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Time-Limit Assessment of some Holocene Transgressive and Regressive Periods in the Northern Netherlands

ORSON VAN DE PLASSCHE *)

Time limit, Holocene, chronology, transgressive period,
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Northern Netherlands, North Sea

A b s t r a c t : The paper discusses the significance of six time limits in the existing chronology of Holocene transgressive and regressive periods in the northern Netherlands. It is concluded that (1) the time limits for the Holland III regressive period remain to be established, (2) the 3525 BP time limit is valid; however, it does not represent the onset of a subphase of the Calais IVB but of the Dunkerque 0 transgressive period, (3) the 3325 BP time limit is an artefact, (4) the 3000 BP time limit pertains to transgressive peat growth during the first half of the Dunkerque IA transgressive interval, and not to the beginning of a regressive phase, and (5) the 2650 BP time limit probably marks the beginning of the Dunkerque IB transgressive interval rather than the end of the Dunkerque IA period.

[Festlegung von Zeitgrenzen für einige holozäne transgressive Perioden in den nördlichen Niederlanden]

K u r z f a s s u n g : Die Arbeit diskutiert die Bedeutung von sechs Zeitgrenzen der gegenwärtigen Chronologie holozäner transgressiver und regressiver Perioden in den nördlichen Niederlanden. Der Schluß wird gezogen, daß (1) die Zeitgrenzen für die regressive Periode Holland III noch festgelegt werden muß; (2) die Zeitgrenze 3525 v. h. wohlbegründet ist, jedoch nicht den Beginn einer Subphase des Calais IVB, sondern den Beginn der transgressiven Periode des Dunkerque 0 markiert; (3) die Zeitgrenze 3325 v. h. ein Kunstprodukt ist; (4) die Zeitgrenze 3000 v. h. einem transgressivem Moorwachstum zuzuordnen ist, das in der ersten Hälfte des transgressiven Intervalls Dunkerque IA liegt und nicht am Beginn einer regressiven Phase, und daß (5) die Zeitgrenze 2650 v. h. wahrscheinlich eher den Beginn des transgressiven Intervalls Dunkerque IB markiert als das Ende der Periode Dunkerque IA.

Introduction

The existing chronostratigraphy for the Holocene coastal deposits in the northern Netherlands has been derived mainly from cumulative frequency histograms of 99 radiocarbon dates for the base and top of organic beds in the provinces of Groningen

*) Address of the author: Dr. O. VAN DE PLASSCHE, Instituut voor Aardwetenschappen, Vrije Universiteit, P. O. B. 7161, 1007 MC Amsterdam.

