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PROBLEMS OF LITHOSTRATIGRAPHIC CLASSIFICATION OF HOLOCENE DEPOSITS IN THE PERIMARINE AREA OF THE NETHERLANDS

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ABSTRACT

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The definition and subdivision of the Westland Formation, especially with regard to the so-called 'perimarine deposits', has met with serious objections. These objections result from the mingling of the concepts of lithostratigraphy, chronostratigraphy, and genesis. It is concluded that the lithostratigraphic classification of the Holocene sediments in the Netherlands' coastal area has to be disconnected from the genetic concept of a 'perimarine' area. A new system for lithostratigraphic classification of the deposits in the perimarine area is proposed.

INTRODUCTION

Part of the Dutch subrecent coastal plain is referred to as the 'perimarine area', which is defined by HAGEMAN (1969) as 'the area where sedimentation or sedentation (peat formation) took place under the direct influence of the relative sea level movements but where marine or brackish sediments themselves are absent'.

The Geological Survey of the Netherlands assigns all Holocene mineral deposits and peat in the marine as well as the perimarine area to the Westland Formation (ZAGWIJN & VAN STAALDUINEN, 1975). The Westland Formation is subdivided into members on the basis of the alternation of clastic sediments and peat. The clastic marine deposits comprise essentially the lower Calais Deposits and the upper Dunkirk Deposits (Fig. 1a). The clastic perimarine deposits comprise the lower Gorkum Deposits and the upper Tiel Deposits. In both areas peat layers are included in the Holland peat (member).

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SOME CONCEPTUAL OBJECTIONS TO THE WESTLAND FORMATION

Since its formal introduction by ZAGWIJN & VAN STAALDUINEN (1975), many objections have been raised against the definition and subdivision of the Westland Formation. These objections can be summarized as follows:

1-BROUWER (1976) argued, that the Westland Formation is based on wrong criteria, namely age and genesis. This holds true for the formation itself as well as for its subdivision into members (Fig. 1a). The lithostratigraphic units that have been introduced comprise deposits of completely different lithology, that have been brought together under the same unit because they are of the same age. This however is incompatible with the principles of lithostratigraphic classification as expressed by HEDBERG (1976).

2-ROELEVELD (1974) and GRIEDE (1978) pointed out that the names for the members of the Westland Formation in the marine area (Fig. 1a) have been used in the literature in a rather confusing way. DE JONG ET AL. (1960) used the terms 'Calais' and 'Dunkirk' in a strictly lithostratigraphic sense; VAN RUMMELEN (1970) used them also to indicate periods of transgression, while PONS ET AL. (1963) used them to indicate

