Predicting Microbial Growth Yields in Low Energy Environments

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Traditional kinetic and thermodynamic biogeochemical models applied to the subsurface rely heavily on either microbial growth yields measured in the laboratory or predicted using standard thermodynamics-based methods. However, the impact of low energy supply on growth yields and their prediction is poorly constrained. In this study, the Gibbs energies of catabolism (ΔG_{cat}) under non-standard conditions were calculated for more than 150 observed growth yields (Y_{obs}) comprising mostly low-energy yielding anaerobic heterotrophic and autotrophic processes. The various methods for predicting growth yields were evaluated and showed a lower relative error in a modified Gibbs energy dissipation model (40%) over the more commonly used thermodynamic electron equivalents model (67%). In addition to predicting growth yields, we will also discuss our efforts to develop a kinetic and thermodynamic based biogeochemical model which explicitly accounts for energy used for both microbial maintenance and growth using a dynamic growth yield.