

## OUTLINE OF THE QUATERNARY STRATIGRAPHY IN THE VOORNE AREA, WITH RELEVANCE FOR THE GEOLOGICAL POSITION OF THE ZUURLAND-2 BOREHOLE

by

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An outline is given of the lithostratigraphic units and their age of Quaternary deposits with relevance for the geological position of the Zuurland-2 borehole. Zuurland is situated near the town of Brielle on the Island of Voorne in the western part of the Netherlands.

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### SAMENVATTING

Overzicht van de kwartair-stratigrafische opbouw van het eiland Voorne, in verband met de geologische positie van de boring Zuurland-2.

Een overzicht en korte beschrijving wordt gegeven van de lithostratigrafische eenheden en hun ouderdom (Kwartair), voorzover van belang voor het onderzoek van de boring Zuurland-2. De plaats van de boring is op het eiland Voorne, nabij Brielle.

### OUTLINE OF THE QUATERNARY LITHOSTRATIGRAPHY

The Zuurland-2 borehole (on the island of Voorne) is situated in what was once the Holocene Meuse/Rhine estuary, close to the present coast of the North Sea (Fig. 1). The coastline shifted several times during the Pleistocene, as shown by alternating marine-shell bearing beds and non-marine deposits in the subsoil.

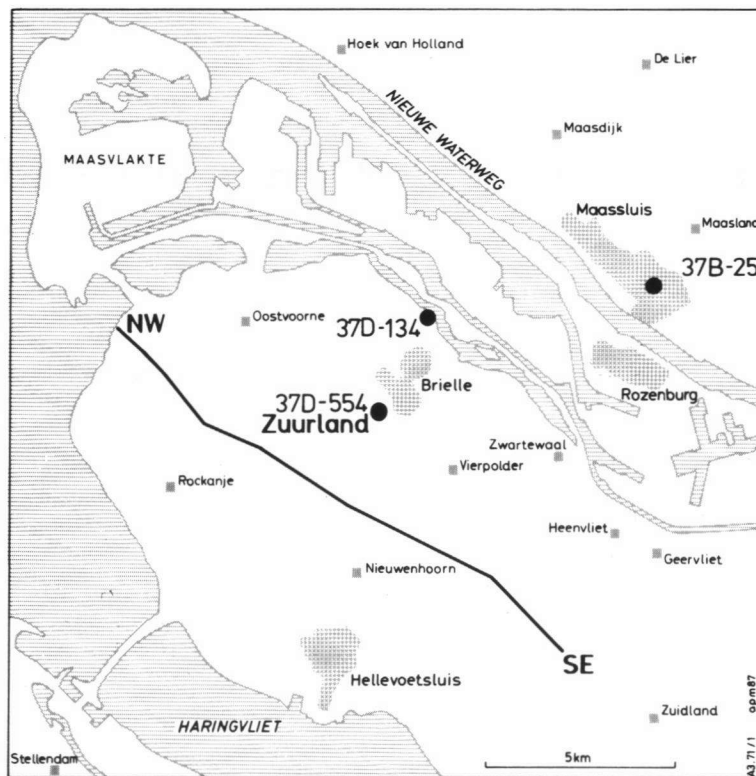


Fig. 1. Situation map of the island of Voorne showing the location of the Zuurland-2 (37D/554), Brielle (37D/134) and Maassluis (37B/25) boreholes and of the cross-section of Figure 2.

