PGK Petroleum Geologische Kring

PEAT IN THE NETHERLANDS

A day trip to discover geology, production and energy

Gouda - Reeuwijk -Nieuwkoop

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Source: Google Maps. View of Nieuwkoop.

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Holocene peat in the Netherlands

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Peat comes in many kinds. Within the Holocene of the Netherlands, various types of deltaic, coastal and lagoonal peat are recognised. Over adjacent inlands even more types are known. We can look at them with ecological eyes (plant species, nutrient availability), hydrological eyes (maintaining their own local groundwater table, or obeying a regional one), with the eyes of miners, farmers and builders (opportunity for fuel and need for drainage and foundations), or with the eyes of palaeogeographers (past marshes, swamps, cushions, away from active sedimentary systems).

Through the eyes of sedimentary geologists, the deeper buried Holocene peats show up as recorders of successive stages of drowning and transgression (Fig. 10). Higher up in the sedimentary sequence and more inland, older Holocene peats occur more localised, filling local depressions rather than filling the accommodation space that was newly created by sea-level rise. Younger surficial peats (including now-gone peats) differ from the older peat, both in the coastal plain (Fig. 10) and in the hinterland (Fig. 11). Inland, the distribution of young Holocene peats has been much more widespread. Some 1500 years ago, great parts of the 'Pleistocene' Netherlands (from Groningen and Drenthe in the north, to the eastern Netherlands, to Noord-Brabant and Zeeuws-Vlaanderen in the southwest) had blankets of young Holocene mesotrophic and oligotrophic peat overlying earlier Holocene soils. In the coastal plain (Zeeland, Holland, Friesland and Groningen, and also in the Rhine-Meuse delta and IJsselmeer areas more inland), widespread swampy peat lands existed since ca. 5000 years ago, in the north more marshy, tidal reed lands dominate, since ca. 4500 years ago.

The rivers Rhine and Meuse maintained relatively narrow tidal-river corridors through this peat land to reach the sea. Since 2500 years ago the rivers Rhine and Meuse began carrying increased loads of clay and silt, due to pre-historic deforestation by Bronze Age agriculture in the hinterland (Germany, Belgium, NE France), doubling their loads towards early medieval times (1500 years ago). The increased sediment loads were deposited as humic-clayey topsoils covering peat lands close to active rivers, especially in the central delta. These areas are nowadays known as Albasserwaard, Krimpenerwaard, Lopikkerwaard, Nederbetuwe: polders where the medieval water-management design was successful enough to survive up to today.

From 3500 years ago other parts of the delta plain, further away from active rivers, were developing mesotrophic and oligotrophic peat domes. The moss-plant ecosystems create these peat domes, that have a surface just a few meters above sea level, and that are fed on rainwater and recycled nutrients rather than depending on regular flooding. Towards their fringes, near river channels, at 1-2 meter lower elevations, eutrophic sedge and swamp peats continued to form (as such types of peat have done since the delta began drowning 9000 years ago). Where the domes were bordering brackish estuarine channels and tidal inlet systems, marshy reed peats developed (as have existed for 8450 years, since marine transgressions are affecting the coastal plain).

