THE DROWNED SCHELDE PALAEOVALLEY IN THE SW-NETHERLANDS

HOLOCENE SEA-LEVEL RISE, RIVER GRADIENT AND CRUSTAL MOVEMENTS

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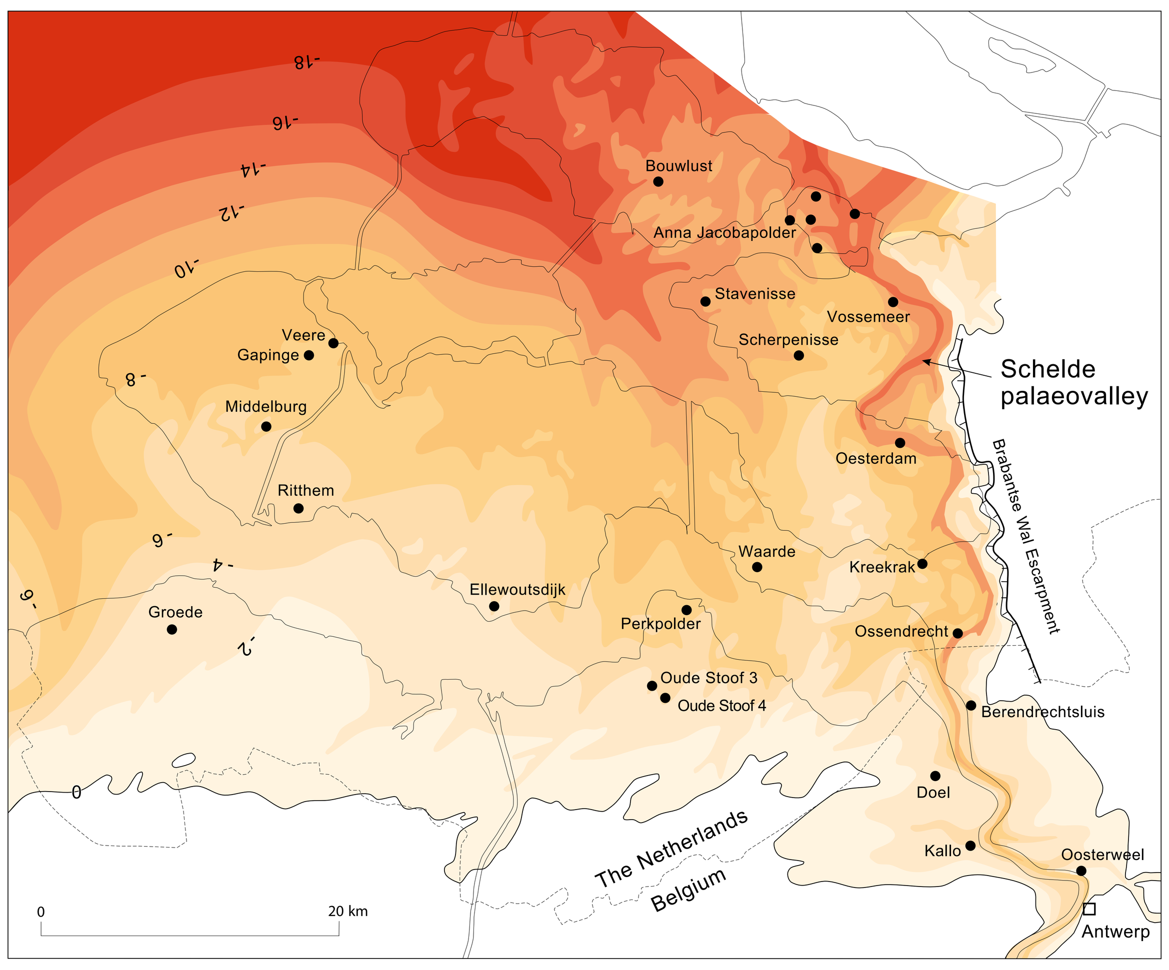

Figure 1. Reconstruction of the Pleistocene topography prior to Holocene marine erosion in the SW Netherlands and adjacent part of Belgium, with locations of radiocarbon dates of basal peat. Contours are in m NAP.

TNO innovation for life

At the end of the last ice age, the river Schelde eroded a narrow winding palaeovalley to a depth of more than 16 m -NAP into the Pleistocene substratum in the southwestern Netherlands (Figure 1). The valley was drowned by Holocene sea-level rise and buried beneath coastal plain deposits (Figure 2). It contains a pristine record of Lateglacial and early Holocene river, groundwater and coastal evolution and climate change, which remained undiscovered until 25 years ago.

