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Fluvial entrainment of low density peat blocks (block carbon)

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In many fluvial environments low density materials are transported in significant quantities and these form an important part of the stream load and /or have a distinct impact on sedimentation in these environments. However, there are significant gaps in understanding of how these materials are entrained and transported by streams and rivers. Eroding upland peatland environments in particular, frequently have fluvial systems in which large eroded peat blocks, often exceeding 1 m in length; form an important component of the stream material flux. Transport of this material is significant in determining rates of erosion but also has important impacts in terms of damage to infrastructure and carbon loss.

This paper describes a field experiment designed to establish for the first time the conditions under which large peat blocks (c. > 0.1 m b axis) are initially entrained from a rough gravel bed. The field site is Trout Beck, in the North Pennines, Northern England which is an upland wandering river channel with occasional lateral and mid channel bars. Mean low flow stage is typically 0.2 m but during flood can rapidly rise, in one to two hours, to over 1.5 m. To study peat block entrainment a bespoke data acquisition system consisting of two pressure transducers, four release triggers and time lapse camera was set up. The pressure transducers provided a record of local depth and the release triggers were embedded in peat blocks to record initial motion and arranged on the rough stream bed. The time lapse camera provided verification of timing of block entrainment (during daylight hours) and also provided information on the mechanism of initial movement. Peat blocks were cut from a local source and were equidimensional, ranging in size from 0.1 to 0.7 m. The derived entrainment function is related to a critical depth of entrainment.

Results demonstrate that peat blocks are entrained when the local depth approximates the height of the peat block. Blocks frequently shift position prior to entrainment but once entrained are rapidly transported downstream. Because of the rough stream bed local depth, measured on the four sides of the block varies markedly and needs to be considered in developing an appropriate entrainment function and; is useful in explaining initial movement prior to entrainment. In some experiments a small accelerometer (HOBO Pendant G data logger) was used to investigate transport dynamics following entrainment. Further work will seek to improve the entrainment function by extending the size range of tests, developing a shear stress related function and investigating the importance of block shape (rounding) on entrainment.