Soil Respiration – A Wetlands Perspective

PHILIPPE VAN CAPPELLEN

Ecohydrology Research Group, University of Waterloo, Waterloo, Canada (correspondence: pvc@uwaterloo.ca)

Wetlands are an essential part of the Earth's life support system. They provide a wide range of ecosystem services, from food production, via flood protection to pollution abatement. In many parts of the world, however, mounting anthropogenic pressures, for example, water diversion, encroachment, salinization and climate change, are threatening wetlands. Because of their significance, as well as their vulnerability, wetlands are the only class of ecosystems with an international convention dedicated to their protection and sustainable use (the Ramsar Convention). In this presentation I will focus on the biogeochemical functions of wetland soils. As soil biogeochemistry is largely driven by the decomposition of plant-derived organic matter by microorganisms, I will review a number of the physical, biological and geochemical factors that control the turnover of organic matter in wetland soils. Besides the nature of the organic matter itself, key controlling factors include the soil pore network, soil aggregation, water saturation, redox conditions, temperature, and the microbial community structure. I will further discuss the importance of bioenergetic limitations on soil respiration processes. To conclude the presentation, I will highlight a number of areas where I believe geochemists can provide new and timely insights, for example on the effects of redox fluctuations and freeze–thaw cycles on soil organic matter decomposition.

Where Groundwater Meets Surface Water

PHILIPPE VAN CAPPELLEN

Ecohydrology Research Group, University of Waterloo, Waterloo, Canada (correspondence: pvc@uwaterloo.ca)

Biogeochemical processes at transitions between groundwater and surface waters play a major role in the regional biogeochemical cycles of carbon, nutrients and trace elements. These interfaces occur along the entire aquatic continuum, from headwaters to the coastal zone, and include flood plains, seepage areas, riparian soils and the hyporheic zone. However, while the biogeochemical significance of groundwater–surface water interfaces (GSWIs) is generally recognized, the underlying mechanisms and determining properties have yet to be fully unravelled. GSWIs exhibit unique hydrological, geochemical and ecological characteristics, including variable hydraulic gradients, complex flow dynamics, fluctuating redox conditions and diverse, multifunctional biological communities. In this presentation, I will highlight the biogeochemical functions of GSWIs, with a particular emphasis on the biogeochemical implications of the dynamic redox conditions that characterize many GSWI environments. The key take-home message of the presentation is that observations made under stable, "average" environmental conditions may not be sufficient to predict the fate of nutrients and contaminants at GSWIs. Stated otherwise, rate measurements, chemical speciation, microbial abundance, biodiversity, and other experimental data should be obtained under the dynamic conditions representative of GSWIs, both in the laboratory and in the field.

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DOI:10.1180/minmag.2013.077.5.22