Mroongovian and Brokian, new stratigraphic units of the Middle Pleistocene in northeastern Poland

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Results of palynologic and lithologic analyses of 6 key sections from northeastern Poland have been reinterpreted. Two new stratigraphic units within the Middle Pleistocene were defined, the warm Mroongovian and the cold Brokian. A completely new interstadial pollen succession, named the Mroongovian one, was distinguished. Lake and lake-fluvial deposits of the Mazovian Interglacial (upper series) and Mroongovian Interglacial (lower series) are separated with a till. Stratigraphic rank of the separating till results from determination of a new palynostratigraphic unit. Petrographic character of its lithologic type and stratigraphic location suggest correlation of this till either to a younger stadial of the Wilgian Glaciation or to a new glaciation.

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INTRODUCTION

In several dozen test-cartographic boreholes, done in northeastern Poland for the Detailed Geologic Map of Poland in scale of 1:50 000, there were also interglacial lake, bog and lake-fluvial deposits. Basing on palynological examination, these sediments were mostly connected with the Mazovian Interglacial. Their lithology and occurrence made, however, univocal stratigraphic interpretation difficult. Interglacial deposits were unusually thick, containing till or locally glacio-fluvial sands with gravels from several to a dozen metres. They were examined in the key section at Goleń (H. Winter, S. Lisicki, 1998). In this paper the other sections are also presented (Fig. 1): Koczarki (Z. Borówek-Dłużakowa, W. Słowański, 1991) in the Mrągowski Lakeland, Węgorzewo III (W. Słowański, 1975) and IV in the northern Mazury Lakeland, Gawrych Ruda (A. Ber, 1998) in the Suwałki Lakeland and Śniadowo (A. Bątuk, in print) in the Łomża Interflue.

194 samples of the Quaternary deposits were collected from the section Koczarki, among them 65 samples for pollen analyses (Z. Borówek-Dłużakowa, W. Słowański, 1991). The section Węgorzewo III supplied with 332 samples of the Quaternary deposits and palynological examination was done for 69 samples (M. Sobolewska, 1975). From the section Gawrych Ruda, 95 samples of the Quaternary deposits were collected and 21 of them were subjected to pollen analysis (Z. Janczyk-Kopikowa, 1986). The section Śniadowo gave 109 samples, with palynological examination of 22 ones (H. Winter, unpubl.). Petrographic analysis of gravels, 5–10 mm in diameter, was done for 54 samples of till from the section Koczarki (J. Czerwonka et al., 1984), 43 samples from the section Węgorzewo III (J. Rzechowski et al., 1975), 38 samples from the section Gawrych Ruda (K. Kenig, 1987) and 33 samples from the section Śniadowo (B. Gronkowska-Kry石家, 1993).

PALYNOLOGY

In northeastern Poland, the pollen succession of the Mazovian Interglacial (i.e. the so-called Mazovian pollen succession according to Z. Janczyk-Kopikowa, 1991) is known from numerous sections. However, only the diagram from Krzyżewo (Z. Janczyk-Kopikowa, 1996) presents a complete vege-
deciduous trees and *Carpinus*. There are also microspores of *Azolla filiculoides*. The spectra from the overlying series of silts and clays (depth 99.90–104.95 m) represent similar vegetation as the one from the lower series. There is pollen of *Pterocarya*. These spectra contain quite a lot of pollen of herbs, particularly of *Artemisia* (to 4%). Z. Janczyk-Kopikowa (1986) suggested affiliation of both series to the pollen period II (Picea-Alnus) of the Mazovian Interglacial. However, correlation of the pollen spectra with the zone Krzę — *Pinus-Betula-Picea* of the pollen period IV of the Mazovian Interglacial from the upper series at Krzyżewo seems possible, whereas the lower spectrum from Krzyżewo can be referred to the lower one from Goleń.

