NOTE ON THE LATE CRETACEOUS OF HOCKAI
(HAUTES FAGNES, NE BELGIUM)¹

by

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(8 figures)

RESUME.- Les dépôts du Crétacé récent dans la tranchée du chemin de fer à Hockai (Hautes Fagnes, NE de la Belgique) consistent en un conglomérat basal d’âge Campanien ancien, surmonté par des sables glauconitiques et un limon résiduel avec du silex noir, cavernueux d’âge Campanien récent, et ensuite un limon résiduel avec du silex gris d’âge Maastrichtien récent. Les dépôts du Maastrichtien ancien semblent absents. De plus, des études ultérieures devraient déterminer si, oui ou non, un équivalent lithostratigraphique de la Formation santonienne d’Aachen est présent dans cette section.

ABSTRACT.- The Late Cretaceous deposits in the railway cut at Hockai (Hautes Fagnes, NE Belgium) consist of an Early Campanian basal conglomerate, overlain by glauconitic sand and residual loam with black, cavernous flint of Late Campanian age, and a residual sandy loam with grey flint of Late Maastrichtian age. Early Maastrichtian deposits seem to be absent. Moreover, future study should determine whether of not a lithostratigraphic equivalent of the Santonian Aachen Formation occurs in this section.

1.- INTRODUCTION

The Late Cretaceous strata of the (now abandoned) railway cut at Hockai (Hautes Fagnes, NE Belgium) have been described already in the past century (e.g. Dewalque, 1886). The section is located some 6 km north of Malmedy and some 17 km south of Eupen.

Dewalque (1886) recognized, in ascending order: Revinian phyllites with a cover of blackish clay; a 1 to 3 m thick conglomerate of poorly rounded quartzites upward passing into gravel mixed with coarse-grained clayey sand; and a silex or flint «conglomerate» (some flints with a black, translucent core possibly derived from the «craie blanche» or Senonian - our Upper Campanian Zeven Wegen Chalk of e.g. Halembaye -), but the bulk of the flints presumably derived from the «craie maastrichtienne» fide Dewalque, 1886, p. 35).

The distinction between «Senonian» and «Maastrichtian» flints was confirmed by the occurrence of echinoid, brachiopod and bivalve moulds in the flints (Dewalque, 1886, p. 36-37).

In recent years, W.M. Felder & H.J. Albers (1980) published a more detailed lithostratigraphic description of the same section. In contrast to Dewalque (1886), they attributed the whole interval of the quartzite conglomerate and the overlying flint «eluvium» to the Late Maastrichtian. According to them, the basal conglomerate should be correlated with the «Wahlwiler Horizon». The overlying flint eluvium was compared with the Lixhe («small flints») and Lanaye («large flints») members of the Gulpen Formation of South Limburg (SE Netherlands) and contiguous regions (e.g. Halembaye) of NE Belgium.

The remnants of the Late Cretaceous cover in the Hautes Fagnes area have been used as an argument for calculating the absolute rise of the Maastrichtian sea level by Hancock & Kauffman (1979). They suggested a sea level rise of 650 m

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The present note is based on a re-examination of the section published by Felder & Albers (1980), who also presented a detailed location map.

2.- Lithostratigraphy

In ascending order, the following fourteen lithostratigraphic units have been distinguished (Figure 1; the base of the quartzite conglomerate is taken as a datum line: 0 m).

Unit 1.- Top of light bluish-grey Revinian phyllites.

Unit 2.- Dark-blue to black clay with some irregular sandy streaks, yielding abundant Revinian acritarchs (M. Vanguestaine, pers. comm.*); top white-coloured with reddish streaks; 50 cm.

Unit 3.- Red-stained breccia of quartz and phyllite fragments in clayey to sandy matrix; 10 cm.

Unit 4.- Yellowish-white to ochre fine- to medium-grained sand with silica cement, with reddish staining near the base; 60 cm.

Unit 5.- Basal conglomerate with up to 17 cm large, poorly rounded pebbles of quartzite and angular fragments of phyllite in limonitic, brown, silty sand; yielding abundant silicified bioclasts in 1.0-2.4 mm sieve fraction, as well as some arenaceous foraminifera; 50 cm.

Unit 6.- Poorly to fairly rounded pebbles of quartz and quartzite (up to 18 cm) in slightly limonitic, light-brown quartz sand of angular to poorly rounded quartz grains; 50 cm.

Unit 7.- Greenish-brown, glauconitic medium-to coarse-grained sand with abundant small quartz and quartzite pebbles, very rare flint fragments and residual pellets of silicified chalk; yielding abundant silicified microfossils; 50 cm.

