Geophysical Research Abstracts
Vol. 12, EGU2010-15083, 2010
EGU General Assembly 2010

Two-Dimensional Stable Isotope Fractionation During Aerobic and Anaerobic Alkane Biodegradation and Implications for the Field

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Quantitatively, n-alkanes comprise a major portion of most crude oils. In petroliferous formations, it may be possible to relate the loss of these compounds to the levels of biodegradation occurring in situ [1]. Moreover, it is important to develop indicators of alkane degradation that may be used to monitor bioremediation of hydrocarbon-impacted environments. Desulfoglaeba alkanexedens and Pseudomonas putida GPo1 were used to determine if carbon and hydrogen stable isotope fractionation could differentiate between n-alkane degradation under anaerobic and aerobic conditions, respectively in the context of the Rayleigh equation model [2]. Bacterial cultures were sacrificed by acidification and headspace samples were analyzed for stable isotope composition using gas chromatography-isotope ratio mass spectrometry. Carbon enrichment factors ([U+F065]bulk) for anaerobic and aerobic biodegradation of hexane were -5.52 $\pm$ 0.2‰ and -4.34 $\pm$ 0.3‰ respectively. Hydrogen enrichment during hexane degradation was -43.14 $\pm$ 6.32‰ under sulfate-reducing conditions, and was too low for quantification during aerobiosis. Collectively, this indicates that the correlation between carbon and hydrogen stable isotope fractionation ([U+F04C][U+F029][U+F020]may be used to help elucidate in situ microbial processes in oil reservoirs, and during intrinsic as well as engineered remediation efforts.

References

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