For the general geological position, the reader is referred to Zagwijn & van Staalduinen (1975), Zagwijn (1974, 1975, 1985) and van Staalduinen (1979). An East-West section (Fig. 2) shows the position of the lithostratigraphical units to a depth of about fifty metres. The generally applied chronostratigraphy and lithostratigraphy are given in Fig. 3 (Zagwijn, 1985), and a temperature curve of the Pleistocene in Fig. 4 (de Jong, 1988). With respect to the present study, the following formations are of importance:

1. Westland Formation. Marine clastic deposits and peat layers. Age: Holocene. The lower peat, which developed on top of the Pleistocene subsoil, is mainly of Atlantic age, although locally the lower parts may be older (Boreal age). The overlying marine deposits are of Atlantic and Subboreal age. The main Holland peat above them has a lower part composed of reed peat, and an upper part containing—in some areas—remains of plants grown in oligotrophic environments (raised bogs). The peat is mainly of Subboreal age, but some of the peat in the upper part dates from the Subatlantic. On the peat the sedimentation is terminated by estuarine Dunkirke deposits differing in age (Subatlantic, some parts Medieval or later).

2. Twente Formation. Mainly fine-grained deposits of periglacial origin. Age: Weichselian. In the area under discussion this formation is only represented locally and occurs as a thin layer of cover-sands situated between the deposits of the Kreftenheye and Westland formations.

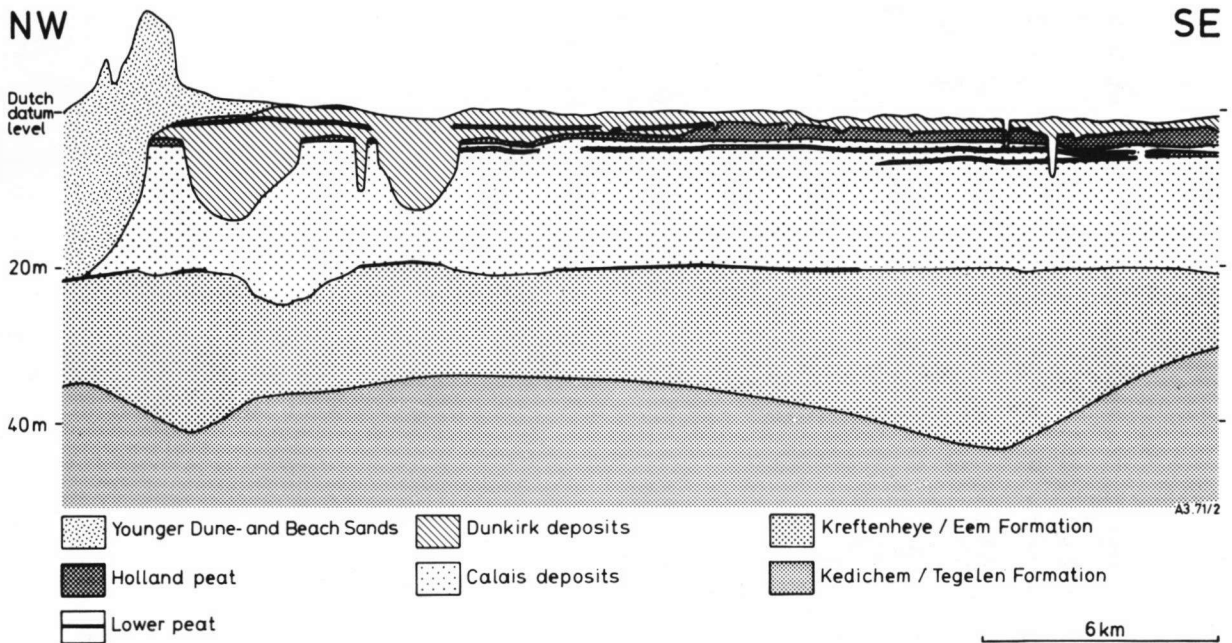


Fig. 2. NE-SW cross-section of the area under study. Simplified after section C-C' of the map with sections belonging to the Geological Map of The Netherlands, sheet Rotterdam 37 West, scale 1:50.000 (van Staalduinen, 1979).

