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THE STRATIGRAPHIC POSITION OF THE ENIGMATIC TERTIARY DEPOSITS CALLED HOLSET SANDS, AND OF RELATED SANDS IN BELGIUM[1]

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ABSTRACT

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The Holset Sands are Tertiary sands of uncertain age that occur on old surfaces in Dutch South Limburg. By comparing the extent and facies of well-known Tertiary deposits in the neighbourhood with those of the Holset Sands, the authors arrive at a likely correlation with the Latdorfian Grimmertingen and Neerrepen Sands. The lower part of the Boncelles Sands from the region of Liege, which were considered to belong to the Upper Oligocene, is also correlated with the Latdorfian sands, while the upper Boncelles Sands are correlated with the Rupelian Berg Sands. This model requires a minimum number of large transgressions and assumes that the Grimmertingen transgression was the only one to reach high Belgium.

INTRODUCTION

Holset Sands is a new lithostratigraphic name (KUYL. 1980) for previously unnamed sands and gravel deposits, including silicified boulders, occurring in the southern part of South Limburg, The Netherlands. These sands were included in the 'Basel gravel complex' by VAN DEN BROEK & VAN DER WAALS (1967) and were later indicated as 'Pliocene' sands by KUYL (1971).

The isolated deposits are found overlying flint eluvium (remains of fossil weathering on Cretaceous limestone) in the part of Limburg that was not covered by Late Tertiary and Pleistocene river terraces, and are not identified north of this area. The stratigraphic position of the deposits is not clear, and KUYL (1980) considers an Oligocene or a Miocene age without discussing this assumption. The deposits are unfossiliferous and not covered by any datable Tertiary deposits. A correlation of the deposits by means of mineral assemblages is bound to fail. Former investigations of heavy mineral fractions have indicated that, although in specific sites it may be possible to mineralogically identify e.g. the Oligocene Grimmertingen, Neerrepen and Berg Sands, regional variations within deposits are larger than differences between deposits (compare MULLER. 1943; TAVERNIER. 1947; RUMES & WILLEMS. 1972). Most of the heavy-mineral fraction consists of the stable tourmaline, rutile, zircon, anatase and opaque minerals. Garnet and epidote vary widely and staurolite and kyanite generally attain 10-20%. In some cases, strong weathering has further reduced the mineralogical differences between deposits.

The aim of this note is to arrive at a likely stratigraphic position by comparing the extension of the Holset Sands with that of similar undated deposits in Belgium and relating these to extensions and facies of well-documented Tertiary deposits in adjacent regions.

THE HOLSET SANDS

KUYL (1980) described the Holset Sands as follows: 'very fine sands of somewhat weathered aspect, mainly consisting of stable minerals. The sands are unfossiliferous and it is not certain whether they should be attributed to the Oligocene or to the Miocene; a Pliocene age appears less probable.

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Included in these deposits are silicified sandstones with 'chert-like' cement, which may have very coarse grain sizes. The deposits are resticted to the pre-Quaternary surface'.

SIMILAR DEPOSITS

Immediately south of South Limburg on the Herve Plateau and still further south and southwest on the Condrusian and Ardennes Plateaus in Belgium, occur Tertiary deposits of uncertain age designated on the Carte Géologique de la Belgique 1:40000 as *Om* (fine, marine sands of Oligocene age, Tongrian) and *Ons,* (gravelly and heterogeneous stratified sands, locally erosive, fluviatile). Further coarse deposits that may be equivalent to *Ons* are coded *Ong* (sandstone), *Onp* (conglomerate) and *Onx* (terrace deposits).

The main extension of the *Om* sands is in a narrow zone north of the River Meuse between Liege and Namur, and on the Boncelles Plateau, south of Liege (Fig. 2). Small occurrences pock the Condroz region, where the sand deposits are preserved in dolinas. The coarser deposits (*Ong, Onp*) are found on the high Ardennes, as far east as Malmédy (Fig. 1, map sheet 160). The *Om* sands are generally overlain by the gravelly deposits designated as *Onx*. After the type locality, the *Om* sands are frequently called 'Boncelles Sands'.

