Discussion note about the Chattian (Upper Oligocene) lithostratigraphic units Voort sand /Veldhoven clay /Someren sand.

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Can we bring the Dutch, Belgian and German practice in line by using a common nomenclature ?

The present discussion text with respect to the Chattian lithostratigraphic nomenclature is structured as follows:
At first an overview of the present stratigraphic nomenclature practice in Belgium, The Netherlands and the German Lower Rhine area.
Secondly a sedimentological model relating these units in the cross-border area of the three countries.
Thirdly a tentative proposal to define the Chattian lithostratigraphic units occurring in Belgium.

This discussion note is closed by the list of references and a set of relevant figures mostly taken from these references (indicated Fig.).

I. Overview of the present stratigraphic nomenclature practice in Belgium, The Netherlands and the German Lower Rhine area.

In Belgium *(situation described is based on ncs website: http://natstratcommbelgium.drupalgardens.com)*

Upper Oligocene deposits described from Belgium (Fig.1) consist of fine-grained and clayey, dark green glauconitic sands, often rich in macrofossils. However, these only represent the lower part of the Upper Oligocene sequence just across the Belgian border. The deposits are well developed and stratigraphically more complete in the subsiding Roer Valley Graben northeast of the Campine basin. Similar but thinner and discontinuous deposits of the same age occur in the north of the Antwerp Campine. The westernmost outlier is north of the city of Antwerp where a pocket of Chattian sand has been observed and confirmed by micropaleontology (benthic foraminifera and dinoflagellate cysts) (Fig.2).

These sands have been stratigraphically assigned to the Voort Sand Formation. The term was introduced by Van Straelen (1923) while describing the overburden traversed in coal mining shafts in the eastern Campine. Voort is a hamlet of the commune Heusden-Zolder in the Belgian province of Limburg, where the shafts of the Zolder colliery are sunk. The reference section is between -21 m to -45 m TAW in the mine shaft 62W0226 (GeoDoc archives Geological Survey of Belgium) (de Heinzelin & Glibert, 1956, p. 202). Lambert '72 co-ordinates: X = 217330, Y = 192725, Z = + 48,5 m.

A clayey part of the Voort Formation, occurring in the very northeastern part of the Campine Basin and in particular north of the Grote Brogel fault in the Roer Valley Graben, is described as the Veldhoven Clay Member (Laga et al., 2001), following the subdivision applied in The Netherlands at that time (see below).

Van Simaeys (2004a, fig. 5.6 = our Fig. 3; 2004b, fig.2 = our Fig. 4; 2004c fig.4 = our Fig. 5) and De Man et al. (2010, fig. 4 = our Fig. 6) have described two gravel layers in the Voort Formation from Weelde and Mol-1 boreholes (Van Simaeys uses the term Veldhoven Formation instead of Voort Formation , following the practice in the Netherlands today, see below). The two gravel layers subdivide the Chattian deposits in three parts which correspond to changes in the dinoflagellate cyst zonation (Figs 3,4,5,6).

In The Netherlands *(reference Van Adrichem Boogaert & Kouwe (1993) and de Mulder et al (2003)).*

The NAM and RGD Stratigraphical Nomenclator (1980) combined the Voort Sand Member and the Veldhoven Clay Member into the Veldhoven Formation. In the revision of the Dutch stratigraphic nomenclature by Van Adrichem Boogaert & Kouwe (1993) three depositional cycles are distinguished within the Voort Sands Member, each consisting of a clayey horizon in a dominantly sandy unit; above the Voort Sand Member (a Member is called Laagpakket) lies the Veldhoven Clay Member (also called Laagpakket), essentially consisting of clay and considered already partly with an Aquitanian age. The Someren Sand Member is the uppermost unit. This threefold subdivision Voort/Veldhoven/Someren is taken over by de Mulder et al (2003, fig. 172, also in Wong et al. , 2007 , fig.9)(= our Fig. 7) and the entire succession called Veldhoven Formation.