In the section Śniadowo (Fig. 3) two series of lake-fluvial deposits, separated by a till, were examined. The lower series (depth 90.02–91.55 m) is composed of sandy silts and silty sands. Pollen spectra of this series are dominated by pollen of *Pinus* (to 55%), with abundant pollen of *Picea, Abies, Alnus* and *Betula*, and small admixture of thermophilous deciduous trees, including *Carpinus*. Relatively high content of herbs (to 30%) is due to high share of *Cyperaceae*. Basing on data from the section Goleń, the lower series from Śniadowo should be correlated with the lower series from Goleń.

Pollen spectra of the upper series (depth 80.70–82.60 m) composed of silts are dominated by *Pinus*, and abundant *Picea* and *Abies*, *Betula*, *Alnus* and *Taxus*. There is a low content of pollen of thermophilous trees and NAP is below 20%. Similar pollen spectra can be referred to the termination of the pollen period III or the beginning of the pollen period IV of the Mazovian Interglacial.

Analysis of sediments and pollen diagrams from other sections in this area indicated particular significance of the section Węgorzewo III (M. Sobolewska, 1975). W. Słowiński (1975) connected the sediments from depth 91.5–166.9 m with the Mazovian Interglacial, subdivided them into the series A and B, and with an erosive contact between them. He stated also that in most sections in central Poland there are no equivalents of the series A. M. Sobolewska (1975) correlated deposits of the series B from Węgorzewo III with the phases II–IV of the Mazovian Interglacial, but she has not determined the age of the samples from the series A. Pollen spectra from the series A indicate their similarity to the spectra from the lower pollen succession at Goleń. It is proved by high content of *Picea* and *Alnus*, accompanied by *Abies* and *Carpinus*.

The section Koczarki contains very thick sediments of the Mazovian Interglacial. In a pollen diagram from this section, Z. Borowski-Dłużakowa and W. Słowiński (1991) distinguished two series: A and B, ascribed to this interglacial. In the series A, three pollen periods (I–III) were distinguished. Typical for the period I there are high contents of *Betula* and *Pinus*, medium of *Alnus*, and at the end high contents of *Picea* and presence of *Pterocarya*. During the period II there are high contents of *Picea*, medium of *Alnus*, early appearance of *Abies, Carpinus* and thermophilous *Celtis*. Presence of *Pterocarya* is distinct. Pollen spectra of the period II of the Mazovian succession from Krzyżewo are slightly different. In this period there is no pollen of such thermophilous taxa as *Celtis* and *Pterocarya*, whereas *Taxus* is relatively abundant, and *Abies* and *Carpinus* appear at the end of this period.
LITHOLOGY AND STRATIGRAPHY

Stratigraphic subdivision of the Pleistocene of northeastern Poland was based on detailed analysis of 32 sections of test-cartographic boreholes from the central part of the Mragowo Lakeland (S. Lisicki, 1996, 1997). Petrographic analysis of gravels (size 5–10 mm) from over 1200 samples of tills (after the method of J. Rzechowski, 1971, 1974) and palynological examination of interglacial deposits (Z. Borówko-Dłużakowa, W. Stowański, 1991; M. Sobolewska, 1975) created foundations to distinguish 14 lithologic types of tills (S. Lisicki, 1996, 1997).

