

# La géologie des argiles de Boom et d'Ypres

Roches hôtes étudiées en Belgique pour le stockage géologique

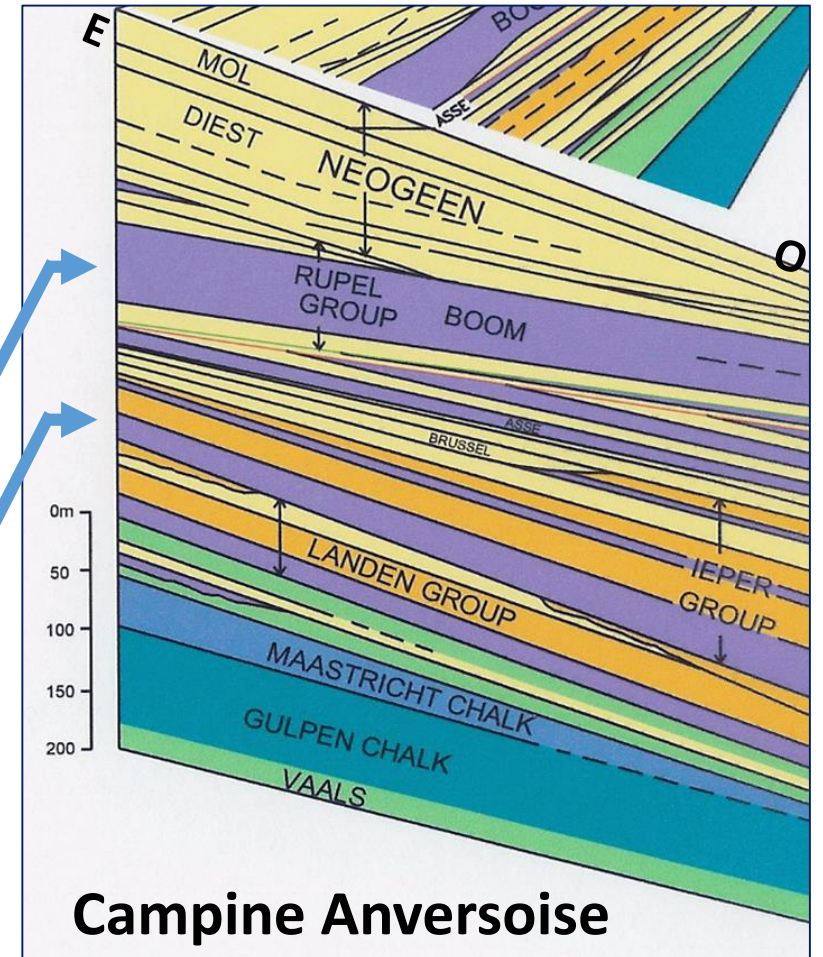
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Laurent Wouters , Hervé Van Baelen

KU Leuven  
ONDRAF-NIRAS

- isoler de la biosphère (**volume, profondeur, étanchéité...**)
- durée de 1 Ma (**dynamique géo- & hydrogéologique....**)

**Possible en Belgique ?**

option d'étudier une argile 'épaisse et étanche', l' **Argile de Boom** et dans une deuxième phase l' **Argile d'Ypres**.



# Les argiles de Boom et d'Ypres dans le contexte international des roches argileuses

## **La Belgique suivie par plusieurs autres pays**

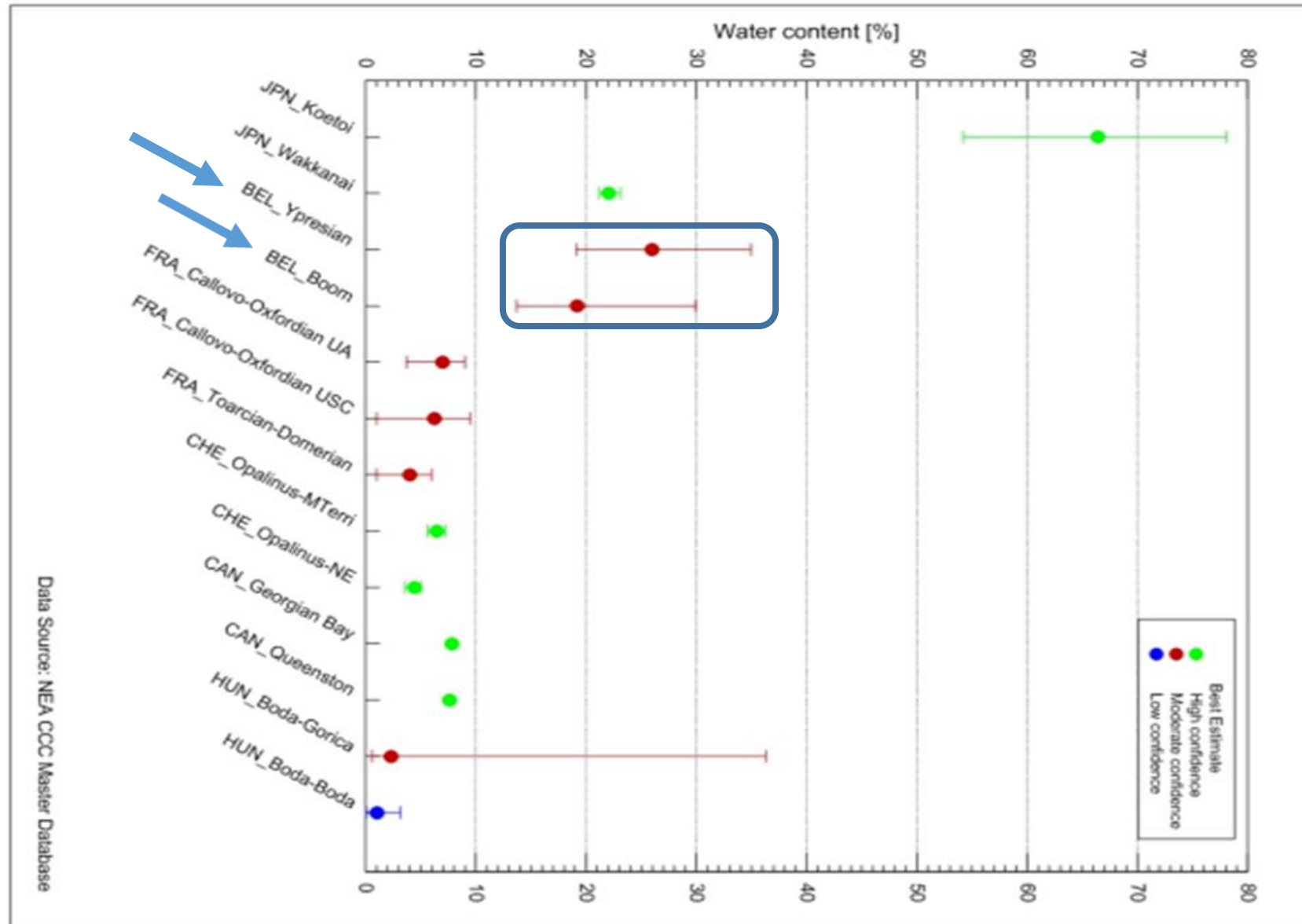
En OCDE: Belgique, Canada, France, Hongrie, Japon, Suisse  
**9 sites et 10 formations géologiques**

## **Paramètres de caractérisation :**

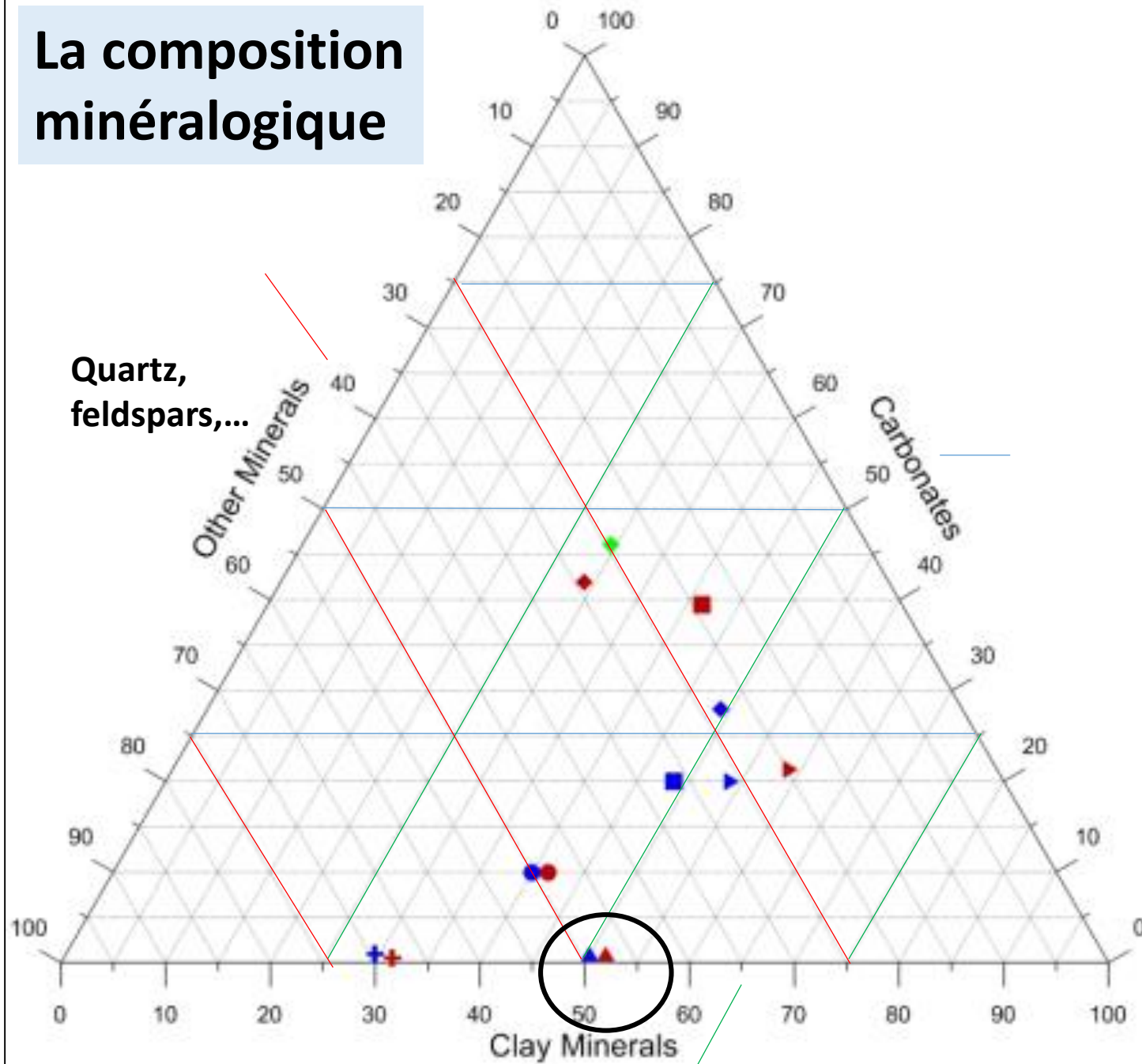
*géologie, minéralogie, chimie colloïdale et chimie des eaux interstitielles, pétrophysique, conductivité hydraulique, diffusion chimique, géomecanique*

*Paramètres de base: **composition minéralogique et**  
**teneur en eau***

# La teneur en eau



# La composition minéralogique

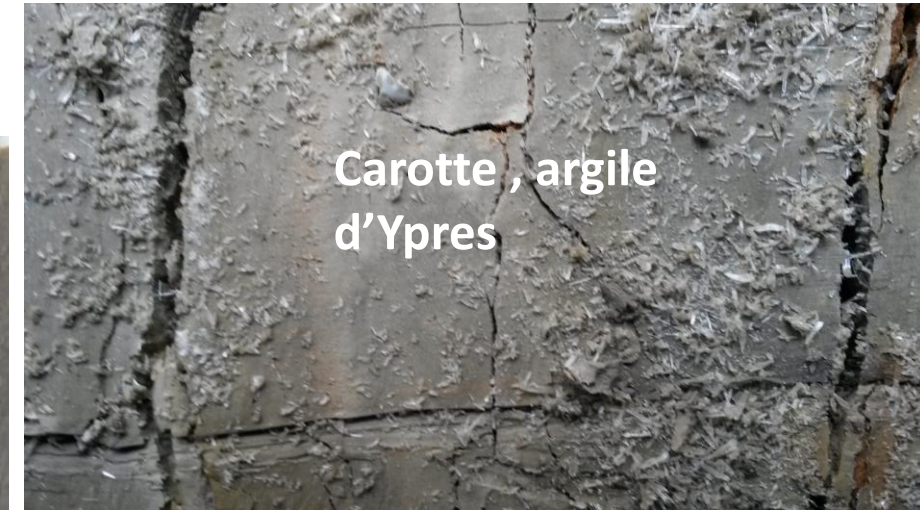
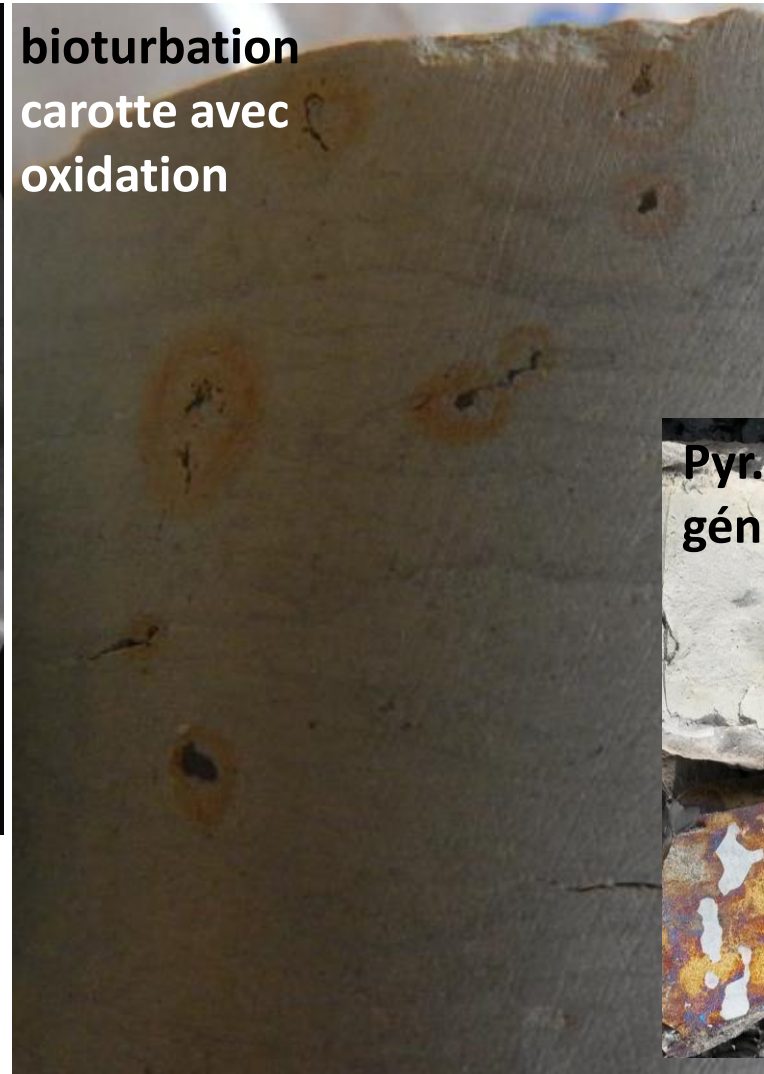