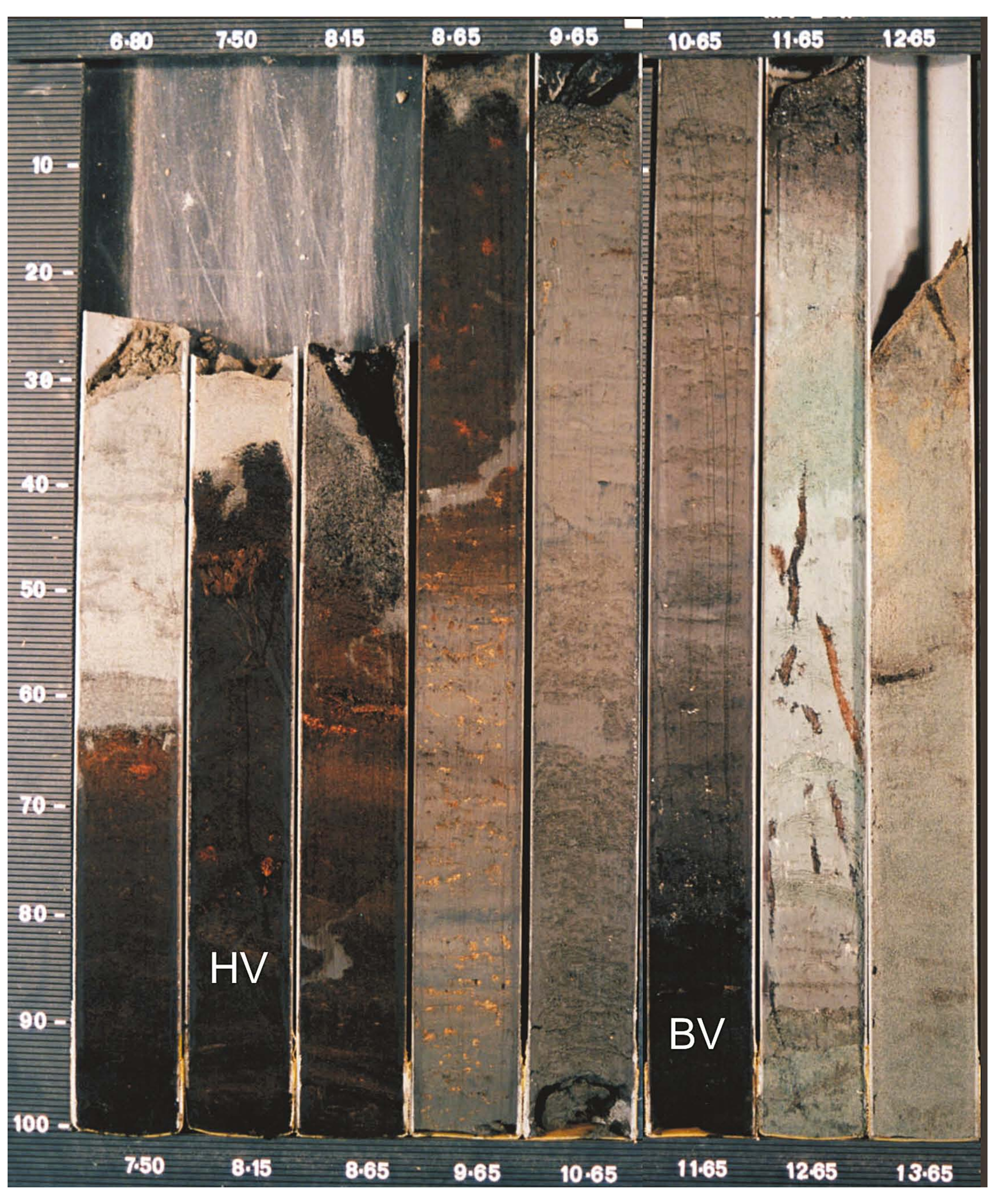

Figure 2. Core from the Schelde palaeovalley near Kreekrak. The Holland peat (HV) is separated from the Basal peat (BV) by organic clay of the Naaldwijk Formation – Wormer Member. The base of the Basal peat resting on sandy Pleistocene deposits at 11.65 m depth was sampled for AMS-radiocarbon dating.

LOCAL GROUNDWATER LEVELS AND PALAEOTOPOGRAPHY

Past groundwater levels are recorded by basal peat growth on the sandy Pleistocene substratum. Radiocarbon dates show that the peat in the deeply incised Schelde palaeovalley formed at a lower level than on the undulating Pleistocene further west (Figure 1 and 3). This indicates better drainage conditions and lower groundwater levels in and near the palaeovalley, hence basal peat development closer to contemporary sea level.