Unit 8.- Dark-green, glauconitic sand with white streaks of residual silicified chalk, abundant small pebbles of quartz and quartzite, and some

*(Note by M. Vanguestaine, Lab. Paléontologie, U.E.L.): According to previous experience in the Stavelot Massif, the Revinian acritarch species recognized in clay unit 2 may have been reworked from at least three different lithostratigraphic units (Rv3, Rv4 and Rv5; acritarch zones 4b, 5 and 6 of Vanguestaine 1974, 1978). However, this assemblage has been recognized in situ near the Rv4/Rv5 boundary in the Rocroi Massif (Meilliez & Vanguestaine, 1983, Vanguestaine, 1986). Thus, for the time being, the co-occurrence of Tiwofeevia aff. lanceae, T. pentagonalis, Stelliferidium spp., Vulcansphaera cf. turbata, Cristallinaum randomense, Trunculumium revinium, Polygonium sp., Stellichnatum (? sp. and Acanthodontocladium cf. ubai cannot be used to distinguish between a clay reworked from different (local) sources and a residual soil on top of Rv4/Rv5 phyllites.

Figure 1.- Lithostratigraphy of Late Cretaceous strata in railway cut at Hockai (Hautes Fagnes, NE Belgium). Asterisks indicate position of samples. The composition of the lithoclast assemblage in the sieve fraction 1.0-2.4 mm roughly confirms the field observations, whereas the lithostratigraphic column is based. The fine-grained sand in this sieve fraction occurs in the form of small pellets with a clayey, siliceous or limonitic cement.

(compared to the actual one), presuming that this area has been a stable massif over a very long period. However, Robazynski (1981) and Gullentops (1987) indicated that the Hautes Fagnes cannot be regarded as a stable massif. Therefore, they concluded that the Maastrichtian sea level had been much lower than advocated by Hancock & Kauffman (1979).
dark, «cavernous» flint (= «silex cavereuse» of Belgian authors; cf. Mourlon, 1879); yielding abundant silicified microfossils; 10 cm.

**Unit 9.** «Cavernous» flints (up to 15 cm) with a black, translucent core and a white, silicified chalk cortex in matrix of sometimes slightly sandy loam with rare small pebbles of quartz and quartzite; yielding abundant silicified microfossils; 200 cm.

**Unit 10.** Loamy sand with some flints and white, residual pellets of silicified chalk, presumably forming top of unit 9 (former hardground??).

**Unit 11.** Light-grey flints (up to 25 cm) in loamy sand with silicified chalk pellets and small, well-rounded quartz pebbles; yielding abundant silicified microfossils near the base; 200 cm.

**Unit 12.** Light-grey, sometimes very fossiliferous flints (up to 40 cm) in loamy sand with silicified chalk pellets and small, well-rounded quartz pebbles; about 100 cm.

**Unit 13.** Few small flints (usually less than 10 cm) in brown, loamy sand with limonitic cement near the base, with upward increasing amount of silicified chalk fragments, and with well-rounded quartz pebbles; about 200 cm.

**Unit 14.** Light-grey, frequently flat flints (up to 25 cm) with thick cortex of white, silicified chalk in brown, sandy loam with silicified chalk fragments and rare quartz pebbles; yielding abundant silicified microfossils near the base; about 200 cm.

Most likely, units 2 to 4 form the weathering product of the underlying Revinian rocks. But the presence of some smectite in the clay of unit 2 (J. Thorez, Lab. Géologie des Argiles, U.E.L., pers. comm.) suggests at least some local reworking during the Late Cretaceous. Future study should determine inhowfar units 2-4 might represent a lithostratigraphic equivalent of the Santonian Aachen Formation.

The sand and loam with flint and silicified chalk of units 9-14 form the residual deposit (flint eluvium) of the Late Cretaceous chalk. Note that flint constitutes only 10 % (in unit 13) to 50% (in unit 9) of this eluvium. The remainder is fine gravel, sand, silt and clay as well as silicified chalk remnants. Although the silicified chalk remnants make up less than 5 % of the eluvium, they illustrate that the original deposit was a relatively pure chalk, and not e.g. a marl. This means that the sand, silt, clay percentage in the original sediment must have been low, and presumably comparable to that in other Late Cretaceous chalk deposits which occur to the north (e.g. Hombourg) or northwest (e.g. Halembaye) in NE Belgium.

### 3.- BIOSTRATIGRAPHY

Four different fossil groups have been observed: foraminifera, ostracodes, sponge spicules and bioclasts (1.0-2.4 mm sieve fraction). All the fossils have been silicified or were originally siliceous (sponge spicules).

