

**LITHOLOGICAL DESCRIPTION OF THE BOREHOLE AT ZUURLAND,
THE NETHERLANDS**

by

A. W. Burger,
Geological Survey of The Netherlands, Haarlem,

L. W. Hordijk,
Brielle

and

T. Meijer,
Geological Survey of The Netherlands, Haarlem.

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A short description of the sediments in the Zuurland borehole, and a lithological column are presented. The description is based on field observations of wet sediments, and analyses of dried samples and coarse material in washed residues.

A. W. Burger, Geological Survey of The Netherlands, P.O. Box 157, 2000 AD Haarlem, The Netherlands; L. W. Hordijk, Annahoevestraat 69, 3232 NB Brielle, The Netherlands; T. Meijer, Geological Survey of The Netherlands, P.O. Box 157, 2000 AD Haarlem, The Netherlands.

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SAMENVATTING

Lithologische beschrijving van de boring te Zuurland, Nederland.

Van boring Zuurland, ten ZW van Brielle, wordt een lithologische beschrijving gegeven van de doorboorde sedimenten tot een diepte van 64 meter beneden maaiveld. Daarnaast wordt een lithologische kolom gepresenteerd.

De beschrijving is gebaseerd op veldwaarnemingen aan vers gepulsd sediment en op de analyse van gedroogde monsters. Tevens werd waar nodig de beschrijving aangevuld met behulp van waarnemingen aan zeefresiduen van gespoelde bulkmonsters.

De hier gegeven beschrijving is een samenvatting van een uitgebreide versie waarin elk monster apart wordt behandeld. Deze uitgebreide beschrijving bevindt zich in het archief van de Rijks Geologische Dienst.

INTRODUCTION

The borehole Zuurland-2 (registration number 37C/554) is located South of the town of Brielle on the island of Voorne, in the province of Zuid-Holland (Fig. 1). The co-ordinates of the location are 69.819/434.453, and the altitude of the surface is 0.40 meter below N. A. P. (= Normal Amsterdam Ordnance Level) (sheet 37C of the Dutch Topographical Survey). Geological information of the area is given by Burger (1988), de Jong (1988) and van Staalduinen (1979).

The material was obtained by manual bailer sampling performed by the second author as a private project (Hordijk 1985, 1986, 1988). Samples were collected from sediment columns with a length of 1 metre. In the field attention was paid to texture, colour, and number of clay layers, the concentration of fossil and other organic remains, the exact position of sedimentary transitions, etc. The bulk of the sediment samples was washed on a sieve with a mesh of 0.4 mm. The usually applied



Fig. 1. Location of the borehole at Zuurland.

method of sediment-welling gave samples much larger than would ever have been obtained with routine procedures. If not performed with caution, the welling-up method gives the risk of contamination of the samples by younger sediments.

Sample contamination was not observed by others (*e.g.* Burger, 1988; van Kolfschoten, 1988; Meijer, 1988). The washed residues showed appreciable concentrations of floral and faunal elements, otherwise rarely found. The residues were carefully examined for the presence of coarse gravel, claystones, other concretionary particles, etc. Air-dried untreated sediment samples are described following the normalized standard methods used at the Geological Survey of The Netherlands (Anonymous, 1977). Coarseness of the sand fraction was estimated by visual comparison with standard-sized grains.

The description given below is a condensed version of the final report in which each sample is described separately. The full description is kept in the archives of the Geological Survey. Fig. 2 shows the lithological column prepared for this location.