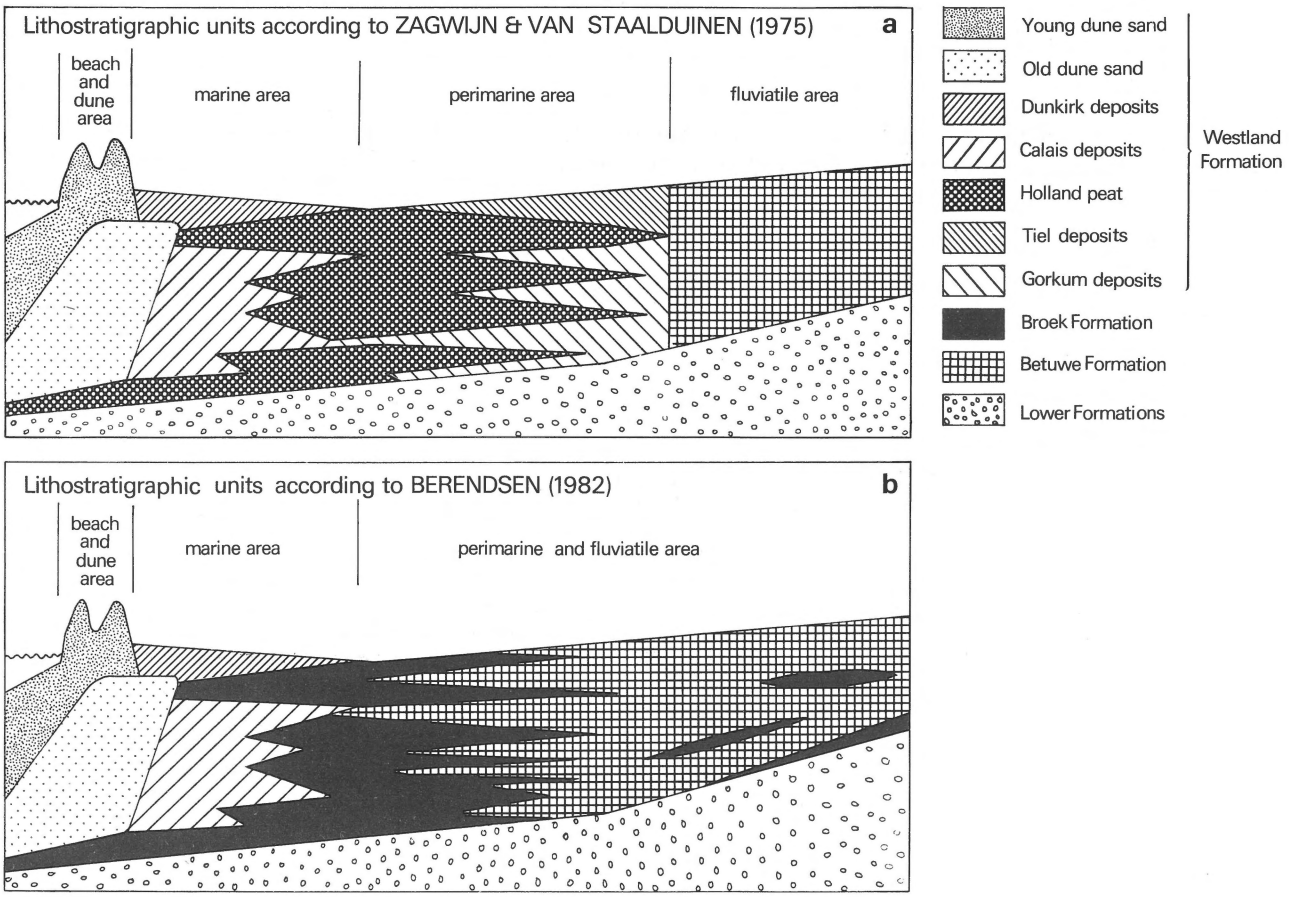

Fig. 1
Schematic diagram comparing lithostratigraphic classification systems of Zagwijn & Van Staalduinen (1975) and Berendsen (1982).

a certain period of time. To avoid ambiguities of this kind, ROELEVELD (1974) and GRIEDE (1978) used the terms 'Calais' and 'Dunkirk' in a strictly chronostratigraphic sense, and proposed new lithostratigraphic names.

Unfortunately their way of discriminating clearly between lithostratigraphy and chronostratigraphy has not yet been adopted by the Geological Survey of the Netherlands.

3-The ambiguities mentioned by ROELEVELD (1974) and GRIEDE (1978) also apply to the terms 'Gorkum' and 'Tiel' (Fig. 1a) in the so-called perimarine area (BERENDSEN, 1982). The 'Gorkum Deposits' and 'Tiel Deposits' cannot be distinguished on lithological grounds; therefore radiocarbon datings have been used to differentiate these members. This causes a mingling of the concepts of lithostratigraphy and chronostratigraphy.

4-The subdivision of the Westland Formation in the perimarine area (Fig. 1a) according to ZAGWIJN & VAN STAALDUINEN (1975) is based on an assumed genetic relationship between the geological development in the marine and the perimarine area (HAGEMAN, 1969): the 'Calais Deposits' are presumed to be synchronous with the 'Gorkum Deposits', while the 'Dunkirk Deposits' are presumed to be synchronous with the 'Tiel Deposits'. This synchronous development however has never been proven by a quantitative analysis of radiocarbon datings. VAN DER WOUDE (1979) discretely challenged the synchronous development, but did not have enough radiocarbon datings to refute it.