Clay Club Catalogue of  
Characteristics of Argillaceous  
Rocks, 2017 OECD, NEA

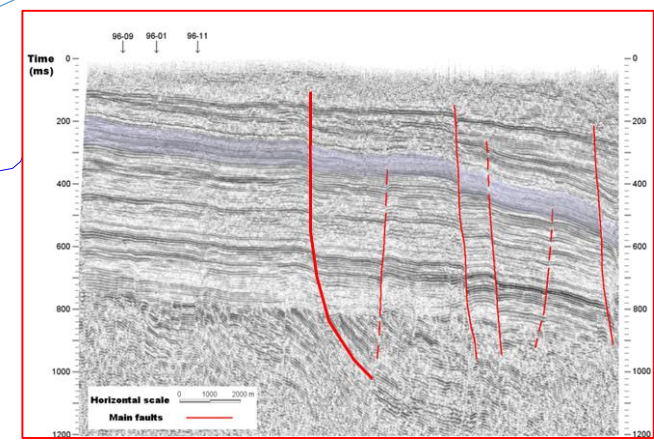
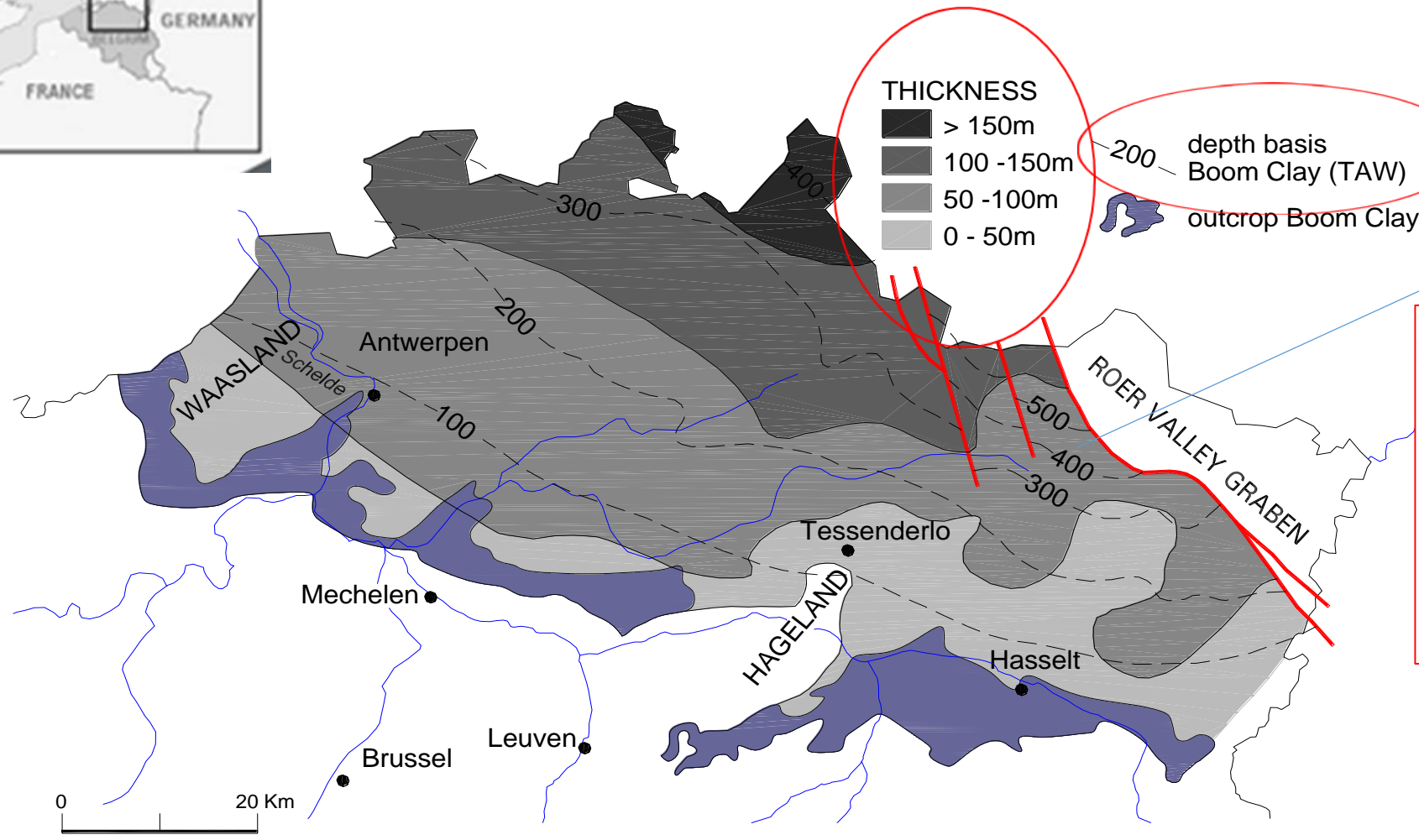


...en faible quantité ...: pyrite  $\text{FeS}_2$

**oxidation**

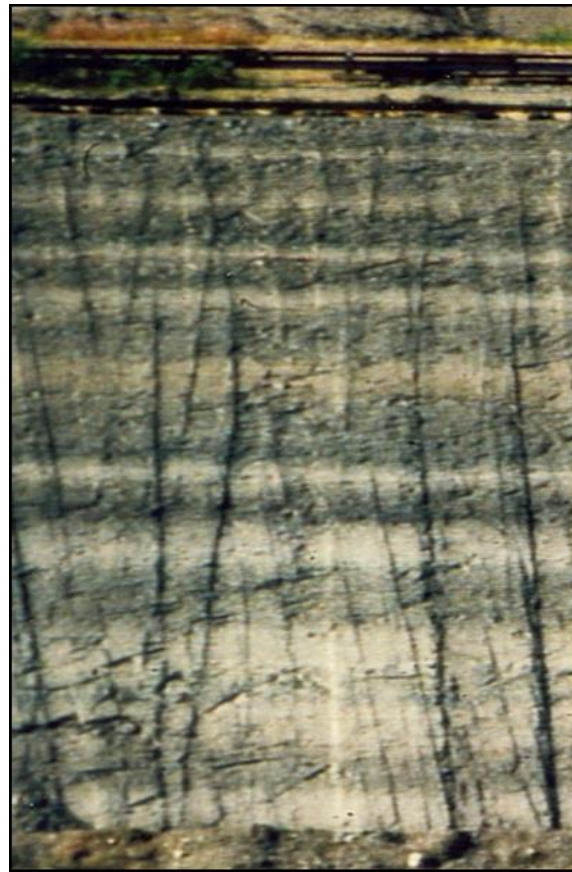
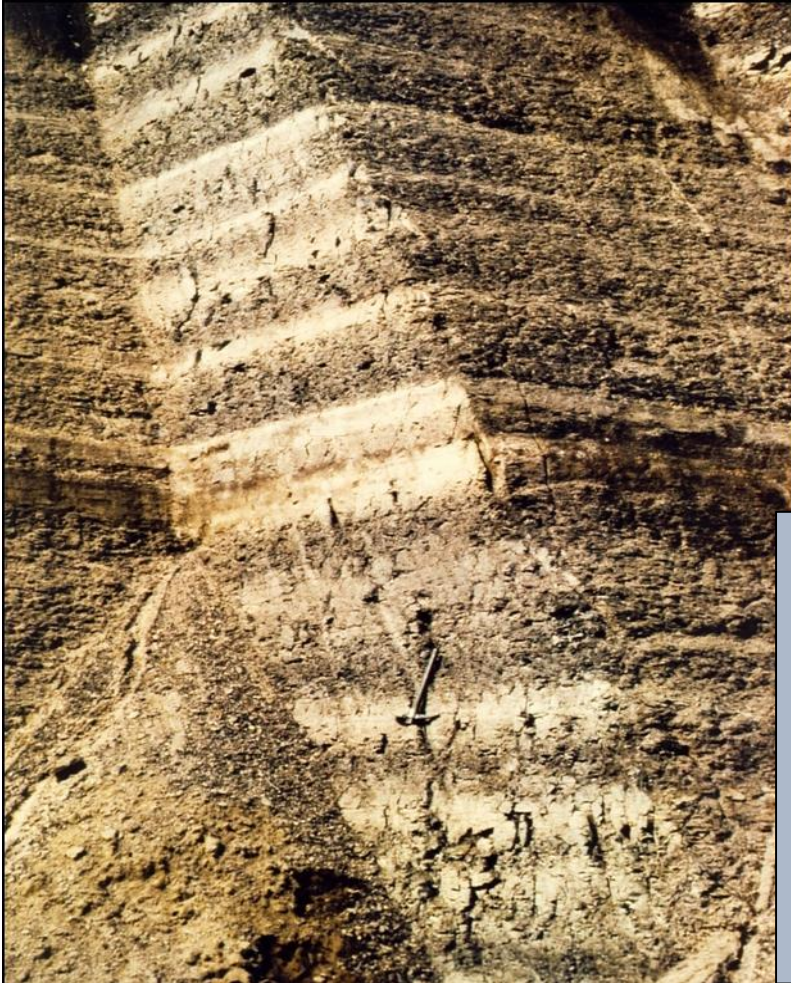