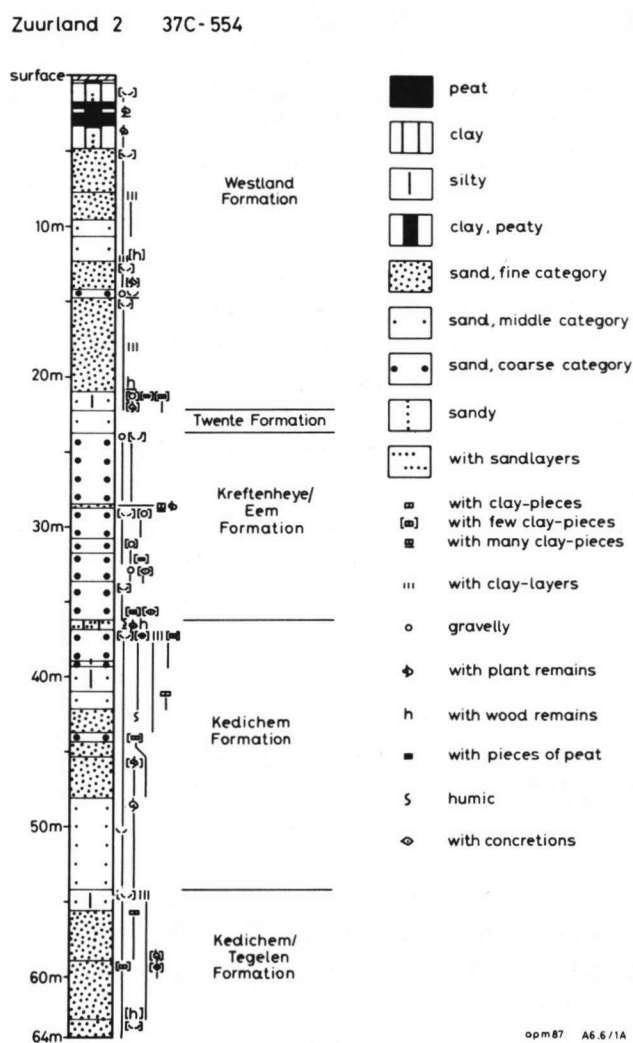


Fig. 2. Lithology of the Zuurland-2 borehole at Brielle, The Netherlands.

LITHOLOGICAL DESCRIPTION OF THE SEDIMENTS

(depths are given in metres below the surface)

- 0.00-0.25 Top soil (sod).
- 0.25-0.40 Clay, black, peaty.
- 0.40-1.75 Clay, down to 0.70 yellowish with some shells, below this depth bluish with some plant remains; below 1.25 brown, somewhat sandy.
- 1.75-2.15 Peat, some wood remains.
- 2.15-2.40 Clay, greyish-brown, peaty, abundant plant remains.
- 2.40-3.30 Peat, black, near the base some woody remains.
- 3.30-4.90 Clay, light blue, down to 3.40 peaty, deeper with decreasing amount of plant remains; 3.90-4.30 sandy; lowermost 10 cm: yellowish blue clay with thin layers of sand.
- 4.90-7.75 Sand, extremely fine, well sorted, greenish grey. Micaceous. Trace of very fine shell grit, a few to very few spines of *Echinocardium*.
- 7.75-9.60 Sand, very fine, well-sorted, grey. Five thin clay layers. A trace of very fine shell grit, a few to very few spines of *Echinocardium*.
- 9.60-10.65 Sand, moderately coarse, moderately well-sorted, grey. A trace of poorly sorted very fine gravel, very few peaty remains. Two thin clay layers. Few shell fragments.
- 10.65-12.30 Sand, moderately coarse to moderately fine, moderately well-sorted, grey with a greenish hue. In the upper part a trace of fine gravel and a few shell fragments. In the lower part a trace of micaceous and three clay layers. At 11.80 some remains of wood.
- 12.30-14.25 Sand, very fine, well-sorted, grey. Few micaceous, a clay-piece. Some very fine shell fragments, some spines of *Echinocardium*. In the lower part some leaf remains.
- 14.25-14.75 Sand, coarse, grey. Gravelly with many shell remains.
- 14.75-21.00 Sand, very fine, well-sorted, at the base moderately well-sorted, grey. Few to very few clay pieces. Few micaceous, a single peat remnant. A clay layer at 18.00-18.10. Some dispersed layers with some wood remains, much wood at 20.90-21.00. At 19.00-20.00 some pieces of pumice. At the top very few, and deeper a trace of shell grit. A trace to a few spines of *Echinocardium*.
- 21.00-22.30 Sand, moderately fine to moderately coarse, silty, moderately well-sorted, grey. A trace to few clay pieces, some poorly sorted fine gravel. In the top layers few peaty remains and a single charred wood remnant. In the lower part a trace of plant remains. Very few to few shell remains. Spines of *Echinocardium*.
- 22.30-23.80 Sand, moderately coarse, well sorted, light-brownish grey, variegated. Few micaceous. Some very fine shell fragments.
- 23.80-28.55 Sand, very coarse, moderately well to poorly sorted, light-brownish grey to greyish brown, variegated. Varying gravel content. Few shell fragments.
- 28.55-28.70 Sand, fine, light-brownish grey, with plant remains. At the top, many humic clay pieces.
- 28.70-30.80 Sand, very coarse, moderately well-sorted, light-brownish grey to greyish brown, variegated. A little fine gravel. Trace to few shell remains.
- 30.80-31.80 Sand, very coarse, moderately well-sorted, light-brownish grey, variegated. Gravelly. Trace of very fine shell remains.
- 31.80-33.70 Sand, very coarse, grey, little variegation. In the top layers well-sorted with very few shell fragments and some peaty grains. In the bottom layers poorly sorted, gravelly. A few rounded green clay stones.

