The relationship between internal sedimentary architecture and meander evolution within the Stuivenberg deltaic channel belt.

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Meandering rivers function in a variety of environments and geological settings [1 - 4]. Important distinction can be made between meandering systems within deltaic respectively valley settings. In the latter, fluvial activity is often laterally constrained (narrow floodplain, channel in incised position), meaning that the river self-reworks its channel belt over long periods of time. In contrast, in major delta plains individual meander belts tend to function for relatively short time only, because of repeated repositioning of channel activity (i.e. avulsions) across the wide delta plain and aggradational setting. The short 'lifespan' and favorable preservation of deltaic channel-belt makes them well suitable to study the architectural products of steady meander evolution,without complications of repeated bend cutoffs, and of abandonment deposits induced by avulsions.

Our main research question is how stage wise meander belt evolution (initial activity, maturation, abandonment) governed the eventual sedimentary architecture in deltaic meander belts. We studied this in detail for the classic Stuivenberg channel-belt (StvCB) in the Rhine-Meuse delta. Using traditional coring based methods (>4000 boreholes in the StvCB) as well as high resolution LiDAR data the channel belt boundaries and the top and thickness of channel, overbank and residual channel deposits were mapped. We developed a procedure to separate 'main activity' from 'abandonment stage' sandy facies in our cross-sectional and planform architecture mapping. Using empirical hydraulic geometry relationships [5, 6] in combination with cross-sectional observations a first order approximation of ~100m is chosen to represent a uniform width of the paleochannel (Fig. 1). The reconstruction of ridge swale morphology made use of borehole- and LiDAR datasets.

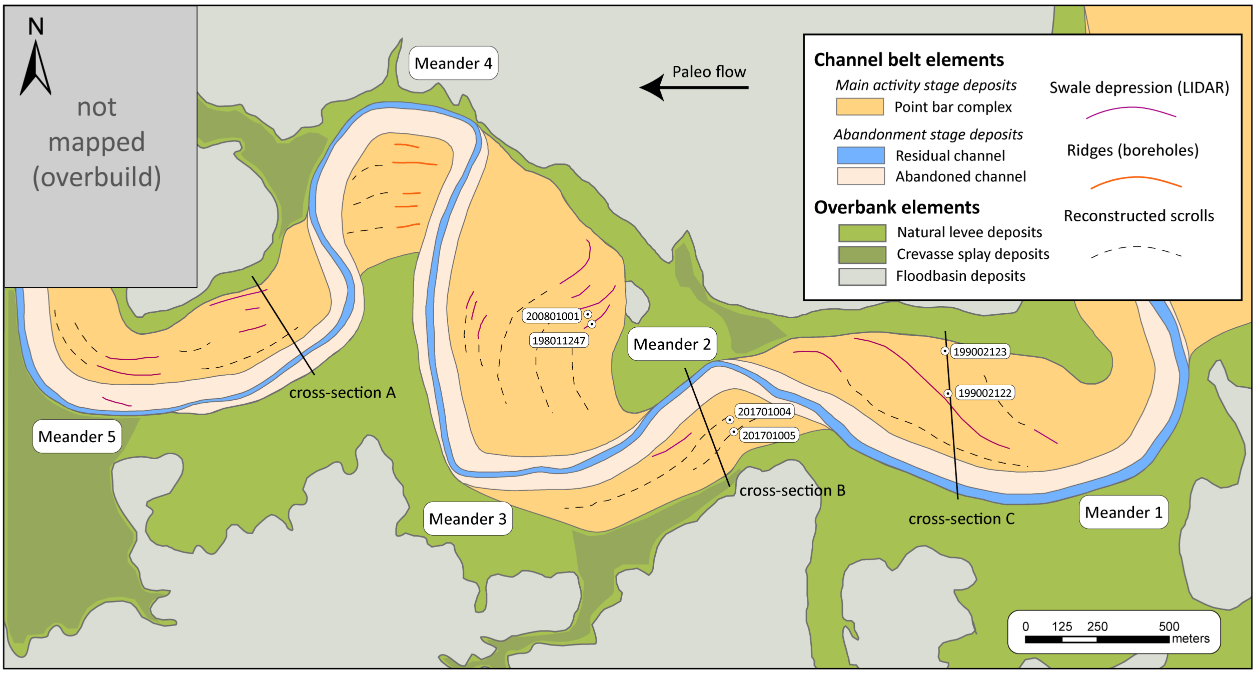

Fig. 1 Planform reconstructions of the main activity and abandonment stages of the StvCB