The oldest deposit of the Pleistocene in the analyzed sections are lag concentrates. They are presumably residuals of tills of the older Narevian Glaciation, present in the sections
Śniadowo and Węgorzewo III (Fig. 4). The oldest analysed till, i.e. lithotype A₂ of the younger stadial of the Narevian Glaciation, occurs at Gawrych Ruda and Śniadowo. Its mean petrographic coefficients are equal to 1.06–1.03–0.93 (6 samples) and 1.02–1.28–0.64 (2 samples). A boulder-gravel lag concentrate at depth of about 200 m in the section Węgorzewo III is presumably a relic of a till of the older stadial of the Nidanian Glaciation. A till of the lithotype N₂, i.e. of the younger stadial of the Nidanian Glaciation, is represented by the following mean petrographical coefficients: at Koczarki 1.17–0.93–0.98 (4 samples), Węgorzewo 1.20–0.89–1.10 (3 samples), and Gawrych Ruda 1.59–0.67–1.46 (4 samples). It is overlain by tills of the Sanian Glaciation. A till of the lithotype S₁, i.e. of the older stadial, has mean petrographic coefficients equal to 0.77–1.69–0.55 at Goleń (3 samples), 0.91–1.29–0.70 at Węgorzewo (4 samples), and 0.96–1.37–0.62 at Śniadowo (10 samples), in both latter sections, large thickness of a till suggest its glaciotectonic (scaly?) push. Mean petrographic coefficients of a till with the lithotype S₂, i.e. of the younger stadial of the Sanian Glaciation, are equal to 1.20–1.05–0.79 at Goleń (2 samples), 1.01–1.09–0.89 at Koczarki (2 samples) and 1.08–1.08–0.80 at Śniadowo (2 samples). The next, younger till of the lithotype G is of the Wilgian Glaciation. It is 2 m thick at Goleń, and 3.1 and 4.8 m thick at Śniadowo. Mean petrographic coefficients of this till are respectively: 1.51–0.72–1.23 (2 samples), 1.33–0.86–1.01 (1 sample) and 1.20–0.89–1.04 (1 sample). Above there is a red clay complex, composed of clayey flow tills, and reservoir clays with single, small gravels. These deposits are red due to content of trivalent iron, derived from the Lower Triassic sediments. It is a marker stratigraphic bed in the whole northeastern Poland, considered previously for the ice-dam lake complex formed at decline of the Wilgian Glaciation (S. Lisicki, 1997). In the section Węgorzewo III (Fig. 4) such deposits occur at 44.6 m b.s.l. on a till of the lithotype G and are 30.7 m thick. Red and brown-red ice-dam clays contain interbeds of beige and grey silt, and also plant remains and pieces of mollusc shells. Pollen analyses of 10 samples (M. Sobolewska, 1975) noted predominance of tree pollen (AP) of boreal forest over pollen of herbs (NAP) in lake clays, and almost their complete absence in vegetation cover (W. Slowanski, 1975). In this part of the section, a new interglacial pollen succession was recorded. In the section Węgorzewo IV, brown silty clays of the red clay complex occur at 51.2 m b.s.l., probably on a till of the Sanian Glaciation and are in total 6.5 m thick. In the section Koczarki there is a 14.1 m thick series of dark brown-red limy clays with single gravels, to 4 cm in diameter. They overlie a till of the lithotype S₂. 2 samples of clays from the top were palynologically-examined (Z. Borówko-Dłużakowa, W. Słowański, 1991), indicating predominance of pine-birch forest. Therefore, the red clay complex seems to be composed of periglacial-lake and lake sediments of cooler part of the Mrongovian period (R). Gravels in clays could be derived form perennial floating pack ice, presumably incorporated in winter into ice in a coastal zone.
III, this till is presumably represented by a gravel-boulder lag concentrate on the red clay complex (Fig. 4).

Deposits of the Mazovian Interglacial (M) are known from all the analysed sections. In the section Goleń they are olive-grey and usually clayey compact silts with mollusc shells, occurring at depth 35.0–36.5 m on a till of the new cold episode. These deposits are underlain by lake-deluvial sandy silts, 0.5 m thick, with single gravels. These silts are located at 112.6 m a.s.l. Interglacial series was subjected to pollen analysis (H. Winter, S. Lisicki, 1998). In the section Koczańki, sediments of the Mazovian Interglacial (M) occur at depth 106.6–166.4 m, and their bottom was noted at 5.4 m b.s.l.. These sediments represent two sedimentary cycles. Lake and bog series in each cycle were covered by fluvial sediments. They were described in detail by W. Słowański (Z. Boróvkow-Dłużakowa, W. Słowański, 1991). A successful pollen analysis was done for deposits at depth below 130 m (Z. Boróvkow-Dłużakowa, W. Słowański, 1991). Pollen material analysis (R. Winter, S. Lisicki, 1998). In the section Koczarki, bog series at depth 91.0–134.5 m. Their bottom is located at 47.7 m a.s.l.. Interglacial series was subjected to pollen analysis (Z. Janczyk-Kopikowa, 1986). They are, however, underlain by a till of the lithotype $O_I$, ascribed in northeastern Poland to the Odranian Glaciation and covered by glacial complex of the Wartanian Glaciation. The described lake sediments from the section Gawrych Ruda should be therefore interpreted as a glacial raft. In the section Śniadowo, sediments of the Mazovian Interglacial (M) are commonly covered with tills of the lithotypes C or $O_I$.