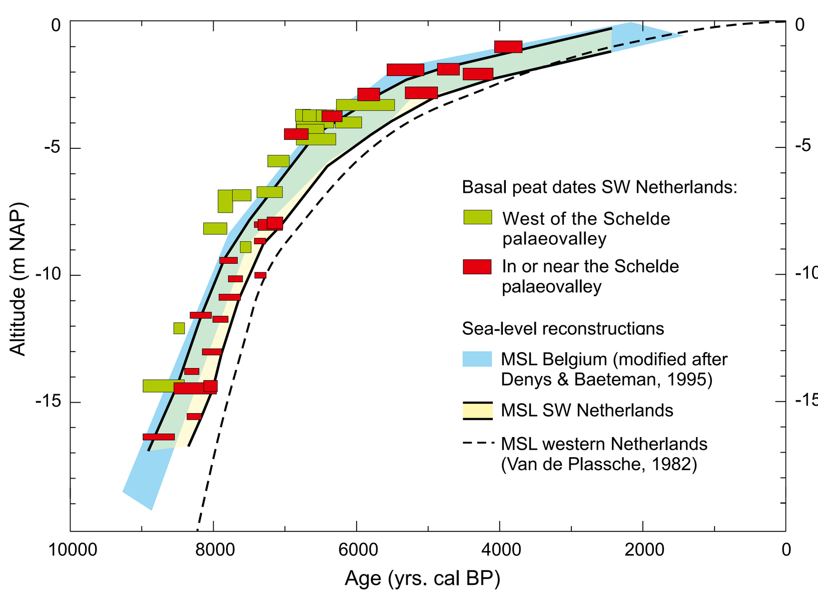

Figure 3. Time-depth diagram of all radiocarbon dates of basal peat (rectangles) and the sea-level error band for the SW-Netherlands, based only on the data from the Schelde palaeovalley (red rectangles).

SEA-LEVEL RECONSTRUCTION

The basal peat dates from the Schelde palaeovalley shed new light on the sea-level evolution in the southwestern Netherlands, especially for the earlier part of the Holocene (7000-9000 yrs. cal BP) (Figure 3).

CRUSTAL MOVEMENTS

Relative sea level in the SW-Netherlands is higher than in the western Netherlands but lower than in Belgium (Figure 3). This is due to glacio-isostatic and tectonic crustal movements, the latter being less important. The subsidence of the western Netherlands relative to the SW-Netherlands and Belgium results from the collapse of the glacial forebulge of the Weichselian Fennoscandian ice sheet. The zone of maximum forebulge collapse is situated just north of the Netherlands (Figure 4).

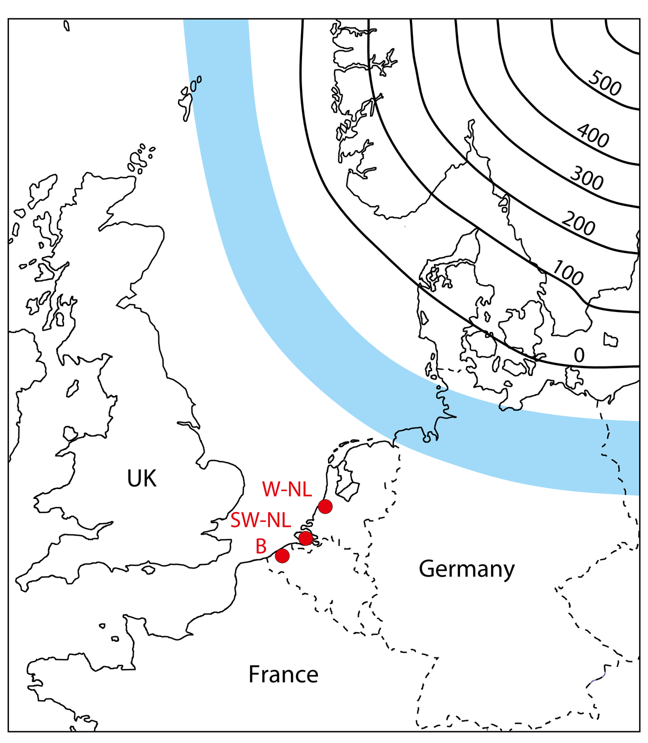

Figure 4. Location of the study area with respect to the zone of maximum glacial forebulge collapse (blue) around the Weichselian Fennoscandian ice sheet. Contour lines in the NE indicate postglacial uplift in meters.

