Microbial bioenergetics along a Scots Pine stand age gradient

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Theoretical ecological frameworks [1] have suggested that the more complex ecosystems become in terms of their food webs, the more efficient they are in utilizing resources. A corollary of this is that microorganisms residing in mature ecosystems will be more efficient in respect of biomass production and will release less CO_2 and heat from the system.Thus, soil carbon sequestration potential may increase with ecosystem maturity. We recently devised a novel thermodynamically based approach for gaining improved comprehension of microbial community function [2]. Pertinent to this, the nominal oxidation state of carbon (NOSC) has been proposed as a universal metric of organic matter to characterize the bioenergetics potential for microbial metabolism [3;4]. These terrestrial bioenergetic approaches may improve our understanding of microbial resource-use efficiency in relation to ecosystem maturity with NOSC as a potential proxy for this property in soil organic matter models.

We will present results from a study focusing on a primary succession gradient with Scots Pine stands between 12 up to 158 years since the last clear cut. Soil samples were amended with a range of carbon substrates varying in NOSC. These substrates are representative for root exudates. Microbial functional diversity (multiple-substrate induced respiration and microbial energetics) were related to community diversity determined via next generation sequencing. We observed a close relation between NOSC, functional diversity profiles and the abundance of fungal communities. Our results indicate that there is a clear scope using NOSC as a proxy for resource-use efficiency in soil organic matter models. We will discuss the potential of using terrestrial bioenergetics to further our understanding of the role of soils in governing the terrestrial carbon cycle and climate regulation.

[1] Odum (1969) *Science* 164, 262-270. [2] Herrmann et al. (2014) *Environ Sci Tech* 44, 4344-4352 [3] LaRowe & Van Capellen (2011) *Geochim Cosmochim Acta* 75, 2030-2042 [3] Nunan et al. (2015) *Soil Biol Biochem* 88, 126-136