# ARGILE DE BOOM Géométrie

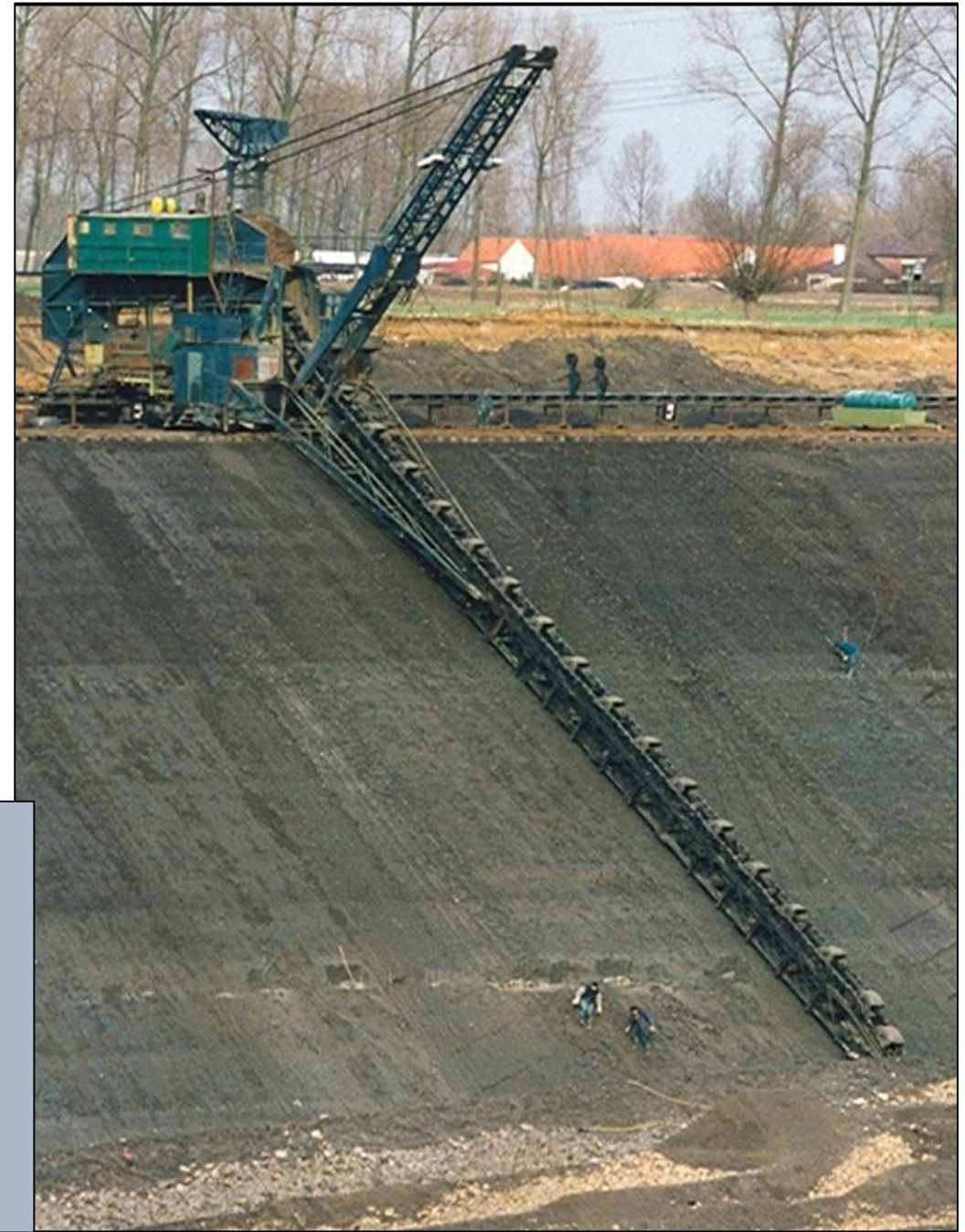




# Variabilité lithologique verticale

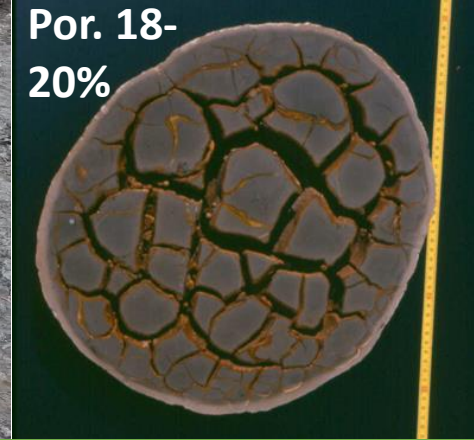


- Rapport Fractions Silt/Argile
- Matière Organique
- Carbonates/Septaria



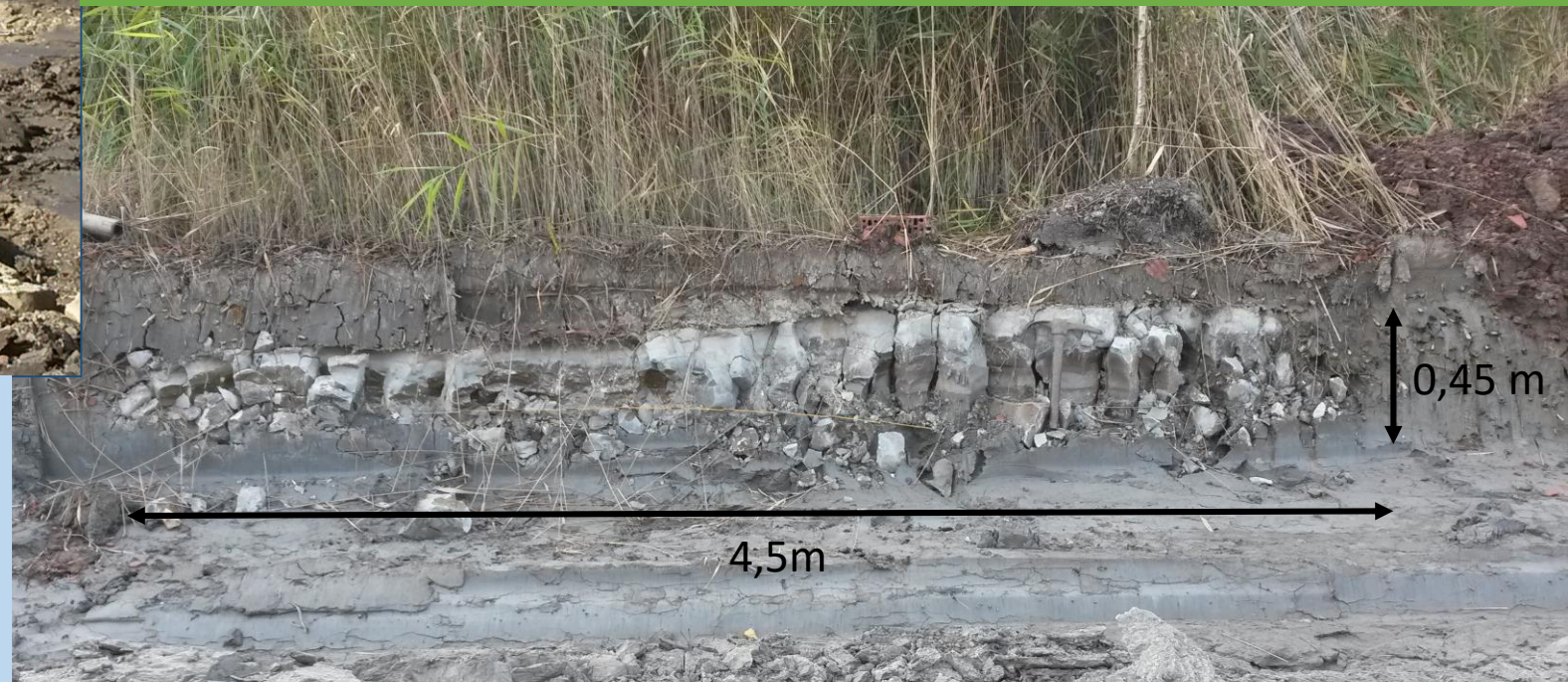


septaria discontinus en couche horizontale  
Couverture 10%



SEPTARIA SEPTARIA SEPTARIA SEPTARIA SEPTARIA SEPTARIA

Couches à concrétions carbonatées dures : - techniques d'excavation ...  
- peuvent contenir de l'eau ..

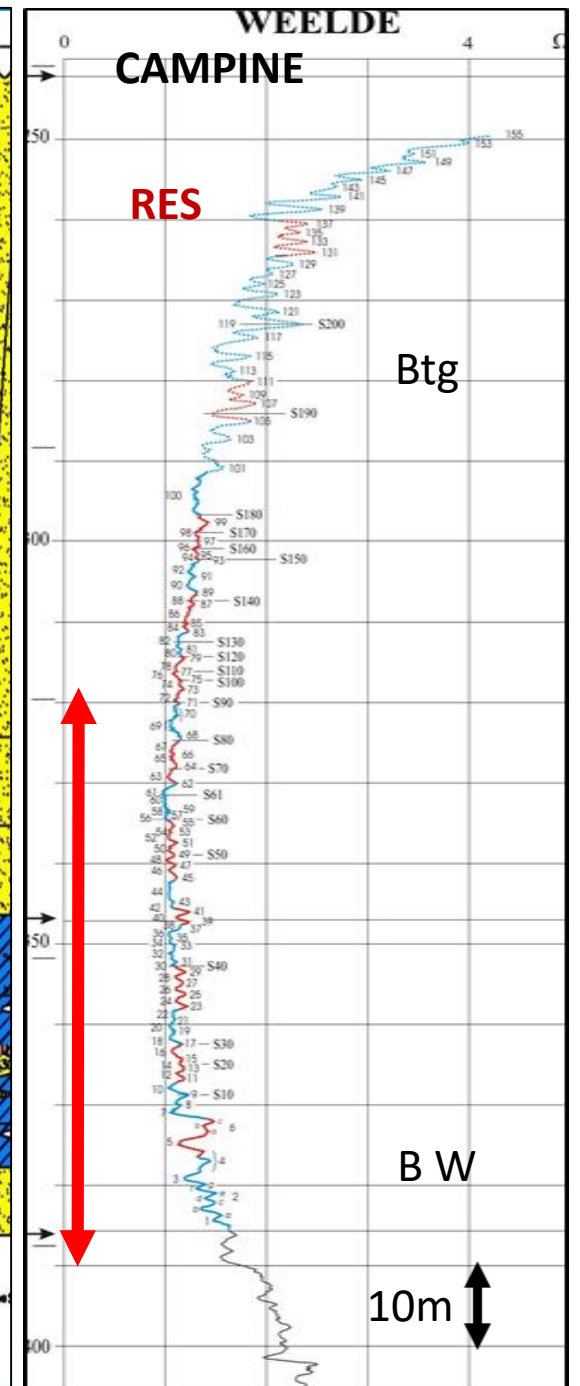
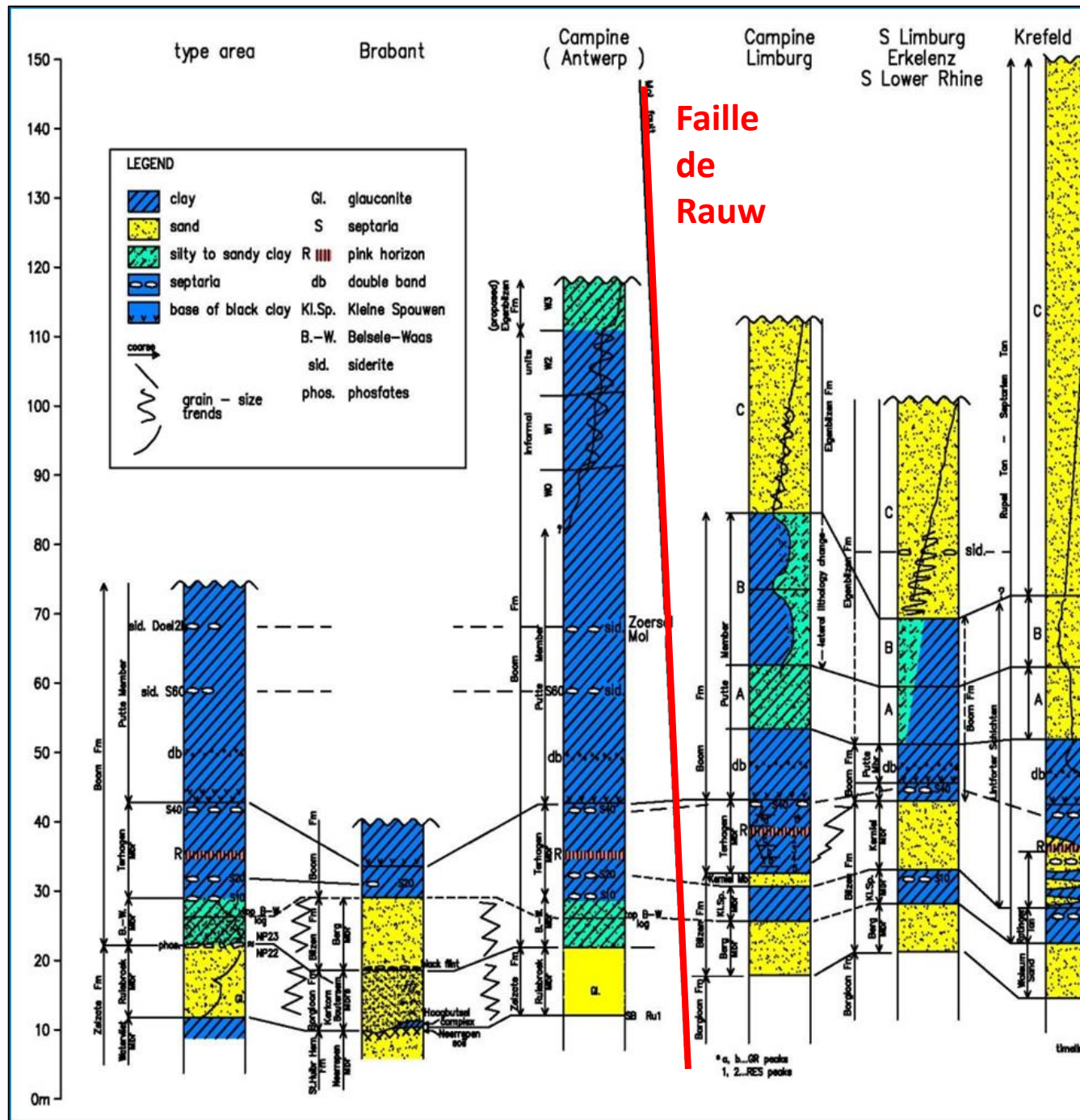




# Variabilité latérale:

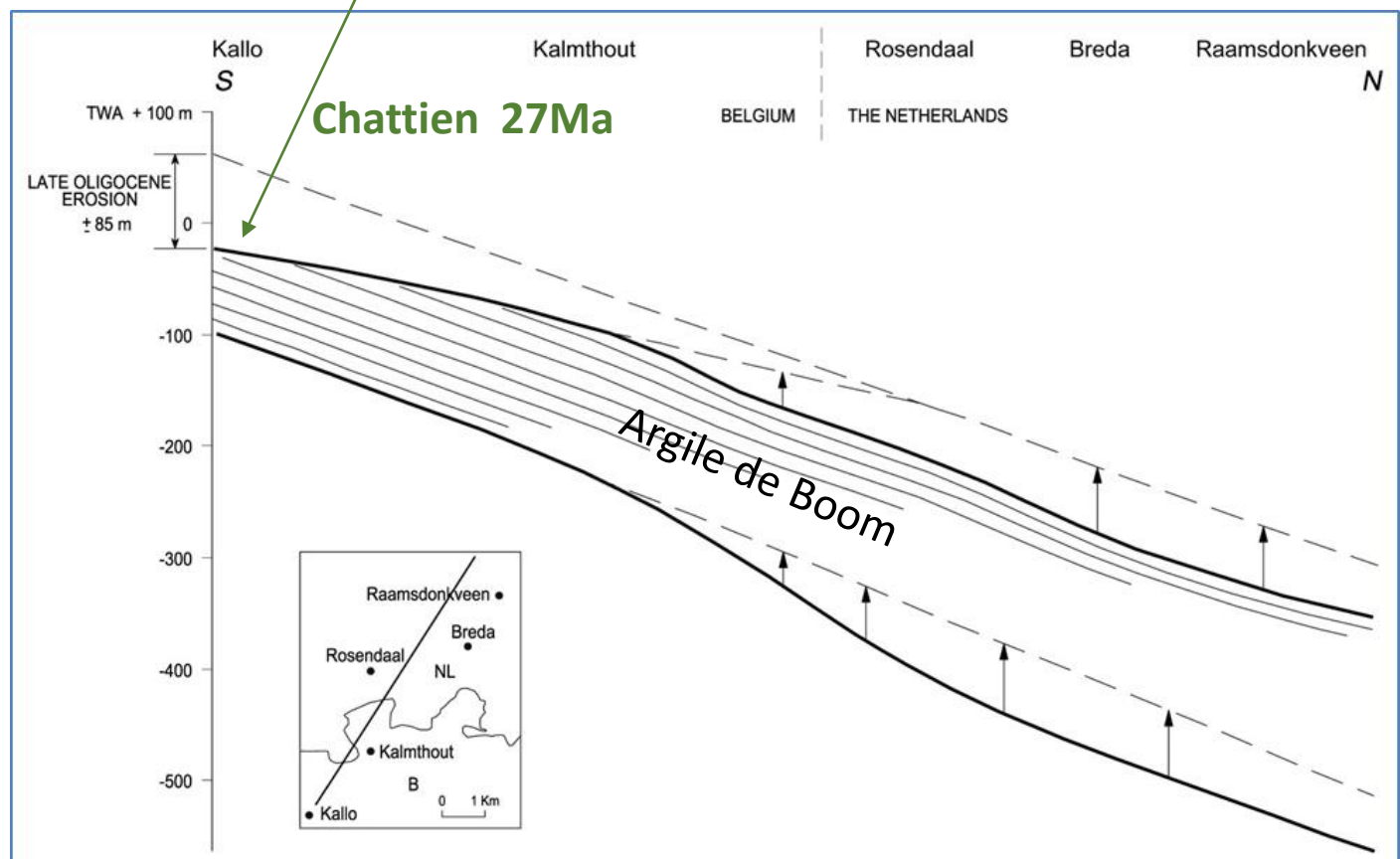
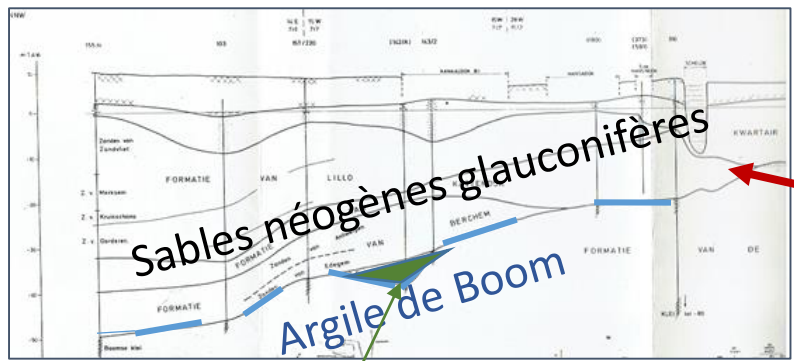
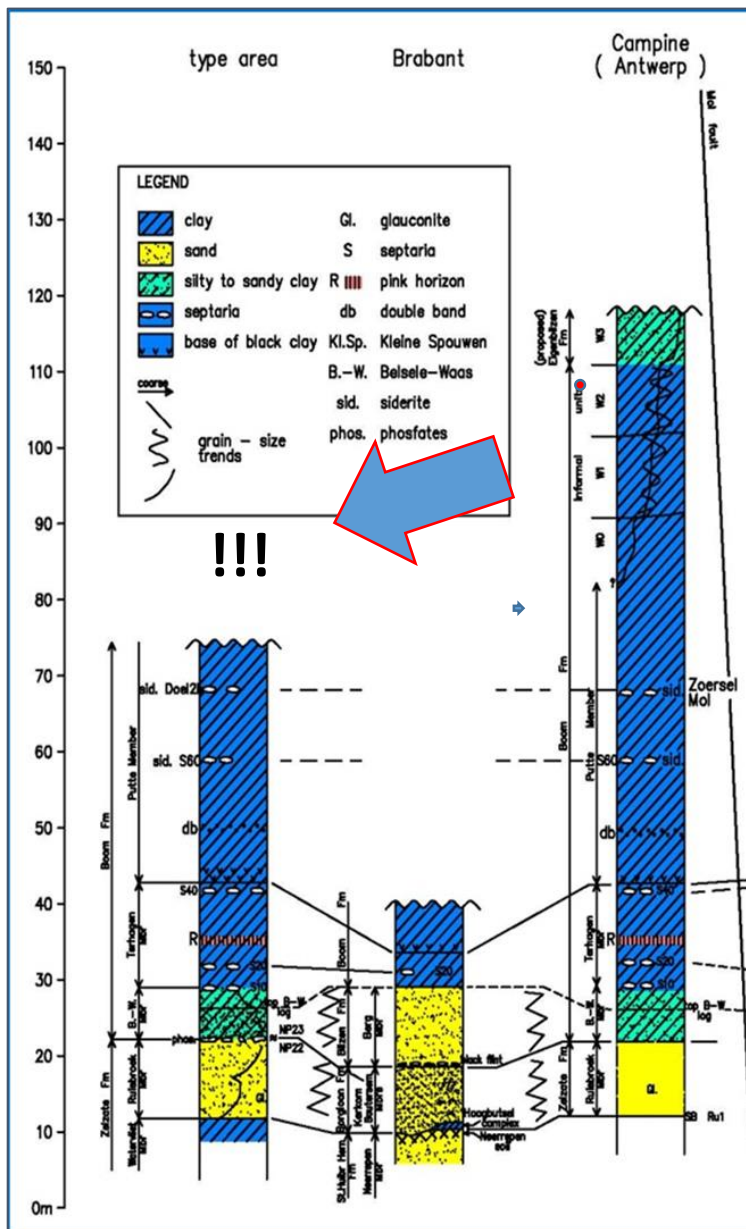
*Campine Limbourgoise*, plus de silt et sable fin dans la partie supérieure

