The Effect of Weathered Bedrock on Peatland Pool Water

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A pool formed through gully blocking, Kinder.

Introduction

Over past decades, many UK peat uplands have suffered from severe erosion on a widespread scale, due to historical pollution and land use practices. In some areas, such as the Peak District, deep erosion gullies have formed, cutting through metres of peat to the bedrock below and holding shallow pools or streams of peaty water.

Even where peatlands have undergone extensive restoration, ground where the peat has been stripped away to expose bedrock, and large gullies with exposed weathered rock, can remain. This study explored the influence of bedrock sediment, from three contrasting geological areas, on the pH, mineral content and dissolved organic carbon (DOC) in peatland water.

Sampling erosion gully sediment on the Kinder Plateau

What we did

Geology can influence the pH and the mineral content of the water leading to changes in DOC solubility and flocculation of humic substances (Evans et al 2015; Evans et al 2013; McKnight et al 2002, Mosher & Findlay 2011). Laboratory column experiments were used to test whether rock sediment on eroded peatlands could be having a similar effect on the on gully pools and streams in eroded peatlands (Figure 1)

- Three different geological sediments were tested: coarse sandstone from Kinder Plateau (Peak District), limestone/clay from Moor House (North Pennines) and schist/clay from the Migneint (Snowdonia).
- Columns had 10cm sediment at the base plus 1.5 litres of pool water from the same peat-enclosed pool.
- Over 40 days, measurements of pH, DOC, POC and specific UV absorbance (SUVA) and free-phase CO_2 and CH_4 were taken
- Light was excluded & temperature was maintained at 10^{o}C.

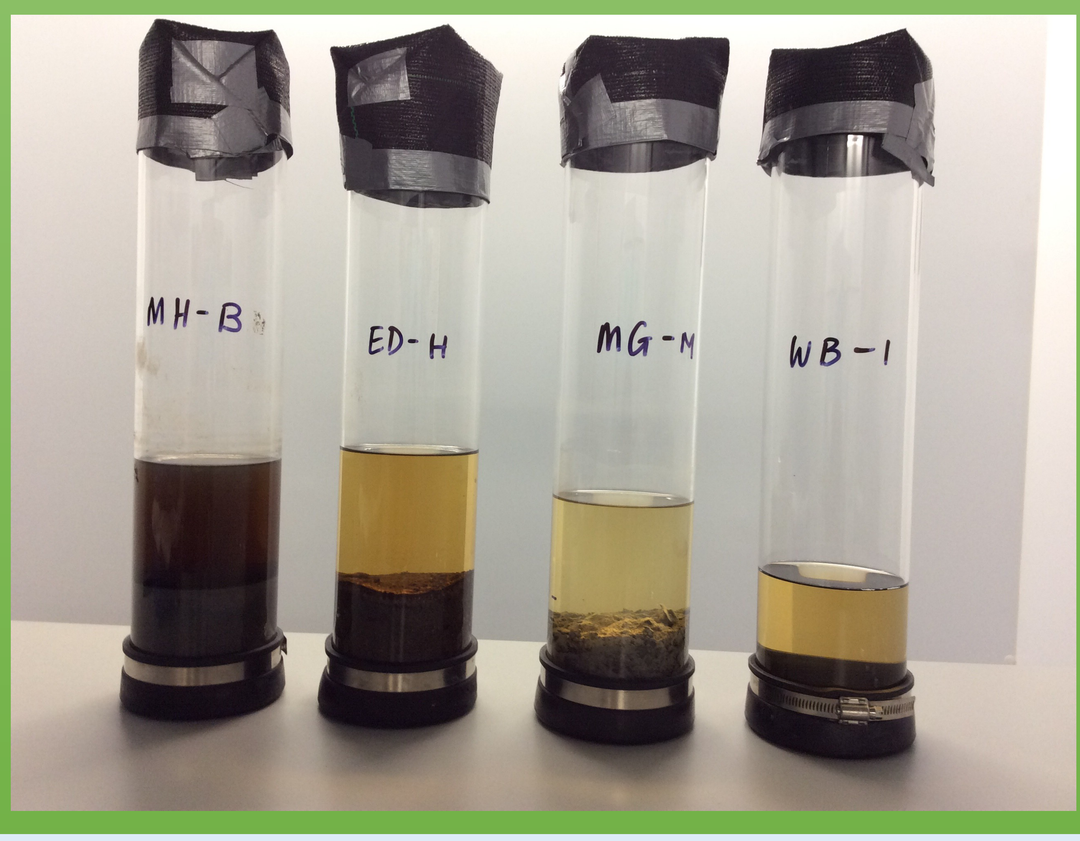

Figure 1: Experimental columns after 40 days with pool water and limestone/clay sediment from Moor House (MH-B), sandstone sediment from Edale (ED-H) and schist/clay sediment from Migneint. The column WB-1 is pool water without sediment. Clear visual differences are apparent between the three different lithologies and in comparison to pool water only.

