and positions of isotopic substitution within a given molecules (isotopomers). Currently, several new analytical technologies have been developed to determine multiply-substituted isotopologues (“clumped” isotopes) and site-specific isotope fractionation (isotopomers) of light hydrocarbons, including high-resolution isotope ratio mass spectrometry and tunable IR laser absorption spectroscopy. We have been developing quantitative NMR spectroscopy techniques to determine both 2H and ^{13}C isotopomers of light hydrocarbon ($C_3 - C_5$), along with theoretical investigations into isotopomers of light hydrocarbons. This presentation is our progress report to highlight and share our success and challenges to date.