Kieseloolite Formation

Unit name: Kieseloolite Formation

Hierarchical unit name : A group name for the white, pale grey quartz-enriched sand units of the Pliocene, eventually transitional to Pleistocene, including a.o. Kieseloolite, Mol, Merksplas …formations can be considered if sufficient sedimentological and mineralogical data become available to characterise individual formations, differentiating them from each other and at the same time showing their degree of relationship. At present no name is proposed for such an eventual group of white to pale-grey sand.

Type: Formation

Code: Kz

Authors:

- Compiled by: Vandenberghe Noël & Dusar Michiel

Alternative names: See note on the orthography below

Origin of the name:

Status: Formal

Date: 01/05/2022

How to refer: Vandenberghe, N., & Dusar, M., 2023. The Kieseloolite Formation, 01/09/2023. National Commission for Stratigraphy Belgium. http://ncs.naturalsciences.be/lithostratigraphy/Kieseloolite-Formation

Note on orthography:
Several ways to spell the name of this unit occur in literature in different languages:

- Kieseloolite (in Westerhoff , 2009),
- Kiezeloolith (in Vandenberghe et al. , 2020 & Vandenberghe et al., 2005)),
- Kiezeloöliet (H3O projects Flanders-the Netherlands (Vernes et al., 2009), in Laga et al. ,2001),
- Kieseloolith (German stratigraphic table www.stratigraphie.de),
- les Kiezeloolithes (Gulinck ,1960)).

In the Neogene 2020 Geologica Belgica Volume the Westerhoff (2009) spelling is mostly used and is also followed in the present LIS.

Preliminary explanatory note on the Belgian and the Dutch stratigraphic practices with regard to the Kieseloolite Formation sensu lato in the Roer Valley Graben (RVG).

- Belgian Neogene stratigraphy practice in borehole studies in the RVG is based on Van der Sluys (2000), followed in the mapping of the Maaseik-Beverbeek sheet 18-10 (Sels et al. , 2001) and as also applied in the Maaseik (049W 0220) reference well by Vandenberghe et al. (2005). This practice is described in the Synthesis by Louwye et al. (2020).

- In the Belgian-Dutch transboundary H3O-project, the results of which are reported by Vernes et al. (2018), the Dutch stratigraphic practice has been the guiding principle. Consequently this has led in this project report to the introduction in Belgian borehole descriptions and profiles of subdivisions and nomenclature different from the Synthesis published by Louwye et al. (2020).
- As the present LIS Kieseloolite Formation is intended by the NCS-Subcommission Paleogene-Neogene to define the stratigraphy in the Belgian part of the RVG, in a first part of the present LIS the Belgian practice is used as a basis for nomenclature and definitions.
- Because the hydrostratigraphic model elaborated in the H3O-project (Vernes et al., 2018) has led to a lithostratigraphic classification and definitions amending what is applied in the Belgian practice, these implications are discussed separately in a second part which is based on Dusar et al. (2014).

I. The traditional Belgian Neogene stratigraphy practice in the RVG (Van der Sluys, 2000; Sels et al., 2001; Vandenberghe et al., 2005; Louwye et al., 2020).

Characterizing description

The Kieseloolite Formation in Belgium is limited to the Belgian part of the Roer Valley Graben (Laga et al., 2001). The main lithology in the formation is a white quartz-enriched sand. The grain-size varies from fine to coarse, in particular in the lower part of the formation. The marked difference in log resistivities measured at different current penetration depths points to a permeable sand. The sand contains small lignitic fragments and ripped up clay clasts.

Lignite, clay and lignitic clay horizons varying in thickness from a few cm to 2 to 4 m in thickness occur in the sand. Subdivisions in the formation are based on the presence of some of the thicker lignite and clay beds which could be aquitards at least at local scale.