Although called 'Tongrian' in the geological map mentioned above, the sands are now frequently attributed to the Chattian (Late Oligocene), an age that was also adopted by BUURMAN (1972).

Because the *Om* and *Ons* deposits occur very close to the South Limburg border and are very similar to the Holset Sands and their coarser equivalents, they are included in this discussion.

In the following, the lithostratigraphy of the well-documented Oligocene and Miocene deposits in South Limburg and adjacent Belgium is briefly discussed in order to select a number of possible lateral equivalents to the Holset Sands.

LITHOSTRATIGRAPHY OF OLIGOCENE AND MIOCENE DEPOSITS IN SOUTH LIMBURG AND EAST BELGIUM

Figure 3 gives the lithostratigraphy of the Oligocene and Miocene in South Limburg and adjacent Belgium.

Lower and Middle Oligocene.

The basis of the Oligocene transgressively overlies a regressive Heersian-Landenian (Paleocene) sequence, and in the east rests immediately on Cretaceous deposits or their dissolution remains, the 'flint eluvium' (Fig. 1).

The basis of the sequence is formed by the unstratified, fossiliferous Grimmertingen Sands overlain by the stratified, unfossiliferous Neerrepen Sands. In South Limburg, the two are difficult to separate and are combined in the Klimmen Deposits. The sands represent shallow marine, respectively

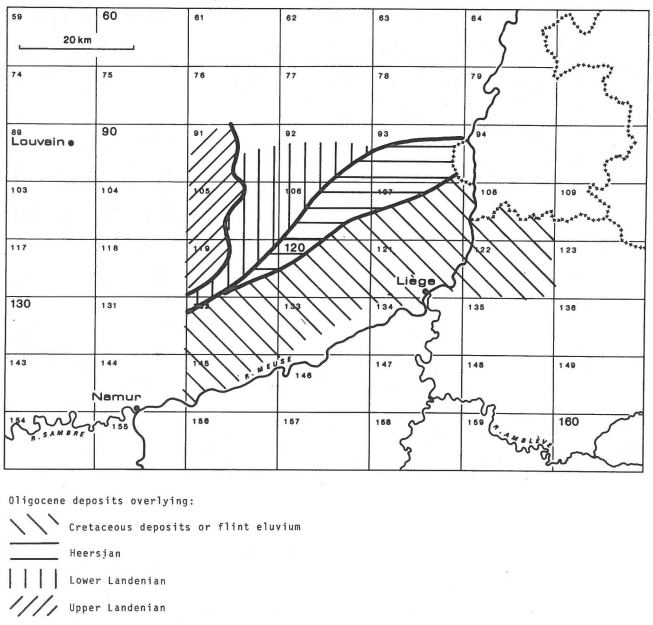


Fig. 1
The basis of the Oligocene transgressions in the Namur-Liege-Maastricht area.