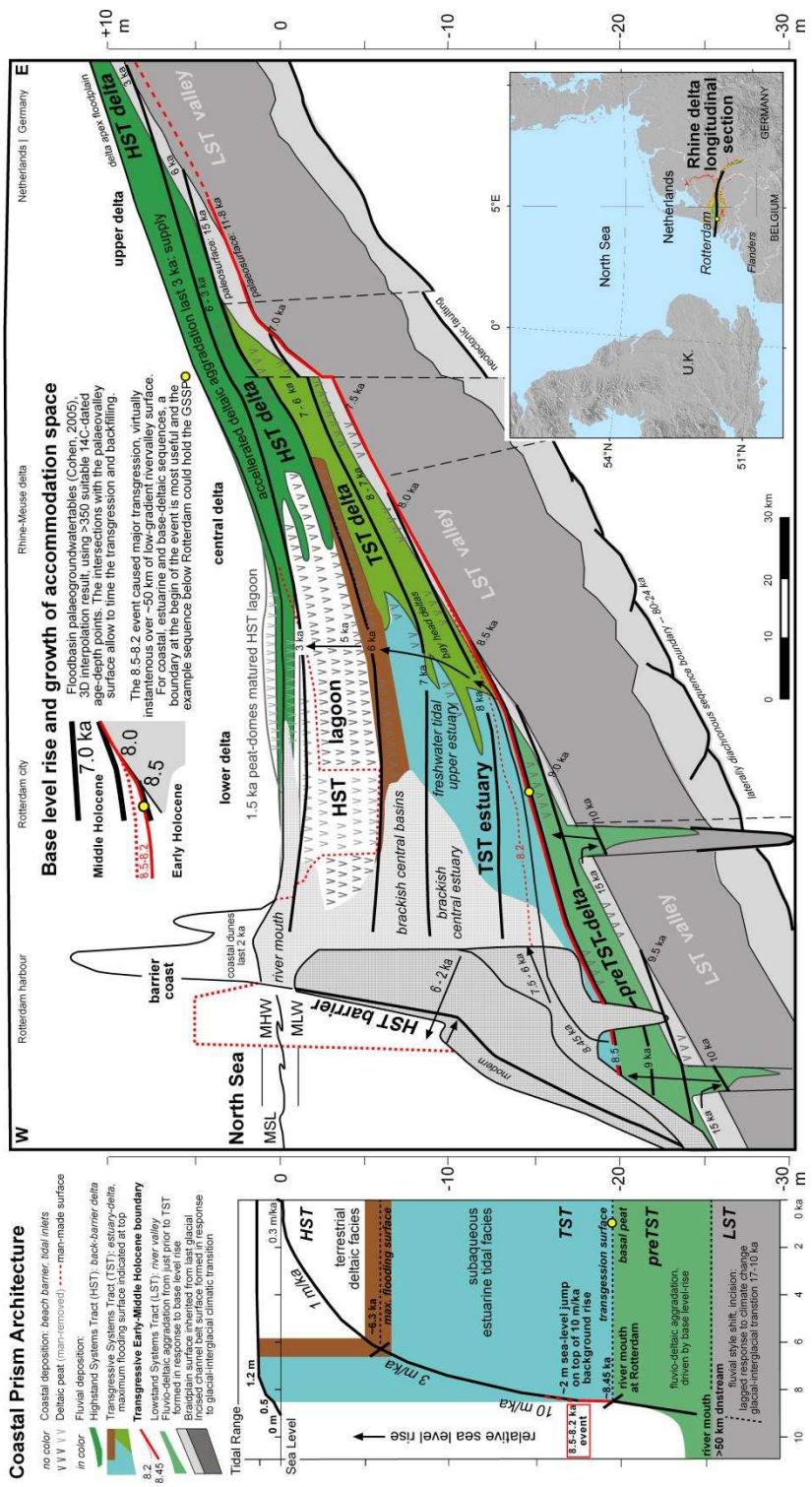

Figure 10. Longitudinal cross-section of the floodbasins of the Rhine-Meuse delta. Focus in this cross-section is on areas between deltaic channels. Sequence stratigraphic slotting is based on sedimentary criteria (cf. Hijma & Cohen, 2011). Pleistocene substrate and Holocene coast are shown in grey. Coloured areas show inland-deltaic and deltaic-estuarine deposition of river clays. Brown colour and "V V V" signatures show main areas and depths of deltaic peat formation. Timelines are past groundwater levels in floodbasins, based on dating peats. Source: Cohen & Hijma (2013).