The subdivisions identified from bottom to top are: the Waubach sand, Brunssum II clay, Pey sand , Brunssum I clay and Schinveld/Jagersborg sand. Except for Jagersborg , these subdivisions and their nomenclature in the Belgian part of the RVG are based on the stratigraphy in the Dutch RVG published a.o. by Wong et al. (2007, fig. 13) as illustrated below (Figure 0-1):

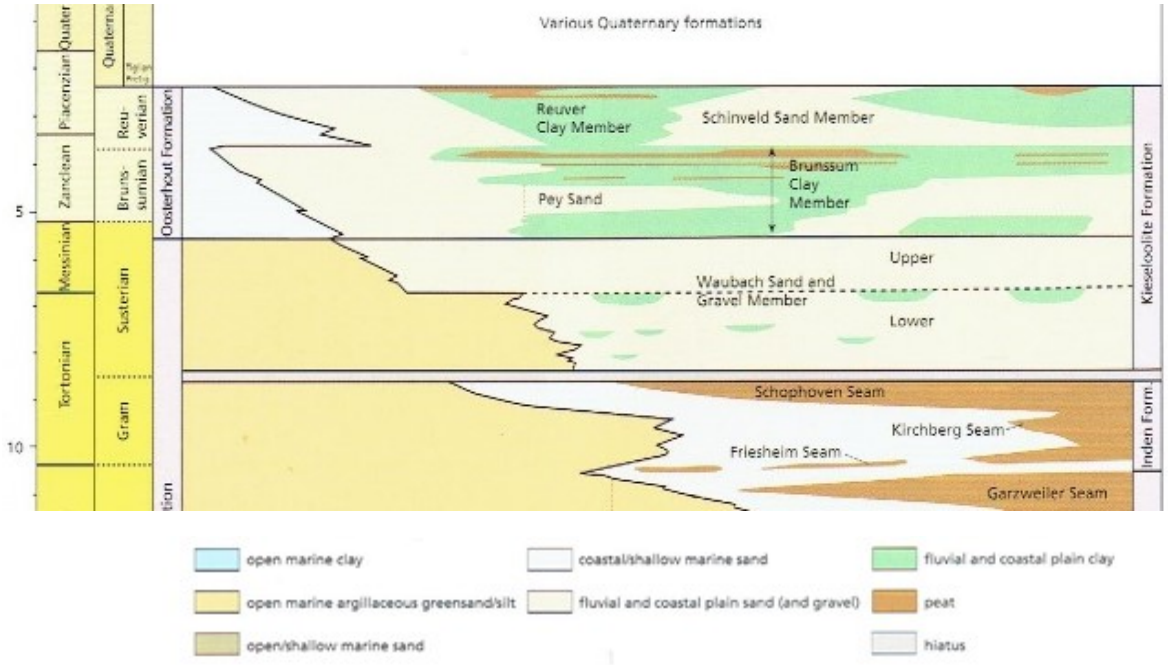

Figure 0-1: Stratigraphic scheme of the Kieseloolite Formation in the southern Netherlands from Wong et al., (2007), after Van Adrichem Boogaert & Kouwe (1997).

Type section, type locality, type borehole, or type geophysical borehole

The reference borehole for the Kieseloolite Formation in the Belgian Roer Valley Graben is the cored and geophysically logged Maaseik borehole (049W0220) between 22 and 166 m, studied by Vandenberghe et al. (2005) and revised by Louwye & Vandenberghe (2020).

It should be noted that the coarse sand below 166 m was originally considered as part of the Kieseloolite Formation but is now identified as the Inden Formation as discussed in Louwye & Vandenberghe (2020).

Description upper boundary

The upper boundary of the Kieseloolite Formation in the reference Maaseik borehole is marked by the appearance above it at 22 m depth of Pleistocene river gravels. At greater distance from the Meuse river, the upper boundary is marked by the appearance of the Sterksel Formation.

Description lower boundary

In the reference Maaseik borehole a sudden drop in the spontaneous potential signal and a marked short drop in resistivity signal at 164 m depth, are characterising the lower boundary. It probably corresponds to a thin level with lignite and clay fragments in otherwise coarse sand. This level marks the top of the underlying Inden Formation following the description by Menkovic & Westerhoff (2010) in the Dutch RVG.

Thickness

In the Maaseik borehole the thickness is 144 m. Van der Sluys (2000) reports a fairly constant thickness between 130 and 160 m of the Kieseloolite Formation including the now recognized Inden Formation (formerly also described as lower Waubach unit) but strongly varying thicknesses for its members (see also Vandenberghe et al., 2020, fig. 6).