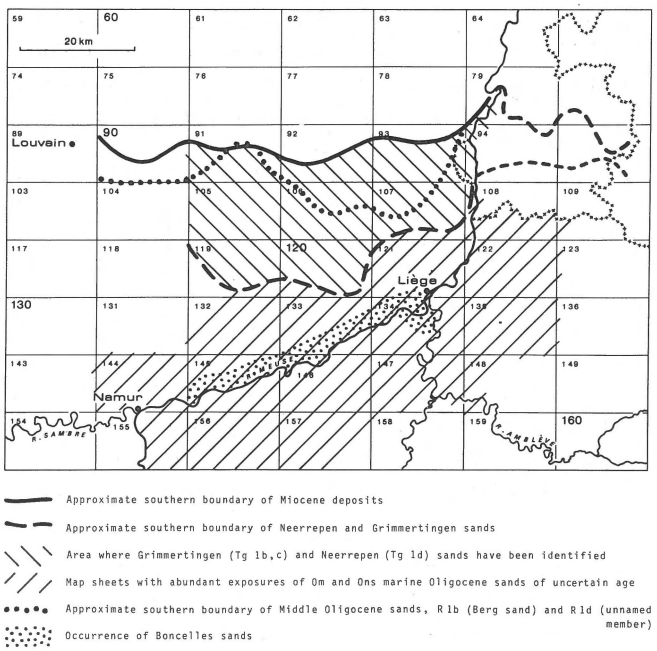
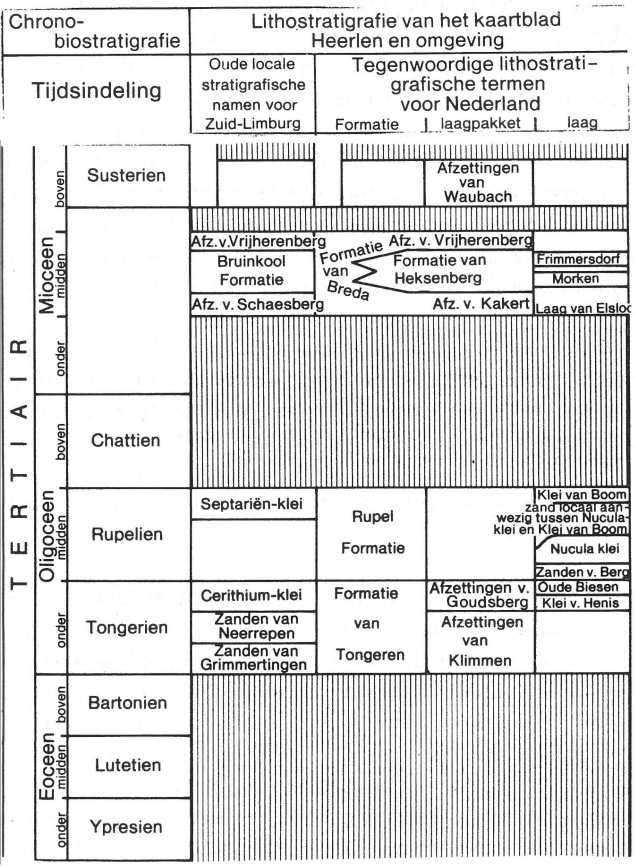


Fig. 2
Approximate boundaries of Oligocene and Miocene deposits in the Namur-Liege-Maastricht area, and the extent of the *Om* deposits.

coastal tidal and beach ridge environments.

On top of the Klimmen Deposits in South Limburg are the Goudsberg Deposits, consisting of Henis Clay and Sands & Marls of Oude Biesen. In South Limburg these deposits are part of the Tongeren Formation, Lower Oligocene, (KUYL, 1975); in Belgium they belong to the Upper Tongeren Formation or constitute the Atuatuca Formation (JANSSEN ET AL., 1976). The Goudsberg Deposits are a series of heavy clays and fossiliferous sands or clays deposited in a euryhaline to brackish environment, protected from direct influence of the sea by sand barriers that are attributed to the Neerrepen Sands (viz. JANSSEN ET AL., 1976; BUURMAN & LANGERAAR, 1975). The Grimmertingen Sands are transgressive, the Neerrepen Sands and the Goudsberg Deposits represent a regressive sequence.



