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PETROGRAPHY AND LITHOSTRATIGRAPHIC SIGNIFICANCE OF THE EOCENE STONE LAYERS IN THE BOREHOLES OF BEERZEL, BOOISCHOT AND RILLAAR

by

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SAMENVATTING

De petrografische kenmerken van de steenbanken van het Eoceen in de diepe boringen van Beerzel, Booischot en Rillaar, gelegen in de Zuiderkempen, werden onderzocht. Daarbij werden enkele typische faciës herkend : zandige kalksteen uit de Formatie van Lede (ondermeer uit het basisgrind), zandige kalksteen en verkiezelde zandsteen uit de Formatie van Brussel en zandige kalksteen met een ijzerrijk calcietcement uit het Lid van Mons-en-Pévèle van de Formatie van Ieper. Het basisgrind van de Formatie van Lede bevat herwerkte en gedeeltelijk verkiezelde nummulieten. In de onderzochte boringen is de Formatie van Brussel enkel vertegenwoordigd door haar kalkfacies. De evolutie van de dikte van de Formatie van Ieper in de doorsnede Beerzel-Rillaar is vergelijkbaar met de eerder onderzochte lijn Mol-Oostham. Haar dikte neemt snel af in zuidoostelijke richting, zowel door pre-Brusseliaan erosie bovenaan (zonder onregelmatige ravinaties zoals in Brabant) als door het dunner worden van het onderste kleiige facies. In Mol en Beerzel bevinden de steenbanken uit het Lid van Mons-en-Pévèle zich in het midden van de Formatie van Ieper. In Rillaar en in boringen rond Oostham liggen zij echter helemaal bovenaan. Mogelijk vond de diagenetische vorming van de banken kort na de afzetting plaats, zodat zij tijdens de pre-Brusseliaan erosie de onderliggende sedimenten beschermden.

RESUME

Les caractères pétrographiques des bancs durs de l'Eocène des sondages profonds de Beerzel, Booischot et Rillaar, dans la Campine Méridionale, ont été étudiés. Quelques facies typiques ont été reconnus : du calcaire sableux de la Formation de Lede, dont son gravier de base, du calcaire sableux et du grès à ciment siliceux de la Formation de Bruxelles et du calcaire sableux au ciment de calcite ferreux du Membre de Mons-en-Pévèle de la Formation d'Ieper. Le gravier de base de la Formation de Lede contient des nummulites remaniées et partiellement silicifiées. Dans les sondages envisagés, la Formation de Bruxelles est représentée uniquement par son facies calcareux. Le profil de la Formation d'Ieper entre Beerzel et Rillaar est semblable qu'entre Mol et Oostham. Son épaisseur diminue vite en direction sud-est, a cause de l'érosion pré-Bruxellienne du sommet (sans qu'eût lieu un ravinement profond et irrégulier comme en Brabant) mais aussi par l'amincissement de l'argile inférieure. Des bancs de calcaire sableux qui se rencontrent au milieu de la Formation d'Ieper aux sondages de Beerzel et de Mol se trouvent au sommet à Rillaar et dans la région d'Oostham. Probablement, leur formation diagénétique s'est produit très vite après la déposition, de tel qu'ils avaient protégé les sédiments inférieurs contre l'érosion pré-Bruxellienne.

ABSTRACT

Petrographical characteristics of stone layers from the Eocene in deep boreholes in Beerzel, Booischot and Rillaar, in the Southern Campine, were studied. Stone facies of the Lede Formation (sandy limestones, including the basal gravel), the Brussels Formation (sandy limestones and silica cemented sandstones) and the Mons-en-Pévèle Member of the Ieper Formation (sandy limestones with a ferroan calcite cement) were recognised. The basal gravel of the Lede Formation contains reworked and partly silicified nummulites. The Brussels Formation is only represented by its calcareous facies. The thickness evolution of the Ieper Formation in the section Beerzel-Rillaar is comparable to the section Mol-Oostham. The thickness is decreasing in southeastern direction, due to pre-Brusselian erosion of the upper part (without deep irregular ravination like in Brabant), but also because the lower clay facies becomes thinner. Sandy limestones occurring in the middle part of the Ieper Formation in Beerzel and Mol are found at the top in Rillaar and around Oostham. This could indicate that lithification took place shortly after sedimentation. The stone layers then protected the underlying sediments during pre-Brusselian erosion.