Occurrence

By definition the Kieseloolite Formation in the Belgian RVG is limited to the RVG east of the Heerlerheide-Reppel boundary faults.

Regional correlations

a) age

The base of the Kieseloolite Formation is correlated with the Messinian Hauptkies Formation in the German Lower Rhine area (Louwye & Vandenberghe, 2020). The palynology in the reference borehole by Vanhoorne in Vandenberghe et al. (2005) suggests a late Pliocene age for the top of the formation although Praetiglian is not excluded. However the palynological stratigraphy needs to be used with caution (see Donders et al., 2007).

b) oolite occurrence

The name Kieseloolite Formation refers to the presence in the sand of small silicified oolite pebbles (Kieseloolite) as also found in the Neeroeteren sand, the Mol Formation and the Hukkelberg gravel. Some of these pebbles are even found as a lag deposit on the hill tops in a curve from Brugge to Kasterlee and are considered to mark a major Pliocene shoreline (Gullentops & Huyghebaert, 1999, p. 193). Similar oolitic pebble gravels also occur in the oldest river terrace along the Meuse between Namur and Huy (e.g., Rixhon & Demoulin, 2018).

c) correlation of the RVG Kieseloolite Formation with the Campine and Antwerp harbour area.

Unfortunately no sediment, mineral nor biostratigraphical data are available of the sediments below the Maat lignite in the eastern Campine area (west of the RVG) . Louwye & Vandenberghe (2020, fig.3) have discussed a possible chronostratigraphic correlation scheme of the lower part of the Kieseloolite Formation and the underlying Inden Formation in the Maaseik reference borehole for the Belgian RVG with the eastern Campine west of the Heerlerheide-Reppel boundary faults and with the Lower Rhine Basin (see Figure 0-2). This correlation assumes no major hiatuses in the RVG section – due to the very high subsidence rates in the tectonically active graben - and is based on limited heavy mineral data, on dinoflagellate cyst biostratigraphy and on palynology; the upper part of the Kieseloolite Formation, above the upper Brunssum complex has a palynology comparable to the Maat lignite in the eastern Campine while the palynology of the section above may grade into the Praetiglian (data by Vanhoorne in Vandenberghe et al. , 2005 p 13-14). It is possible that in the eastern Campine area (west of the RVG) hiatuses exist below the Mol Formation (see Vandenberghe and Louwye, 2020).