#### 3.1.- FORAMINIFERA

Six assemblages are distinguished (also compare figures 2, 3 and 5).

**0.0 - 0.5 m.** Poor, monotonous fauna of agglutinated species, including *Trochammina* sp. and *Ataxophragmium crassum*. In the FRG, the latter ranges from the Late Santonian into the Early Campanian. In South Limburg and NE Belgium, this species is restricted to the Early Campanian (Hofker’s 1957 forum zone A'-lower to A' -middle).

**1.0 - 3.6 m.** Rich and diverse assemblage, including *Hedbergella* sp., *Bolivinoides decorata* (3-4 pustules on last chamber), *B. australis* (5 pustules on last chamber), *Neoflabellina leptodisca*, *Flabellina radiata*, *Glabrotalites micheliniana*, *Lenticulina ordinaris*, *Sarcenaria triangularis*, *Marssonella turris*, *Frondicularia* sp., *Marginulina* sp., *Dentalina* spp., *Nodosaria* spp., *Lagena aspera*, *Stenioina pommerana*, *Bolvina* sp., *Gyroidinoides nitida*, *Gavelinella clementiana*, *Cibicides* sp. This assemblage points to a Late Campanian age (Hofker’s 1966 forum zone A = Zeven Wegen Chalk or «craie blanche» of Halembaye).

Remarkable is the common presence of *Cymbalopora radiata* in the glauconitic sand (1.0-1.6 m). Schijfia (1946) described this species from the «Upper Hervian» of South Limburg (now attributed to the Late Campanian; cf. Felder & Bless, 1989). However, Hofker (1957, 1966) considered this to be a Late Maastrichtian species, restricted to his forum zones J-K-L-M. Maybe, this is a useful facies fossil.

**3.6 - 4.6 m.** Assemblage includes a.o. *Bolivinoides australis* (with 5-7 pustules on last chamber), *Gyroidinoides nitida*, *Flabellammina* sp., *Lenticulina* sp., *Lagena* sp., *Dentalina* spp., *Nodosaria* spp., *Cibicides* sp., *Præbulimina* sp. This association suggests a Late Maastrichtian age, presumably Hofker’s (1966) forum zone C (= Vijlen Chalk or «craie grise» in Halembaye).

**6.6 - 8.6 m.** Small, non-distinctive assemblages with *Gyroidinoides* sp. and *Gavelinopsis* cf. *voltziana*.
8.6 - 9.6 m.- Diverse assemblage with a.o. Bolivinoides australis, Eponides beisseli, Frondicularia ogivelis, Gyroidinoides sp., Gavelinopsis bembix, Lenticulina (Saracenaria) trilobata, Praebulimina sp., Lenticulina sp., Spiroplectammina sp., Nodosaria sp., Sigmomorphina sp. (fig. 5). The mean number of pustules on last chamber of sixteen specimens of B. australis is 6.0. This suggests a Late Maastrichtian age, presumably the top of Høyer’s (1966) foramin E or the base of zone F (top of craie grise or base of craie tigrée) in Halembeay.

9.6 - 10.6 m.- Small, non-distinctive assemblage with Gyroidinoides sp.

3.2.- OSTRACODES

Five assemblages are distinguished (also compare figures 4 and 5).

1.0 - 3.6 m.- Rich and diverse assemblage with common to abundant occurrence of Cytherella ovata and Bairdia spp.; also including some twenty more species, most of these shown on figure 4 (4.5 to 4.22). The assemblage is characteristic of the Late Campanian chalk deposits in South Limburg and NE Belgium (cf. Deroo, 1966; Bless, 1988). Species characterizing the Late Campanian «Pre-Valkenburg» sandy marls or «Sandy Chalk of Benzenrade» (cf. Felder & Bless, 1989) in the area bordering the Rur Valley Block have not been observed. Therefore, this must be regarded as a typical «craie blanche»/«craie glauconifère» assemblage as found in e.g. Halembeay.

3.6 - 4.6 m.- Poor, monotonous assemblage, dominated by Cytherella ovata and Bairdia sp. Mosaeleberis cf. macrophalma and Pterygocthyereis serrulata are restricted to the Late Maastrichtian in South Limburg and NE Belgium, where they become common in Høyer’s foramin zone F. This may be one of the earliest occurrences of these species (presumably in foramin zone C; see above).
7.6 - 8.6 m. Only Cytherella ovata was found.

