Revisiting the theory of ‘enzymic latch’ on carbon in peatlands

Peatlands are sinks of atmospheric carbon, mainly due to water-saturated soil conditions, decay-resistant plant litter and other factors such as the presence of biochemical inhibitors of decomposition. Soluble phenolics are traditionally considered to be the key inhibitors as they may immobilize microbial exoenzymes. The ‘enzymic latch’ theory assumes that phenolics accumulate in peat water due to anoxia, because it limits the activity of phenolics-degrading oxidative enzymes (Freeman et al. 2001). However, later studies do not support this theory. We aimed to verify the effect of added soluble phenolics at different concentrations on the activity of oxidative and hydrolytic enzymes and on respiration rate of the microbial community. We also tested the ability of various phenolics and Sphagnum-derived pectinaceous carbohydrate (sphagnan) to suppress enzymatic activity in vitro (without microbes). We found no negative relationship between hydrolytic enzymes activities and phenolics concentration. On the contrary, extreme addition of phenolics supported the activity of both, enzymes and microbial respiration. Phenolic monomers we tested did not reduce the in-vitro enzymatic activity while the polysaccharide sphagnan inhibited the activity similarly to tannic acid (phenolic oligomer). In summary, our results do not support the enzymic latch theory at all. Peatland phenolics are poor enzyme inhibitors; sphagnan has an inhibitory potential but it waits for evaluation.