- 33.70-36.25 Sand, moderately to very coarse, moderately well- to well-sorted, dirty grey colour (not variegated). Single gravel grain, trace of fine shell remains. In the bottom layers few micas and some pieces of peat. At the base some ironstone concretions.
- 36.25-36.90 Clay, strongly humic, with plant and wood remains. Above 36.70 the clay is interrupted by three thin sandlayers. The colour of the individual clay layers is, from top to bottom: brownish grey, intense dark-blue, light-green, and brownish green. At 36.50, a thin layer of plant remains. Below 36.70, the clay is light-bluish grey and interrupted by two thin layers of sand.
- 36.90-38.95 Sand, very coarse, moderately well-sorted. Dirty grey in colour. Trace of very fine gravel. Some purplish brown rounded hard clay pebbles. Some ironstone concretions. Below 37.54 nine light-bluish grey thin clay layers. Trace of fine shell fragments.
- 38.95-39.35 Sand, very coarse, silty, moderately well-sorted, light-brownish grey, little variegation. Trace of fine gravel, a single clay piece. A trace of shell fragments, some ironstone concretions. One light-bluish grey thin clay layer.
- 39.35-40.95 Sand, moderately fine to moderately coarse, silty, bimodally sorted, greyish brown. A small amount of fine, poorly sorted gravel. A few clay pieces, some ironstone concretions. A trace of shell fragments. Six thin layers of light-bluish grey clay.
- 40.95-42.20 Sand, moderately fine, well-sorted, greyish brown to grey, with micas. Clay pieces, a single ironstone concretion. A few fine shell fragments. Six thin layers of light-bluish grey clay.
- 42.20-43.75 Sand, very fine, moderately well-sorted, grey. Micras, few clay pieces. Trace of fine shell fragments. Nine thin layers of clay, above 42.70 humic and brownish grey, deeper light-bluish grey.
- 43.75-44.40 Sand, very coarse, moderately well-sorted, light-brownish grey. Some rounded clay stones. A single shell fragment.
- 44.40-45.30 Sand, moderately fine to moderately coarse, moderately well-sorted, grey, moderately variegated. Few micras, some rounded clay stones, some clay pieces. A trace of shell fragments.
- 45.30-48.10 Sand, moderately fine (at the base slightly coarser), moderately well- to well-sorted, grey, little variegation. Micras, some plant remains, some rounded clay stones, a single clay piece. Trace of fine shell fragments.
- 48.10-54.15 Sand, moderately coarse, down to 53.00 well- sorted, deeper moderately well-sorted, in the upper part light-brownish grey, deeper grey, little variegation. Few micras, plant remains. Increasing amounts of shell fragments from 50.00 downward.
- 54.15-55.60 Sand, moderately coarse, silty, poorly sorted, light-brownish grey. Few micras, very few clay pieces. Trace of shell fragments. Eight thin layers of light-grey clay.
- 55.60-58.95 Sand, at the top extremely fine, deeper very fine, bimodally sorted, olive-greenish grey. Few micras, in the bottom layers some plant remains. Clay and silt pieces. A trace to very few shell fragments. Fifteen thin layers of light-grey clay.
- 58.95-62.80 Sand, extremely to very fine, at the top poorly sorted, deeper well-sorted, olive-greenish grey. A trace to few micras. At the top some iron concretions and some plant remains. At the base some wood remains. Some silt pieces. Sixteen thin layers of light-grey clay.
- 62.80-64.00 Sand, very fine, poorly sorted, light-greenish grey. Micras and a trace of plant remains. Some rounded clay stones and clay pieces. A trace of fine shell fragments.

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