*Campine Anversoise*, continuité couche par couche, épaisseur .....



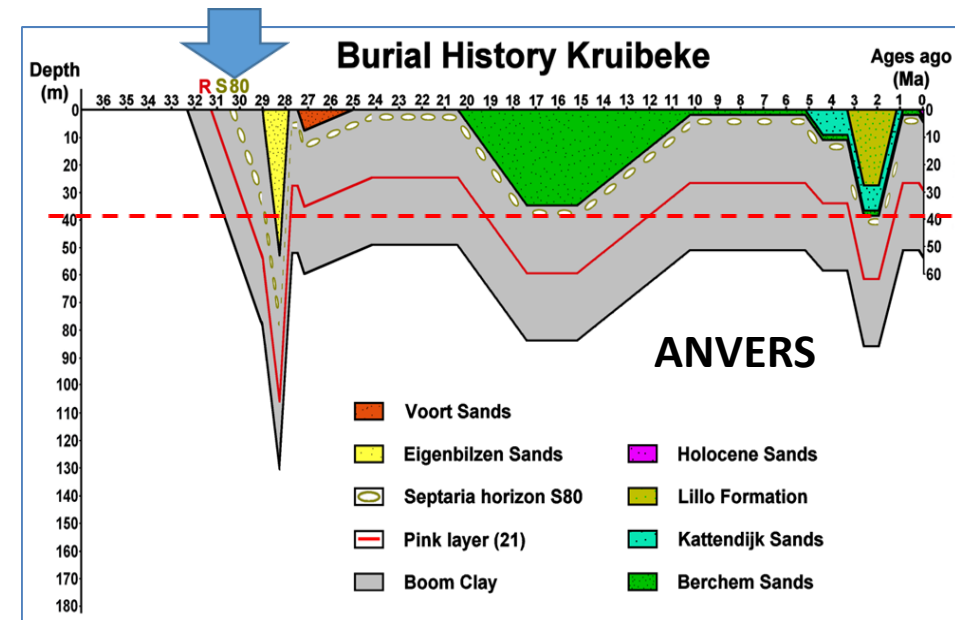
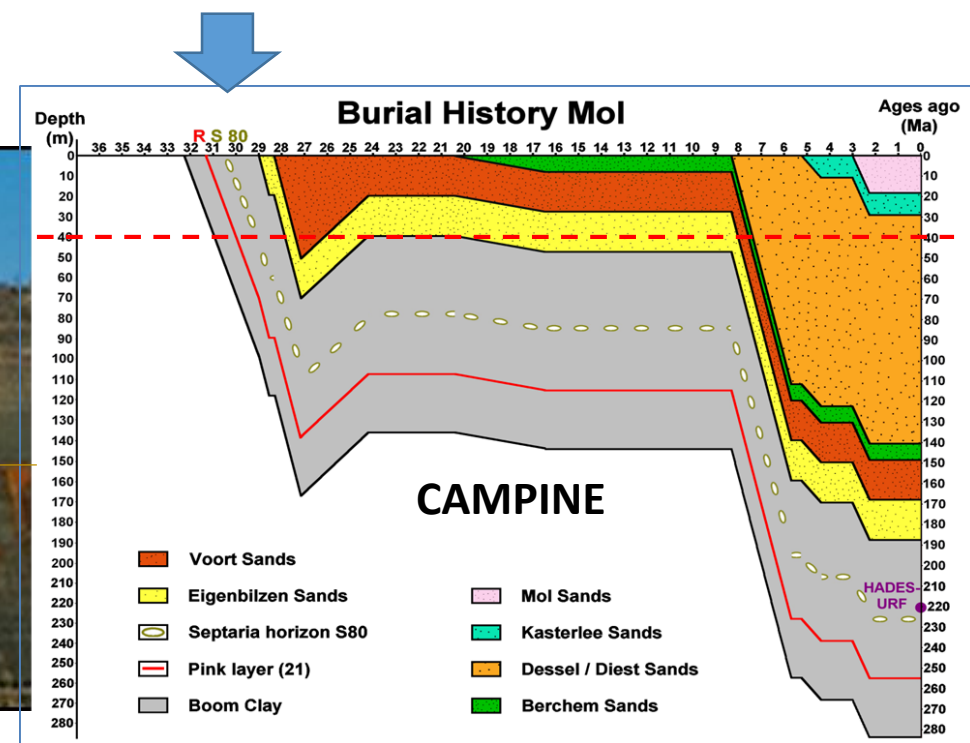
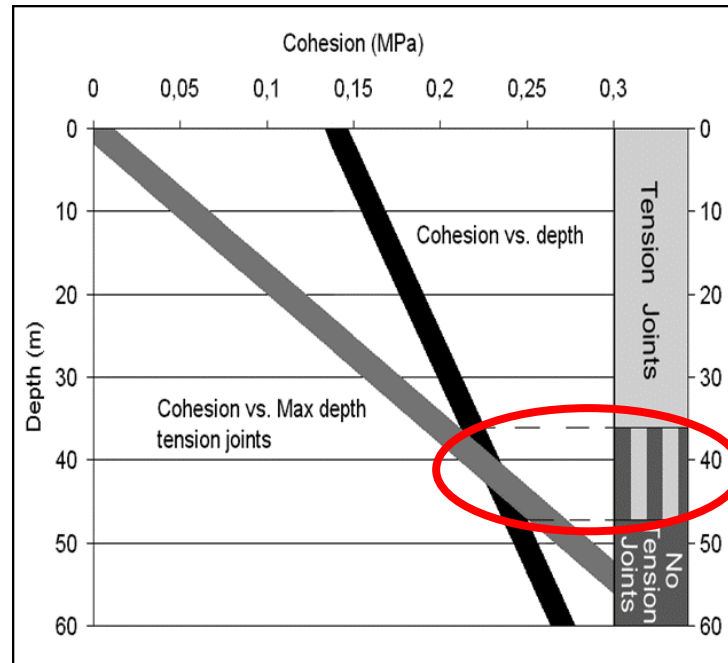
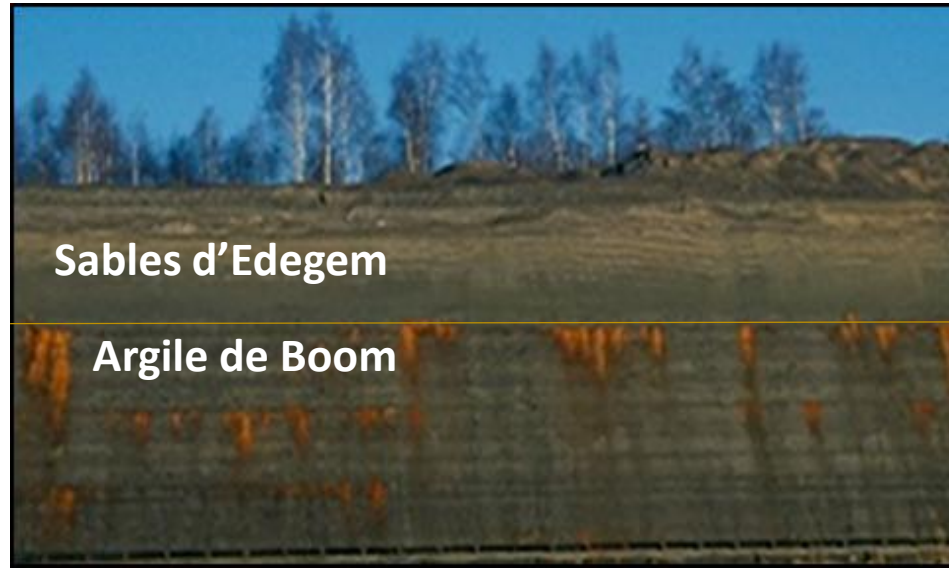
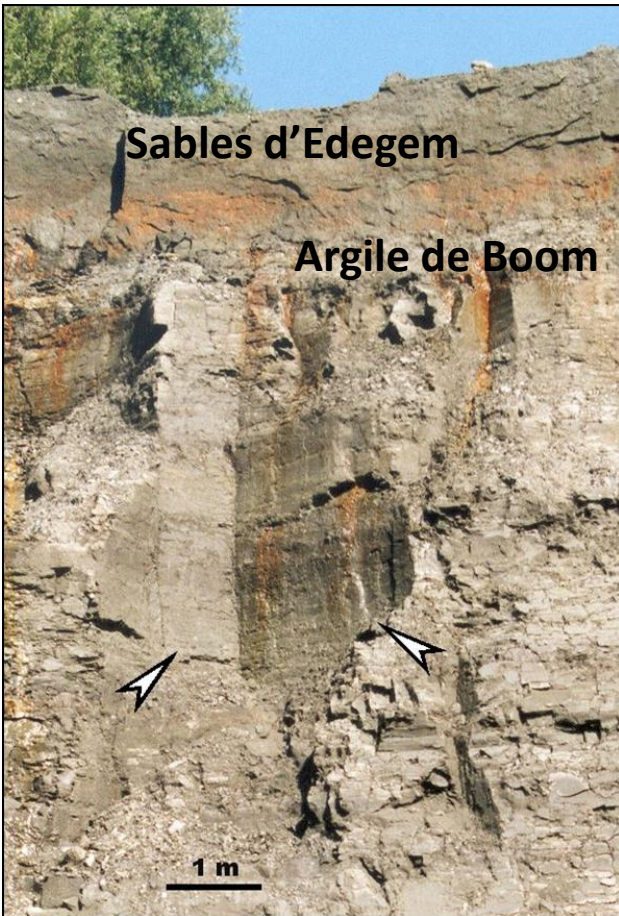


# Différence en épaisseur Anvers – Mol tectonique à la fin du Rupélien





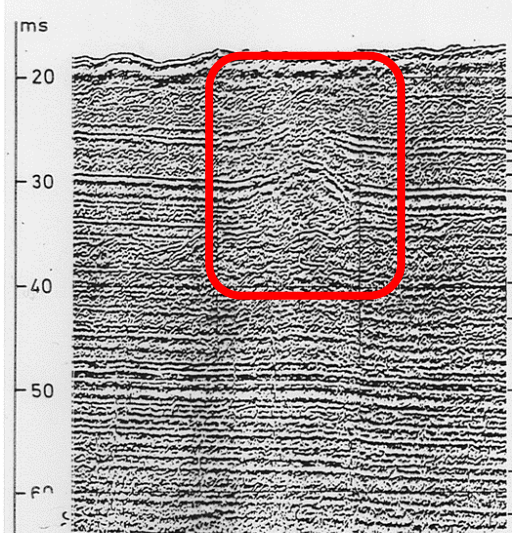
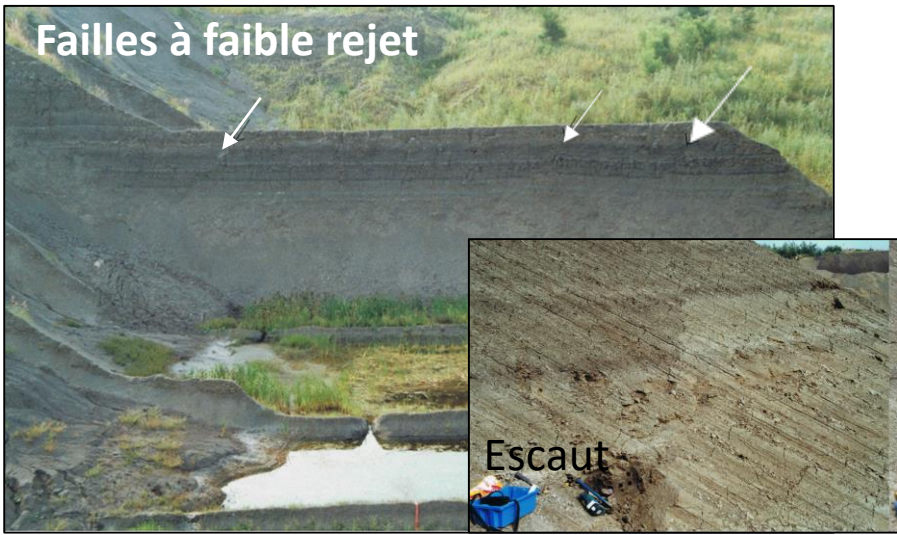
# JOINTS type diaclasses