The currently followed lithostratigraphic subdivision (de Lang, 2003) describes the Veldhoven Formation as consisting of fine greenish sand and subordinate silty clay. In boreholes, boundaries with over- and underlying formations are sharp if the base of the overlying

formation - whether at the base or top of the Veldhoven Formation - is more clayey and glauconitic (transgressive greensand facies) but rather vague in other cases. The subdivision in three members is applied but cannot be sufficiently recognised everywhere. In order to avoid confusion between formation and member names, Veldhoven is the name retained for the formation, whereas the clayey middle member is renamed Wintelre, as proposed by de Lang (2003).

The Veldhoven Formation is put in equivalence with seismostratigraphic units V-VI (after NITG, 2001 and Verbeek et al., 2002; our Fig. 16), whereby unit V encompasses the Eigenbilzen Formation and the Veldhoven Formation up to the Wintelre Member, and unit VI the Someren Member. Each Member of the Veldhoven Formation has a different seismic character: prograding for the lower Voort Member, more continuous reflectors on the clay-sand alternation in the middle Wintelre Member (building the top of seismostratigaphic unit V) and more transparent for the upper Someren Member (characteristic for seismostratigraphic unit VI) - (personal communication J. Deckers, VITO). However the correspondence between this seismostratigraphic interpretation and the formal lithostratigraphic units should be used with caution as a good calibration between both was not possible.

In the Lower Rhine Graben area of Germany *(reference Schäfer and Utescher , 2014 fig. 3) (= our Fig.8).*

A mollusc based stratigraphic subdivision, Chatt A, B and C has been proposed by Anderson et al. (1971) and a twofold Eochatt and Neochatt was proposed by Hinsch (1956). These form the biostratigraphic basis for the regional definition of the Chattian and for the interregional correlation. Gliese (1971) has introduced the term Kölner Schichten or Unterflöz Gruppe for the sediments in the Lower Rhine Graben area of Chattian age underlying the main lignite bearing deposits.

In recent publications about the Lower Rhine geology Schäfer et al. (2004) and Schäfer & Utescher (2014) have systematically used the term Köln Formation for the deposits overlying the marginal marine Grafenberg Formation. The Köln Formation consists of cycles of marginal marine sand, minor fluvial sand, lagoonal or lacustrine clay and lignite layers (Schäfer and Utescher, 2014 fig. 3 and Hager et al., 1998 fig. 3 = our Fig.9).

The fig.3 in Schäfer and Utescher (2014) (= our Fig. 8) is also showing the Schneider and Thiele (1965) hydrostratigraphic codes in the Köln Formation; these codes are used in the Hager et al. (1998) sections and profiles (= our Figs. 9, 10, 13).

The relationship between the Chatt A,B,C subdivisions and the Schneider and Thiele codes (S&T), and hence the position of the Chatt A,B,C subdivisions in the Köln Formation could be determined in the Schacht 8 section in the Lower Rhine area (Hager et al. , 1998 fig. 5) (= our Fig.10):

Chatt C (ChC) = S&T 1 + 2 to 4;

Chatt B (ChB) = S&T 07 to 09;

Chatt A (ChA) = S&T 05 + 06.

The position of the Eochatt and Neochatt in the Chattian is shown in Van Simaeys et al. (2005, fig. 4) (= our Fig.11), based on dinoflagellate correlations of Belgian and Dutch sections with the Gartow research borehole in northern Germany:

Neochatt = Dinocyst zone	NSO-8 partim
Eochatt = Dinocyst zones	NSO-8 partim
	NSO-7
	NSO-6
	NSO-5b.

II. Sedimentological correlation models between the Lower Rhine Graben in Germany and Roer Valley Graben – Campine transition in The Netherlands and Belgium

By dinoflagellate analysis, Van Simaeys (2004) has demonstrated that the three sedimentological cycles in the Voort Sand in Belgium (boreholes Weelde, Mol, Hechtel, see also De Man et al. , 2010 fig. 4 = our Fig. 6) can consistently be traced laterally into the Dutch Roer Valley Graben (Groote Heide section) where the three cycles become thicker and where more clayey intervals are intercalated in the sand intervals (our Fig.3).

