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Spatio-temporal variability of nitrogen and major ions in a nitrogen-enriched, calcareous fen and contiguous waters

PHILLIP AGREDAZYWCZUK, STEVE ROBINSON AND ANDREW WADE

University of Reading

Presenting Author: jy829835@student.reading.ac.uk

Peatlands are unique ecosystems and can be important hotspots of geochemical cycling, including nutrient retention and export which is sensitive to environmental change such as hydrologic fluctuations or pollutant loading. However, questions regarding the response of nutrient retention and export processes to environmental deterioration remain, especially the response of lowland fens. To better understand and quantify peatland nutrient processing, a fortnightly and spatially comprehensive monitoring programme was initiated in a lowland calcareous riparian fen in South East England, subject to groundwater abstraction and nitrate enrichment, emanating from 'legacy nitrate storage' of the Chalk aquifer. Hydrological and hydrochemical monitoring is ongoing to characterise groundwater springs, surface water, Chalk groundwater, and peat porewater. Preliminary results suggest a limited hydrologic drawdown gradient across the fen which is restricted to the fen sites closest to the abstraction, and consistently low C/N ratios across the fen peat (median range: 14.0 to 19.1). High nitrate concentrations are evident in the groundwater (M = 7.36 mg NO_3-N l^{-1}, CV = 0.27), springs (9.55 mg NO_3-N l^{-1}, 0.30) and stream (7.85 mg NO_3-N l^{-1}, 0.27), contrasting with the peat porewater (1.10 mg NO_3-N l^{-1}, 1.39) which varies across the fen and over time. Principle components and hierarchical cluster analysis (PCA and HCA) of the concentrations of major nutrients (NH_3-N, NO_3-N, DON, P), selected cations (Ca^{2+}, Mg^{2+}, Na^{+}, K^{+}, Fe^{2+}, Al^{3+}) and non-purgeable organic carbon (NPOC) identified a grouping of groundwater spring, surface water and Chalk groundwater data distinct from the peat porewater. Furthermore, correlation analysis of peat porewater show negative relationships between NO_3-N and Fe^{2+} ($r = -0.46$, $p = 2.55E^{-09}$), and between NO_3-N and NPOC ($r = -0.42$, $p = 8.70E^{-08}$). The results suggest a relatively high water table was maintained throughout, facilitating a near-constant supply of nitrate-enriched water and anoxic conditions, despite the adjacent groundwater abstraction. Currently, evidence suggests hotspots of considerable nitrogen processing exist within the fen. Laboratory-based studies of intact peat columns from the fen will investigate further the response of geochemical cycling in peat porewater to hydrologic and nitrate fluctuations.