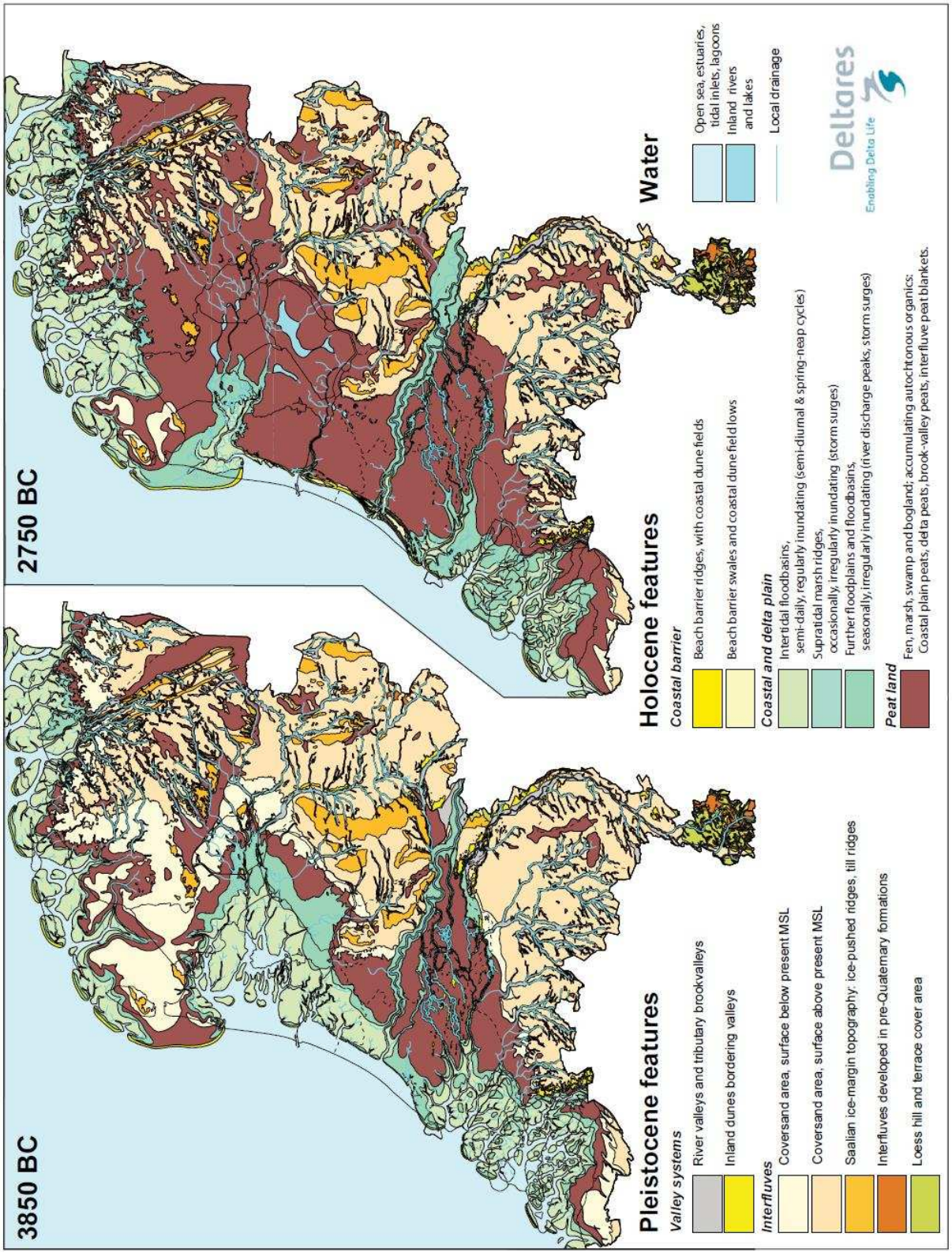

Figure 11. Selected palaeogeographical maps, showing distribution of peat land and sedimentary activity for two stages in the Holocene development (BC = Before Christ). Source: Vos & De Vries, 2013.