VAN LOON (1981) noted that the possibility of lateral changes in facies and diachrone sedimentation in general has hardly been considered. BERENDSEN (1982) observed the occurrence of both lateral and longitudinal changes in facies and studied the genetic relationship between the geological development in the marine and perimarine area on the basis of 89 radiocarbon datings in the perimarine area. He concluded that the presumed synchronism is non-existent (BERENDSEN, 1984).

5-ZAGWIJN & VAN STAALDUINEN (1975) attributed the Holocene river deposits partly to the Westland Formation and partly to the Betuwe Formation, which consists of fluvial deposits of the rivers Rhine and Meuse, and bounds the Westland Formation in the East. The fluvial deposits of these formations do not show any significant lithological differences; the boundary between the formations therefore is not based upon a difference in lithological character of the river deposits.

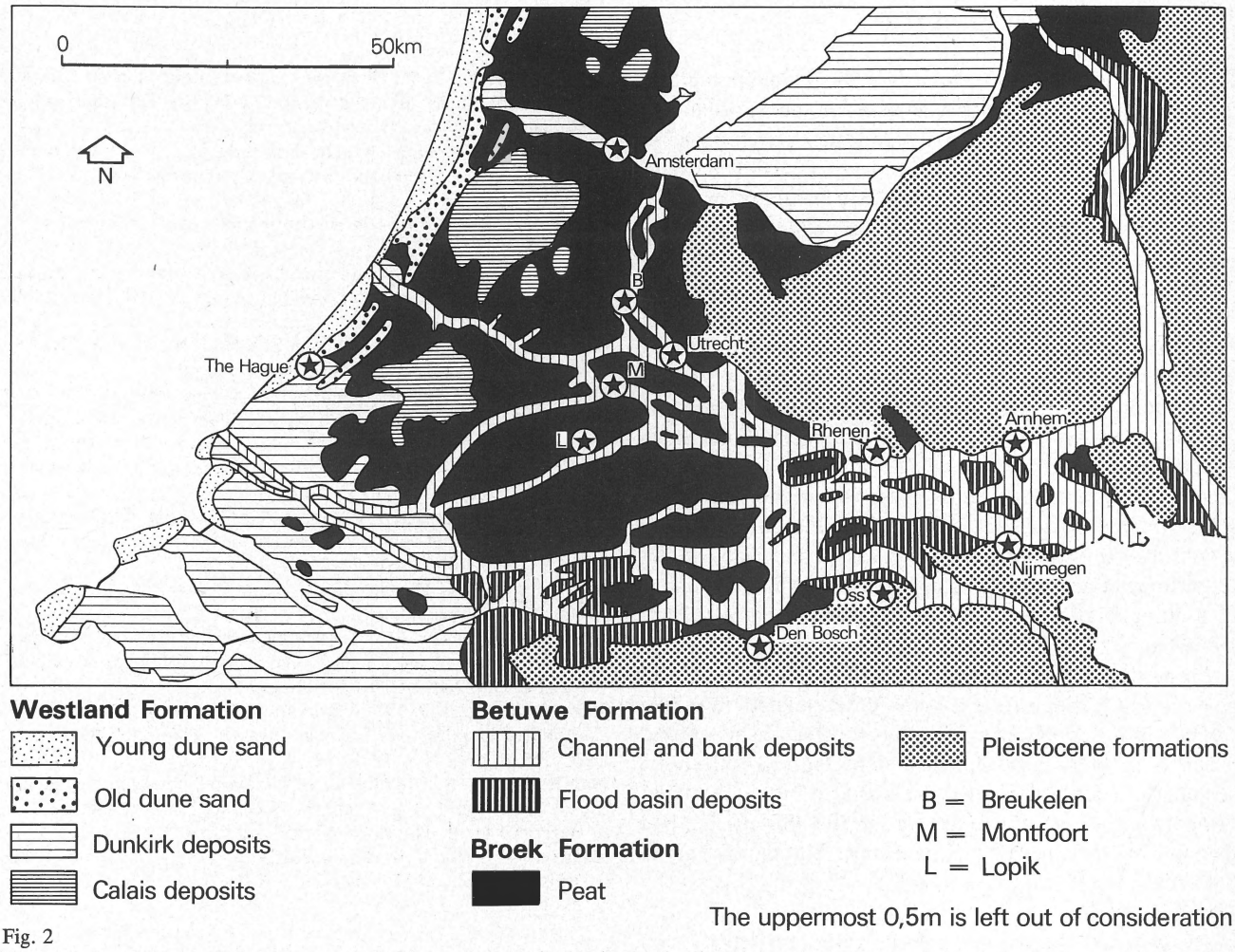

Fig. 2
Geological map of the Holocene deposits in the central Netherlands. Partly after the geological map of the Netherlands, scale 1:600.000. Lithostratigraphical units after Berendsen (1982).

Instead, the Westland Formation (which comprises all 'perimarine' deposits) is bounded genetically by HAGEMAN's (1969) definition of the perimarine area. However, lithological characteristics that are easily recognizable in the field should be applied in lithostratigraphy (HEDBERG, 1976). ZAGWIJN & VAN STAALDUINEN (1975) tried to use the extent of the flood basins and thickness of peat layers as criteria to differentiate the two formations. However, it is very hard to apply these criteria in an objective manner because all transitions of this kind are gradual. Moreover, it has never been proven that these lithological characteristics do have any genetic relationship with the 'perimarine' nature of the deposits. For example, the area in which peat is found increases as the extent of the flood basins increases west of a line drawn from Rhenen to Oss (Fig. 2). The increasing size of the flood basins is caused primarily by a broadening of the river-clay area west of this line. The occurrence of peat in the flood basins therefore is not necessarily related to the 'perimarine mechanism' as tacitly presumed by ZAGWIJN & VAN STAALDUINEN (1975). In other words, the genetic boundary of HAGEMAN (1969) and the lithological boundary of ZAGWIJN & VAN STAALDUINEN (1975) do not necessarily coincide.

VAN LOON (1981) also noted that the boundaries of both the Westland Formation and its members are ill-defined.