The position of the two gravel layers marking the boundary between the three cycles with respect to the Schneider and Thiele units and the chronostratigraphy are published in Vandenberghe et al. (2004, fig.6) (= our Fig.12).

The gravel layers closely correspond to the boundaries between respectively Chattian 1 /2 (= Chattian A/B) and Chattian 2/3 (= Chattian B/C). They are also parallel to the boundaries between dinocyst zones NSO-6 - NSO-7 and NSO-7 - NSO-8 respectively.

Hager et al. (1998) have correlated geophysical well logs that identified the Schneider and Thiele coded units between Belgium, The Netherlands and the Lower Rhine Graben (= our Fig.13). It is essential to note that the marine clay units identified in Molenbeersel (Belgium) and in Asten (The Netherlands) by Hager et al. (1998) (Fig.13) are interpreted in terms of the Schneider and Thiele units, which are defined in marginal marine to lagoonal environments associated with lignite in the Lower Rhine delta plain (see also Schäfer and Utescher, 2014 fig. 3) (our Fig.8). Their identification as a consistent vertical succession across facies boundaries from the southeastern fluvial border into the deeper marine Roer Valley Graben (Molenbeersel- Asten) is necessarily in contrast with the Schäfer et al. (2004) sedimentological model (= our Fig.14) presenting a lateral transition from marginal facies of the Köln Fm in the southeastern blocks over the shallow marine Voort Sand in the Dutch – German boundary realm to the deeper water Veldhoven Clay in the deeper part of the Roer Valley Graben basin in The Netherlands. Also, like the Schäfer et al. model , the model in the de Mulder et al. (2003 , fig.172) (our Fig. 7) suggests that the Veldhoven Clay is a deeper marine facies compared to the Voort Sand and the Someren Sand. In the latter interpretation the transition between sand and clay-dominated facies cannot be defined as a laterally consistent vertical succession.

Therefore, the depositional environment of all clay layers in the Upper Oligocene needs to be determined before the relationship between e.g. the Veldhoven clay unit (now Wintelre , see below) and the Schneider and Thiele clay units can be fully understood. Nevertheless, geophysical log signature trends can be correlated across lateral lithological variation, for example from contemporaneous clayey sediments into sandy sediments. This is the case for example when sea level changes cause the trends in the sediment size, which are reflected in the geophysical log signature. Hence, geophysical correlation lines do not necessarily coincide with lithological boundaries. Moreover, log response is not always unequivocal, so that recognition of sand – clay sequences in borehole does not necessarily lead to mappable units.

The implications for the stratigraphical interpretation and subdivisions can be well illustrated in the Belgian case, for example the Molenbeersel well in the RVG in the very NE of Belgium (our Fig. 15).

The interpretation in the threefold terms (as proposed in IV. Tentative proposal), and using the Dutch nomenclature is :

Formation Veldhoven (formerly Voort) : Member Someren 680-774 m / Member Wintelre (formerly Veldhoven) 774-840 m / Member Voort 840-975 m .

Such subdivision however neglects the presence of a clayey unit between about 906 and 945 m, within the Voort Member.

In the interpretation published by Hager et al. (1998) (= our Fig. 13) this latter clay unit is interpreted to correspond to Schneider and Thiele unit 06 . This identification would allow the subdivision of the Chattian into 5 units, all coded using the Schneider and Thiele system (S&T) and correlated in this system to for example the Asten boreholes (see Hager et al. , 1998 fig. 4 & 5) (= our Fig.10, 13). Remembering that the stratigraphic level of the two gravel layers observed in Weelde and Mol boreholes can be positioned (see Vandenberghe et al. , 2004, our Fig. 12) below the S&T unit 1 (Veldhoven Member) or base Chattian C and below the S&T unit 06 (within Chattian A, not formally identified in the above 3-fold interpretation but incorporated into the 'Voort' Member), the lithological interpretation by Hager et al. (1998) fits the thickness increase of the three cycles from the marginal areas to the deeper Roer Valley Graben as established by Van Simaeys, but based on biostratigraphical criteria (2004a fig. 5.6) in our Fig.3.