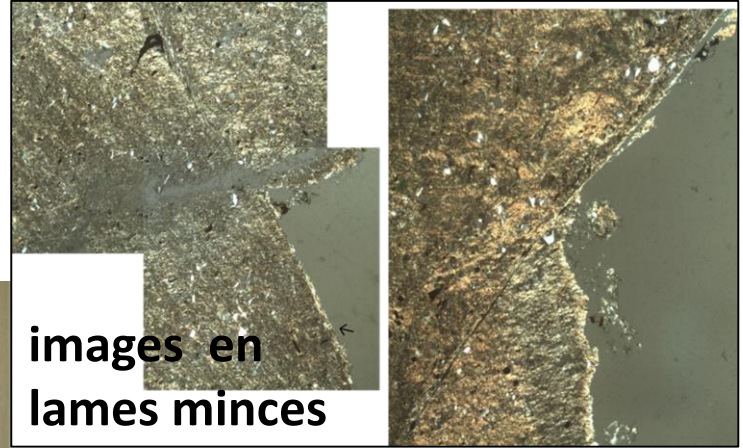
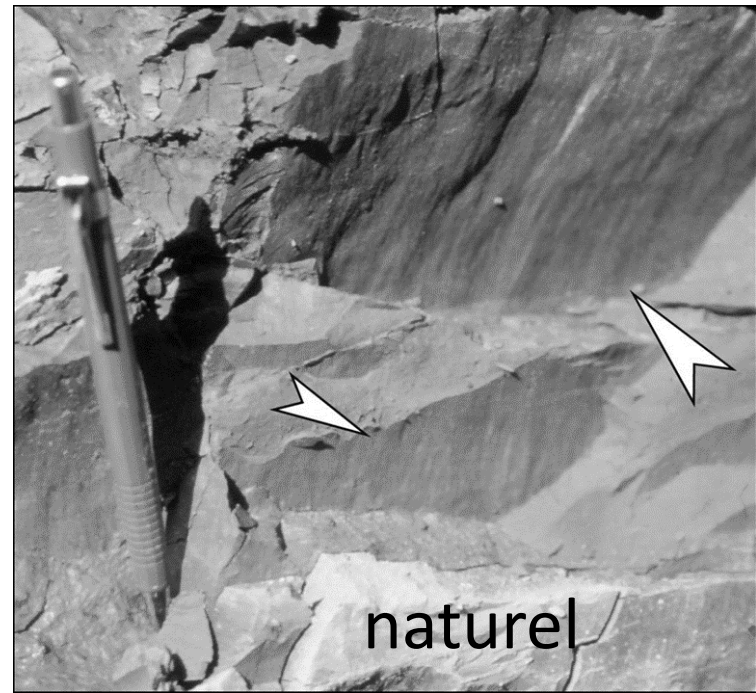
# Discontinuités

## Argile de Boom



**Diapirisme dans L'Escaut (valley bulging)**

## Slickensided surfaces



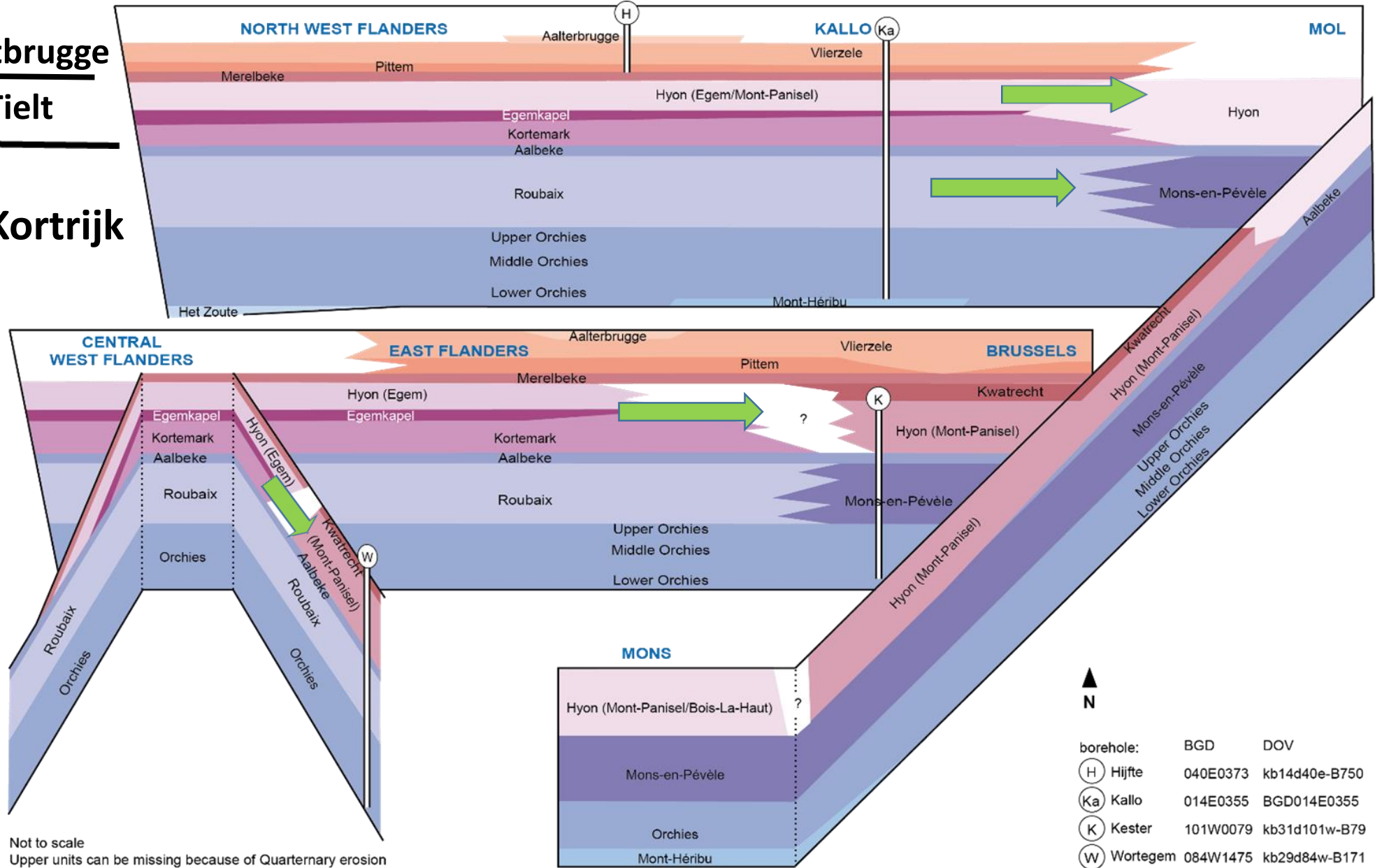


leper  
*Les*  
*argiles*  
*d'Ypres*

Gentbrugge

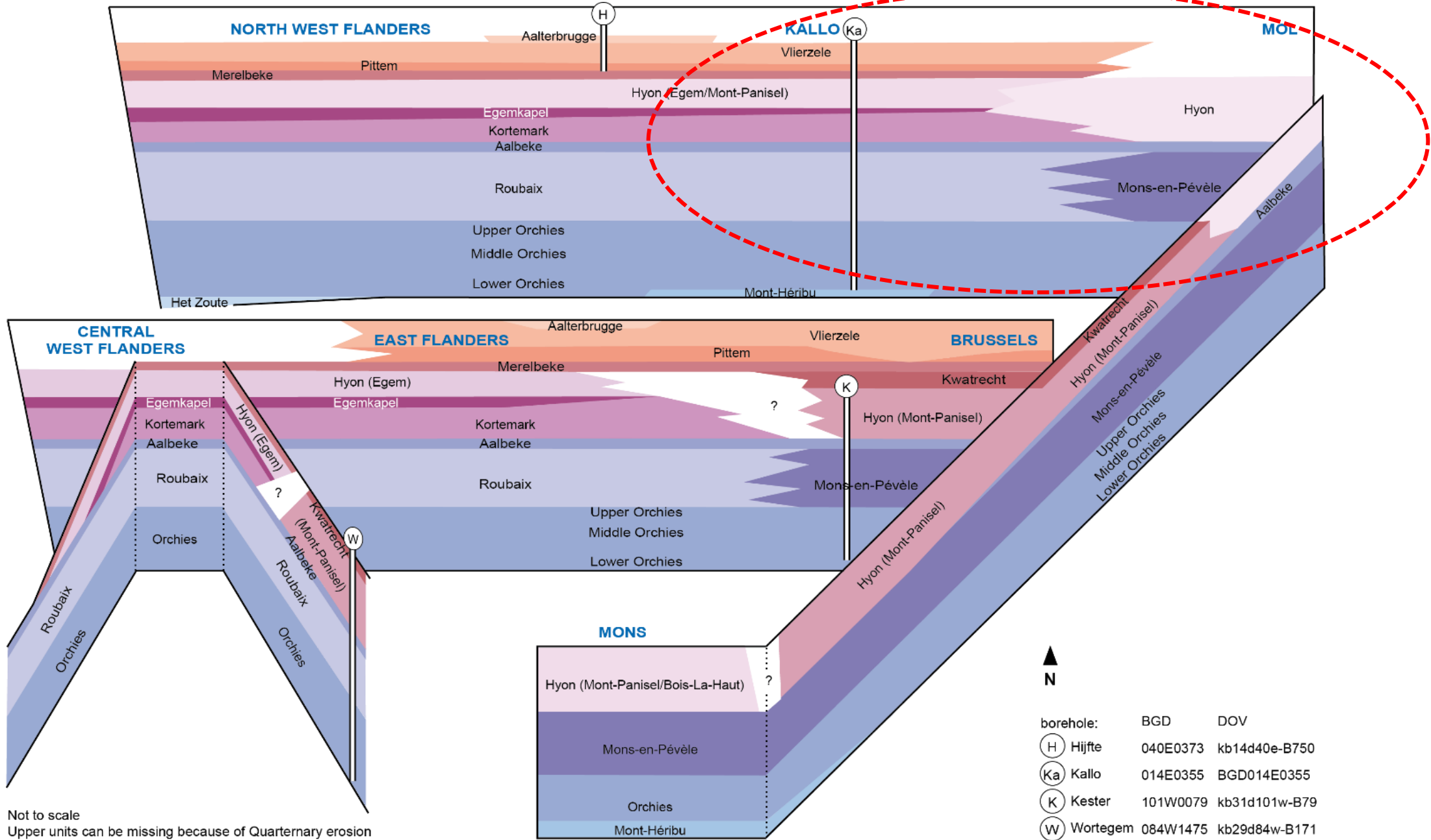
Tielt

Kortrijk



Reference: ncs website <https://ncs.naturalsciences.be>

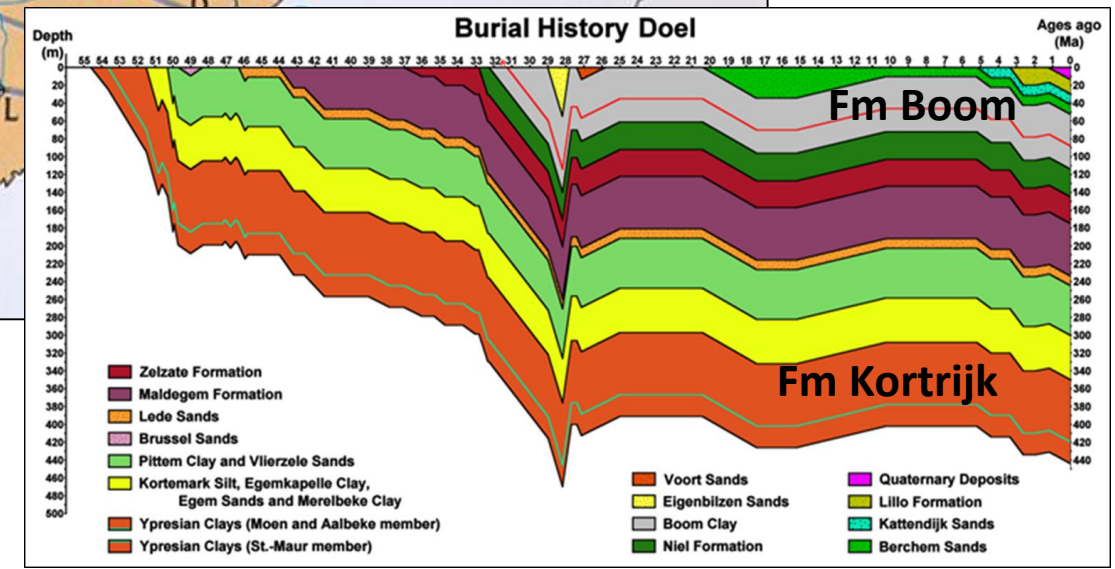
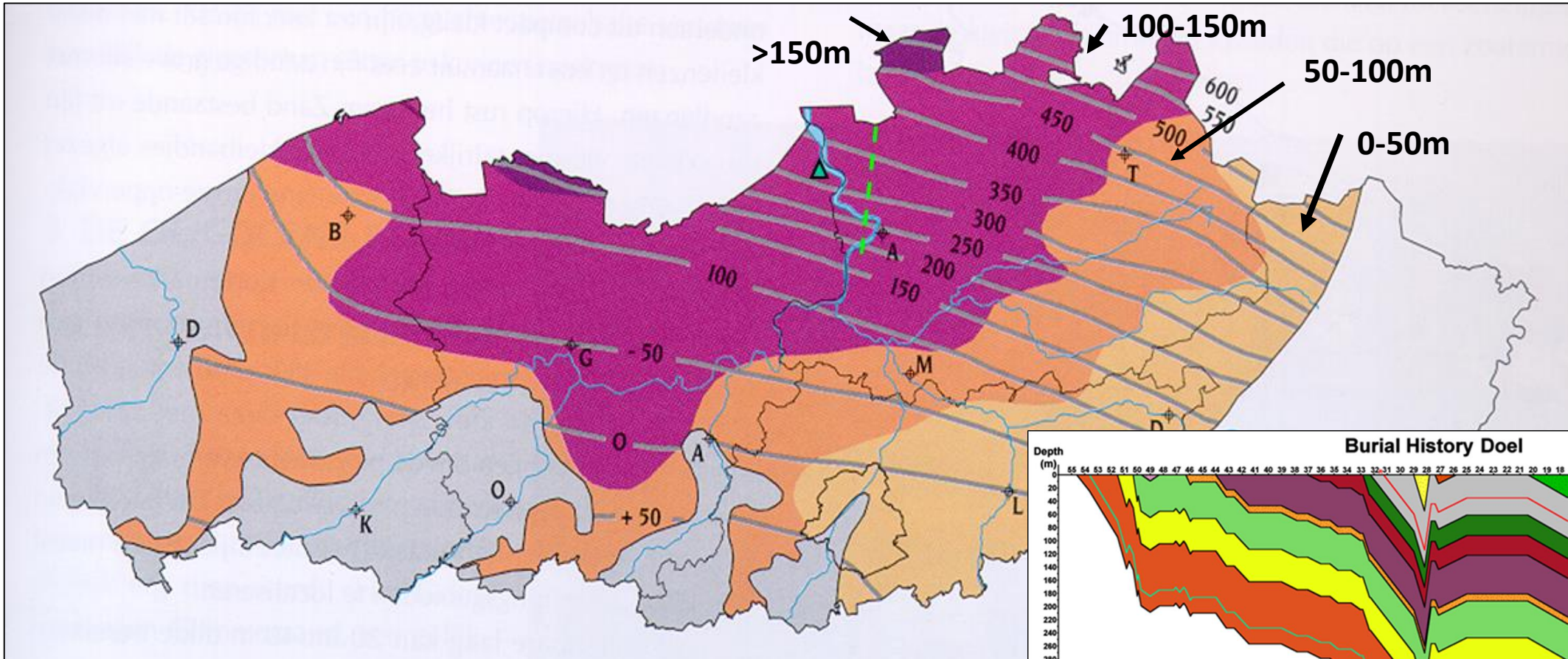




