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What controls the oxidative ratio of UK peats? A multi-site study of elemental CHNO concentrations in peat cores

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The oxidative ratio (OR) is the amount of CO_2 sequestered in the terrestrial biosphere for each mol of O_2 produced. The OR governs the effectiveness of a terrestrial biome to mitigate the impact of anthropogenic CO_2 emissions and it has been used to calculate the balance of terrestrial and oceanic carbon sinks across the globe. However, few studies have investigated the controls of the variability in OR. What factors affect OR – climate? Soil type? Vegetation type? N deposition? Land use? Land use change? Small shifts in OR could have important implications in the global partitioning of CO_2 between the atmosphere, biosphere, and oceans.

This study looks at peat soils from a series of sites representing a climatic transect across the UK. Duplicate peat cores were taken, along with samples of above-ground vegetation and litter, from sites in northern Scotland (Forsinard), southern Scotland (Auchencorth), northern England (Moor House; Thorne Moor) through the Welsh borders (Whixhall Moss) and Somerset levels (Westhay Moor) to Dartmoor and Bodmin Moor in the south west of England. Sub-samples of the cores were analysed for their CHNO concentrations using a Costech ECS 4010 Elemental combustion system. Using the method of Masiello et al. (2008), OR values could be calculated from these elemental concentrations.

Results show that OR values of UK peats varied between 0.82 and 1.27 with a median value of 1.08 which is within the range of world soils. There were significant differences in OR of the peat between sites with the data falling into two broad groupings – Group 1: Forsinard, Auchencorth, Dartmoor and Bodmin Moor; Group 2: Moor House, Thorne Moor, Westhay Moor, Whixhall Moss. Whilst there were significant changes ($p < 0.05$) in elemental ratios with increasing peat depth (increasing C:N ratio and decreasing O:C ratio) there was no significant difference overall in OR with depth. This paper will explore some of the possible controlling factors on these ratios.

Local vegetation was also sampled along with agricultural soils from the local area of the peat cores to compare the relative differences in different mediums. Significant differences ($p < 0.01$) between vegetation, agricultural soils and surface peat layers were found where vegetation had OR values of 1.03 ± 0.04 and agricultural soils had OR values of 1.15 ± 0.04. Further discussion of these results from these comparisons is also presented in this study.