So, a choice has to be made between a 3-fold and 5-fold subdivision of the Veldhoven Formation.

III. Arguments for a 3-fold subdivision of the Chattian deposits

A tentative proposal is submitted for discussion to the subcommission which prefers the 3-fold subdivision; further informal (hydrostratigraphic) subdivision could be based on the Schneider and Thiele coding system, although a full sedimentological understanding of their meaning in the deeper part of the basin is not yet clear.

It is first of all suggested to follow the Dutch nomenclature practice by using the term Veldhoven for the Formation, replacing the term Veldhoven by Wintelre to avoid the use of Veldhoven for both formation and member, and ranking Voort Sand

as a member. This means that the following nomenclature is proposed: Veldhoven Fm consisting of Voort , Wintelre and Someren Members.

The Veldhoven Formation is the youngest of the Paleogene stratigraphic units in Belgium, but it is also the first formation whose depositional area and thickness is controlled by active subsidence of the Rur Valley Graben. As this formation is only accessible from boreholes, initial information came from the Campine coal mining district. There, only the lower marginal part of the formation is encountered, named Voort Sand, after the locality name where the shafts of colliery Zolder were sunk (Van Straelen, 1923).
In the southern part of The Netherlands, boreholes encountered a more complete and much thicker succession characteristic for the Rur Valley Graben, and hence had a different approach to the stratigraphic terminology (NAM & RGD, 1980).
Also in Belgium north of the coal mining district, in the direction of the Rur Valley Graben, the Veldhoven Formation becomes thicker and more complete, to incorporate first a clay unit, named Wintelre Clay and finally, within the deepest part of the graben, a new sand unit, named Someren Sand. The latter is new for the lithostratigraphic scale of Belgium.
Information from these boreholes is scant as this sandy – clayey unit presents no economic interest; it has been summarized for lithostratigraphic purposes in Vandenberghe (1988) and de Lang (2003). Lithostratigraphic and seismostratigraphic correlation between Belgium and The Netherlands has recently been finalized for establishing a cross-boundary 3D (hydro)stratigraphic model of the Rur Valley Graben (Deckers, Vernes et al., 2014), allowing the present update of the Veldhoven Formation.

Objections against the threefold subdivision proposed could be either based on the naming of the lithostratigraphic units or on the weight attached to the clayey intercalations.
Preference for a Dutch formation name has to be justified because priority might be claimed for the Belgian name Voort. However, the formation is more complete and much thicker in The Netherlands and also geographically more extensive. Moreover, in Belgian studies Voort has always been associated with the sandy lower unit; renaming the Voort Sands in order to use this name exclusively for the formation is not evident. The Dutch stratigraphical nomenclature has already three names available, so that the Belgian NCS is saved the tedious task of finding another name in an area that is saturated with stratigraphical locality names.

Although it is likely that the clayey unit identified within the Voort member (e.g. 906-945 m interval in borehole Molenbeersel), correlated with S&T 06, could have a comparable sedimentological origin and displays a similar log signature as the Veldhoven => Wintelre member (e.g. 774-840 m interval in borehole Molenbeersel), correlated with S&T 1, it has markedly lower overall gamma-ray readings and would not qualify yet as a clay. Log response in other boreholes is equivocal, as there is only the well Molenbeersel to have traversed the entire Chattian sequence in Belgium and the clayey nature of the strata correlated to S&T 06 – or any other sequence within the Voort Member - is not well established.
Belgian practice so far thus has not identified the need for a 5-fold subdivision, but further subdivision of the Voort Member in 3 subunits or splitting this member in 3 equal members would be technically and scientifically feasible. For the time being, adhering to the Dutch nomenclature is the most convenient.