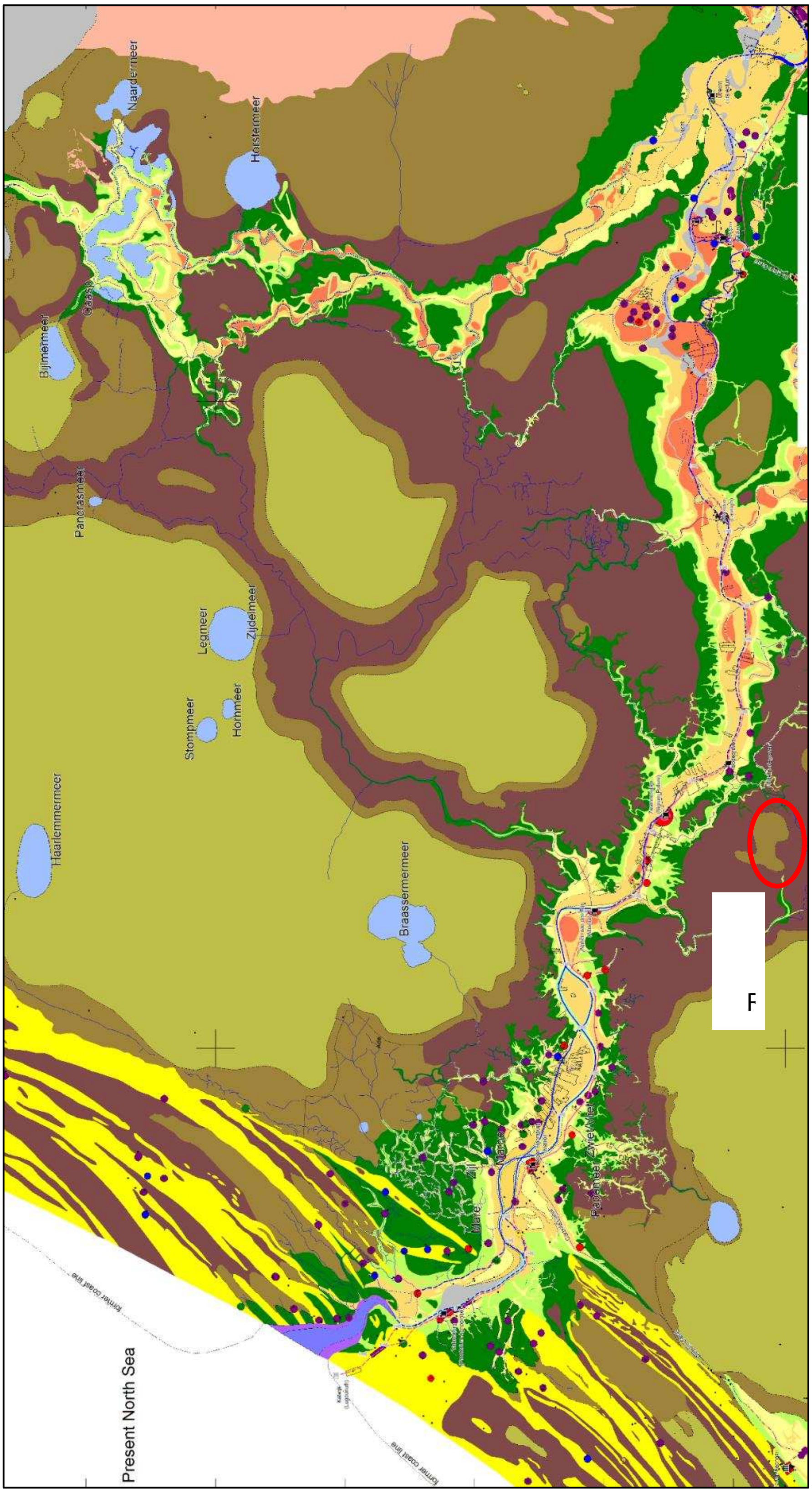

Figure 12. Reconstruction of the landscape at time of Roman military presence along the Oude Rhine ('Limes' road, watchtowers and castella). Brown colours show the different zones of peat landscape away from the main river and creeks / drainage systems into the peat land. Green: clay deposition. Yellow: beach ridges. Pale yellow/orange: river channel belts, natural levees. Note positioning of watchtowers opposite main creeks. Source: Van Dinter, 2013.