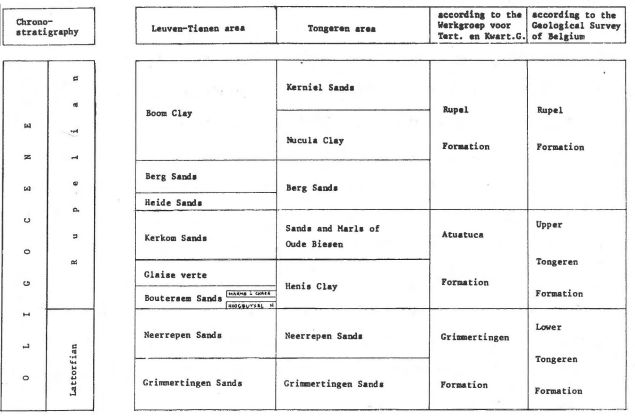


Fig. 3
Lithostratigraphy of Oligocene and Miocene deposits in South Limburg and adjacent Belgium. A) South Limburg (KUYL, 1980), Holset Sands are not indicated. B) Belgium (JANSSEN ET AL., 1978).

Overlying this complex are the transgressive, fossiliferous Berg Sands, followed by the Nucula Clay and the Boom Clay, all of Rupelian age. Locally, sandy deposits are found between the Nucula and Boom clays. The Nucula Clay and the overlying sands (Kerniel Sands) are considered as lateral equivalents of the Boom Clay. (viz. e.g. JANSSEN ET AL., 1978); the Berg Sands represent a near coastal environment, while the Nucula Clay and the Boom Clay were deposited in a progressively deeper and quieter environment.

Thus, in the Lower and Middle Oligocene, there are three major sandy members: the Grimmertingen Sands, the Neerrepen Sands, and the Berg Sands. These three deposits represent different environments.

The Kerniel sands are of local importance only, the other three have a widespread occurrence and should be considered for correlation with the Holset Sands.

Upper Oligocene

Upper Oligocene deposits are not found anywhere in the southern part of South Limburg or immediately South of the Dutch border. In the Namur-Liege region, the Boncelles Sands (*Om*) are ascribed to the Chattian. Their Late Oligocene age is based on the interpretation by DESTINEZ (1909) of an assemblage of badly preserved limonitic casts of molluscs found in the top of the deposit, but VELGE (1909) put the same fauna in the Rupelian. Since then, attributed ages have varied from Middle Oligocene to Miocene (viz. BUURMAN, 1972). The actual stratigraphic position of these deposits will be discussed later.

Miocene

The southern margin of Miocene deposits in Belgium and South Limburg is given in figure 2. In South Limburg, the sequence starts with fine, bioturbate marine sands of the Kakert Deposit. Upwards, these grade into the less clayey, stratified Heksenberg Formation, which consists of marine to terrestric fine to medium stratified sands, locally coloured by organic matter, and intercalated with lignite.

The Miocene sequence ends with the marine loamy sands of the Vrijherenberg Deposits. In Belgium, the basis of the Miocene sequence consists of the more glauconitic Bolderberg Sands, followed by Houthalen Sands, which are overlain by deposits similar to those of the Heksenberg Formation. Near the Dutch border, at Elsloo the basis of the Miocene is clearly indicated by a transgression conglomerate, the 'Elsoo gravel'.

Unequivocal Miocene deposits were not identified south of the line given in figure 2. Because all Miocene deposits in the area are sandy, the whole sequence should be considered for correlation with the Holset Sands.

POSSIBLE CORRELATIONS

Among the deposits of uncertain stratigraphic position, the Boncelles Sands have the widest occurrence and have been studied in large undisturbed exposures. Part of the stratigraphic puzzle will be solved once the position of these deposits is established. Therefore, this topic will be discussed first.

The stratigraphic position of the Boncelles Sands (Om)

Before fossils were encountered at Boncelles, the Boncelles Sands were considered to belong to the Tongrian (Early Oligocene), and equivalent to the Grimmertingen and Neerrepen Sands that occur further north. Although the sands are now frequently attributed to the Chattian (Late Oligocene), a review of their position is allowed because there are no confirmed Chattian deposits anywhere in the neighbourhood and because the determinations and interpretations of the fossil assemblage encountered in the sands were already disputed seventy years ago and this matter has never been settled.