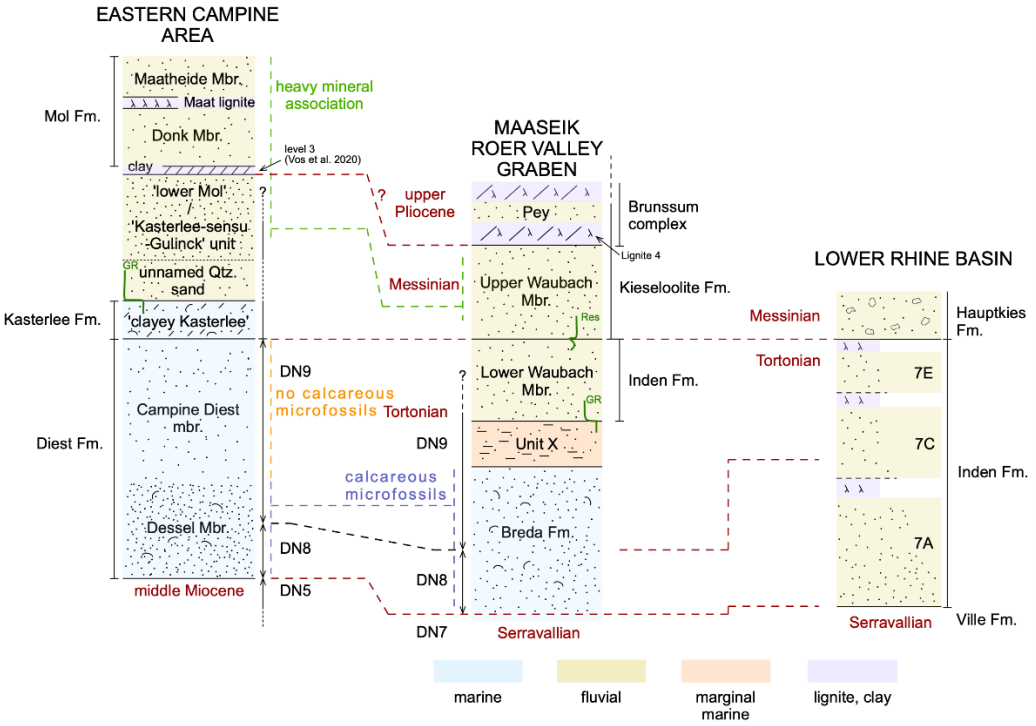

Figure 0-2 Stratigraphic position of the Kieseloolite Formation in the RVG with respect to the Eastern Campine area and the Lower Rhine Basin according to Louwye & Vandenberghe (2020)

II. Implications of the H3O-hydrogeological model for the Belgian lithostratigraphy in the RVG.

The Dutch stratigraphic practice has been the guiding principle in the hydrostratigraphic model elaborated in the H3O-project (Vernes et al. , 2018). This principle has led to the introduction in this report of subdivisions and nomenclature different from the Synthesis published by Louwye et al. (2020) in Belgian borehole descriptions and profiles (this LIS part I). These implications are discussed separately in this second part, based on Dusar et al. (2014) and Vernes et al. (2018).

Given below (

Figure 0-3) is an extract of the correlation table between the H3O geological and hydrogeological model units, the lithostratigraphic units in the Belgian part of the RVG discussed in part I above and in the Neogene-2020 volume, and the Flemish hydro-stratigraphic units (HCOV), presented as Table 1 in Dusar et al. (2014). In addition the Kieseloolite Formation is lithostratigraphically subdivided in two members (‘laagpakketten’), a lower Waubach Member, equivalent to the Waubach sand, encompassing the hydrostratigraphic unit KI-z-4 and beyond (only KI-z-4 in Maaseik borehole), and an upper Brunssum Member, equivalent to Jagersborg inf, Brunssum I clay, Pey sand, Brunssum II clay, encompassing the hydrostratigraphic units KI-k-1 to KI-k-3:

H3O Geologisch model	H3O Hydrogeologisch model	Vlaamse stratigrafische eenheid (formatie - lid)	Vlaamse hydrogeologische eenheid (HCOV kartering)			
		Zutendaal - Winterslag				
Sterksel	ST-z-1	Sterksel - Lommel			0171	Afzettingen Hoofdterras
	ST-k-1	Sterksel - Harmont				
	ST-z-2	Sterksel - Bocholt				
Stramproy	SY-z-1	Kiezeloöliet - Jagersborg sup.	0200	0210		
	SY-k-1					
	SY-z-2				0211	Zand boven Brunssum I-klei
	SY-k-2					
	SY-z-3					
	SY-k-3					
	SY-z-4					
Kiezeloöliet	KI-z-1	Kiezeloöliet - Jagersborg inf.		0210		
	KI-k-1					
	KI-z-2					
	KI-k-2	Kiezeloöliet - Brunssum I			0212	Brunssum I-klei
	KI-z-3	Kiezeloöliet - Pey			0213	Zand van Pey
	KI-k-3	Kiezeloöliet - Brunssum II			0214	Brunssum II-klei
	KI-z-4	Kiezeloöliet - Waubach			0215	Zand van Waubach
	KI-k-4					
	KI-z-5					
Inden	IE-z-1	Inden (+ herwerkt Breda)		0210/0230	0234/0215	Zand van Poederlee en/of top Kasterlee of Zand van Waubach
	IE-k-1					
	IE-z-2					
	IE-k-2					
	IE-z-3					

Figure 0-3: Comparison of the RVG lithostratigraphic and hydrostratigraphic nomenclatures in use in Flanders and used in the H30 reporting (Dusar et al., 2014).