The introduction of a threefold subdivision with a clay unit intercalating between sands necessitates adaptation of the hydrostratigraphic code (operated by VMM): Someren Member stands for HCOV code 0254-1, Veldhoven Member for 0255, and Voort Member for 0254-2.

IV. Proposal of description and subdivision of Chattian deposits in Belgium

Veldhoven Formation

Name

Veldhoven is a municipality south of Eindhoven in The Netherlands. The name was mentioned for the first time in Van Staalduinen et al. (1979, p. 25, 29) and is described in the NAM-RGD Nomenclator (1980, p. 51-52), but meant for the clay member now called Wintelre member.

General characteristics and subdivisions

The Veldhoven Formation consists of fine grained glauconitic sands (Voort and Someren Members) containing in some locations molluscs at its base (Voort Member) and with a clay unit in its middle part where the formation is complete (Wintelre Member) . Other clayey intercalations can occur in the sands.

Occurrence

The Veldhoven Formation is subcropping in the Rur Valley Graben and adjoining part of the Campine Basin. In marginal position only the lower Voort Sand Member is present; the middle Wintelre Clay Member appears below the Miocene disconformity on the graben shoulder; the upper unit or Someren Sands is only known from the deepest parts of the Roer Valley Graben in Belgium, but may extend over adjoining tectonic blocks in The Netherlands.
The overlying Miocene deposits are the Houthalen Sand (Bolderberg Fm) in the east and to the west the Berchem Formation. In borehole interpretations distinguishing the Veldhoven Formation from the overlying Houthalen Member or Berchem Fm is not always straightforward and erroneous interpretations may have been made. For example in the Molenbeersel well, comparing the Figs 15 (present interpretation) and Fig. 16 (from Wong et al. ,2007 fig.8) shows that the upper sandy part of the Formation, the Someren Sand overlying the Veldhoven Clay Member, had been incorporated in the Miocene Breda Fm (seismostratigraphic unit VI) by Wong et al. (2007).

The Veldhoven Formation overlies the Eigenbilzen Fm from which it often can be distinguished by the presence of molluscs in the former or by specific geophysical log signature (our Fig.17-19), although the distinction is not always straightforward (see also Gulinck,1954).
Nevertheless, the contact between Voort Member and Eigenbilzen Formation corresponds to an unconformable contact due to different dip related to reactivation of the graben (Eigenbilzen dipping to the north, Voort to the north east). Seismic sections perpendicular to the graben boundary faults show the reflector assigned to the base Veldhoven Formation wedging in between the Eigenbilzen and Bolderberg Formations in the northeastern Campine (Lie, 1983). In the Mol area, the steady thickness increase of the Veldhoven Formation is mainly due to the formation becoming gradually more complete, whereby the clayey interval in the Voort Member (higher gamma-ray readings on Fig. 17) shifts from top to middle of the preserved interval. Also note on Fig. 17 that the Veldhoven Formation displays overall higher gamma-ray readings and resistivities than the underlying Eigenbilzen Formation, indicative for higher glauconite content and increased granulometry. The same applies for the base of the overlying Berchem Formation, which in turn is glauconite rich and coarser grained than the Veldhoven Formation.

Stratotype

Borehole Veldhoven-1 (NAM) in Veldhoven (NL) with the Veldhoven Formation 860 – 1103 m below rotary table (NAM & RGD 1980) – [http://www.dinoloket.nl/veldhoven-formation-nmvf].