SLEUTELWOORDEN : Boring van Beerzel, Boring van Booischot, Boring van Rillaar, Eoceen, Lithostratigrafie, Kempen, België.

MOTS CLE : Sondage de Beerzel, Sondage de Booischot, Sondage de Rillaar, Eocène, Lithostratigraphie, Campine, Belgique.

KEY WORDS : Beerzel borehole, Booischot borehole, Rillaar borehole, Eocene, Lithostratigraphy, Campine, Belgium.

1. INTRODUCTION

The deep boreholes of Beerzel, Booischot and Rillaar were drilled for the Belgian Geological Survey during the early sixties. They are located in the Southern Campine, 25 km north and northwest of the outcropping areas of the southward dipping Eocene near Brussels, Leuven and Tienen (Fig. 1). About 20 km northeast of Rillaar lay the boreholes of Oostham and Kwaadmechelen, the easternmost observation points of the Eocene in Belgium. The boreholes of Beerzel, Booischot and Rillaar reached the Paleozoic basement, but interesting material was also available from the coverlayers. In the present text, petrography and lithostratigraphy of stone layers in the Eocene of the boreholes will be discussed.

2. BOREHOLE DESCRIPTIONS

The following borehole descriptions and interpretations are based on the files of the Belgian Geological Survey (BGS). Figure 2 shows the sections of the Eocene in the boreholes.

BEERZEL : BGS 59 E 145; Lambert co-ordinates: x = 170.200; y = 197.875; alt. = +12 m. Description (GULINCK 1964, unpubl.): Cenozoic: 0 - 313 m, Mesozoic (Cretaceous): 313 - 413 m, Paleozoic (Silurian).

Post-Eocene deposits consist of Miocene Edegem Sands (0-15 m), Oligocene Boom clay (15 - 60 m), Berg sand and Eo-Oligocene transition beds, wherein the upper limit of the Eocene could not be fixed exactly. The most probable boundary was set at a thin layer of lignitic silty clay at 87.5 m. A nummulite rich gravel at 97.0 m probably corresponds to the base of the Wemmel sands. At 102 m, the basal gravel of the Lede Formation was found. The Brussels Formation (102 - 128.5 m) covers a deposit of heavy clay with silty intercalations, the Merelbeke Member (128.5 - 137 m). Next, fine sand and silt with intercalations of clay (137 - 170 m) and clay (170 - 222 m) were encountered, respectively the Yd and Yc of the Ieper Formation.

BOOISCHOT : BGS 59 E 146; Lambert co-ordinates: x = 177.800; y = 194.700; alt. = +10 m. Description (GULINCK 1963, unpubl.): Cenozoic: 0 - 315 m, Mesozoic (Cretaceous): 315 - 449 m, Paleozoic: Carboniferous and Devonian: 449 - 1288 m and Silurian 1288 - 1330 m.

The Eocene and younger deposits were not completely cored. Between 0 and 70 m, the Oligocene Boom clay was encountered, overlying the Bartonian clays. No samples were taken between 87 and 115 m. This section probably corresponds to the Lede Formation (88 - 98 m) and the upper part of the Brussels Formation (98 - 124 m). The Ieper Formation (124 - 180 m), which was only cored by intervals, consists of clay and silt (124 - 133 m and 165 - 180 m) and of sand and clay (133 - 165 m).

RILLAAR : BGS 75 E 317; Lambert co-ordinates: x = 184.300; y = 184.300; alt. = +20 m. Description (GULINCK 1962, unpubl.): Cenozoic: 0 - 227 m, Mesozoic (Cretaceous): 227 - 366 m, Paleozoic (Carboniferous): 366 - 370 m.