RIVER GRADIENT EVOLUTION

The new palaeovalley data enabled the reconstruction of the Lateglacial and Holocene evolution of the river gradient in the lower Schelde river (Figure 5). A knickpoint in the Late Pleistocene thalweg near Antwerp is probably due to Oligocene clays forming a local erosional base level. The Holocene gradient lines show the aggradation as a result of sea-level rise and suggest that river gradient was almost zero downstream of the Belgian-Dutch border as early as 7500 yrs. ago.

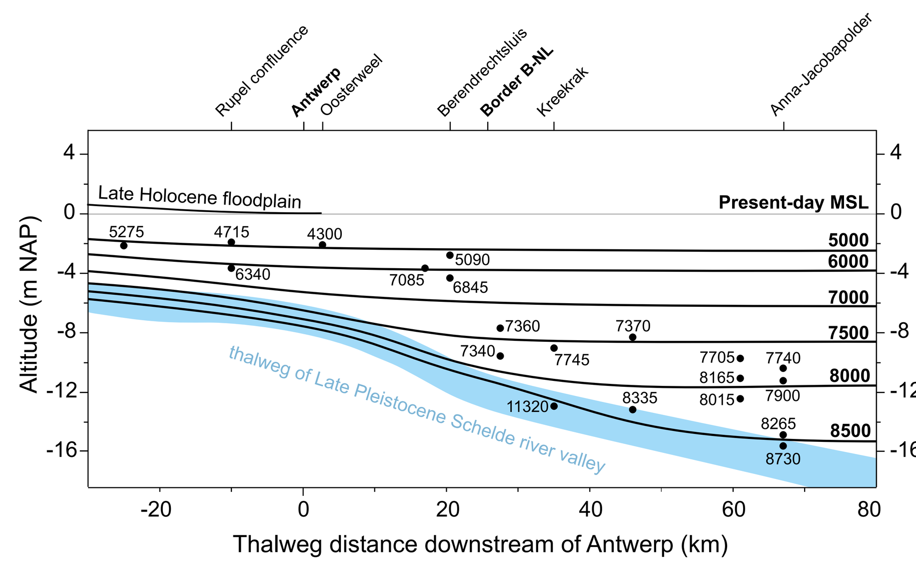

Figure 5. Holocene river gradient evolution in the lower Schelde river, based on radiocarbon dates from the Schelde river palaeovalley. Ages are in years cal. BP. For locations see Figure 1.

MARINE INFLUENCE IN THE SCHELDE RIVER

Marine influence was already present in the lower Schelde river near Anna-Jacobapolder at 8000 yrs. cal BP (Figure 6). A first transgressive maximum occurred around 6000 yrs. ago, when brackish conditions almost reached Antwerp. The subsequent regression was triggered by the closure of the coastal barrier system. Brackish-marine conditions were replaced by widespread peat growth. From Roman times on, destruction of the coastal barrier and human interference led to a rapid increase in marine influence and tides, which now reach 70 km upstream of Antwerp.

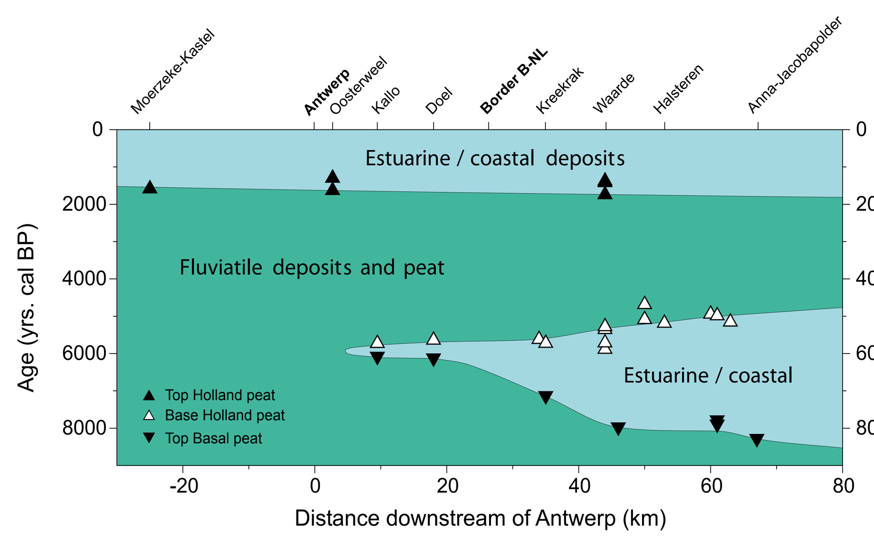

Figure 6. Holocene evolution of marine influence and fluvial vs. estuarine facies distribution in the lower Schelde river. Locations are given in Figure 1.

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