Although the Boncelles Sands are normally considered as one homogeneous deposit, it consists of several phases that are separated by thin erosive contacts. Eight lithostratigraphic columns given by BUURMAN (1972) show at least three stages of deposition, separated by thin levels with flint pebbles, in the Boncelles area. The sections that do not show these flint levels were described around 1911 and, as the flint levels are inconspicuous, it is quite possible that these early descriptions are less accurate.

The deposits at Sart Haguet, Boncelles, are strongly bioturbate, and show thin parallel lamination, mainly in the lower four metres of the deposit, but also at several levels higher in the section. The deposits are well sorted and consist for 90% (weight) of a grain size between 105 and 210 μm. The sediments near the flint levels are less sorted (25-60% between 105 and 210 μm. (MACAR & KOLATCHEVSKI. 1935; BUURMAN. 1972). The Boncelles fauna described by DESTINEZ (1909) lists two species of *Glycymeris,* which points to a Rupelian (Berg Sands) rather than to a Chattian or Latdorfian age, while the two fossils on which a Chattian age was based, i.e. *Pecten 'biffidus'* and *Cominella* cf. *bolli* could easily be erroneous identifications owing to the bad conservation of the fossils. VELGE (1909) described a gradual transition of the top of the Boncelles Sands into a deposit that was very similar to the Boom Clay; this would corroborate a correlation of the top of the Boncelles Sands with the Berg Sands.

The Berg Sands do not normally contain levels of flint pebbles, and the sands below the flint level will have to be correlated with a deposit older than the Berg Sands. Bioturbation and parallel stratification are characteristics of the Grimmertingen Sands and not of the Neerrepen Sands and therefore a correlation of the lower Boncelles Sands with the Grimmertingen Sands is most likely.

The level with casts of fossils in the Boncelles Sands was only found in the area around Liege, and not in any of the hundreds of other locations of *Om* deposits. This suggests that in general the *Om* deposits should be correlated with the lower Boncelles Sands and thus with the Grimmertingen Sands. This is quite suitable because the Grimmertingen Sands represent a major transgression phase.

In agreement with such a correlation is the occurrence of a deposit containing glauconitic illites, reported from the Tongrian deposits of Aardebrug and Hoogbutsel by PORRENGA (1968) and from the lower part of the Boncelles section by BUURMAN (1972). This glauconitic horizon was found in various exposures of the Boncelles Sands (MACAR. 1934; ANCION & VAN LECKWIJCK. 1947).

If the top of the Boncelles Sands is correlated with the Berg Sands, the Boncelles occurrence is a considerable distance removed from the southern boundary of the Berg Sands as indicated in the geological maps (compare Fig. 2).

Correlation of the Holset Sands with the Grimmertingen and Neerrepen Sands

Grimmertingen and Neerrepen Sands in Belgium have approximately the same southern boundary (Fig. 2) but it was already demonstrated in the preceding paragraph that when the lower Boncelles Sands are correlated with the Grimmertingen Sands (and with the Klimmen Deposits) this boundary is fictive and that the actual boundary extends much further south and east. The Grimmertingen and Neerrepen Sands are not separated in South Limburg because this is very difficult in auger samples. It is possible, however, to make the distinction when exposures are available, because the deposits represent different facies.

Grimmertingen Sands are shallow marine, well homogenized and without apparent stratification, while Neerrepen Sands range from tidal deposits to beach ridges and are clearly stratified. The interpretations by CADÉE & VAESSEN (1975) and BUURMAN & LANGERAAR (1975) of the exposure in the talus of the new highroad near Valkenburg are based on this distiction. The Neerrepen Sands in this exposure were developed as tidal deposits, called 'Valkenburg Deposit' by the latter authors, and were clearly separated from the underlying Grimmertingen Sands. The transition of the Valkenburg Deposits to the overlying Henis Clay had a more gradual character.