In the Rillaar borehole, the Oligocene and the youngest Eocene deposits were eroded by the transgression of the Diest Formation (0 - 62 m). The borehole file warns for uncertain limits in the uppermost 103 m, because of sample losses when sands were cored. The youngest Eocene layers are the Bartonian Wemmel sands (62 - 74 m) and the Lede Formation (74 - 85 m). The base of the underlying Brussels Formation should occur near 100 m. The Ieper Formation (100 - 144 m) consists of a fine sandy to silty (100 - 127 m) and a clayey (127 - 144 m) section.

The borehole sections of Beerzel and Rillaar have been included in a correlation study of Ypresian deposits (GULINCK 1967). The limits proposed in the original descriptions were maintained. In Beerzel GULINCK (1967) found little differentiation in the Ieper Formation, except for the presence of the Merelbeke Member. In Rillaar, the two subdivisions (sand "Yd" 100 - 127 m and clay "Yc" 127 - 145 m) were correlated with a borehole (BGS 46 E 97) in the area of Oostham and Kwaadmechelen, where a similar sequence with comparable thickness was observed.

Stratigraphy of the Ypresian in the Beerzel and Rillaar boreholes was reviewed by STEURBAUT (1988). The sandy and clayey Ypresian deposits in Rillaar were correlated with the Mons-en-Pévèle and Orchies Members respectively. Both were also present in the Beerzel boring. The clay originally considered as the Merelbeke clay (128.5 - 137 m) in Beerzel was now correlated with the Aalbeke Member, belonging to the Yc.

3. SAMPLE DESCRIPTIONS

Thin sections of cored stone layers from Eocene deposits were studied. They were stained with K-ferricyanid and Alizarine Red S, in order to assess the distribution of ferroan and non-ferroan calcite (EVAMY 1963). Samples from the following depths were studied: Beerzel 102 m, 106 m, 110.8 m, 112 m, 114.8 m, 117.5 m, 119.5 m, 121 m, 126 m, 128 m, 128.5 m, 150 m and 158 m; Booischot: 120 and 121 m; Rillaar: 78.5 m, 85 m, 104 m (sample 104a m) and 110 m. The file of the Rillaar borehole mentions that sample 104a m is most probably providing from a coherent layer at 100 m.

A few sand samples were taken for grain size distribution analysis (Beerzel 98 m, 99 m, 100.5 m, 101.5 m and 137 m). This method was also applied on stone material (Beerzel 106 m, 110.8 m, 119.5 m, 150 m and 158 m and Rillaar 78.5 m, 85 m and 104a m).

All the coherent samples are gray, a characteristic stain of Eocene stone layers from deep borings. Most of the stone layers look mottled. Two samples are rich in coarse quartz grains: Beerzel 102 m and Rillaar 85 m. In the Beerzel boring, several samples contained burrows (117.5 m, 128 m and 128.5 m) or were formed around such structures (112 m, 121 m and 126 m). Burrows appear as circular structures, about 1 cm in diameter, surrounded by a rim (1 - 2 mm) of fine grained sediment. In Beerzel 158 m, laminations, 1 mm thick, are observed. Sample Beerzel 110.8 m contains a few bivalve shell moulds. The most striking presence of macrofossils is found in Rillaar 104a m, containing many *Solarium* species, a gastropode with rather flat convolutions.

A few samples from boreholes closer to the outcropping area were also studied : Mechelen (BGS 58 E 18; Lambert co-ordinates: x = 185.100; y = 192.300; alt. = +7 m) and Rotselaar (BGS 74 E 68; Lambert co-ordinates: x = 174.100; y = 182.350; alt. = +14 m). In Mechelen, the Lede Formation occurs between 51 and 67 m (stone sample 58 E 18/61 from 55 m). In Rotselaar, one stone sample (74 E 68/24 from 24 m) from the Lede Formation was studied.

4. PETROGRAPHY

4.1. Ieper Formation

Three samples (Beerzel 150 m and 158 m and Rillaar 104a m) are sandy limestones with a relative coarse grained, clear, ferroan calcite cement, looking bright blue after chemical staining. The quartz grains are very fine, like the many glauconite grains. Foraminifera tests are surrounded by epitaxial calcite rims. Laminations (Beerzel 150 m) are due to variations of quartz and micrite content. Large circular structures, several millimeters wide, of coarse sparite with a few quartz grains floating in it are observed. They may represent infillings of cavities of vanished gastropod shells.