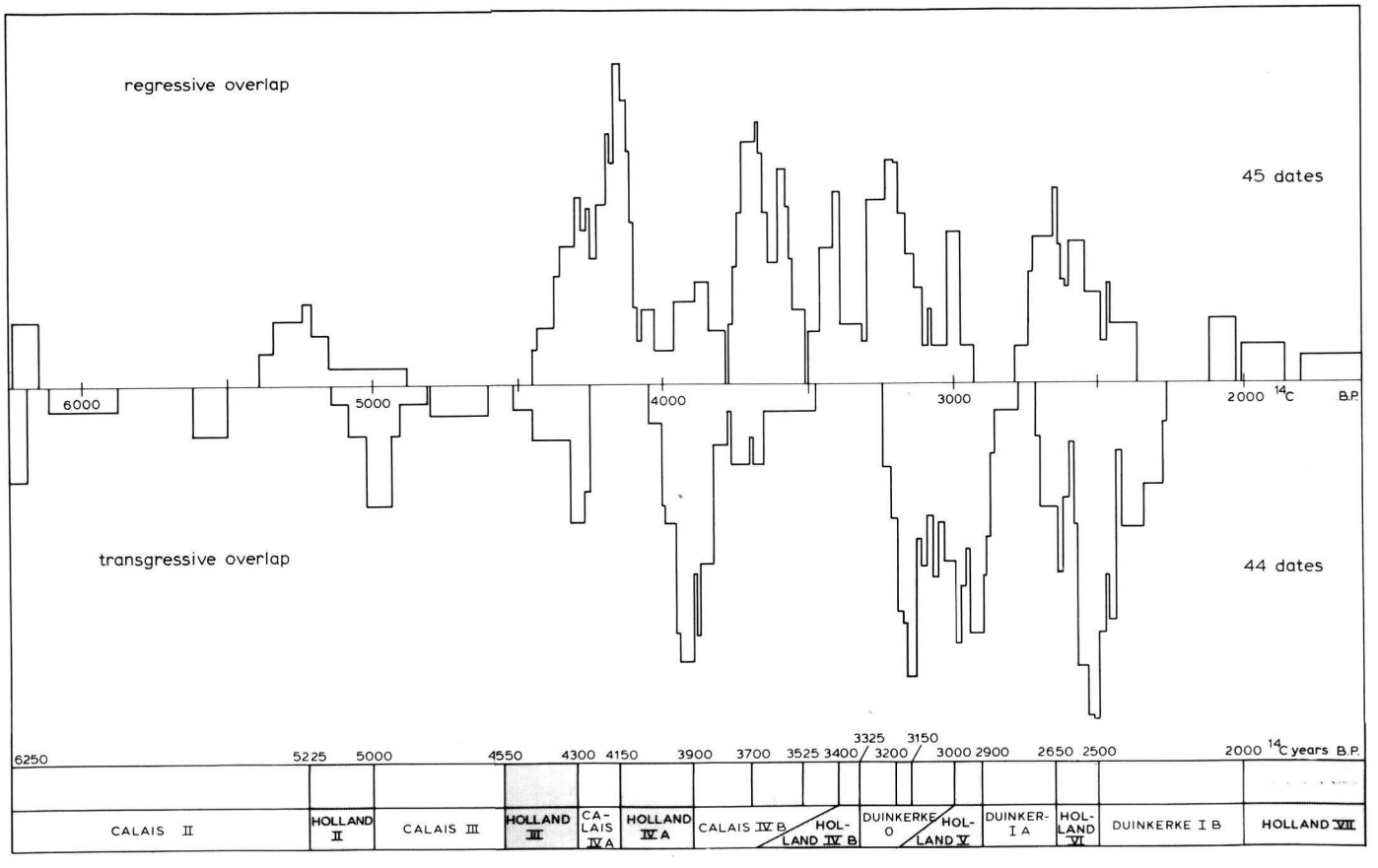

Fig. 1: Chronology of transgressive and regressive intervals for the northern Netherlands, derived from cumulative frequency histograms based on 99 radiocarbon dates for transgressive and regressive overlap (from GRIEDE 1978).

and Friesland (Fig. 1) (GRIEDE 1978, ROELEVELD 1974). Such a technique superficially appears an attractive way of establishing a chronostratigraphy, since the frequency peaks and troughs allow objective determination of maxima and/or minima of peat-growth activity, and hence of transgressive and regressive periods. However, the step from a frequency histogram to chronology of transgressive and regressive events may be fraught with difficulties. In order to avoid, as much as possible, artificial or erroneous time limits from entering into a transgression/regression chronology for a given coastal area, it is important that the chronostratigraphic significance of each frequency peak is evaluated in terms of the geological and paleogeographical context of the radiocarbon data on which it is based.

The paper summarizes the results of such an assessment made for six time limits in the chronostratigraphy for the Holocene coastal deposits in the northern Netherlands. The time limits discussed are 4550, 3000 and 2650 BP for the onset of the Holland III, V, and VI regressive periods and 4300, 3525, and 3325 BP for the onset of the Calais IVA, Calais IVB, and Dunkerque 0 transgressive (sub)phases.