Around 2000 years ago, marshy reed peats accumulated in Friesland, Noord-Holland, Flevoland and Zeeland, and in areas north and south of the Oude Rijn (old Rhine branch), such as near Reeuwijk (Fig. 12; Stop 1). The peat domes were high grounds of fertile, living organic soil, in otherwise regularly flooding areas. Within a few centuries opportunistic farming, beginning in the Iron Age and Roman times, and increasing in medieval times, led to lowering of the oligotrophic

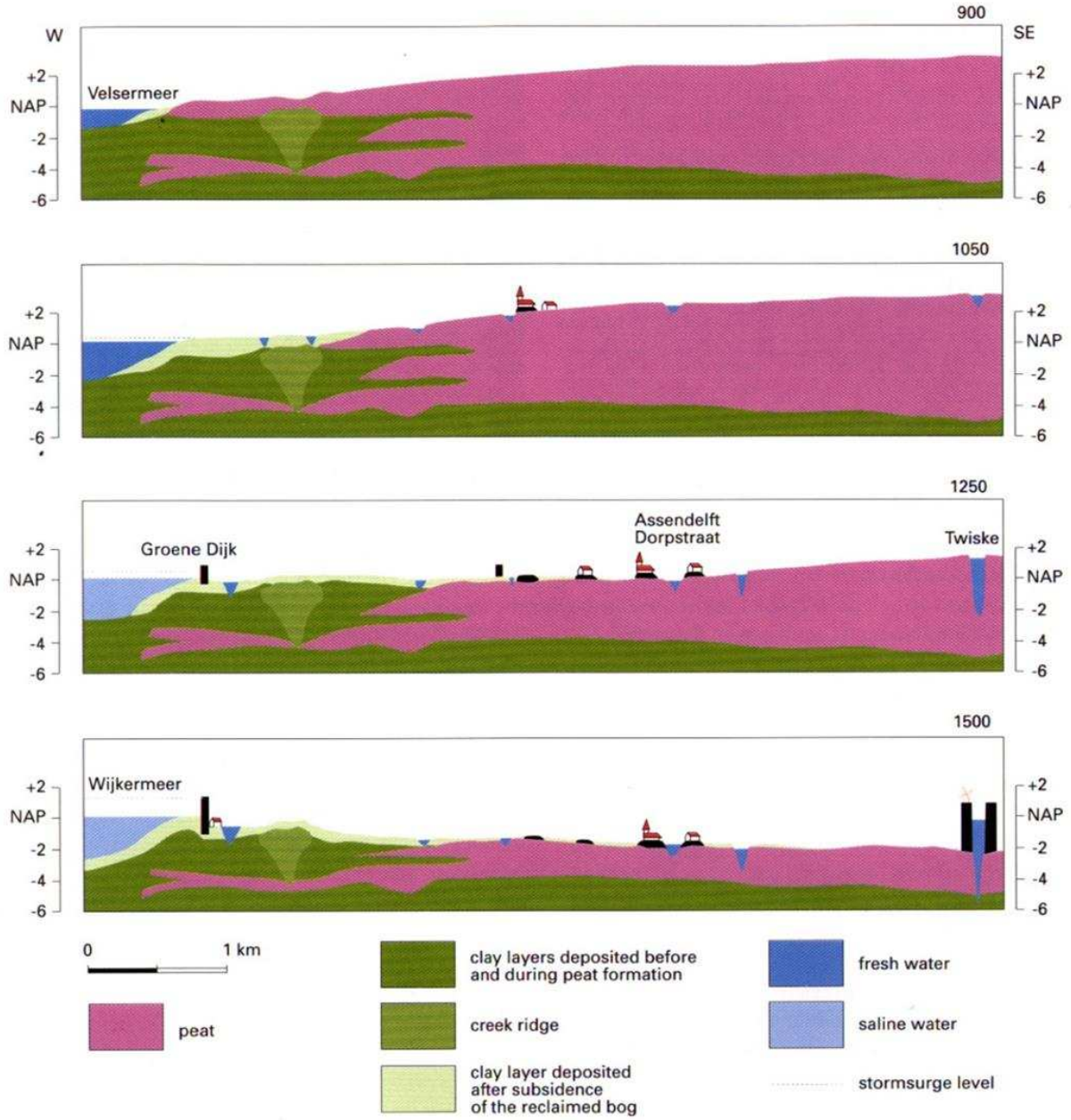

Figure 13. Stages of human occupancy of deltaic peat land, example for the area near Assendelft (Noord-Holland: Oer-IJ tidal inlet). Source: Vos, 1983.

peat domes (draining, oxidation) to the deltaic base levels of regular flooding and sea-level. Thereafter, opportunistic mining of the most-organic peats (highest caloric value) led to further lowering of the land surface and increase of water surfaces (lakes).