Additional Belgian parastratotype is the borehole Molenbeersel, drilled 1988 till final depth of 1773 m; GeoDoc 049W0226, ground level +33 m; Lambert ’72 coordinates x 247660, y 207752, Veldhoven Formation 680 – 975 m below ground level. The formation can be further subdivided as follows (see log Fig.15b):

Someren Member	680 – 774 m
Wintelre Member	774 – 840 m
Voort Member	840 - 975 m

Age

The Veldhoven Fm is Chattian in age based on biostratigraphic investigations of calcareous microfossils in the type area of the Voort Sand Member (review in Vandenberghe et al., 1998 and refined by dinoflagellate cysts by Van Simaeys (2004) and Van Simaeys et al. (2005). However, on TNO-DINOloket (http://www.dinoloket.nl/someren-member-nmvfs) an earliest Miocene age is suggested for the Someren Member instead of a Chattian age: “Probably earliest Miocene (Aquitanian, NN 1-2)”. Nevertheless age control is poor and the interval does not yield stratigraphically useful nannoplankton species. In Germany, sediments that occupy similar stratigraphic positions, i.e. in between the NP 25 and NN 3-5 zones, have tentatively been placed in the NN 1-2 interval (Cĕpek et al. 1988). The foraminiferal fauna is characterised by the abundant occurrence of *Asterigerina guerichi* and *Florilus boueanus*”. We may conclude that the Veldhoven Formation is essentially of Chattian age, although continuation into the Aquitanian cannot be excluded.

Voort Member

Name

The term was introduced by Van Straelen (1923) while the describing coal wells in Limburg. Voort is a hamlet of the municipality Zolder in the Belgian province of Limburg, location of the mine shafts of Zolder colliery.

General characteristics

The Voort Member consists of fine-grained and clayey, dark green glauconitic sands, rich in fossils. Gulinck (1954) remarked that the lower part of the Voort Sands passes gradually into the underlying Eigenbilzen Sands without noticeable boundary.

Occurrence

The Voort Member is principally known from the subsurface of North and East Limburg. The lower boundary is with the Eigenbilzen Formation. Generally the upper boundary of the formation is with the Miocene Houthalen Sands (lower part of Bolderberg Formation), and to the west with the Miocene Berchem Formation, but in case the Veldhoven Clay Member is present in northeast Limburg , the latter overlies the Voort Member. Probably, identifications of Veldhoven Clay in coal exploration boreholes represent in reality the S&T coded 06 unit, forming part of the Voort Member. In the area north of Voort type locality, this clayey interval forms the top of the formation (Fig. 18). Fig. 18 indicates that in the western Campine mining district, the Veldhoven Formtion still shows intermediate resistivities (and porosity – permeability) between the Eigenbilzen and Bolderberg Formations, but the gamma-ray readings are no longer higher than those of Eigenbilzen (except the clayey top). In the eastern Campine mining district, the intermediate character of the Voort Member between the Eigenbilzen Formation and the Bolderberg Formation is even more pronounced (Fig. 19).

During the last geological mapping in Flanders, the Voort Member was also recorded in the north of the Antwerp province. Also along the river Scheldt - north of the city of Antwerp – an isolated relic of the Voort Sand has been observed, based on the presence of the foraminifer *Nonion roemeri* (Vandenberghe & Laga, 1986) and confirmed by dinoflagellate cyst analysis (S. Van Simaeys, unpublished).

Stratotype

Coal mine shaft at Voort-Zolder (archives Belgian Geological Survey 62W-226); reference section from -21 m to -45 m (de Heinzelin & Glibert, 1956, p. 202); geological map 25/3-4 (Beringen-Houthalen). The original stratotype referred to in Laga et al. (2001) – GeoDoc 062W0226 exposed the Voort Formation in a marginal position, limited to the lower sand unit and thus representative only for the Voort Member. It remains the stratotype for this unit

Lambert ’72 co-ordinates: X = 217330, Y = 192725, Z = + 48,5 m.

Former designations

Geological map 1/40.000: no reference

Stratigraphical register (1929, 1932): Voort Sands: Chattian (Ch) p.p.

New Geological map 1/50.000: Vo.

Wintelre Member

Name

The name Wintelre is introduced by de Lang (2003) and is exactly referring to the previously used Veldhoven member; the change in name is only meant to allow the name Veldhoven to be used for the whole formation consisting of Voort, Wintelre and Someren members.

