Peat compaction and formation; key processes controlling alluvial architecture

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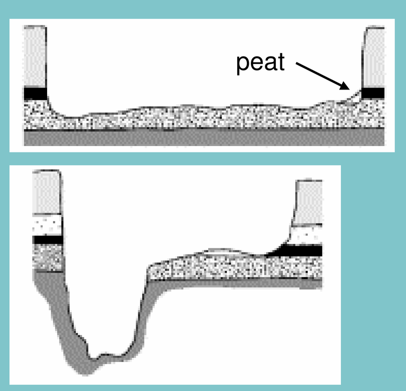
BACKGROUND

In alluvial environments such as floodplains and deltas thick peat layers are often formed in the floodbasins. So far, the role of peat compaction and formation on the evolution of such areas has seldom been investigated and seems to be underestimated. On this poster, possible effects of peat compaction and formation on alluvial architecture are presented, focussing on its effect on avulsion, which is one of the most important processes controlling alluvial architecture.

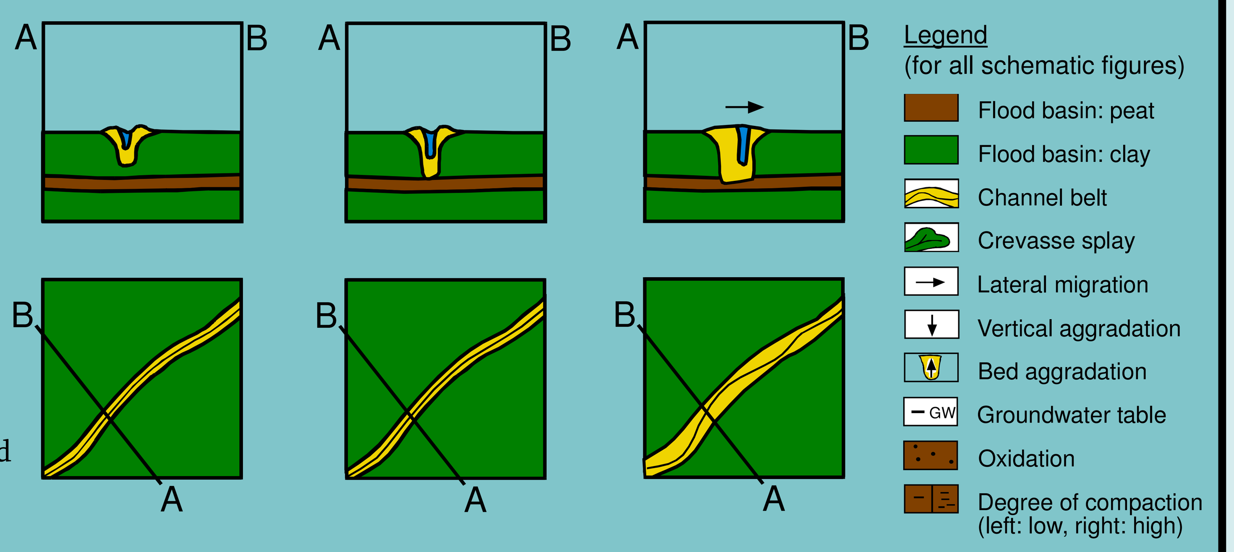
CHANNEL BELT GEOMETRY

Peat is **resistant to fluvial erosion**, which affects channel dimensions:

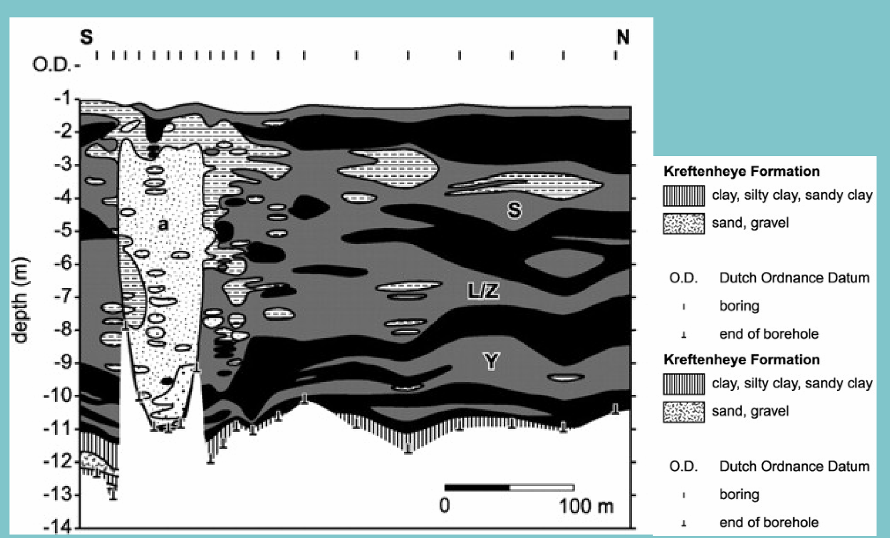
1. If an incising channel encounters an intercalated peat layer it will first erode vertically to the depth of the peat layer, which then, due to its high resistance, prevents further vertical incision resulting in channels with a **high width/depth ratio** (until the peat layer is eroded).

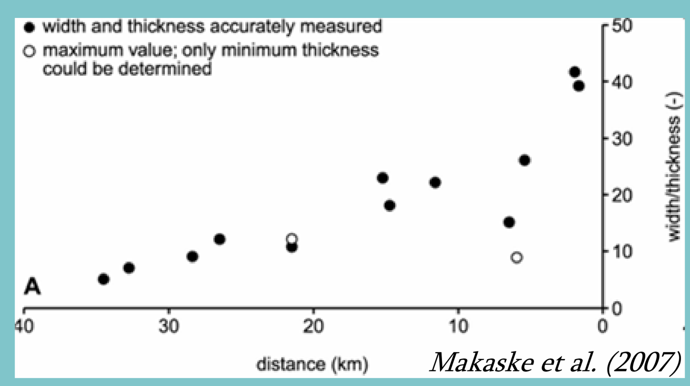


Cross sections based on logged boreholes from the Cumberland Marshes, Canada (Smith and Perez-Arlucea, 2004).