The layer Rillaar 104a m contains shells of the gastropod *Solarium*. The shells are filled with sparite cemented glauconitic very fine sand, as in the surrounding sediment. Some of the shells are only partly filled with detrital material, capped by a thin pelitic layer (Fig. 3). The remaining void space above the internal sediment was filled with elongated and with equidimensional large clear sparite crystals, 400-600 µm in lenght, or respectively in diameter. The sedimentary fillings of all the *Solarium* shells are in the same direction, a good example of a geopetal structure. The outer border of the *Solarium* shells is often corroded. In one shell, a circular secondary void (diam. 500 µm) has been filled up with chalcedony.

Sandy limestones with similar textures were described from the upper part of the Ypresian in Kwaadmechelen and from its middle part in Mol (FOBE 1989). These deposits were correlated with the Mons-en-Pévèle Member (STEURBAUT 1988). The limestone beds from the Ypresian in Beerzel, Rillaar, Mol, Oostham and Kwaadmechelen are a facies of sandy limestones, rich in *Nummulites planulatus-elegans*, occuring near Brussels ("Vorst sands") and in the Mons-en-Pévèle Member between Brussels and Ronse (FOBE 1988).

4.2. Brussels Formation

The stone layer Beerzel 106 m is a homogeneous, fine grained sandy limestone. Its texture can be defined as a wackestone: quartz and some scarce glauconite grains, microfossils and fragments of larger calcareous skeletons are floating in a matrix of non-ferroan micrite. Locally, small patches of fine slightly ferroan sparite are found, mainly as infillings of voids from vanished fossils. In the next layer (Beerzel 110.8 m), quartz grain size looks somewhat coarser an a little more glauconite is present. The matrix is richer in ferroan microspar.

In other wackestones from Beerzel (119.5 m) and from Booischot (120 m and 121 m), subhorizontal laminations (1-2 mm) are present. A laminated structure of quartz-rich, sparite cemented layers, alternating with a micritic zone with microfossils is observed in sample Booischot 120 m. The cement is non-ferroan, except for the last infillings of fossil voids. The other studied layer from Booischot (121 m) has a sparitic ferroan calcite cement and contains a large amount of small fossil fragments. In the laminated sample from Beerzel (119.5 m), much of the structure was destroyed by burrowing animals.

Several stone layers in the Brussels Formation are silica cemented, like Beerzel 112 m. The sample shows a packstone texture, with quartz and glauconite grains in a matrix of opal. A calcareous fraction, consisting of foraminifera, bivalve shell fragments and many micrite pellets is present. Siliceous fossils, mostly sponge spicules, filled with chalcedony, are also encountered. In two other layers from Beerzel (126 m and 128.5 m), the opal cement contains irregular patches of chalcedony.

In some sandstones, burrows are present. They are recognised as rounded structures, several millimeter across, with quartz grains cemented by chalcedony. Glauconite, opal cement and calcareous particles are nearly absent. The burrows are bordered by a dark rim of finer grained material, as it looked like at the hand specimen. Bioturbation was found in several samples from Beerzel (114.8 m, 117.5 m, 121 m, 126 m, 128 m and 128.5 m). The last mentioned layer is laminated, with rythmic variations of detrital quartz content. The structure was partly destroyed by bioturbation. One sample from Rillaar (89 m) is also an opal cemented sandstone. It shows horizontal laminations, with chalcedony in the quartz-rich layers.

The lithology of these sandy limestones and silica cemented sandstones is characteristic for stone layers from the calcareous facies of the Brussels Formation. In outcrops of this formation, such limestones and sandstones are found respectively as plates and concretions. The latter are often formed around burrows, like in the Beerzel borehole. In the exposures of the calcareous facies of the Brussels Formation near Brussels, Braine-l'Alleud and Tienen, up to 8 limestone layers and even more silica cemented sandstone levels were counted.