A till of the lithotype C (Liviecian Glaciation) occurs in situ in the section Węgorzewo III only and presumably in the section Węgorzewo IV. Its mean petrographic coefficients in the former are equal to 2.00–0.57–1.51 (3 samples). A till of the lithotype $O_I$ (older stadial of the Odranian Glaciation) was noted in three sections. Mean petrographic coefficients of this till are equal to 2.40–0.45–1.92 at Goleń (1 sample), 2.65–0.42–2.02 at Śniadowo (3 samples) and 1.34–0.82–1.10 (2 samples) in the upper weathered part, and 2.64–0.40–2.43 at Gawrych Ruda (8 samples) and 2.41–0.43–2.36 (6 samples) for a till raft of the lithotype $N_I$ in the lower part. Both tills in the latter section are firstly different for their contents of above a grey ice-dam clay, overlain by probable oxbow sediments: very fine-grained and silty sands with brown organic matter. These sediments are 21.1 m thick and occur at 22.4 m b.s.l.. In the section Gawrych Ruda at depth 97.3–106.0 m, there are lake sediments with plant remains. They are located at 47.7 m a.s.l.. Pollen analysis ascribes these sediments to the Mazovian Interglacial (Z. Janczyk-Kopikowa, 1986). They are, however, underlain by a till of the lithotype $O_I$, ascribed in northeastern Poland to the Odranian Glaciation and covered by glacial complex of the Wartanian Glaciation. The described lake sediments from the section Gawrych Ruda should be therefore interpreted as a glacial raft. In the section Śniadowo, sediments of the Mazovian Interglacial (M) are commonly covered with tills of the lithotypes C or $O_I$.

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local silts of the lithotype C (10% for the lithotype B2). A till of the lithotype W1 (younger stadial of the Odranian Glaciation) occurs in three sections. Its petrographic coefficients are equal to 2.09-0.52-1.65 at Sniadowo (1 sample) and 1.88-0.56-1.67 at Goleń (3 samples). At Koczarki, a till of the younger stadial of the Odranian Glaciation is the thickest (34.8 m) and could be glacially deformed. Its mean petrographic coefficients are equal to 1.93-0.55-1.72 (32 samples). A till of the lithotype W2 (younger stadial of the Wartanian Glaciation) was noted in four sections. Its mean petrographic coefficients are equal to 1.54-0.70-1.29 at Sniadowo (2 samples), and 1.58-0.67-1.45 at Goleń (3 samples). At Węgorzewo mean petrographic coefficients of a till of the Wartanian Glaciation are equal to 1.43-0.72-1.37 (3 samples). At Gawrych Ruda, a till of this age contains rafts of till of the lithotypes C and O2. Beneath the described glacial sediments in this section, there is a raft of lake sediments of the Mazovian Interglacial, 8.7 m thick. Mean petrographic coefficients for a till of the lithotype W1 are equal to 1.50-0.69-1.40 (4 samples), and for rafts of a till of the lithotype W2 they are 1.93-0.53-1.77 in the upper part and 2.28-0.45-2.10 for a till of the lithotype C in the lower part. A till of the lithotype C contains abundant northern dolomites (Dp), equal to 21% (12% in a till of the lithotype W2). Such high content of dolomites is a diagnostic feature for this till in the whole Suwalki Lakeland, i.e. for the lithotype T5 according to J. Czerwonka, D. Krzyszkowski (1995) in the Augustów Plain. In the central Mazury Lakeland, a till of the lithotype C contains considerably less dolomites (Fig. 4). Mean petrographic coefficients for a till of the lithotype W2 (younger stadial of the Wartanian Glaciation) are equal to 1.55-0.79-0.99 at Koczarki (1 sample), 1.48-0.78-1.07 at Sniadowo (1 sample) and 1.29-0.88-1.02 at Węgorzewo III (10 samples). A till of the younger stadial of the Vistulian Glaciation is represented by the lithotype B1. It occurs in all the analysed sections. Its mean petrographic coefficients are equal to 2.04-0.56-1.47 at Koczarki (1 sample), 2.01-0.52-1.76 at Goleń (2 samples), 2.02-0.54-1.67 at Węgorzewo III (4 samples) and 2.21-0.53-1.52 at Sniadowo (5 samples). The youngest till of the lithotype B2, i.e. of the younger stadial of the Vistulian Glaciation, is noted in two sections only. In the section Goleń, it forms the upper part of the Pleistocene complex. Its mean petrographic coefficients are equal to 2.51-0.43-1.97 (3 samples). In the section Koczarki, this till occurs also at land surface, and its mean petrographic coefficients are equal to 2.29-0.45-1.68 (5 samples). In the section Węgorzewo III, the youngest glacial bed under the outwash cover is composed of rafts of tills only of the lithotypes C and S2. Thus, the youngest till (of the lithotype B2) in this area has presumably eroded by meltwaters.

