



Evolution of the lower Rhine-Meuse delta (the Netherlands) in the Early and Middle Holocene: an interplay between fluvial and coastal processes

M.P. Hijma (1,2), K.M. Cohen (1,2), E. Stouthamer (2), A.J.F. Van der Spek (3), S. van Heteren (3)

(1) Utrecht Centre of Geosciences, Utrecht, the Netherlands, (2) Department of Physical Geography, Utrecht University, Utrecht, the Netherlands, (3) Geological Survey of the Netherlands, Utrecht, the Netherlands (m.hijma@geo.uu.nl / Fax: +31 30 2531145 / Phone: +31 30 2532766)

The landscape in the south of the North Sea Basin (Rotterdam, the Netherlands) changed dramatically during the Early and Middle Holocene. 12000 years ago sea-level stood ~ 57 m lower than today. The Early Holocene landscape, at present buried below 15-20 m of Holocene sediment was a wide Rhine river valley bordered by slightly higher terrain (dune fields on river terraces). 9000 years ago, delta formation set on in the area [1]. 6000 years ago, sea level had risen to within 5 m of the present level [2]. The landscape had evolved into a barrier-lagoon system, initially with many and eventually with only few river outlets [3]. In the back-barrier lagoon, the Rhine-Meuse delta developed [4]. In the study area, river outlets functioned as estuaries and attracted human activities at all these stages of deltaic and coastal landscape development [1-4].

Especially for times of rapid sea-level rise and rapid drowning between 9000 and 6000 years ago, interlinked reconstruction of developments is a challenge. Established modern-analogue based landscape evolution models for coastal and fluvial systems do not apply because the Early Holocene rates of sea-level rise have no modern analogue. We aim to reconstruct the sedimentary architecture of the Early-Middle Holocene base of the Holocene delta in detail, distinguish and map different facies (proximal-

distal, water depth, tidal-fluvial, lithology, palynology, provenance), quantify volumes of sediment (budget analysis), and establish and densify records of groundwater-level and sea-level rise. Hereto a huge amount of data has been made available: >50,000 corings and >50,000 cone penetration tests, detailed offshore seismic data, many dates from ^{14}C and OSL, and pollen and diatom counts.

Here, we present the development of the lower Rhine-Meuse delta, based on the new data and interlinked coastal and fluvial mapping approach. We will show the influence of the Early-Middle Holocene development on the modern landscape and highlight the differentiating and unifying factors when contrasting Rhine delta evolution 9-6 ka compared to 6-0 ka.

References

- [1] Berendsen HJA, Stouthamer E. 2000. Late Weichselian and Holocene palaeogeography of the Rhine-Meuse delta, The Netherlands. *Palaeogeography, Palaeoclimatology, Palaeoecology* 161, 3-4: 311-335.
- [2] Van de Plassche O. 1982. *Sea-level change and water-level movements in The Netherlands during the Holocene*. Ph.D. Thesis. Free University: Amsterdam.
- [3] Beets DJ, Van der Spek AJF. 2000. The Holocene evolution of the barrier and the back-barrier basins of the Belgium and the Netherlands as a function of late Weichselian morphology, relative sea-level rise and sediment supply. *Netherlands Journal of Geosciences - Geologie en Mijnbouw* 79: 3-16.
- [4] Berendsen HJA, Stouthamer E. 200. *Palaeogeographic development of the Rhine-Meuse delta, the Netherlands*. Koninklijke van Gorcum: Assen.