General characteristics

The Wintelre Member consists of grey-green clay. A study of the Chattian deposits in the euregion The Netherlands - Belgium - Germany by Hager et al (1998) shows that clayey deposits occur in the graben and thus north of the Grote Brogel fault. The clays are interpreted as deltaic deposits, while the glauconitic sands have a marine origin. The interpretation of the Asten-2 well in the latter study, compared with an interpretation of the same well by Van Adrichem Boogaert & Kouwe (1993), indicates that only the clay unit 1 (S&T) in Molenbeersel (see fig. 4 in Hager et al., 1998) can be regarded as the Veldhoven Member sensu Van Adrichem Boogaert & Kouwe (1993) and Wintelre Member sensu de Lang (2003).

Occurrence

The Wintelre Member does not crop out, and is only recorded in the subsurface north of the Grote-Brogel - Heerlerheide faults. It is also recorded from few boreholes in the northeastern Campine, between the mining district and the graben (Opoeteren – Gruitrode area).

Stratotype

The Wintelre Member in Belgium is rather silty and the unit was until now only encountered in wells in North East Limburg. The reference section in the Dutch well Veldhoven-1 (NAM-RGD, 1980, p. 51, encl. 32) in Veldhoven can be used as a stratotype: Wintelre Clay Member (interval 935 – 1047 m). [http://www.dinoloket.nl/veldhoven-formation-nmvf].

Former designations

Veldhoven member in Belgium

Someren Member

Name
Derived from Someren, commune in Noord-Brabant, in proximity to location of the parastratotype borehole Asten-1.

Stratotype:
Borehole Veldhoven-1 (NAM) in Veldhoven (NL), [http://www.dinoloket.nl/veldhoven-formation-nmvf]. 860-935 m is the stratotype for the Veldhoven Formation. Parastratotype: Borehole Asten-1 (NAM) in Asten (NL), is also the stratotype for the Someren Sand Member (interval 867 – 952 m).

Additional Belgian parastratotype borehole Molenbeersel, drilled 1988 till final depth of 1773 m; GeoDoc 049W0226, ground level +33 m; Lambert coordinates x 247660, y 207752, Someren Member: 680 – 774 m

Description
Light grey fine to very fine glauconiferous sand is characteristic for the Someren Member.

Underlying and overlying strata
The Someren Member is conformably overlying the Wintelre Member. The Someren Member at its top is covered by the Bolderberg Formation, at the base of which occur the more greenish, clayey Houthalen Sands, with rather high gamma-ray readings.

Area
The upper unit or Someren Sands is only known from the deepest parts of the Roer Valley Graben in Belgium, but may extend over adjoining tectonic blocks in The Netherlands.

Thickness: There is only one site in Belgium where the Someren Member has been detected, borehole Molenbeersel, designated as new Belgian parastratotype for the Voort Formation. The Someren Member attains a thickness of 94 m in this well, for a total thickness of 295 for the entire formation

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The full reference list in Laga et al., 2001 and on the ncs website , Paleogene Lithostratigraphy 5. References.

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Figures

19 Figures referred to in the text are enclosed in an addendum, of which Figs 15, 17-19 are original.

Fig. 15. Stratigraphical interpretation of the Veldhoven Formation in borehole 49W0226, Molenbeersel, depths according to DOV vs gamma-ray log. Note that top and base of the Veldhoven Formation may be shifted 5 m downward.

Fig. 17. Geophysical well log correlation in the Mol area, from concept of profile for the transboundary 3D (hydro)stratigraphical cartography 'project H3O2 De Kempen).

Fig. 18. Geophysical well log delineation of the Veldhoven Formation in borehole 47W0260 KS13, Koersel – Hemelbrug (western mining district). Stippled line indicates base of the clay unit, erroneously assigned to the Veldhoven Caly but more likely corresponding to S&T code 06 incorporated in the Voort Member.

Fig. 19. Geophysical well log delineation of the Veldhoven Formation in borehole 63E0218 KB161 Opglabbeek – Louwelsbroek (eastern mining district).