1. On the presence of the Stramproy Formation and the disuse of Jagersborg/Schinveld sand unit.

   The Jagersborg Sand unit as used in Belgium is split up (inf. and sup.) and the upper part included in the Stramproy Formation (TNO-GSN 2021). The Stramproy Formation is consequently used in a more broader sense than in the Belgian practice and also previously in the Netherlands. In Belgian practice, the very low GR values are the determining characteristic of the Stramproy Sand (see e.g. Fig. 10 in Vandenberghe et al., 2005). In the hydrostratigraphic H3O-project practice a more clayey interval is included near the base of the Stramproy Formation. Although not yet formally defined on the NCS website , the Belgian practice considers the Stramproy Formation as a Pleistocene unit and hence it was not discussed in the Neogene stratigraphic nomenclature reviews.
   The lower part of the Jagersborg unit is included in the Kieseloolite Formation and the Jagersborg unit is no longer used in the H3O stratigraphy. Schinveld sand, considered equivalent with Jagersborg sand in Belgium, is also taken out of the Dutch DINOloket database.

2. The identification of additional clay layers and the labelling of the clay beds illustrated by the H3O interpretation of the Maaseik (049W0220) and Bocholt (033W0153) boreholes.

In the hydrogeological model a leading principle is the identification of aquitard clay layers between porous sand layers.
In the interpretation of the Maaseik (049W0220) borehole in the H3O project report, a separate clay unit around 50 m is individualised and labelled SY-k-3 as part of the Stramproy Formation (Sy). In the interpretation by Vandenberghe et al. (2005) and discussed above this interval was not individualised and it was included in the Jagersborg sand (see further in Stramproy unit). The same clay level is interpreted in the H3O report to occur between about 91 and 101 m in the Bocholt (033W0153) borehole described by Van der Sluys (2000).

The Brunssum I (upper) and II (lower) clay units (see LIS Brunssum beds) identified in the Belgian practice as discussed above are labelled respectively Kl-k-2 and Kl-k-3 (Kl for Kieseloolite) in the H3O hydrogeological model.
Besides the Brunssum I (upper) and II (lower) clay units (see Brunssum beds), in the hydrogeological model an additional clay unit labelled Kl-k-1 is identified closely above the Brunssum I = Kl-k-2. In the Maaseik (049W0220) borehole it occurs at a level with thinner clay layers and a lignite bed (lignite 2 in the section described in Vandenberghe et al., 2005) between 63,2 and 73,6 m. However, this unit should not be present everywhere nor possess aquitard properties. In the Bocholt (033W0153) borehole this clay layer is not present; it is suggested in the H3O-project report that is eroded by the overlying sand unit.
Van der Sluys (2000), with the information available at that time, interpreted the sand above the upper Brunssum I clay unit in this Bocholt borehole as Kedichem Formation or a sand unit transitional to the Kieseloolite Formation.