Evaluation of time limits

4550 BP: beginning of the Holland III regressive interval

The time of 4550 BP for the onset of the Holland III regressive interval is only assumed. Its existence is inferred by GRIEDE (1978) from (1) the local occurrence of an undated peat bed in Northeast Friesland that must have originated between 4980 and 4175 BP, and (2) maxima of peat-growth cessation around 5000 and 4300 BP (Fig. 1). It is clear that on the basis of this evidence the 4550 BP time limit must be considered very preliminary. Moreover, as will be argued below, one should be cautious in accepting the 4300 BP frequency peak as indicating the onset of a transgressive phase.

4300 BP: beginning of the Calais IVA transgressive period

The 4300 BP transgressive peak is based on three radiocarbon dates for the top of the basal peat. The suitability of samples from the top of basal peat to derive the onset of transgressive intervals is questionable. Firstly, in the (general) case of gradual marine influence expansion the time peat growth ceases at a given location is a function of the site distance from the seaward edge of the peat marsh at the time transgression commenced. The factor 'distance' is especially important if the surface of the basal peat has developed a slight seaward inclination. Secondly, the situation in the West of Northeast Friesland, where the three dates are located, can be regarded as having been very favourable for submergence of the coastal swamp seaward fringe without the additional influence of regional transgression. Thus, the rather steeply sloping Pleistocene subsurface and the thick layer of (oligotrophic) peat that developed there (GRIEDE 1978), may well have allowed peat compaction to favour continued clay deposition over the seaward fringe of the peat marsh. Consequently the 4300 BP time limit should also be considered preliminary until more data have become available.

3525 and 3325 BP: onset of the Calais IVB and Dunkerque 0 transgressive (sub-)intervals

The two time limits to be considered now are not based on radiocarbon data, but have been derived indirectly from the troughs between the three consecutive frequency peaks for regressive overlap at 3700, 3400 and 3200 BP (Fig. 1). In cases like these it is important to be aware of the possibility that within a given coastal area clay deposition may continue longer in some parts than in others. This may give rise to more than one frequency peak for regressive overlap, without, however, the need to assume an intervening transgressive event.

Although there are sufficient grounds to take the onset of a transgressive interval around 3525 BP seriously (Roeleveld 1974; Ter Wee 1976), this cannot be maintained for the assumed onset of a transgressive period around 3325 BP. Analysis of available information indicates that the frequency maxima of regressive overlap around 3400 and 3200 BP belong to the same regressive period. The 3200 BP peak seems to be the result of later peat-growth commencement, since conditions at the five sampling sites favoured continued clay deposition. It may be added that the data published for Groningen and Friesland do not in any way lead to the assumption that the sea expanded its influence in the area shortly after 3400 BP. Finally, the fact that the estuaries in Groningen experienced peat growth for the first time in their history around 3200 BP points to considerable environmental change and renders it less logical to view the time between 3150 and 3000 BP as a sub-phase of the Dunkerque 0 transgressive interval (Fig. 1).

3000 BP: beginning of the Holland V regressive interval

This time limit is based on two ^{14}C dates for the base of peat beds. In both cases the sediment surface on which the peat developed reaches a high level. Hence, the possibility should be considered that peat growth at the two sampling sites was of a transgressive nature. Support for such an interpretation is obtained from the frequency histogram: the frequency maximum for regressive overlap at 3000 BP is more than counterbalanced by the frequency maximum for transgressive overlap at 2975 BP. Moreover, this latter maximum would have been even more pronounced had the Stiens III top-of-peat date (3020 ± 50 BP) been included in the frequency analysis. Griede (1978) considered it as being possibly too young. However, given the consistency with other dates for the top of the same bed (3160 ± 30 BP and 3030 ± 80 BP; Griede 1978) there is no reason to reject the Stiens III date.

With the above considerations in mind the following alternative interpretation of the frequency histogram between 3200 and 2900 BP can be offered. The major frequency maximum for transgressive overlap at 3150 BP, being the first phase of renewed clastic deposition after 3200 BP, represents the (local) onset of the Dunkerque IA transgressive interval. The regressive peak around 3000 BP can be explained as relating to transgressive peat-growth situations, and the pronounced transgressive peak at about 2900 BP marks the final break-through of marine influence expansion in the northern coastal district.