2. If the substrate consists of predominantly of peat (and clay), channels with **low width/depth ratios** develop.



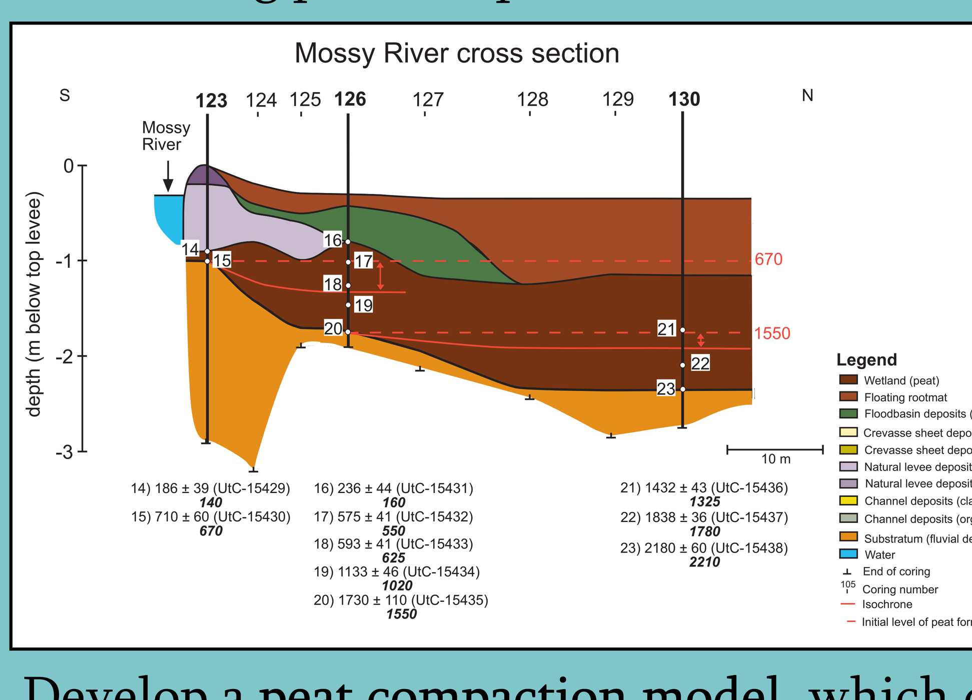


Increasing peat component in substrate; decreasing width /depth ratio (mainly caused by decrease in width).

CURRENT RESEARCH

Main objective: to determine the influence of peat compaction on alluvial architecture and avulsion, and to quantify this process.

1. **Field research** in the Cumberland Marshes (Canada) and the Rhine Meuse delta (The Netherlands). The amount and rate of peat compaction is determined in different alluvial settings (floodbasin, natural levee, crevasse splay,…), based on dry bulk density measurements and reconstructions of initial levels of peat formation (=former groundwater levels). Individual factors influencing peat compaction are studied.