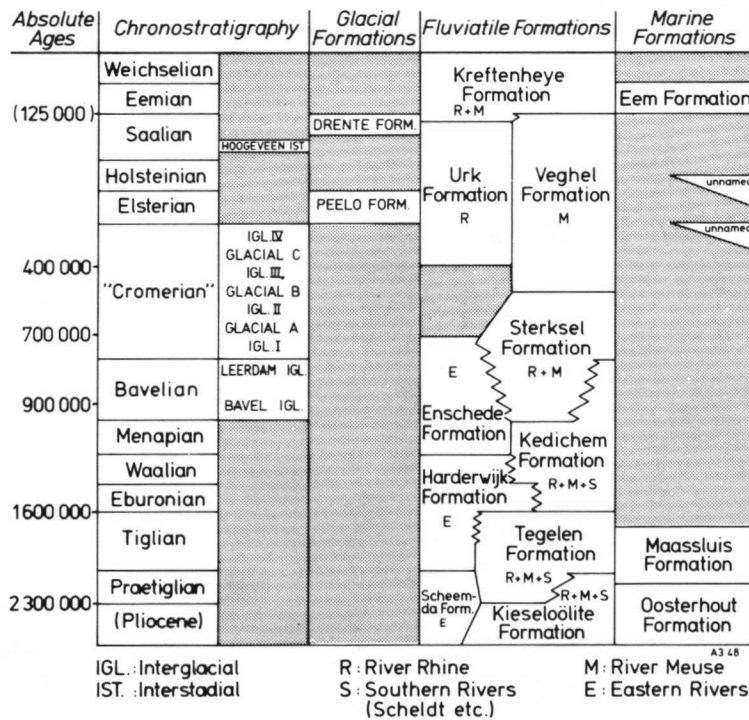


Fig. 3. Lithostratigraphy and chronostratigraphy as applied by the Geological Survey of The Netherlands (after Zagwijn, 1984, fig. 4).