Our reconstructions show that abandonment stage deposits turn out to comprise roughly 1/3 of the width, while ridge-and-swale scroll complexes cover the other 2/3 of the Stuivenberg meander belt. Combining ridge-swale curvature and channel belt width mapping allows trace meander migration history and to classify the trajectories of individual meanders (e.g. translation, expansion and rotation). Strategically positioned cross-sections (Fig. 1-2), allows to explore relationships between the lithological composition of the StvCB meander belt sands and the stage-wise meander evolution. Sands laid down during the StvCB's main activity stage, show a clear difference between convex and concave zones. Where convex accretion occurred, lower bar deposits lack vertical sorting trends, whereas upper bar deposits express great variability in such sorting trends (with both FU and CU sequences occurring locally Fig. 2). Lower bar deposits identified to be deposited in initial stages of StvCB activity, are finer grained than those trapped in later stages (Fig. 2). Where concave accretion and downstream translation of meanders occurred, the sedimentary architecture is more complex and the lithology finer (including non-sand accretionary units). The lithology of the abandoned channel zone, is found to be only modestly finer grained compared (and their top only subtly lower elevated) compared to neighboring deposits from the main activity stage.

Our results show that the architectural subdivision of the deposits into 'abandoned channel zone', 'active phase: convex point bar' and 'active phase: concave accretion' turned out functional in analyzing grainsize variation in heterolithic deposits of the StvCB.

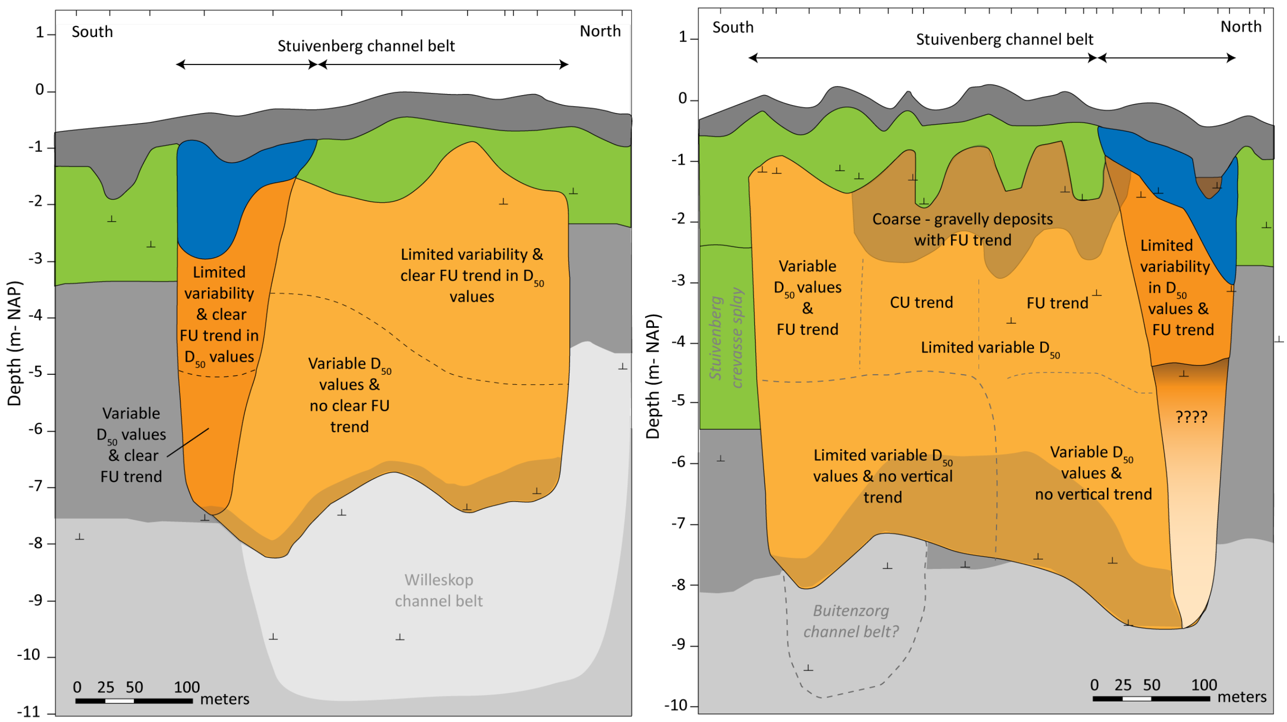

Fig. 2 Lithological cross-sections A (left) and B (right) over the StvCB.

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