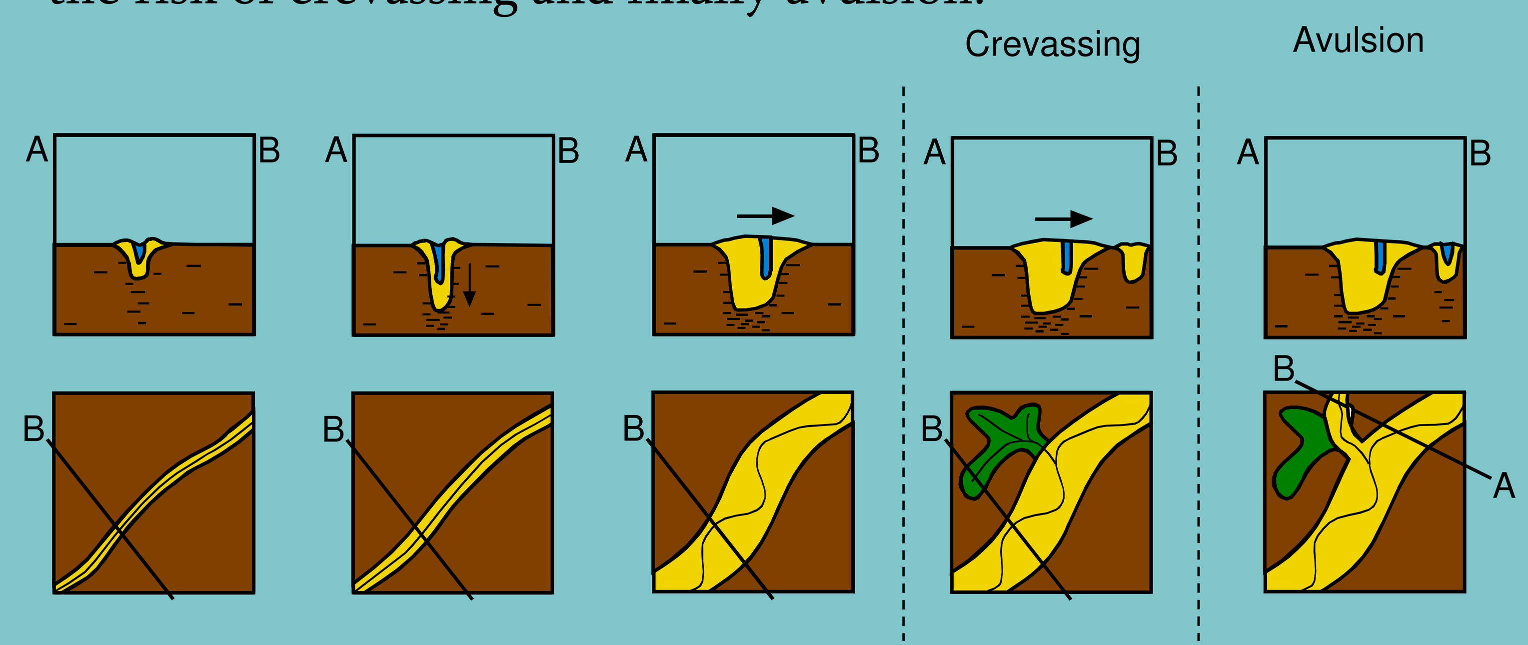


2. Develop a **peat compaction model**, which can be implemented in a 3D alluvial architecture model. Field data and modeling results are used to determine effects of peat compaction and formation on alluvial architecture.

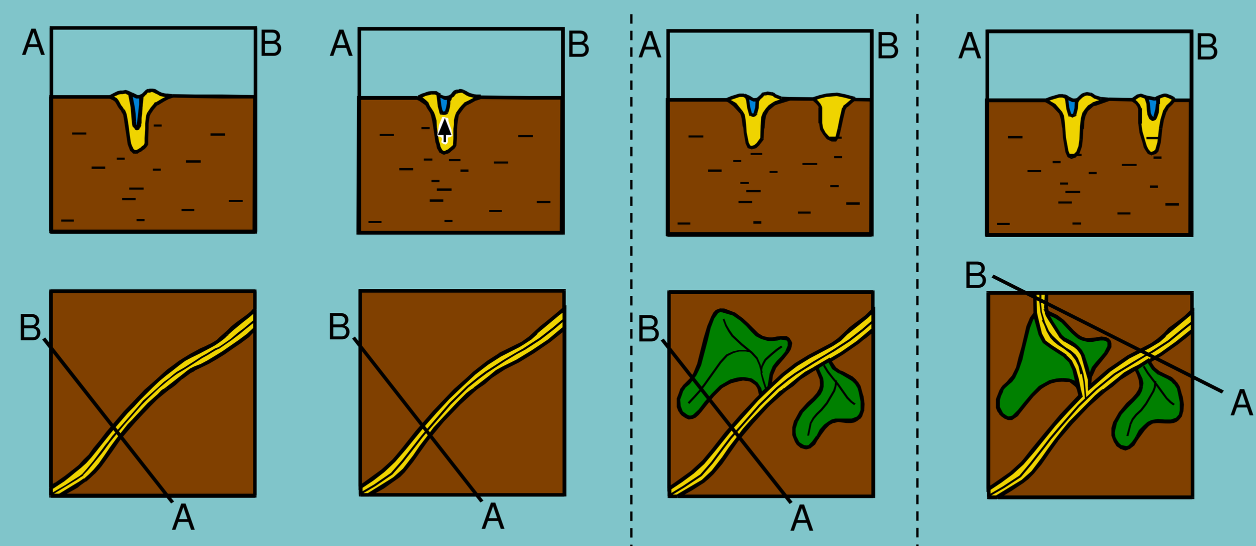
CHANNEL BELT CONFIGURATION

Possible effects on **avulsion**:

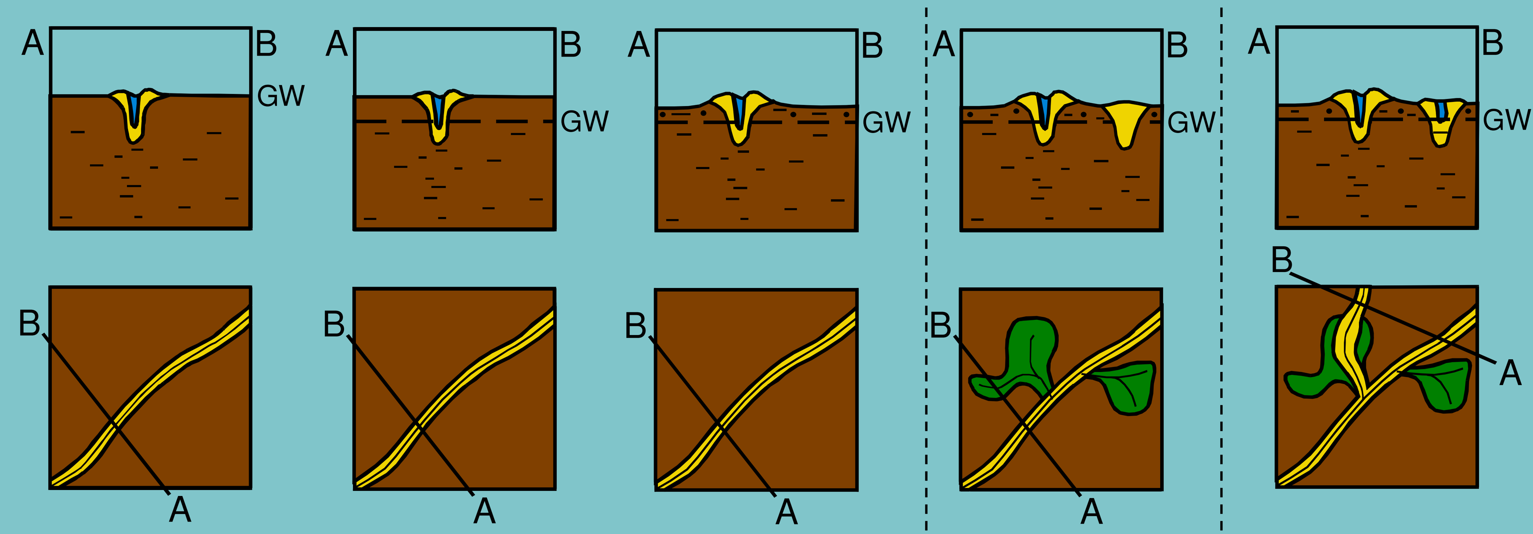
1. Peat compaction under a channel, induced by the load of the channel deposits, creates accommodation space. Through time, a **decrease in the rate of accommodation space** created by peat compaction under a channel, results in an increase in lateral migration and a higher sinuosity of the channel, which increases the risk of crevassing and finally avulsion.



2. If the rate at which accommodation space is created by peat compaction under the channel is relatively low, a high sediment load, in combination with the high resistance of peat to fluvial erosion inhibiting channel enlargement, stimulates **bed aggradation**. This reduces transport capacity, which increases the risk of crevassing and potentially avulsion.



3. Groundwater table lowering leads to oxidation of peat situated above the groundwater table. This leads to **super-elevation** of sandy channel belts, which leads to an increase in cross-valley gradients which potentially stimulates the occurrence of crevassing and avulsion.



4. At a larger scale, invasion of a river system onto a new part of a floodplain is stimulated by I) variations in compaction rate across a floodplain and II) a sudden drop in gradient a river experiences when it enters a peatland.

CONCLUSIONS

Peat compaction and formation have important implications for the rock record, as it influences the shape and distribution of sandstone bodies and carbonaceous and coal layers within alluvial sequences.

References
Makaske, A., Berendsen, H.J.A., Ree, M.H.M, 2007. Middle Holocene avulsion-belt deposits in the central Rhine-Meuse delta, the Netherlands. Journal of Sedimentary Research 77, 110-123.
Smith, N. D., Pérez-Arlucea, M., 2004. Effects of peat on the shapes of alluvial channels: examples from the Cumberland Marshes, Saskatchewan, Canada. Geomorphology 61: 323-335.

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