Not to scale  
Upper units can be missing because of Quarternary erosion

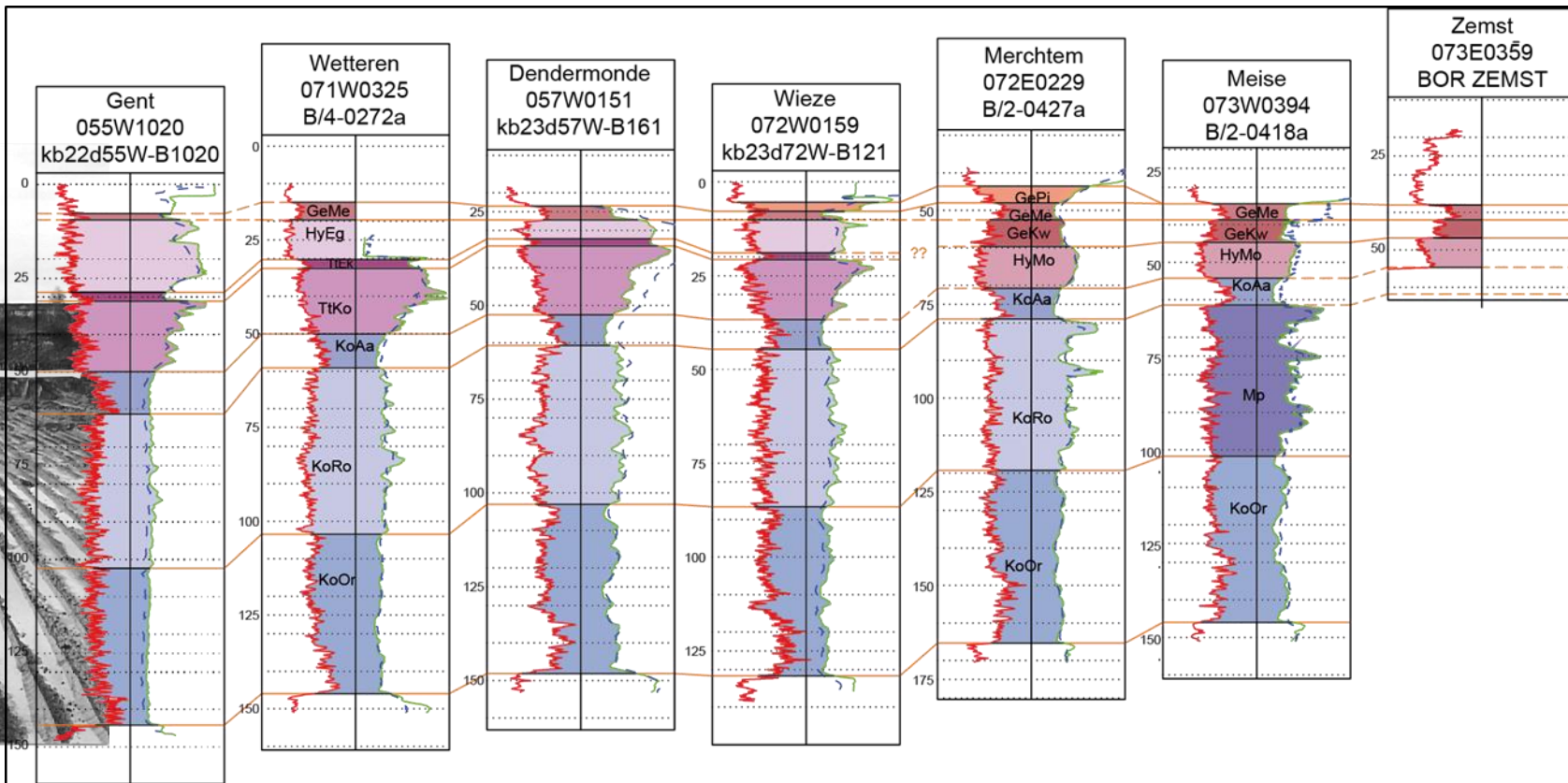
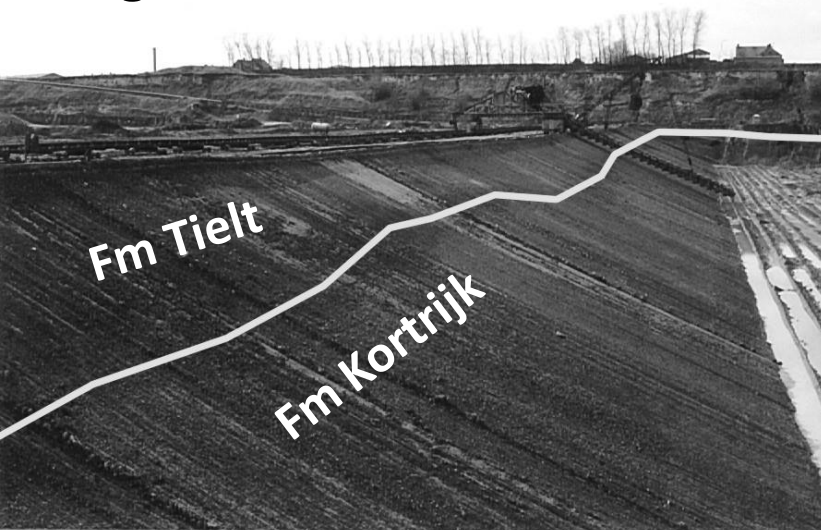
**Reference: ncs website <https://ncs.naturalsciences.be>**

# Profondeur sommet et épaisseur de la Formation de Kortrijk (Groupe de Ieper)



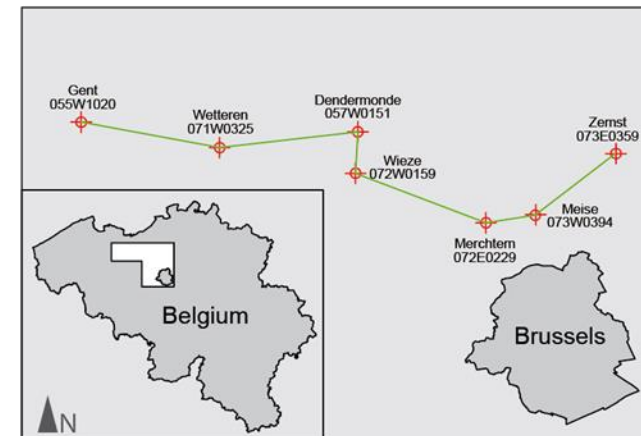


# Argilière de Kortemark



## Stratigraphie en sous-sol: Diagraphies de résistivité et de radioactivité naturelle

- Ge Gentbrugge Formation
    - GePi Pittem Member
    - GeMe Merelbeke Member
    - GeKw Kwatrecht
  - Hy Hyon Formation
    - HyMo Mont-Panisel Member
    - HyEg Egem Member
  - Tt Tielt Formation
    - TtEk Egemkapel Member
    - TtKo Kortemark Member
  - Mp Mons-en-Pévèle Formation
  - Ko Kortrijk Formation
    - KoAa Aalbeke Member
    - KoRo Roubaix Member
    - KoOr Orchies Member
- GR SN LN



From: 'Lithostratigraphy Ieper Group. A practical guide to identify a lithostratigraphic unit in the Ieper Group. National Commission for Stratigraphy of Belgium, 2017. <https://ncs.naturalsciences.be/paleogene-neogene/ieper-group>'

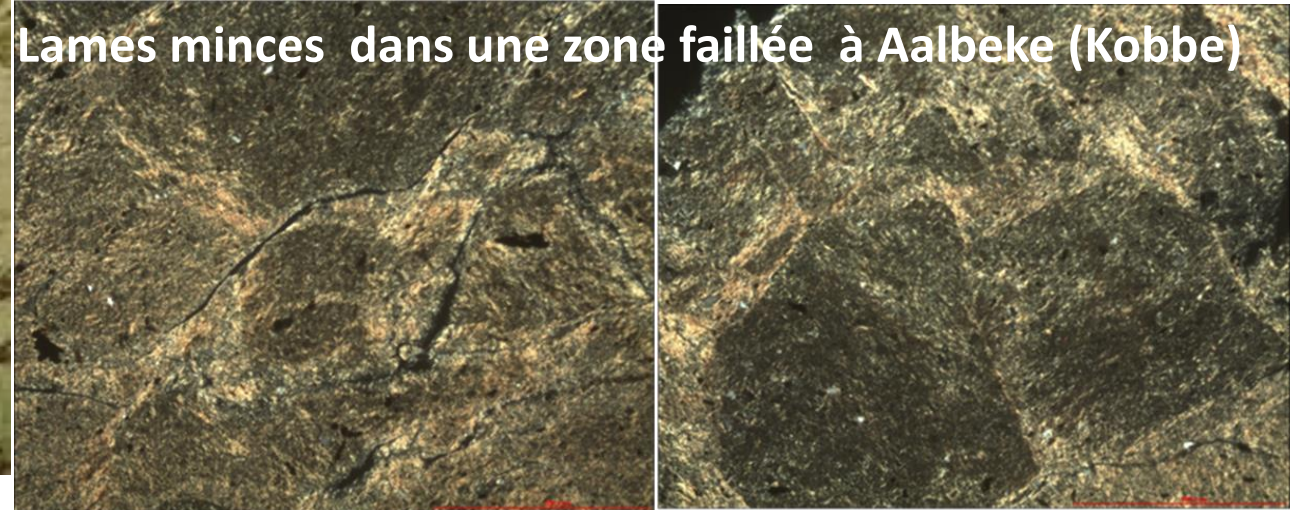
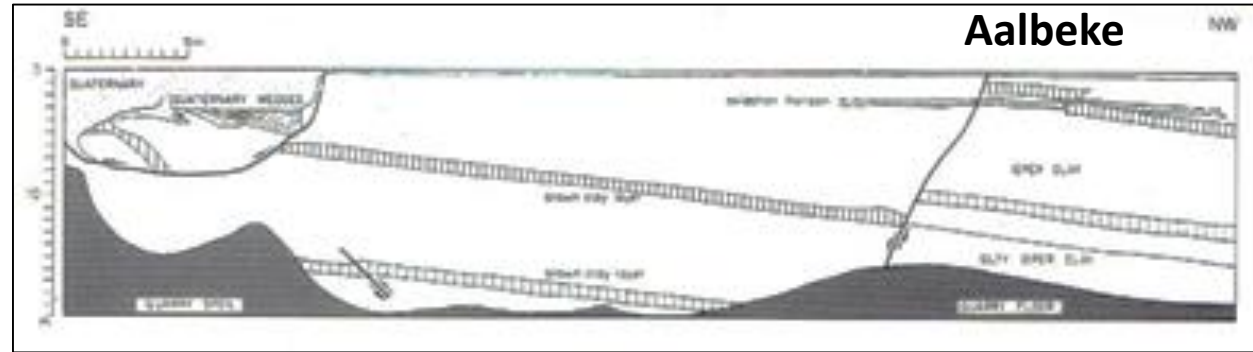
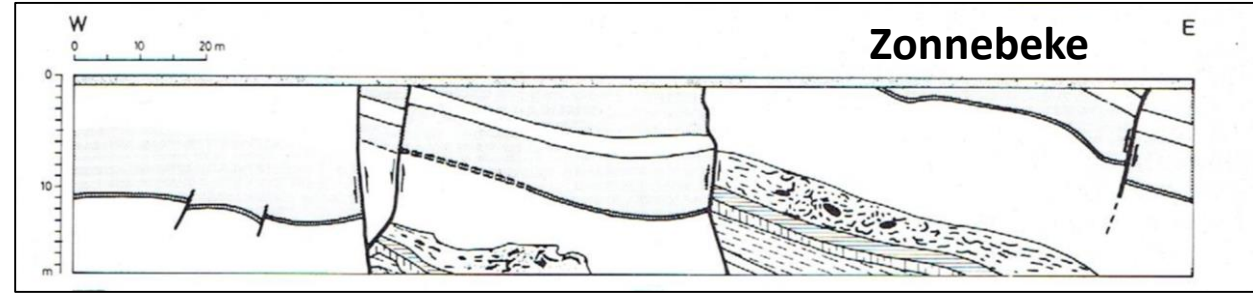


# Déformations dans les argiles d' Ypres

Slickensides , joints .....