**RECAPITULATION**

Basing on pollen analysis two lake, bog and lake-fluvial series in the sections Gawrych Ruda, Goleń and Sniadowo, separated by a till and sands, were connected with the Mazovian Interglacial: the lower series to the stage II, and the upper to stage III of the scheme of W. Szafer (1953). The fact that these series were separated by a till was hardly interpreted, and the younger series of lake sediments was expected to have been a raft in the lower part of the younger tills (S. Lisiecki, 1997).

Petrographic composition of tills in the Mragów Lake-land is considerably varied (S. Lisiecki, 1996, 1997). However, this variation is much smaller for a definite lithotype (its chronostratigraphic position was determined on the basis of palaeogeographic reconstruction), equal to 25% if referred to mean values of each lithotype (S. Lisiecki, 1998). Only tills of the Wilgian (G) and Livieciian (C) Glaciations were described with two different sublithotypes. Such changing petrographic characteristics of tills was explained (S. Lisiecki, 1997) by different directions of glacial lobes and streams, advancing onto the central part of the Mazury Lakeland, both during the Wilgian and Livieciian Glaciations. It has not been, however, concordant with a general picture of advance of the Scandinavian ice sheets. These geologic problems are solved by introduction of a new interstadial pollen succession (H. Winter, S. Lisiecki, 1998), interpreted in the discussed sections as the pollen stage II of the Mazovian Interglacial (cf. W. Szafer, 1953).

The idea of a pollen succession of at least the interstadial-rank and located beneath deposits of the Mazovian Interglacial is not a new one. Already J. Dyakowska (1952), basing on the pollen diagram from Nowiny Wielkie, suggested a possible warm interval at the termination of the Cracovian Glaciation (Elsterian). It is indicated by pollen spectra in a bottom part of the section, with Picea to 21.9%, Abies to 18.3%, and Carpinus to 8.5%.