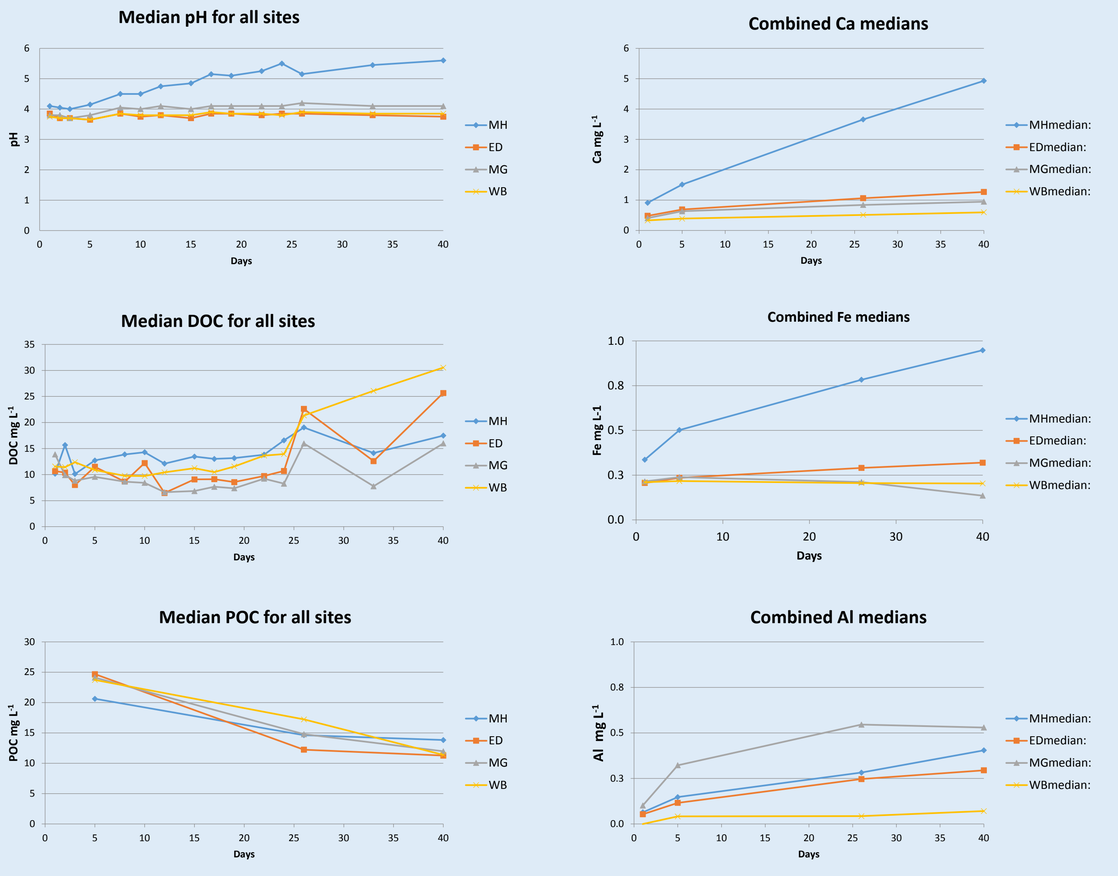

Figure 2: Variations in column test chemistry over time dissolved organic carbon (DOC), particulate organic carbon (POC) and cations.

What we Found

- Results indicate that the different bedrock chemistry does have a significant effect on the pool water.
- Over the 40 days of the experiment, changes in cation and anion content and pH were observed to be different for each rock type, along with differences in water colour which is a proxy for the organic content composition (see Figure 2).
- The sediment columns were significantly different for several measures from the control columns of pool water without any bedrock.
- Visual changes in the colour and opacity of the water were seen for different rock types (see Figure 1).
- On limestone and schist-rich clays, the higher pH and higher concentrations of Ca, Al, Fe and Mg ions (Figure 2) appear to inhibit the loss of carbon, possibly through the formation of organo-metal complexes which form flocculates and settle out to some degree.
- This was observed to a much lesser degree for water on coarse sandstone bedrock.

References:

Evans, C; Allott,T; Billet,M; Burden, A; Chapman, P; Dinsmore, K; Evans, M; Freeman, C; Goulsbra, C; Holden,J; Jones, D; Jones T; Moody C; Palmer S; Worrall F (2013) Greenhouse gas emissions associated with non-gaseous losses of carbon from peatlands- fate of particulate and dissolved carbon. *DEFRA Project SP1205 Final Report*.

Evans, M; Stimson A; Allott T; Pilkington M; Shuttleworth E; Holland N; Spencer T; Maskill R; Walker J. (2015) Restoration of Blanket Bogs; flood risk reduction and other ecosystem benefits. Final Report of the Making Space for Water Project, Moors for the Future Partnership.

McKnight D.M, Hornberger G.M, Bencala K.E, Boyer E.W., (2002) In-stream sorption of fulvic acid in an acid stream: a stream-scale transport experiment. *Water Resources Research, 38*, 1005

Mosher J.J & Findlay R.H., (2011) Direct and indirect influence of parental bedrock on streambed microbial community structure in forested streams. *Applied and Environmental Microbiology* 77, 7681-7688