

Effects of Deep Ocean Pressure on Enzymatic Mechanisms of Organic Matter Degradation

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Microbial communities use extracellular enzymes to hydrolyze high molecular weight organic matter to sizes suited for uptake. Hydrolysis of polysaccharides yields products available to other organisms (via 'external hydrolysis'); polysaccharides may also be processed via 'selfish uptake', in which binding, hydrolysis, and uptake occur without loss of hydrolysis products to the environment. Both mechanisms are widespread in the surface ocean. We recently discovered that selfish uptake is also common throughout the depths of the water column. These experiments, however, were carried out at atmospheric pressure. To investigate the effects of pressure on enzymatic processes, we measured hydrolysis in surface and deep waters at atmospheric and high hydrostatic pressures. External hydrolysis of polysaccharides by surface-ocean communities was greatly reduced by high hydrostatic pressure; deep ocean communities showed less pressure sensitivity, and in some cases showed pressure enhancement. Even for deep ocean communities under pressure, however, some polysaccharides were not externally hydrolyzed. Selfish uptake of polysaccharides, in contrast, was considerably less affected by elevated pressure, even for surface ocean communities. Moreover, all polysaccharides tested to date were selfishly taken up under pressure. These results suggest that selfish uptake plays an important role in carbon processing, consuming polysaccharides that are not externally hydrolyzed in the deep ocean.