6-Even if genetic criteria were to be used to define lithostratigraphic units it would not seem to be justified to consider Holland Peat as part of a formation of marine origin, because peat can develop only in periods and areas where direct marine influence is small. Indeed, only part of the Holland peat can be (indirectly) related to the rising sea level; a large part of the peat formation was stimulated by inundations by the rivers, seepage from the higher Pleistocene sand hills or even rainwater.

Summarising these objections it can be concluded that the definition and subdivision of the Westland Formation have caused problems of both theoretical and practical nature. These problems are caused by a mingling of the concepts of lithostratigraphy, chronostratigraphy and genesis.

CONCLUSIONS

To evade the objections mentioned in the previous paragraph the lithostratigraphic classification of the Holocene sediments in the perimarine area has to be disconnected from the genetic concept of a perimarine area, and a clear distinction between lithostratigraphy and chronostratigraphy should be made.

The lithostratigraphy of the Holocene deposits in the perimarine area only has local validity (BERENDSEN, 1982). It proved to be impossible to corroborate the presumed synchronism of periods of sedimentation in the perimarine area with those in the marine area. Therefore, the terms 'Gorkum' and 'Tiel' as applied by the Geological Survey of the Netherlands certainly should not be used in a chronostratigraphic sense, as has been done by various authors. Since river deposits in the fluviatile area do not show any significant lithological differences with river deposits in the perimarine area, attempts to make a lithostratigraphic differentiation should also be discouraged. However, since many of the recently introduced stratigraphic names are already commonly used, alterations should be restricted to a necessary minimum.

A lithostratigraphic system in which clastic sediments and peat in the perimarine area are differentiated into two formations was proposed by BERENDSEN (1982). In his system, which is schematically represented in Fig. 1b, all clastic sediments in the marine area are included in the Westland Formation; all clastic sediments in the perimarine and fluviatile area are included in the Betuwe Formation. Peat in both areas is included in a new lithostratigraphic unit, the Broek Formation.

The so-called 'perimarine deposits' (Gorkum deposits and Tiel deposits) are no longer distinguished, neither lithostratigraphically, nor chronostratigraphically. For full details and definitions the reader is referred to BERENDSEN (1982).

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