Région de Ieper-Courtrai , failles

## Argillère de Marke



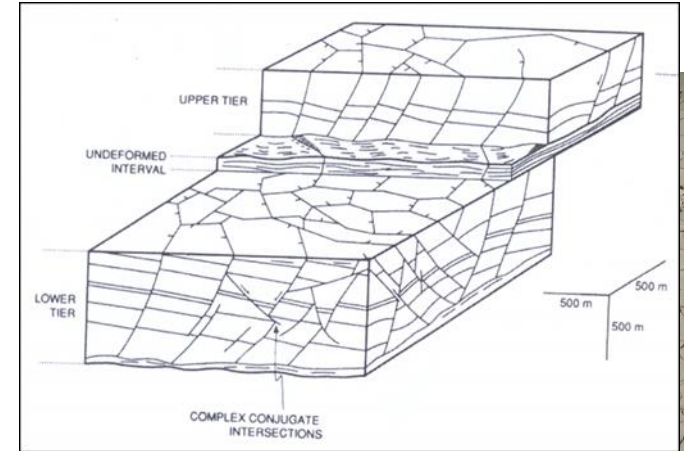
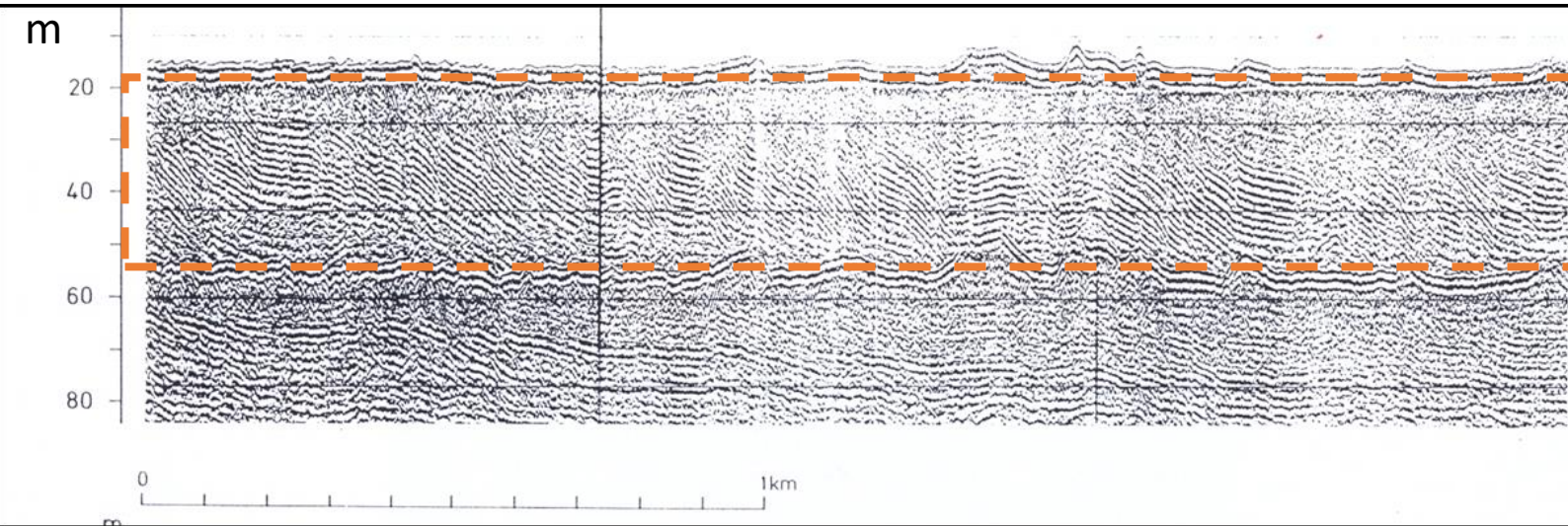
Lames minces dans une zone faillée à Aalbeke (Kobbe)



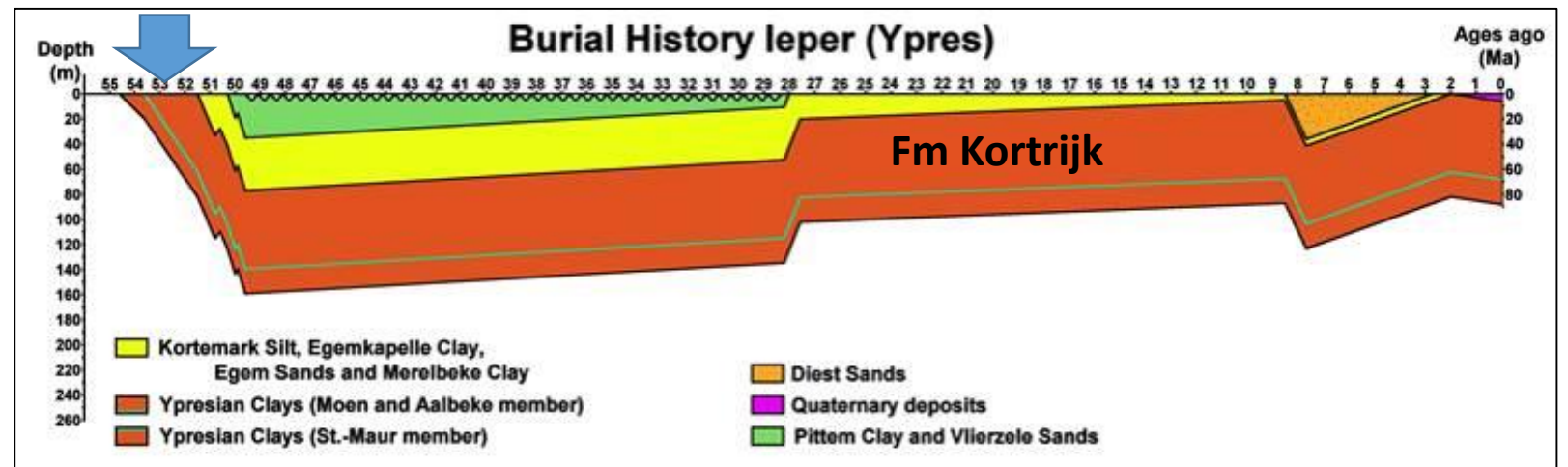


... en rapport avec la structure compartementée du socle ? (R. Paepe)

Relation avec les déformations observées en Mer du Nord ? (J.P. Henriet)

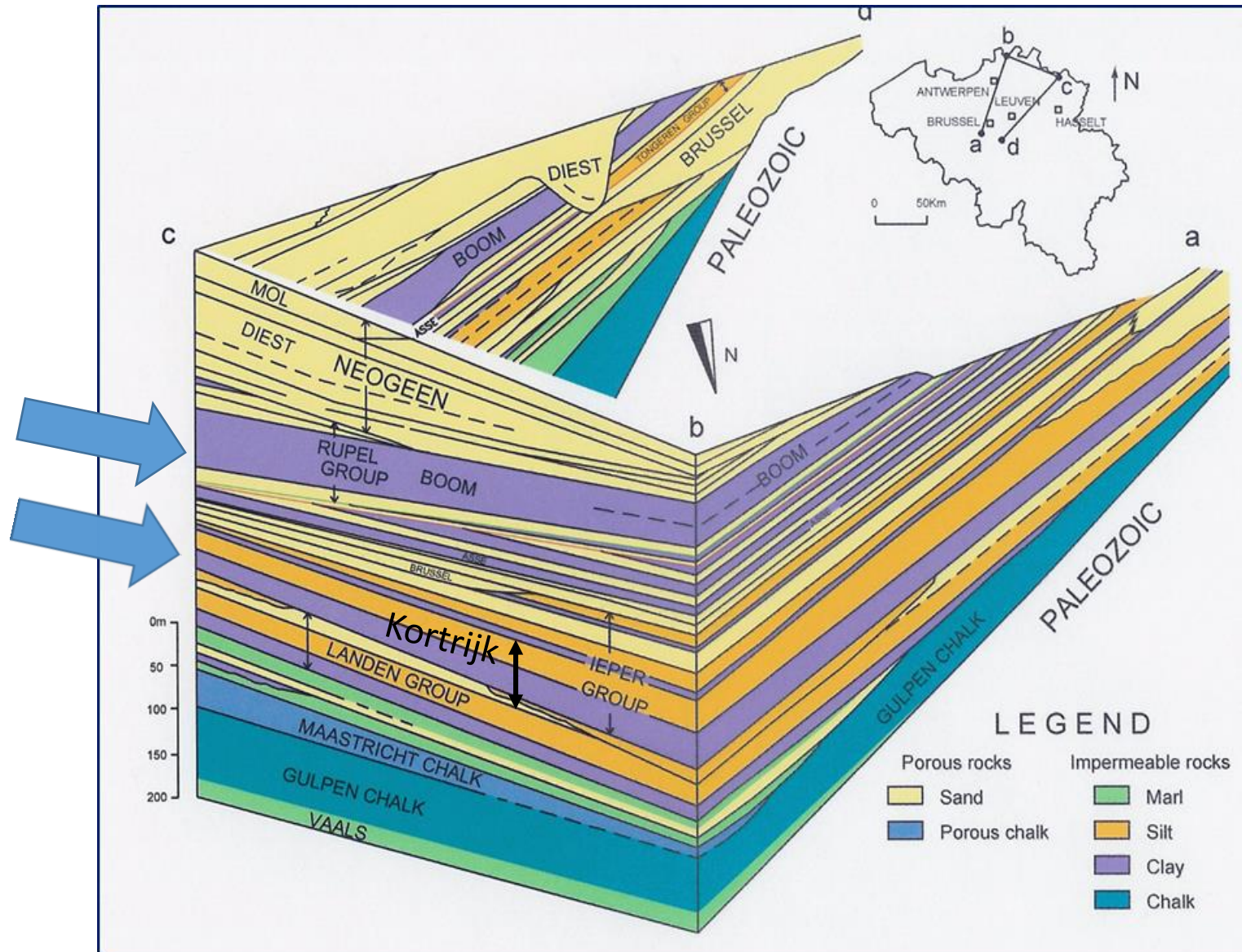


... en Mer du Nord.....  
...décharge par érosion ?  
(analogie 'valley bulging') ?





# Le contexte régional des roches hôtes : profondeur, autres couches argileuses, contexte hydrogéologique ...







# Argiles d'Ypres

Reference: ncs website <https://ncs.naturalsciences.be>

- Stratigraphie

- Lithologie

- Minéralogie

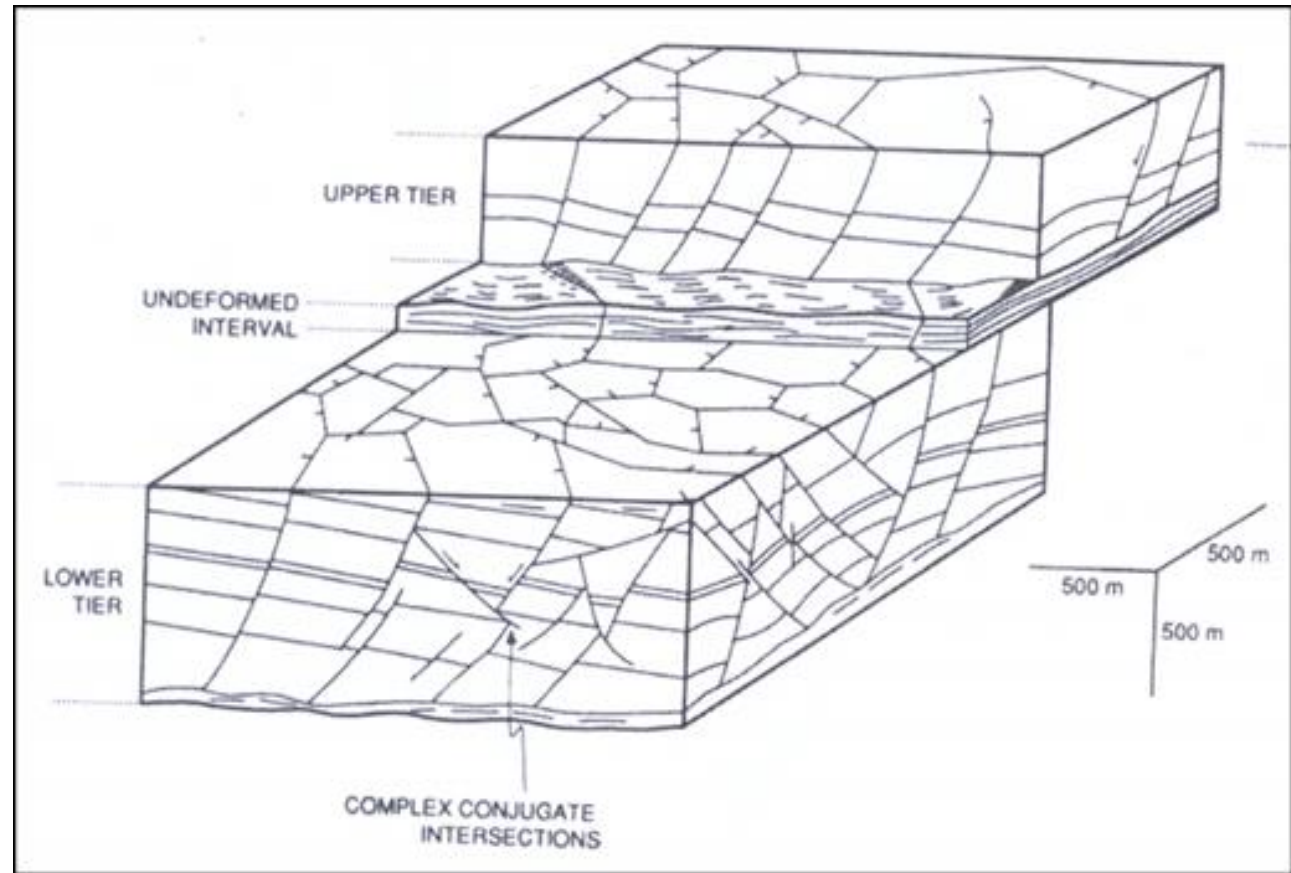
Argile de Londres

| Laga et al. (2001) <sup>(1)</sup> |                    |           | Tertiary Lithostratigraphy Flanders (2010) <sup>(2)</sup> |                   |                             | NCS (2017) <sup>(3)</sup> |  |                  |                     |  |  |   |                |  |
|-----------------------------------|--------------------|-----------|---|-------------------|-----------------------------|---------------------------|--|------------------|---------------------|--|--|---|----------------|--|
| GROUP                             | FORMATION + Code   | MEMBER    | GROUP + Code  | FORMATION + Code  | MEMBER + Code               | MEMBER + Code             | Description                                  | FORMATION + Code | GROUP + Code        |  |  |   |                |  |
| IEPER                             | GENTBRUGGE<br>Ge   | Vlierzele | IEPER<br>IE   | GENTBRUGGE<br>Ge  | Vlierzele<br>GeVI           | Aalterbrugge GeAb         | clays and sand with lignite and wood (≤ 10m) | GENTBRUGGE<br>Ge |                     |  |  |   |                |  |
|                                   |                    | Pittem    |   |                   | Pittem<br>GePi              | Vlierzele<br>GeVI         | fine glauconitic sand (≤ 20m)                |                  |                     |  |  |   |                |  |
|                                   |                    | Merelbeke |   |                   | Merelbeke<br>GeMe           | Pittem<br>GePi            | silty clay and clayey sand (15 - 20m)        |                  |                     |  |  |   |                |  |
|                                   | TIELT<br>Ti        | Egem      |   | Egem<br>TIEg      | Hooglede Bed<br>GeHg        | Hooglede Bed<br>GeHg      | sandstone (40cm)                             |                  |                     |  |  |   |                |  |
|                                   |                    |           |   |                   | Egemkapel                   | Egem<br>HyEg              | Merelbeke<br>GeMe                            |                  |                     | Merelbeke<br>GeMe                                | heavy to silty clay (6 - 7m)                 |   |                |  |
|                                   |                    | Kortemark |   | Kortemark<br>TiKo |                             |                           | Kwatrecht<br>GeKw                            |                  |                     | Kwatrecht<br>GeKw                                | layered complex of sand and sandy clays (5m) |   |                |  |
|                                   |                    |           |   |                   | Kortemark<br>TiKo           | Mont-Panisel<br>HyMo      | Mont-Panisel<br>HyMo                         |                  |                     | clayey fine sand (≤ 20m)                         |  |   |                |  |
|                                   |                    |           |   |                   |                             | Bois-la-Haut<br>HyBo      | Bois-la-Haut<br>HyBo                         |                  |                     | glauconitic, sorted fine to medium sand (3 - 4m) |  |   |                |  |
|                                   |                    | IEPER     |   | KORTRIJK<br>Ko    | Aalbeke                     | KORTRIJK<br>Ko            | Aalbeke<br>KoAa                              |                  |                     | Aalbeke<br>KoAa                                  | Aalbeke<br>KoAa                              | very compact heavy clay (5 - 15m)       | KORTRIJK<br>Ko |  |
|                                   |                    |           |   |                   |                             |                           |  |                  |                     |  |  |   |                |  |
| Orchies                           | Saint-Maur<br>KoSm |           | Upper Orchies (10m)<br>KoOu                               |                   | Upper Orchies (10m)<br>KoOu |                           | clayey micaceous sand (40 - 50m)             |                  |                     |  |  |   |                |  |
|                                   |                    |           |   |                   |                             |                           |  | Mont-Héribu      | Mont-Héribu<br>KoMh | Middle Orchies (15 - 20m)<br>KoOm                | Middle Orchies (15 - 20m)<br>KoOm            | heavy stiff bluish-grey clay (10 - 45m) |                |  |
|                                   |                    |           |   |                   |                             |                           |  |                  |                     |  |  |   |                |  |
| Het Zoute                         | Het Zoute<br>KoZo  |           | Mont-Héribu<br>KoMh                                       |                   | Mont-Héribu<br>KoMh         |                           | clayey sand, sandy clay (5 - 10m)            |                  |                     |  |  |   |                |  |
|                                   |                    |           |   |                   |                             |                           |  | Het Zoute        | Het Zoute<br>KoZo   | Het Zoute<br>KoZo                                | Het Zoute<br>KoZo                            | Silty to sandy clay (5m)                |                |  |