A similar phenomenon was also noted by M. Brem (1953) in the diagram from Ciężkowickie I. Also A. Srodon (1954) when presenting the section from Tarzymie-

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*Fig. 4. Stratigraphic correlation of the study sections*

1.—till, 2.—gravel, 3.—sand, 4.—silty sand or sand with silt, 5.—silt, 6.—clay and varved clay, 7.—glaciofluvial-flow till deposits, 8.—red clay complex, 9.—peat, 10.—gyttja, 11.—glauconite (large concentrations), 12.—fossil flora, 13.—fossil fauna, 14.—pollen diagram, 15.—pollen expertise, 16.—palaeozoological expertise, 17.—petrographic coefficients of tills of the red clay complex (O — total of sedimentary rocks, R — total of crystalline rocks and rocks with sand or sand with silt, W — total of carbonate rocks, Kr — crystalline rocks, Wr — limestones of northern origin, Dr — dolomites of northern origin, Pr — sandstones and quantities of northern origin, local rocks: Wr — limestones and marls, Pl — sandstones, Ms — silts of claystones); lithologic symbols: f — fluvial sediments, l — lacustrine sediments; chronozostratigraphic symbols: Cr — Cretaceous, Pe — Paleocene, Ec — Eocene, Me — Miocene, Pl — Pliocene, P — Podolian (Augustovian) Interglacial, l — Lateplonian Interglacial, R — Mongolian warm period, D — Broken cold period, M — Mazovian Interglacial, Z — Zhouian Interglacial, L — Lubian Interglacial; lithostratigraphic symbols are in italics; chrono- and lithostratigraphic symbols in brackets are for glacial rafts.
Establishment of a new pollen succession permits for reinterpretation of the pollen diagrams for the sections Węgorzewo III and Koczarki. In both these sections, sediments of the Mazovian Interglacial are found to be of different age. In the upper series (B) at Węgorzewo and in sediments at depth 130.0–166.4 m at Koczarki, there is evidence for the Mazovian Interglacial. On the other hand, pollen spectra from the lower series (A) at Węgorzewo and from a depth 166.4–175.8 m at Koczarki, can be referred to the Mrongovian succession. Consequently, establishment of the interstadial-rank Mrongovian succession results in a new lithotype of a till which separates deposits of the Mrongovian period from the ones of the Mazovian Interglacial. This till can belong to a new glaciation or to a younger stadial of the Wilgian Glaciation (Fig. 5). S. Lisicki speaks for the first version rather.

A renewed analysis of the pollen examination of M. Sobolewska (1975) for the section Węgorzewo III, the red clay complex is of periglacial-lake and lake origin. Its deposition should be connected with the Mrongovian warm period after the Wilgian Glaciation.

Considering the new geologic data from the Suwałki Lakeland, the section Gawrych Ruda was the most difficult to interpretation in its fragment above a till of the lithotype \( O_1 \) (Fig. 4). Because lake slits of the Mazovian Interglacial, 8.7 m thick, are underlain by a till of the lithotype \( O_1 \) (the older stadial of the Odranian Glaciation), and are overlain by a till of the lithotype \( C \), i.e. interpreted in this section as a raft of an older till of the lithotype \( W_1 \) (of the older stadial of the Wartanian Glaciation), the lake sediments at Gawrych Ruda could be incorporated into a glacial raft only. Such interpretation corresponds with conclusions of A. Ber (1998).

**CONCLUSIONS**

Results of pollen and petrographic analyses, and their interpretation formed the basis to distinguish a new chronostratigraphic unit, i.e. the Mrongovian warm period. It could be introduced due to:

- individuality of the Mrongovian pollen succession if compared with other interglacial and interstadial ones;
- its equivalents in other sections;
- consequent overlying of sediments in which it is recorded, by the ones of the Mazovian Interglacial;
- separation of sediments of these two warm intervals by a till or gravel-boulder accumulation;
- common occurrence of the red clay complex in bottom sediments of the Mrongovian warm period.