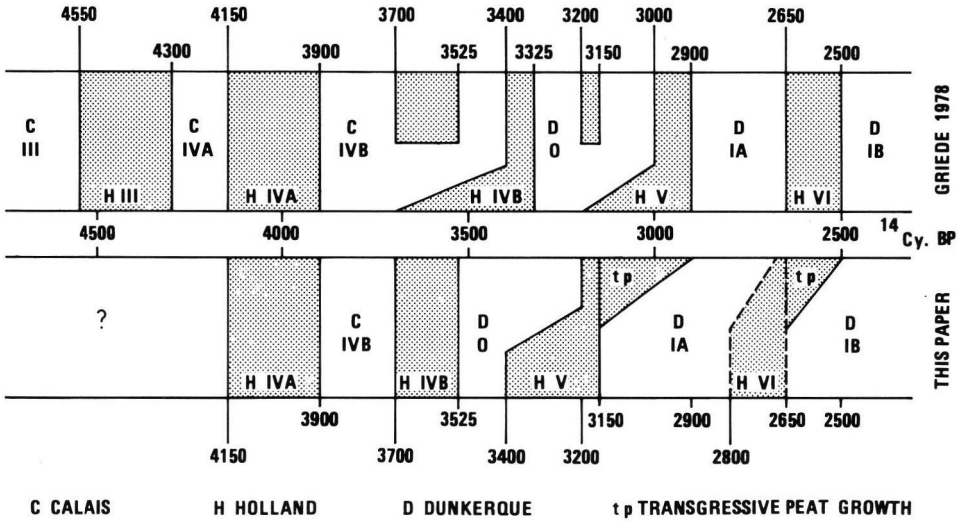

Fig. 2: Chronology of transgressive and regressive periods for the northern Netherlands as arrived at by GRIEDE (1973) and by the present author.

2650 BP: onset of the Holland VI regressive interval

A first indication that the regressive peak at 2650 BP need not be accepted at face value is the pronounced frequency maximum for transgressive overlap at 2625 BP. This could imply that all or some of the radiocarbon dates, on which the 2650 BP frequency maximum is based, relate to transgressive peat-growth situations. In this respect it is noteworthy that one of the five dates regards the upper part of a peat bed and not the base, and furthermore, that three of the remaining four dates come from sites where the underlying sediment surface originally reached a rather high level.

Another indication that the beginning of the Holland VI regressive interval may have to be placed earlier (than 2650 BP) is a radiocarbon date (Stiens II; GRIEDE 1978) for the base of an extensive peaty clay/clayey peat bed in Northeast Friesland: 2820 ± 50 BP. GRIEDE rejected that date as possibly too young because the top of this bed was dated at 2900 ± 35 BP (Stiens I), which he assumed to be correct. In our opinion, however, no objective criteria are presented to consider rejecting the Stiens II in favour of the Stiens I date.

The above discussion leads to the preliminary conclusion that the frequency maximum of regressive overlap at 2650 may be more representative for the onset of the Dunkerque IB transgressive interval than for the end of the Dunkerque IA transgressive period. The time limit for the latter is tentatively placed at 2800 BP.

Conclusions (see fig. 2)

(1) Beginning and end of the Holland III regressive interval (in Friesland) remain to be established.

(2) The Calais IVB transgressive interval does not continue until 3400 BP but ends at around 3700 BP.

(3) The Dunkerque 0 transgressive interval begins shortly before 3500 BP and does not continue until 3000 BP, but ends either at 3400 BP, or, if conditions favour continued sedimentation, at about 3200 BP.

(4) The Dunkerque IA transgressive interval begins in parts of the northern coastal district shortly after 3200 BP. Expansion of the marine influence reaches a maximum at around 2950 BP.

(5) The beginning of the Holland VI regressive phase should possibly be dated around 2800 BP. The start of the next transgressive interval (Dunkerque IB) may be placed at 2650 BP.

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