Apart from the Valkenburg Deposits, the sediments of the Klimmen Deposits in South Limburg and of the Grimmertingen and Neerrepen Sands in Belgium are very well sorted and do not show any fluviatile influences that could be attributed to the proximity of a shore. If the proposed correlation of

the lower Boncelles Sands and the *Om* sands with these sands is considered, the former shore should be found a considerable distance to the east and south. Coarser deposits such as the *Ong* gravels and coarse sands could represent such a shore while coarser deposits overlying the Klimmen Deposits or their equivalents would represent the westward migration of this shore. Such a thesis is supported by the identification by the second author of Latdorfian mollusca in a silicified sandstone with chert fragments found in the neighbourhood of Aachen.

If this model is adopted, the Holset Sands are within the extension of the transgressive/regressive Grimmertingen-Neerrepen cycle and would most likely belong to this cycle. Coarse deposits would indicate the margins of this transgression.

Correlation of the Holset Sands with the Berg Sands

Except for the occurrence at Boncelles, the southern margin of the Berg Sands does not extend as far south as that of the Grimmertingen and Neerrepen Sands (Fig. 2). Both in South Limburg and in Belgium the margin is found between that of the Miocene and that of the Latdorfian sands. Apart from differences in fossil assemblage, the Berg Sands are easily distinguished from the Grimmertingen Sands by lesser sorting and from the Neerrepen Sands by lack of stratification. The fine members of the Holset Sands show better sorting than the Berg Sands and correlation between the two is not likely. The typical fauna of the Berg Sands is found nowhere in the Holset Sands, which have not yielded any fossils.

Correlation with Miocene sands

The sediments of the transgressive lower part of the Miocene deposits are strongly to mildly glauconitic. Neither the Holset Sands, nor the equivalent deposits in Belgium do show any trace of glauconite or its weathering products, and a correlation between the two is unlikely. Furthermore, the southern boundary of the Miocene sands is far North of that of the Latdorfian Sands, an no remains are found that might link this boundary to the occurrences of Holset Sands and related deposits.

CONCLUSION

It is clear that the Holset Sands and related deposits have to be correlated with a major transgression during the Tertiary. The only transgression that would link all the deposits of problematic age is that of the Grimmertingen/Neerrepen Sands. By supposing a correlation of the Holset Sands with the Rupelian Berg Sands or with Miocene sands, wide gaps in the distribution of the sediments of such a transgression would have to be explained away. By absence of specific tectonic activity zones in the area between the river Meuse and the region of Tongeren, and by absence of major erosive phases during the Late Oligocene or Early Miocene, such an explanation would be very unsatisfactory. Such a correlation would also imply that no sediments could be found to indicate the shores of the Latdorfian transgression. A correlation of the Holset Sands with the Latdorfian Sand deposits, and with the lower Boncelles Sands and other *Om* appears most likely.

SOME REMARKS ON THE CHRONOSTRATIGRAPHY

When comparing the lithostratigraphy used by KUYL (1980) with that of JANSSEN ET AL. (1978) it strikes the eye that the former puts the Goudsberg Deposits in the Tongrian, while the latter consider the Atuatuca Formation, which is the lateral equivalent of the Goudsberg Deposits, to belong to the Rupelian (Fig. 3). The Tongrian age attributed by KUYL is based on the assemblage of foraminifera encountered in the Goudsberg Deposits of South Limburg, while the attribution to the Rupelian by JANSSEN is based on the presence of sporadic marine molluscs of Rupelian character in the euryhaline Atuatuca Formation of Belgium Limburg. The division by JANSSEN ET AL. (1978) corresponds to the division made more recently by CAVELIER (1979) who, after a re-evaluation of foraminifera, nanno-plancton, molluscs, mammals and pollen assemblages, puts these deposits in the Stampian (= Rupelian).

The other suggestion by CAVELIER, i.e. to put the Neerrepen and Grimmertingen Sands in the Late Eocene, is at variance with both JANSSEN ET AL. (1978) and KUYL (1980). Except for this, and for a number of different names, there are no major discrepancies between the two lithostratigraphies.

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