MUD LAYERS AND CYCLIC SEDIMENTATION PATTERNS IN THE ESTUARY OF THE SCHELDE (BELGIUM - THE NETHERLANDS

Lits vaseux et successions sédimentaires cycliques dans l'estuaire de l'Escaut (Belgique - Pays-Bas)

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Tide dominated environments are characterised by periodic changes in current speed and direction. This periodicity results in a cyclic sedimentation pattern of alternating mud, silt and sand layers depending on the energy of the currents. In the main channel and on the tidal flats of the macro-tidal **estuary of the Schelde, different mud** facies, some showing a cyclic sedimentation pattern, can be recognised.

1. Mud deposits several decimetres to metres thick and consisting of alternating mud and silt layers of varying thickness form under relatively calm conditions in sheltered areas.

2. In the main channel and on shoals outside the turbidity maximum mud deposits are of minor importance and occur as thin veneers (slack water drapes) in sand or as clay-pebbles. The latter may form layers and in some cases the pebble-structure may disappear, or be hardly visible, leaving a mud layer with sharp boundaries.

3. Inside the turbidity maximum the sedimentary deposits show different structures. Alternating beds composed of gravels and shells, fine sands and shell grit, and muddy sands occur in areas where water turbulence is intensive. The beds can be several centimetres thick and are structureless or, in the case of fine sand, layered. Mud beds, a few centimetres to tens of centimetres thick, may show a clotty texture and hold large amounts of small gas voids. Layering is difficult to see and, if present, is partially destroyed by migrating gas bubbles (Wartel et al. 1985). Heterolitic rythmic facies occur on the tidal flats and in the main channel as well. Laminae, generally less than 2 mm thick, are discontinuous, parallel or lenticular. They occur as "couplets" composed of a mud lamina overlain by a sand lamina and showing a gradational contact between both. The upper boundary of the sand lamina is sharp and sometimes erosional. These couplets resemble "tidal bundles" (i.e. the deposit of one single tidal cycle) as described by Tessier and Gigot (1989). However, a sequence of upwards progressive thickening and then thinning has not been observed so far. Instead, a first order sequence approximately 1 cm or more thick and composed of several couplets (10 or more) is seen. The clay content is highest at the base of the sequence and the thickness of the sand laminae increases and that of the mud laminae decreases upward. The transition of the overlaying sequence is sometimes sharp and erosional. An upward increasing density further characterises the sequence.

First order sequences are in their turn arranged to a second order sequence characterised by an upward increasing thickness of the sand laminae of successive first order sequences, and an accompanying increase in bulk density. Second order sequences have a thickness of the order of 10 cm or more and contain 9 to 15 first order sequences. A sharp decrease in density due to the occurrence of a mud-rich first order sequence indicates the start of a new second order sequence.

In some cases a several centimetres thick structureless mud layer, containing many gas-voids, interrupts the normal succession, indicating an abrupt change in the sediment supply pattern.

Tessier and Gigot described sequences of tidal bundles and attributed them to the deposition during a neap-spring tidal cycle. This seems not to hold for the sediments described here. The accumulation rate measured using the '-1OPb-isotope is of the order of 0.6 to 1 cm per year on the tidal flat. Accordingly the second order sequences, having a thickness of the order of 10 cm, correspond to a sedimentation period of approximately 10 to 16 years. This would indicate that the sequences are rather related to the 18.6 year nodal-lunar cycle as suggested by Van Oost (1992). In this case the thickest sand layers correspond to deposition at the moment that the tidal amplitude (under influence of the lunar cycle) is at maximum. The first order sequence then corresponds to a sediment accumulation of one year, indicating that relatively few tidal bundles are preserved. The fact that only 9 to 15 first order sequences are preserved is a result of the sedimentation-erosion ratio. It indicates that only 50 to 83% of the yearly deposition is preserved.

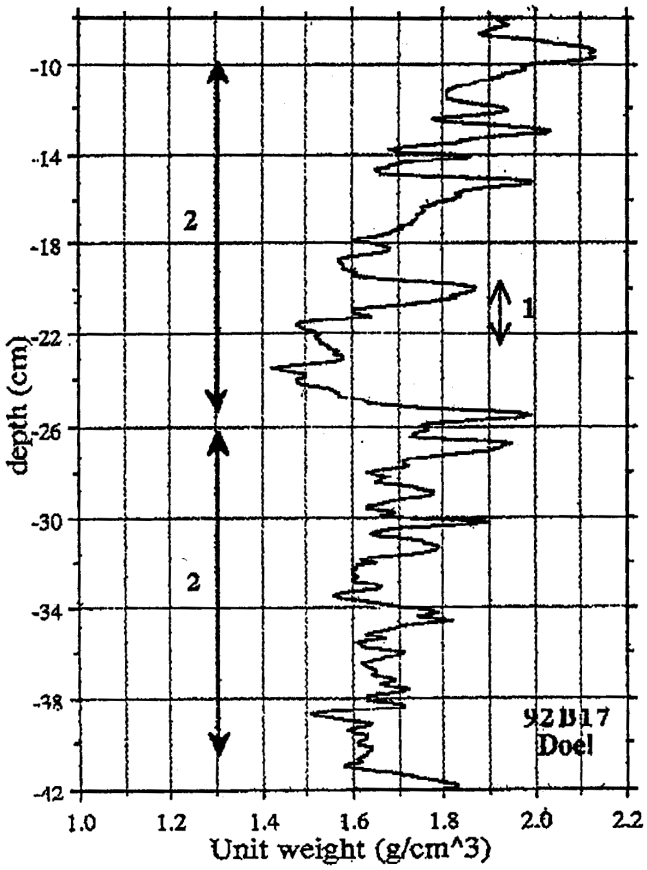

Figure 1: **Example of bulk-density profile showing first order sequences (1) and second order sequences** (Z).

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