At present, sediments of the Mrongovian warm period can be distinguished as the Mrongovian substage within the Wilgian Stage (according to H. Winter) or as the Mrongovian Stage, being a short interglacial (according to S. Lisicki). In northeastern Poland, sediments of the Mrongovian warm period are separated from deposits of the Mazovian Interglacial by a till or its gravel-boulder remains. This new cold episode, presumably a short glaciation, during which deposition of till occurred, is postulated to be a substage (Brokian Stadial) within the Wilgian Stage or a stage, named the Brokian, after the right tributary of the Bug River.
REFERENCES


NOWE JEDNOSTKI STRATYGRAFICZNE ŚRODKOWEGO PLEJSTOCENU POLSKI PÓŁNOCNO-WSCHODNIEJ

S t r e s z c z e n i e


W Goleniu seria górna obejmuje osady interglacjalu mazowieckiego, czyli okresy piłykowe II–IV, natomiast seria dolna prezentuje fragment nowej, interstadialnej sukcesji piłykowej — sukcesji maragowskiej. Do nich charakterystycznych tej sukcesji należą: duża rola świerk (Picea) w całej sukcesji ze znacznym udziałem obfic (Alnus) na początku, wczesne pojawienie się jodły (Abies) wraz z gрабem (Carpinus), niski udział procentowy cieplolubnych drzew liściastych, głównie dębu (Quercus), obecność piły Tučar, kalaminy brzony (Betula) łącznie z roślinami zielonymi i jodłą (Abies), a następnie z sosną (Pinus) i świerkiem (Picea).


Suwałczysků w profilu Gawrych Ruda osady jeziorne w średniej części zawierają liczny detrytus roślinny. W profilu Śniadowo, między Łomzą a Ostrołęką, do ciepłego okresu mrlgowskiego (R) zaliczono osady jeziorno-rzeczne wykształcone w dwóch cyklu akumulacyjnych. 

Na osadach ciepłego okresu mrlgowskiego zalega najczęściej glina zwałowa lub rezyduum żwirowo-glazowe, przykryte utworami interglacjalu mazowieckiego (fig. 5). Występują one w profilach: Golen, Węgorzewo IV i Śniadowo. Litotyp gliny charakteryzuje średnie współczynniki petrograficzne wynoszące 1,46-0,73–1,29 w Goleniu (4 próbk., a 1,53–0,75–1,12 w Śniadowie (1 próba — tylko 61 ziarn). W profilu Węgorzewo III rezyduum po tej glinie stanowi zapewne bruk żwirowo-glazowy, leżący na osadach czerwonego kompleksu lądowego.

Utwory interglacjalu mazowieckiego występują we wszystkich analizowanych profilach (fig. 5). Są to osady bagienne, jeziorne, jeziorno-rzeczne i rzeczne. W profilu Gawrych Ruda na głębokości 97,3–106,0 m występują zbadane palinologicznie jeziorne mulki interglacjalu mazowieckiego. Jednak w tym profilu znajdują się one w położenia porwaka (kry lodowcowego) w średniej części glacjalnego kompleksu lodowcowego warty.

Powtórna analiza dokumentacji paleobotanicznej i litologiczno-petrograficznej dala podstawy do wyróżnienia nowego, ciepłego okresu mrlgowskiego (R), interpretowanego dawniej w niektórych dyskutowanych profilach jako Szaferowski II okres pylkowy interglacjalu mazowieckiego. Do podstaw tych należy odrębność sukcesji mrlgowskiej w stosunku do innych znanych sukcesji interglacjalnych i interstadialnych, konsekwentny związek osadów tego okresu z utworami reprezentującymi interglacjum mazowieckie, rozdziałność osadów obu okresów cieplnych w postaci gliny zwałowej lub bruku żwirowo-glazowego oraz częstą występowanie w spągu osadów okresu mrlgowskiego utworów czerwonego kompleksu lądowego.

Nowo odkryty okres jest chłodnym interglacjum ale ciepłym interstadial. W takiej sytuacji glinę zwałową o nowym litotypie, rozdzielającą osady okresu mrlgowskiego od utworów interglacjalu mazowieckiego należy określić jako należącą do nowego zlodowacenia aż do młodszego stadialu zlodowacenia warty (fig. 5). S. Lisicki przychylila się do pierwszej wersji interpretacji i nazywa nowy zimny okres zlodowacienia broku (D) — od nazwy prawego dopływu Buga na międzyrzeczu Lomżyńskim, a nowy litotyp oznacza literę D (fig. 4 i 5).