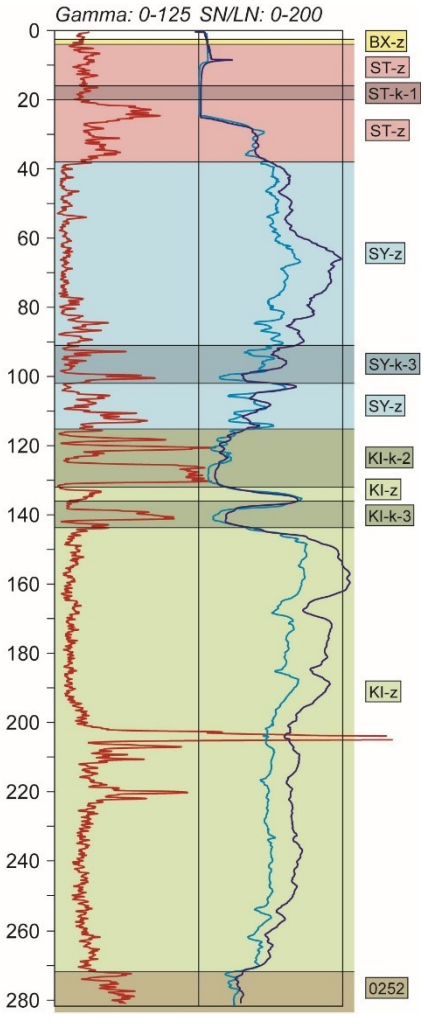

Figure 0-4: H3O interpretation of the Bocholt-Sluis (033W0153) borehole (courtesy Jan Walstra, Geological Survey of Belgium) to be compared with the interpretation given in Van der Sluys (2000). In the above figure the interpreted Stramproy Formation is coloured blue; the grey blue interval is the clay layer SY-k-3 between 91 and 101 m. The yellowish colour is the Kieseloolite Formation; the two upper dark yellow layers are the Kl-k-1 and Kl-k-2 (= Brunssum I). Note the small thickness of Kl-kz bed between the two Brunssum clay beds (Kl-k-2 en Kl-k-3) in the Maaseik borehole in Figure 5. The original interpretation by Van der Sluys (2000) : 2,5 -38,5 m Sterksel Fm-Lommel Sand , 38,5-115 m Kedichem Fm. The top of the Kieseloolite Fm is 115 m en Brunssum I Bed is between 115 and 133 m; Pey Sand 133-137,7 m ; Brunssum II bed 137,7-143,7 m. Below 143,7 -272 m is interpreted as Waubach Sand

and deeper below occurs the Breda Fm. Van der Sluys (2000) also reports in Brunssum I clay the occurrence of moderately cold palynology comparable to Campine and Tegelen clay while in Brunssum II clay a palynology occurs comparable to Mol and Merkspslas deposits.