In the siliceous facies of the Brussels Formation, sandstone concretions are mainly cemented by chalcedony and they only occasionally contain opal. Although the amount of chalcedony increases downwards in the silica cemented sandstones from the Beerzel boring, they still can be ranked without doubt in the calcareous facies of the Brussels Formation.

4.3. Lede Formation

Stone layer Beerzel 102 m is a sandy limestone, cemented by ferroan microspar, micrite and locally clear sparite. The stone contains very fine angular quartz grains and a small fraction of glauconite grains of the same size. Less important by numbers but not by size, is a population of rounded quartz grains with a diameter approaching 1 mm.

Nummulite tests (*N. laevigatus*) are the most important fossils. Many of them are damaged or broken. In most of the tests, the chambers are filled with glauconite. In others, the infilling consists of fine, clear sparry calcite. In some of the tests, borings occur, also filled with glauconite. A few nummulites have undergone internal dissolution. The voids were later filled with sparry calcite. Many nummulites are surrounded by a thin rim of epitaxial ferroan calcite cement.

Several nummulite tests contain silicifications (Fig. 4). In an early phase, silicification is limited to the infilling of a small circular or elliptical cavity between two convolutions of the test. In a further stage, much of the nummulite consists of chalcedony, having wiped out most of the original structure. A few remains of the original material are found as inclusions. Dissolution of such tests in HCl yields a brittle white nummulite-like skeleton, consisting of quartz (analysed by X-ray diffraction). Chalcedony texture has no relationship with the original pallisade calcite of the nummulite. It occurs as equidimensional crystals, showing a wavy extinction when observed between crossed polarisers. Neither the direction nor the moment of extinction are the same as the surrounding elongated calcite of the nummulite. In one case, chalcedony has an elongated habit.

Other fossils present are echinoid plates and fragments of bivalve shells. Some of the latter are also silicified.

In layered shells, formation of chalcedony only took place in some of the layers, while the others remained in their original state.

A stone layer from Rillaar (85 m) contains a slab of laminated micrite with a few horizontal layers with quartz and fossils. This slab is surrounded by a mixture of fine and very coarse quartz grains and glauconite filled tests of *N. laevigatus* in a cement of ferroan microspar. No silicifications were observed in the nummulites. The micritic stone inclusion is reworked from the calcareous facies of the Brussels Formation.

In another layer from Rillaar (78.5 m), fine grained quartz is cemented by ferroan microspar, mixed with micrite. Its texture is homogeneous. It ressembles those parts of the sandy limestone from Beerzel 102 m, devoid of coarse elements. Quartz grains look finer than those in the sandy limestones from the Brussels Formation in Rillaar and Beerzel. Besides, sample Rillaar 78.5 m shows a closer packed fabric than the layers from the Brussels Formation. Sample Rillaar 110 m shows the same structure, but considering the previous results (Ieper Formation), this was a caving sample, as it was also suggested in the borehole file.

The texture of the stone samples (very fine quartz in a cement of ferroan micrite and microsparite) is characteristic for sandy limestones from the Lede Formation. Comparable stone layers were found in exposures near Brussels. In the neighbourhood of Beerzel and Rillaar, they were found in boreholes in Mechelen (BGS 58 E 18/61) and Rotselaar (BGS 74 E 68/24). East of Rillaar, they occur in the boreholes of Oostham and Kwaadmechelen. The high amount of coarse grained quartz and of reworked, sometimes partly silicified *N. laevigatus*, in the samples Beerzel 102 m and Rillaar 85 m is characteristic for the basal gravel of the Lede Formation. cementation of this gravel is not uncommon.

5. GRAIN SIZE DISTRIBUTION

Samples from Beerzel and Rillaar were decalcified with HCl 10%. The unsoluble fraction was sieved, in order to analyse grain size distribution (Fig. 5). The stone layers from the sandy Ypresian from Beerzel (150 m and 158 m) show a characteristic grain size distribution. The amount of sand (>50 µm) was rather low (51-76 %) and less than 10% was coarser than 88 µm. Sample Rillaar 104a m, the stone layer with Solarium, showed comparable results.