1. Laga, P., Louwye, S. & Geets, S. (2001). Paleogene and Neogene lithostratigraphic units (Belgium). *Geologica Belgica* 4/1-2: 135-152.  
 2. Tertiary Lithostratigraphy Flanders, version 2010. Retrieved from <http://dov.vlaanderen.be>.  
 3. <http://ncs.naturalsciences.be/paleogene-neogene/ieper-group>. Based on Steurbaut, E., De Ceukelaire, M., Lanckacker T., Matthijs, J., Stassen, P., Van Baelen H. & Vandenbergh, N. (2016). Lithostratigraphy Ieper Group.









Les options argile peu endurcie

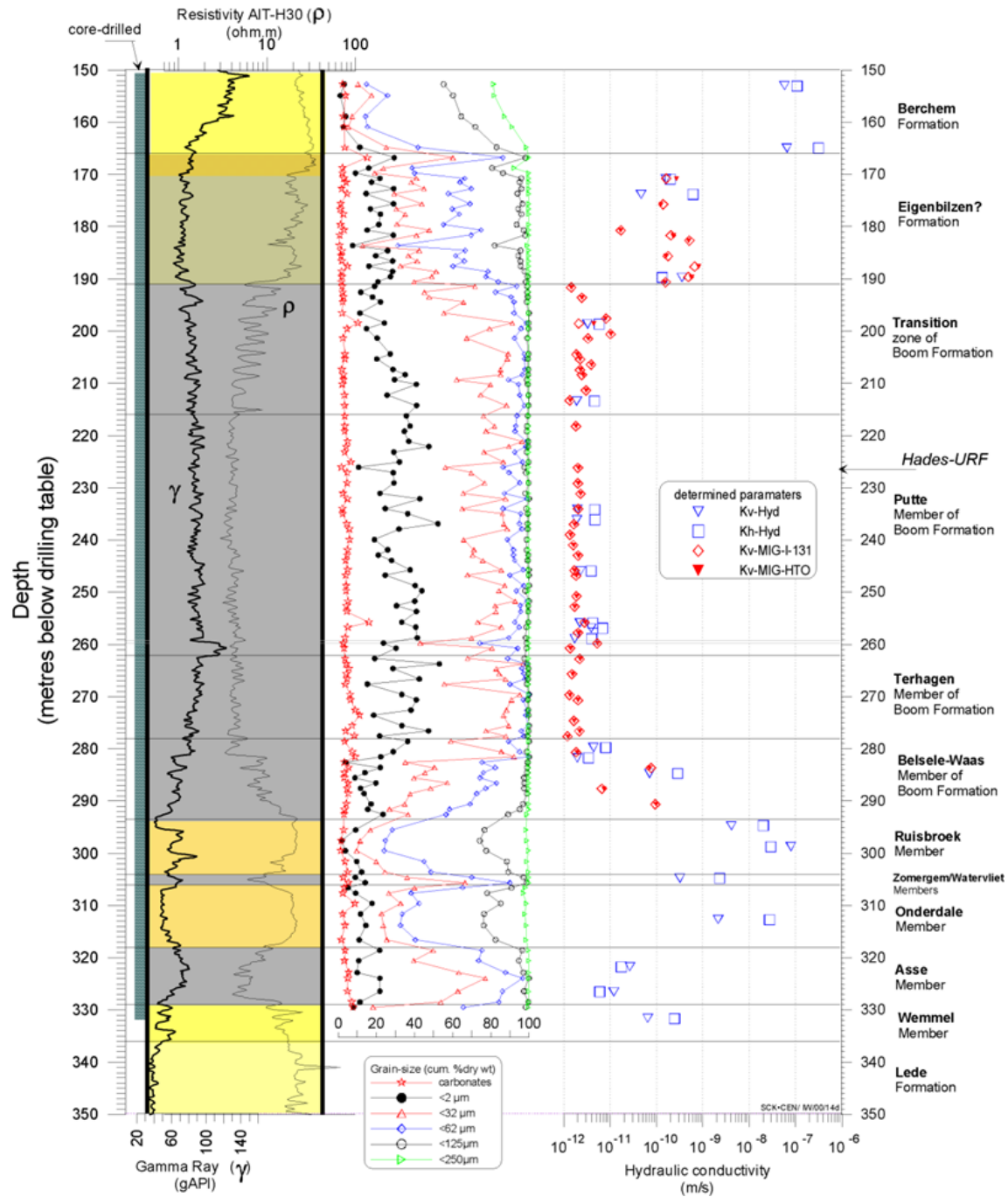
Au début la Belgique pioniers

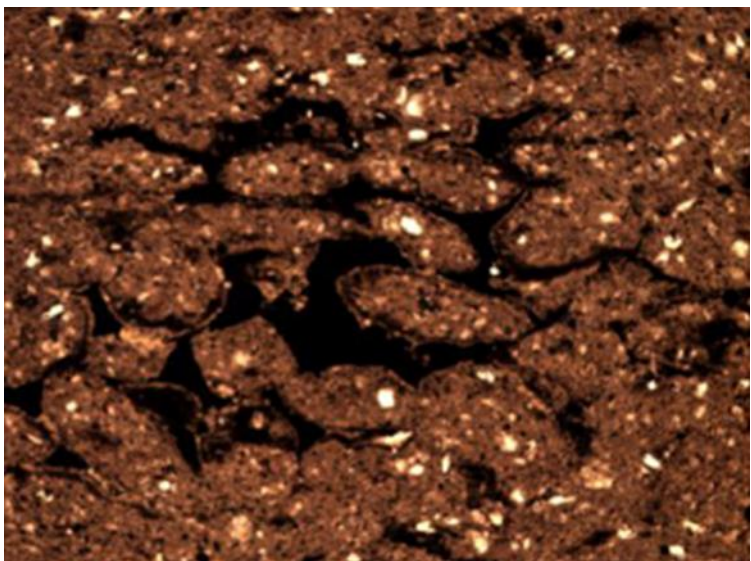
Après suivi de plusieurs pays

Deux possibilités géologiques bien étudiées et comprises













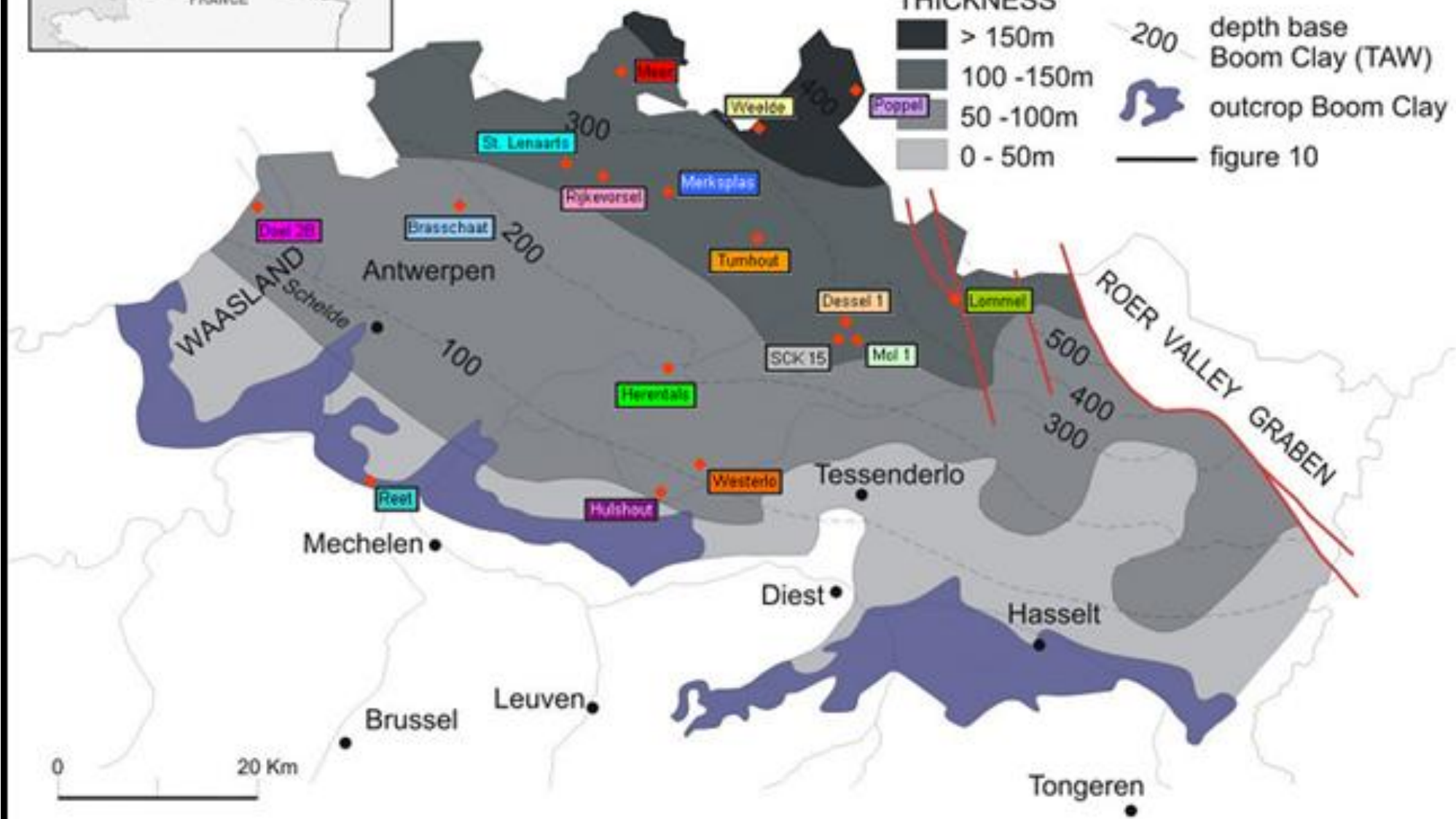


# The NETHERLANDS

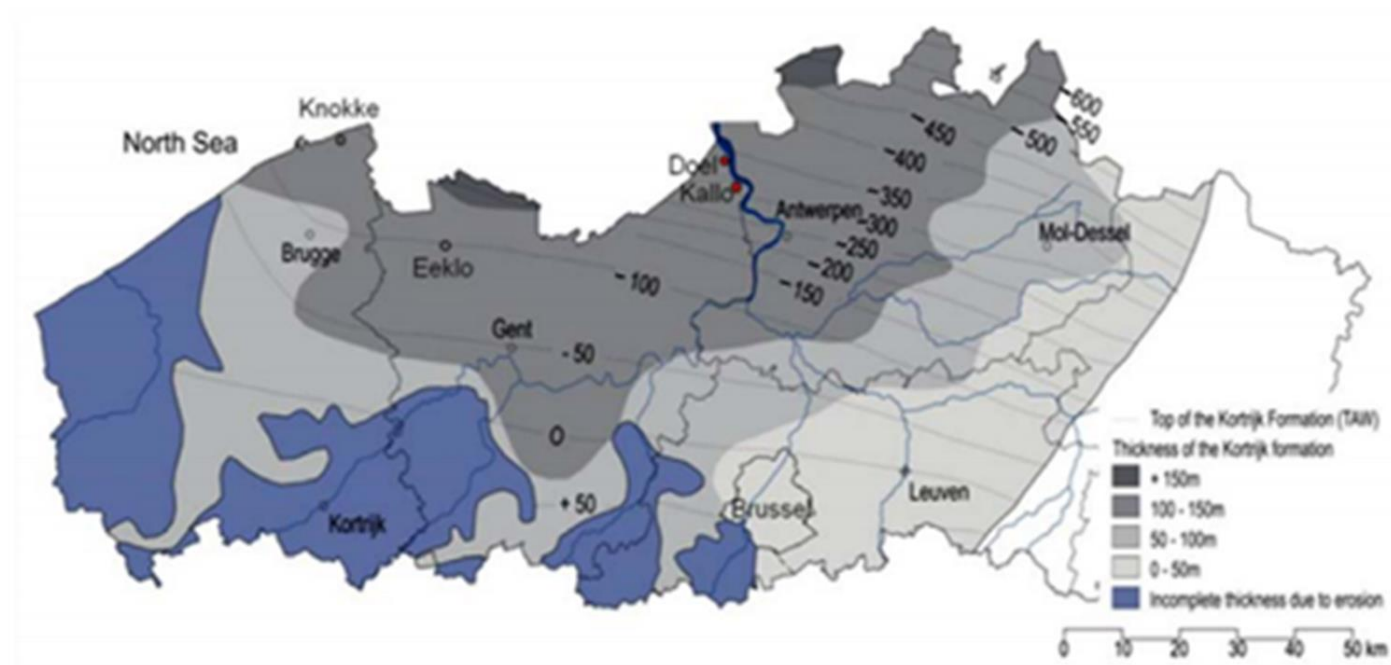
## THICKNESS

- > 150m
- 100 - 150m
- 50 - 100m
- 0 - 50m

- 200 depth base Boom Clay (TAW)
- outcrop Boom Clay
- figure 10







**Figure 3: Map of Northern Belgium, Showing the Depth Below Sea Level for the Top of the Kortrijk Formation and Thickness**

# Enfouissement

