Forms and Stability of Organic Phosphorus in Wetlands

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Introduction

Our research at AMRIS has used solution ^{31}P NMR spectroscopy to determine the chemical nature of organic phosphorus in natural and constructed wetlands. The resulting advances in our understanding of phosphorus sequestration in wetlands will contribute to informed management decisions aimed at improving water quality from constructed wetlands and preservation of natural wetlands.

Our studies at AMRIS are part of the first comprehensive effort to study organic phosphorus in wetlands using solution ^{31}P NMR spectroscopy. This has yielded surprising results, including the fact that in direct contrast to upland systems, a large proportion of the phosphorus in wetlands is to be found in forms that are considered to be unstable in the environment, including phosphate diesters (DNA, phospholipids) and polyphosphates [1]. This has significance for efforts to sequester phosphorus in stable forms in constructed wetlands.

Experimental

Current work is progressing on three fronts: (1) the development of the methodology applied to the study of phosphorus by solution ^{31}P NMR spectroscopy in wetland soils [2,3]; (2) the expansion of previous work to encompass a range of wetland types and environmental gradients; (3) manipulative studies to investigate mechanisms regulating the forms of organic phosphorus in wetland soils.

Spectra have been acquired at the McKnight Brain Institute's AMRIS facility. Specifically we have used the Bruker Avance 500 Console, Magnex 11.75 T/54mm magnet, deploying both the 10 and 5 mm BBO Probe. Briefly, lyophilized extracts are dissolved in 3.6 ml of 1 M NaOH plus 0.1 M EDTA, with 0.4ml D2O for signal lock. Due to the low concentrations of phosphorus present as well as the nature of the re-suspended soil extracts, acquisition is carried out at a stabilized 25°C with a 4.83 µsec (~30°) pulse length and a 2.00 sec recycle delay.

Conclusions

Acquisition techniques and personnel skills have been developed to provide high quality quantitative spectra at the AMRIS facility. These skills are providing key data on a range of issues arising from the routine analysis of soil extracts. Specifically data on the fate of organic phosphorus molecules under anaerobic conditions, and the range of inputs into wetland systems that can be expected from plant detrital material.

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References

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