The way in which landscapes were reclaimed during the last ~1000 years has been roughly the same for both the central delta and western peat lands. The Medieval polders of the central river delta, have survived to the present-day. However, towards the 17th century the western peat

landscape of Holland turned into a lake-dominated landscape (Zoetermeer, Haarlemmermeer) and since the 18/19th century a deep-polder landscape appeared (Fig. 13). The present-day appearance of this landscape is thus considerably younger than that in the central delta, despite a similar reclamation history. This difference has a Late-Holocene geological origin. In the central delta the peat is covered by a clay layer resulting from deforestation and farming in the hinterland. In the western peat lands, this clay layer was never deposited. When humans started reclaiming the swamps, their reclamation method initially worked well. However, due to the absence of a clay-cover in the west, reclamation was quickly followed by the need for strong drainage and water-pumping windmills. The dewatering led to compaction and oxidation of the peat, which finally was unsustainable resulting in large lakes. Later on, these lakes were reclaimed again. In Reeuwijk (Stop 1) we will see polder Middelburg, which is one of these former lakes with its former lake bottom at about 5-6 m below sea level (the surrounding lands lie around 2-3 m below sea level.

Further reading (*-marked: easily available online):

Bos, I.J. (2010) Distal delta-plain successions : architecture and lithofacies of organics and lake fills in the Holocene Rhine-Meuse delta, The Netherlands. Proefschrift Universiteit Utrecht. *

Cohen, K.M. (2013) Hoofdstuk 2: Achtergrond: ontstaan van de Nederlandse rivierdelta. In: Kleinhans, M.G., Klijn, F., Cohen, K.M. & Middelkoop, H. Wat wil de rivier zelf eigenlijk?. Deltares & Universiteit Utrecht. Deltares rapport 1207829. 50 pp *

Cohen, K.M. & Hijma, M.P. (2013) The transgressive Early-Middle Holocene boundary – the case for a GSSP at Rotterdam, Rhine Delta, North Sea Basin. Ciências da Terra Volume Especial VII – STRATI 2013 1st International Congres on Stratigraphy, pp. 148-149.

Dinter, M. van (2013) The Roman Limes in the Netherlands: how a delta landscapedetermined the location of the military structures. Netherlands Journal of Geosciences 92, 11-32.

Erkens, G. (2009) Sediment dynamics in the Rhine catchment : Quantification of fluvial response to climate change and human impact. Netherlands Geographical Studies 388. Proefschrift Universiteit Utrecht. *

Hijma, M.P. & Cohen, K.M. (2011) Holocene transgression of the Rhine river-mouth area, The Netherlands / Southern North Sea: palaeogeography and sequence stratigraphy. Sedimentology 58, 1453-1485.

Vos, P.C., 1983. De relatie tussen de geologische ontwikkeling en de bewoningsgeschiedenis in de Assendelver Polders vanaf 1000 voor Chr. In: R.W. Brandt et al. (eds.) De Zaanstreek archeologisch bekeken. Zaanstad, pp. 6-32.

Vos, P.C., Bazelmans, J., Weerts, H.J.T. en Van der Meulen, M.J. (Eds.) (2011) Atlas van Nederland in het Holoceen. Landschap en bewoning vanaf de laatste IJstijd tot nu. Amsterdam (Uitgeverij Bert Bakker), 96 pp.

Vos, P.C. & De Vries, S. (2013) 2e generatie palaeogeografische kaarten van Nederland (versie 2.0). Deltares, Utrecht. http://www.archeologieinnederland.nl *