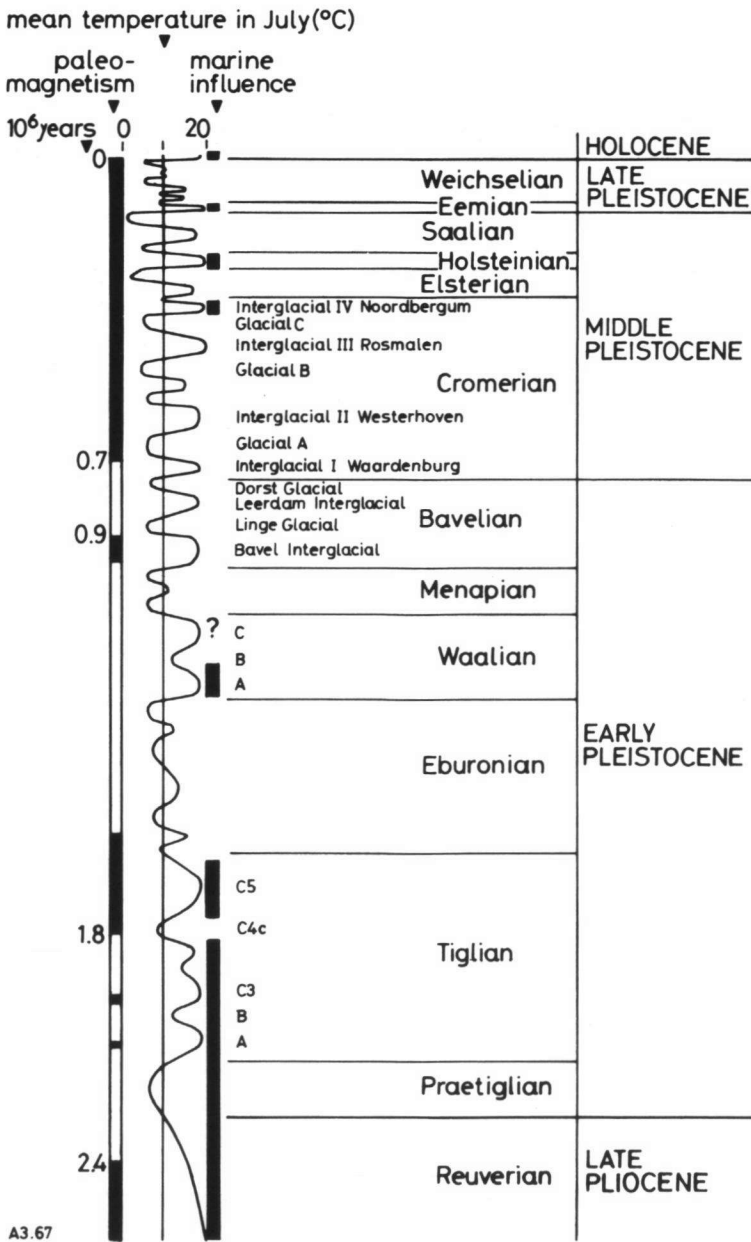


Fig. 4. Chronostratigraphy and temperature curve of the Quaternary (after de Jong, 1988).

3. Kreftenheye Formation. Generally rather coarse-grained deposits of the river Rhine. Age: Eemian and Weichselian. All coarse-grained deposits overlying those of the Kedichem Formation in the present area have been assigned to the Kreftenheye Formation. Although the Kreftenheye Formation contains mainly coarse deposits, there are also some less coarse sediments, which leads to a very heterogenous composition in which the most characteristic features are marine shells, fragments of clay and, less frequently pieces of peat. These deposits obviously belong to a transitional zone between fluvial and marine deposits. At the base, deposits of older formations may be present (due to reworking?). The estimated depth range is between 20 to over 40 m. Especially the depth of the base varies considerably (erosional unconformity).

4. Kedichem Formation. Mainly fine-grained deposits (clay and fine sands) sometimes showing periglacial phenomena. East of the present area there are intercalated layers of peat or other organic material. Coarse-grained deposits occur incidentally, especially in the regions where the deposits alternate with those of other formations (Fig. 3). Age: Eburonian up to and including the Leerdam Interglacial (Bavelian stage). Until recently, no true marine deposits were known for this formation. However, pollen-analytical data obtained in deposits of Waalian Interglacial age pointed in some cases to a locality close to the coast (Zagwijn, 1974). Marine molluscs have now been found in deposits which in all probability belong to the Kedichem Formation (Meijer, 1987; 1988, this volume).

5. Tegelen Formation. In the present area this formation comprises mainly non-marine deposits of clay and fine sands, partially forming the equivalent of the Tegelen clay. Age: in the western part of The Netherlands Late Tiglian (TC4c and later), in some localities possibly up to early Eburonian. This formation marks the final termination of the over-all Late Tertiary and Early Pleistocene transgression. Recent investigations have shown, that some deposits of this formation in the western part of The Netherlands, also show a marine influence (Kasse, 1986; Meijer, 1986, 1988). In the Zuurland-2 borehole at Brielle (RGD registration number 37D/134) the thickness of the formation is indicated approximately by the interval from -66 to -90 m.

6. Maassluis Formation. Fine shell bearing sands with intercalated clay layers. Age: Early Pleistocene (Tiglian and Pretiglian). Depth in the Maassluis stratotype-borehole 37B/25 (Fig.1) 99-207 m, in the Brielle borehole 37D/134 90-325m (final depth) (van der Meulen & Zagwijn, 1974; van Voorthuysen *et al.*, 1972). Deposits of Tiglian-A age are not known from this area. In the present region the deposits of this formation are underlain by sediments of the Oosterhout Formation (Pliocene).

Remark: In the area under discussion it is not always possible to distinguish between deposits of the Kedichem and Tegelen formations on lithological grounds; the fine-grained deposits occurring between the sediments of the Kreftenheye Formation and those of the Maassluis Formation are therefore indicated as the Kedichem/Tegelen Formation (Fig. 2).

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