In the sandy limestones from the Brussels Formation in Beerzel (106 m, 110.8 m and 119.5 m), the sand fraction ranges between 84% and 98%. About 70-87 % is coarser than 88 µm and 25-33 % is coarser than 125 µm. Compared to analysis results from exposures of the calcareous facies of the Brussels Formation, grain size distribution in Beerzel is relatively fine. Only near Braine-l'Alleud, a sand of comparable composition was found. In four other studied exposures of the calcareous facies of the Brussels Formation, the fraction coarser than 125 µm generally exceeds 50%.

Analyses of four sand samples from the Lede Formation in Beerzel (98 m, 99 m, 100.5 m and 101.5 m) also showed typical results for this deposit. The sand fraction varies between 77% and 88%. The fraction coarser than 88 µm does not exceed 30% and less than 10% is coarser than 125 µm. Comparable values were found in stone layer Rillaar 78.5 m. The grain size distribution of Rillaar 85 m is coarser (>500 µm : 14%; >250 µm : 35%) and characteristic for the basal gravel of the Lede Formation.

Together with grain size distribution, the carbonate content (weight percentage) was measured. The following results were obtained : Mons-en-Pévèle Member, sandy limestones from Beerzel and Rillaar : 50-59 %; Brussels Formation, limestones from Beerzel : 75-91 % and Lede Formation, stone layers from Rillaar : 59% and sand samples from Beerzel : 13%.

6. LITHOSTRATIGRAPHY

The original subdivisions of the Eocene in Beerzel, Booischot and Rillaar are confirmed by the petrographical study of the stone layers. The Ieper, Brussels and Lede Formations succeed each other in this area, as it is also the case near Brussels, southwest of the Southern Campine and near Oostham, east of the studied boreholes. The base of the Lede Formation can be fixed easily because its basal gravel was cemented.

In the boreholes of Beerzel, Booischot and Rillaar, the Brussels Formation is dominated by its calcareous facies. The formation is about 26 m thick in Beerzel and Booischot and 15 m in Rillaar. Sandy limestone and siliceous sandstone layers, all characteristic for the calcareous facies were found throughout the whole Brussels Formation. Only in Rillaar, the borehole file mentioned some occurrences of glauconite rich sand in its lower part. In the outcropping areas near Leuven, 25 km south of the studied borings, the Brussels Formation entirely consists of its siliceous facies. In Brussels and locally near Tienen, the calcareous facies mostly covers the siliceous facies. The calcareous facies was also present in the Oostham-Kwaadmechelen region (FOBE 1989), but it was not certain whether it included the whole formation.

Compared to the outcropping area, the Brussels Formation in the Beerzel, Booischot and Rillaar region is located in a more seaward area (HOUTHUYS 1990). The basal surface is not marked by ondulations and deep narrow trenches created by tidal currents, as are found between Brussels and Tienen. This could explain the finer grain size, the constant thickness and the dominance of the calcareous facies. However, due to the decreasing density of observation points in northern direction, our knowledge of the topography of the pre-Brusselian erosion surface is less detailed than in the outcropping area HOUTHUYS (1990).

In the original borehole descriptions, the sandy facies in the upper half of the Ieper Formation was correlated with the Yd, the Egem Member. Yet, in agreement with biostratigraphic investigations by STEURBAUT (1988), the sandy limestones from the Ieper Formation in Beerzel and Rillaar belong to the Mons-en-Pévèle Member, overlying the Orchies Member (Yc). Except for Beerzel, where the Aalbeke Member should be present, the Mons-en-Pévèle Member is the youngest Ypresian deposit in the studied boreholes. Like in Oostham and Kwaadmechelen, the younger members of the Ieper Formation are missing. In Mol, a more complete sequence was encountered, as also the Aalbeke, Kortemark and Egem Members (or at least their corresponding biostratigraphical zones) are present (STEURBAUT and NOLF 1986). In the region of Brussels, the youngest Ypresian deposits are the Vorst (or Forest) sands. Formerly they were also correlated with the Yd (Egem Member), today with the older Mons-en-Pévèle Member (STEURBAUT 1988, KING 1988). In a borehole in Brussels, described by STEURBAUT and NOLF (1986), the Ieper Formation is about 56 m thick (Mons-en-Pévèle Member : 37 m, Orchies Member : 19 m). MOURLON (1910) described a boring with Ypresian (65 m thick), consisting of 25.5 m of sand ("Yd"), covering 39.5 m of clay ("Yc"). The Vorst sands contain sandy limestones like the Ypresian from Beerzel and Rillaar.

