How to use extracellular enzyme biochemistry to better predict the effect of increasing CO_2 on microbe-organic matter interactions

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Microorganisms interact with complex organic matter through the intermediate of extracellular enzymes, which convert large biomolecules into oligomers or monomers small enough to be taken up via membrane transport proteins. The response of extracellular enzymes to increasing temperatures and decreasing seawater pH will therefore depend to an important degree on the physical/chemical effect of those changing conditions on extracellular enzymes, and on changes in the set of enzymes that are expressed under changing conditions. While environmental enzyme activities have been the subject of considerable study (including the response of enzyme activities to increasing CO_2), these studies are largely instrumental: they collapse large classes of enzymes, and typically only examine maximum potential hydrolysis rates of model compounds. In this talk, I will describe how a closer examination of the biochemistry of extracellular enzymes in aquatic environments can lead to a more detailed, mechanistic understanding of microbe-organic matter interactions. For instance, I will describe a technique to evaluate the substrate specificity of aquatic peptidases *in situ*, which may be used to evaluate how changing pH may change the fraction of organic matter that is labile to extracellular peptidases. Finally, I will suggest how an improved mechanistic understanding of microbial extracellular enzymes can be used to create better predictive models of organic carbon remineralization / preservation rates under changing environmental conditions.