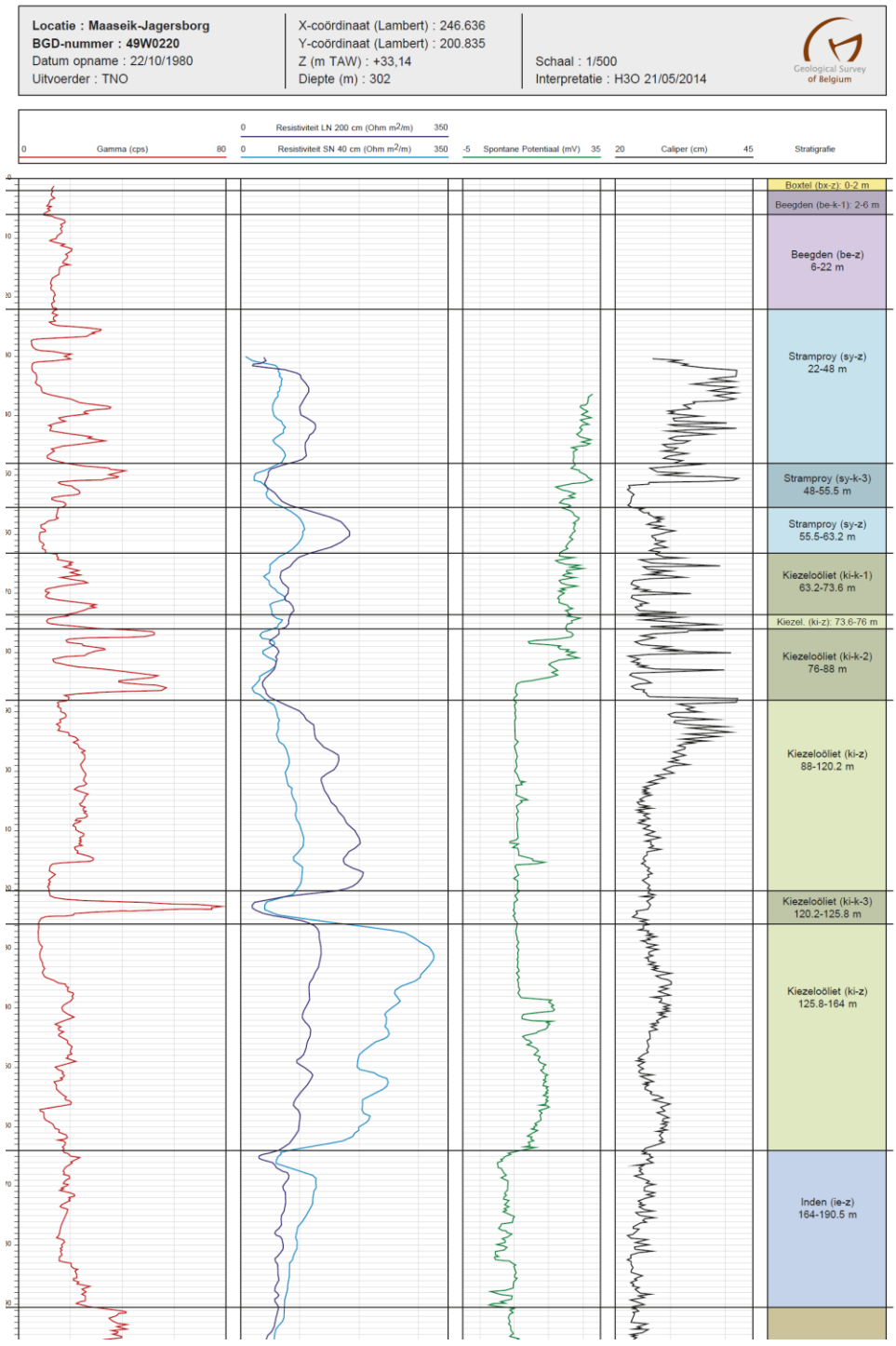

Figure 0-5: H3O interpretation of the Maaseik (049W0220) borehole to be compared with the interpretation in Vandenberghe et al. (2005) and discussed above in I (from Vernes et al., 2018, annex D fig.7.3).

3. Definition of the Kieseloolite Formation

In the hydrogeological model, the base of the Stramproy Formation defines the top of the Kieseloolite Formation. This base of the Stramproy Formation is defined at the point where the high RES value of the basal sand layer in the Stramproy unit sharply drops to marked lower values pointing to more clay in the underlying sediment. This top clayey unit in the Kieseloolite Formation is the newly introduced clay level Kl-k-1 in the Maaseik (049W0220) borehole or the upper Brunssum =Kl-k-2 clay level in the Bocholt (033W0153) borehole.

This implies that the Stramproy Formation includes the sandy part of the former Jagersborg unit (TNO-GSN DINOloket Stramproy, 2021) (Jagersborg sup in Dusar et al., 2018, Tabel 1) while the clayey basal part of the latter (Jagersborg inf in Dusar et al., 2014, Tabel 1) is now included in the top of the Kieseloolite Formation (Dusar et al. ,2014; Vernes et al., 2018, annex D fig.7.3).

4. Disused names

Schinveld and Jagersborg sand units are not defined in the Dutch DINOloket database.

The terminology Brunssum I and Brunssum II clays, Pey sand and Waubach sand is not formally used in the figures of appendix D in H3O report and these intervals are coded as Kl-z sand units in the hydrostratigraphic model. Pey Sand is labelled Kl-z-3 and Waubach Sand is labelled Kl-k-4 in Dusar et al. (2014, Tabel 1). However, the names Waubach and Brunssum are retained as members of the Kieseloolite Formation in the Dutch stratigraphy.

See also note on the

Age

Detailed chronostratigraphy of the Kieseloolite Formation is poorly documented. The age of the lowest lithostratigraphic unit of the Kieseloolite Formation, the Waubach Member, is latest Miocene while the Brunssum and Jagersborg members probably are continuously formed during the Pliocene. The transition to the Pleistocene is uncertain. The introduction of an alternative lithostratigraphic subdivision including the Stramproy Formation above the Kieseloolite Formation places the Kieseloolite definitely in the Pliocene and the Stramproy Formation in the early Pleistocene - Middle Pleistocene (Tiglian - early Cromerian) (TNO-GDN (2022)

Dataset

Data in the LIS are part of the DOV-Neogene data collection, including links to the GSB-collection data sheets

Name	GSB name	DOV name	GSB Collections URL	DOV URL
Maaseik borehole	049W0220	kb18d49w-B220	https://collections.naturalsciences.be/ssh-geology-archives/arch/049w/049w0220.txt	https://www.dov.vlaanderen.be/data/boring/1980-025921
Bocholt borehole	033W0153	B/7-0356	https://collections.naturalsciences.be/ssh-geology-archives/arch/033w/033w0153.txt	https://www.dov.vlaanderen.be/data/boring/1995-025169

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