According to GEETS (1988), the basal clay deposit of the Ypresian in the Campine is a lateral facies of the Mont Héribu Member. This member contains more silt than the Orchies Member. In the region west of Brussels, the Mont Héribu Member is restricted to the lowermost meters of the Ieper Formation and overlain by the Orchies Member, which is absent in the subcrops of the Campine. The increasing importance of the Mont Héribu Member in this area marks a transition from open shelf mud (Orchies clays) towards an environment with coastal influence.

The absence of Ypresian beds younger than the Mons-en-Pévèle Member (or locally the Aalbeke Member) in the region of Brussels is due to an erosion phase that preceeded the deposition of the Brussels Formation. The upper part of the Ieper Formation, some 20-30 m, were removed. In the Kallo borehole (35 km northwest of Beerzel), the Ieper Formation, including the Merelbeke Member, is 140 m thick, the same as in Mechelen, 13 km southwest of Beerzel. In the Southern Campine, the Ieper Formation undergoes a thickness reduction between Beerzel (96 m) and Booischot (56 m) of 40 m over 8 km only (Fig. 6). In Rillaar, the formation is only 45 m thick. This transition is comparable to the section of between Mol (96 m) and Oostham (48 m) and Kwaadmechelen (65 m) borings, over a distance of 13 km and also in southeastern direction (FOBE 1989). Besides pre-Brusselian erosion (removal of the upper part of the Ieper Formation between Mechelen and Beerzel and between Mol and Oostham), the reduction of its thickness is also observed internally (the lowermost clay Member becomes thinner towards Oostham). Apparently, no strong ondulations of the basal surface of the Brussels Formation (26 m in Beerzel and Booischot, 15 m in Rillaar and 10 m in Mol and Kwaadmechelen) occurred.

The Ieper Formation in the region between Beerzel-Mol and Oostham-Rillaar is characterised by coastal sediments (Mont Héribu and Mons-en-Pévèle Members). Its deposition was followed by erosion, removing its uppermost part. Stone layers, occurring in the middle part of the formation in Beerzel and Mol are found at the top in Rillaar and in borings in the Oostham-Kwaadmechelen region (GULINCK 1967, FOBE 1989). The position of the limestone beds, immediately below the base of the Brussels Formation in boreholes 46 E 97 (mentioned by GULINCK 1976), 46 E 179 (Kwaadmechelen), 46 E 180 (Oostham) and 75 E 317 (Rillaar) could indicate that they protected the underlying sediments against erosion (Fig. 6). Consequently, diagenesis of these layers took place before deposition of the Brussels Formation. It should be reminded that reworked limestone layers from the Brussels Formation are found in the basal gravel of the overlying Lede Formation, e.g. in the Rillaar borehole (85 m). Many indications exist that the sandy limestones from the Lede Formation were also formed before the next transgression took place (e.g. the local occurrence of reworked slabs and the limestone sometimes formed the lower limit of the erosion surface of the Wemmel Member (JACOBS 1978)). Until now, little information was available about the time of diagenetic formation of the limestones from the Mons-en-Pévèle Member, but it appears now that, like other calcite cemented stone layers in the Belgian Eocene, this process took place shortly after deposition, before the pre-Brusselian erosion phase.

At last, the occurrence of *Solarium* shells in the Ypresian in Rillaar should be mentioned. After GLIBERT (1938), *Solarium* is only encountered in younger Eocene deposits (Lutetian, Auversian and Bartonian) in France, England and Belgium. In Rillaar, this gastropod was found in a stone layer from an Ypresian deposit.

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