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PEAT SOIL PROPERTIES AND EROSION: DOES DEGREE OF HUMIFICATION AFFECT EROSION CONDITIONS AT PEAT MINING SITES?

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SUMMARY

Active peat mining is carried out in circa 60 000 ha in Finland. Drainage and production operations enhance the peat soil properties and expose bare peat to weathering forces, and further release elements to water courses. The erosion rate at production surfaces is mainly controlled by climate conditions and peat soil properties. However, earlier studies have scarcely investigated the effect of the varying characteristics of the peat layers to erosion rate. To study this phenomenon, we took peat core samples (1m depth, 2 replicates) from 15 peat mining sites across Finland. Peat soil and hydraulic properties from different layers (10 cm slices) were measured in detail in the laboratory. Further, critical shear stress and erosion rate was determined using a cohesive strength meter instrument. This paper (and oral presentation) presents preliminary results from this study with a special focus on the effect of humification on erosion. Potential differences of peat deposits and their effect on contributing to the load to water courses are discussed.

KEY WORDS: peatland, peat mining, soil properties, degree of humification, erosion

INTRODUCTION

Once the active surface layer has been cleared, peat is removed from bare surfaces through the action of running water, wind and chemical oxidation (Evans and Warburton, 2007). In peat mining areas, erosion by running water is a dominant force and therefore surface soil physical properties directly affect erosion conditions. Despite this, given the importance of the topic and links to water quality, peat erosion has not been the subject of a large body of research. Few studies have researched erosion of peat sediments in peat mining (Marttila and Klöve, 2008) and in peatland forestry conditions (Marttila and Klöve, 2010). Rain erosion in peat mining has been studied by Klöve (1997) and Svahnbäck (2007). Further afield, erosion conditions have been studied in blanket peatland areas (see Evans and Warburton, 2007). Composition and deforming conditions of peat are often linked to erosion conditions at peat surface. The degree of humification may affect shear strength and particle size and thus affect erosion. However, peat is a highly variable material and the composition of plants, and their binding forces, may have a larger effect. Also water content and density may have potency.

Previous studies have made these assumptions largely on a visual and conceptual basis and have not been concerned with the process of hydraulic erosion with relation to peat properties with direct measurements. This is a significant limitation as soil properties are supposed to have a direct effect on erosion conditions. To address this problem, recent advances in measurement techniques are exploited herein in an attempt to improve the assessment of erosion conditions in peatlands under use.. Specifically, we used a cohesive strength meter (CMS) to measure direct hydraulic erosion from peat soils. CSM is widely used in studies of intertidal flat sediments (Paterson, 1989; Torhurst et al, 1999; Torhurst et al, 2000) and river-bank erosion (Darby et al. 2010), but have not yet been used for studies in peat soils or sediments. A similar method, submerged jets, has been widely used in bank soil erosion and sediment erosion, but CSM offers some advantages over this conventional jet testing device (Darby et al. 2010). Both methods fire submerged jets of increasing intensity at the target surface, but the CSM detects the onset of erosion by measuring optical transmission in a test chamber.

In this study we used CSM to measure direct erosion forces from peat layers. We hypothesise that peat soil properties have a significant effect on erosion conditions and therefore we test that it is possible to find different limits for erosion ignition e.g. levels at degree of humification, plant composition or soil moisture conditions. The results enable parameterization of shear stress erosion models without recourse to calibration and provides a strong physical basis for erosion studies in peat mining conditions. Further, the results can be used for load prediction calculations from different peat mining areas.

MATERIAL AND METHODS

Peat Sampling

Peat samples were taken during summer 2011 (June-August) from 15 different peat mining areas across Finland. One meter long plastic pipe (diameter 5cm) was hammered into the peat at the production surface and dug out in order to get an undisturbed peat profile. Two samples were taken from different parts of each mining area and stored at +4 before analysis.

Peat Properties

In the laboratory the peat samples were taken from storage, cut into 10 cm slices and analyzed for water content, porosity, LOI_{550}, degree of humification, plant composition and density.

Mechanical and Erosional Strength

The vane tester was used at the peat mining sites to determine the *in situ* peat shear strength. Every sampling point was tested for 3 depths (2, 5 and 15cm) with 2 repetitions. To determine the erosional strength of the peat soil profiles, the Cohesive Strength Meter (CSM) was used (Tolhurs et al. 1999). At test runs, the testing chamber from the CSM was put carefully onto the soil surface and filled with water. Before analysis the user of the CSM chose different test parameters from a selection of test sequences such as initial and final pulse strength, pulse increments, optical transmission logging parameters and pulse duration. At this study, preliminary tests were conducted to select the proper test. The jet nozzle was deployed at a height of 2.0 cm above the soil surface. For peat sample analyses the following selections were made: initial pulse pressure 3.4kPa, increments at 3.4kPa intervals to a maximum value of 138 kPa, pulse duration 1s and optical transmission values were logged for 30s at 1s intervals after each pulse.

Afterwards the results from the CSM were plotted against jet pressure for each of the individual tests from the peat profiles. If test results showed clear mistake in laboratory measurment (human error), the test was removed from further analysis. The threshold condition for peat erosion was defined as the point at which the optical transmission value drops. According to Tolhurst at al. 1999, the vertical jet pressure was calibrated to a horizontal critical shear stress.

RESULTS AND DISCUSSION

By the time of submission of extended abstract, the results were not ready and therefore they are presented at conference presentation.

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