8.6 - 9.6 m. Monotonous assemblage dominated by Cytherella ovata. Rare specimens of Bairdia spp., Cythereis zygopleura varia and Aversovalva v-scriptum (fig. 5). Similar non-distinctive assemblage dominated by Cytherella ovata frequently occur in the Vijlen-Lixhe Chalk facies of e.g. Halembaye and Thermae.

9.6 - 10.6 m. Only Cytherella ovata was found.

3.3. SPONGES

Siliceous sponge spicules occur throughout the intervals 0.0 - 0.5 m and 1.0 - 4.6 m. But these abound particularly in the interval 1.0 - 2.6 m, where rich and diverse assemblages are found (cf. fig. 6). Between 1.0 and 1.6 m they make up about 25 % of the sieve fraction 0.25 - 1.0 mm! Some spicules show dissolution and/or secondary silification features.

The most common spicule forms are large (up to 5 mm) oxeas and equally large, variably-shaped, long-shafted tetraxons (triaenes), as well as variably-shaped desmas (megaclones and rhizoclines), all presumably derived from lithistid sponges. Less common are isolated hexactas (triaxons) and calthrops (regular tetraxons), as well as up to 2 mm large fragments of rigid hexact skeletons, presumably derived from "hexactinellid" Hyalospongea (glass sponges).

Although sponge spicules have a limited stratigraphic value, their relative abundance and diversity may help to unravel the depositional environment. The relative abundance and diversity of lithistid sponge spicules in the 1.0 - 2.6 m interval at Hockai might point to a "littoral to upper neritic" environment (cf. Lagnieu-Herenger, 1959). Hyalosponges would prefer lower neritic to bathyal facies.

![Figure 4](image_url)

Figure 4. Selected ostracodes from Late Cretaceous of Hockai.
5.22: Late Campanian species from 1.0 to 3.6 m interval.
5. Pterygocythere laticrista, 2.6-3.6 m; 6. Eucytherea dorsotuberculata, 1.5-1.6 m; 7. Mosaeleberis rotata, 2.5-3.6 m; 8. Cytherelloidea levigata, 2.5-3.6 m; 9. Bythoceratina bonnemai, 2.5-3.6 m; 10. Pterygocythereis aserrulata, 1.6-2.6 m; 11. Mosaeleberis sp., 1.6-2.6 m; 12. Bythocypris limburgensis, 1.6-2.6 m; 13. Curtisina cf. alseni, 1.5-1.6 m; 14. Oerttiella binkhorsti, 1.5-1.6 m; 15. Sphaereolobis saccata (= Pterygocythere virginea), 1.6-2.6 m; 16. Phacurchabotus semiplicatus, 1.5-1.6 m; 17. Schizocythere bonnemai, 1.5-1.6 m; 18. Cytherelloidea cf. obliquirugata, 1.5-1.6 m; 19. Trachyleberidea acutilobata, 1.5-1.6 m; 20. Aversovalva v-scriptum, 1.0-1.5 m; 21. Cythereis hallemayensis, 1.5-1.6 m; 22. Bythoceratina sp., 1.0-1.5 m.

![Figure 5](image_url)

Figure 5. Selected foraminifera (1-5) and ostracodes (6-10) from Late Maastrichtian (top foramin zone C or base foramin zone E) of Hockai, 8.6 to 9.6 m interval.
1: Fronsiculina ogivalis; 2: 4: Bolivinoides australis (in this sample, twelve specimens with 6 pustules on last chamber were found, two with 5 pustules, one with 7 and one with 8 pustules); 5: Eponides beisseli; 6: Cythereis zygopleura varia; 7: Aversovalva v-scriptum; 8: Cytherella ovata; 9-10: Bairdia sp.
3.4.- BIOCLASTS

Only the bioclasts from the sieve fraction 1.0 - 2.4 mm are considered here, as well as the moulds in a flint from 6.6 m. All the bioclasts are silicified.

0.0 - 0.5 m.- A one kilogram sample has yielded about 800 bivalve fragments. This is a common feature for the Early Campanian (cf. Felder, 1988; Felder & Bless, 1989).

1.0 - 2.6 m.- Three samples have yielded assemblages with relatively abundant large agglutinated foraminifers (notably Lituola nautiloidea) and sponge fragments, along with some bivalve and echinoid clasts. Similar assemblages mark the lower portion of the Late Campanian deposits in NE Belgium (cf. Bless et al., 1988).

2.6 - 3.6 m.- Small assemblage of bryozoans and bivalves (some of these with *Inoceramid-type* prismatic layer) characterizes upper portion of Late Campanian deposits, as well as Early Maastrichtian in NE Belgium and South Limburg (cf. Jagt et al., 1987).

6.6 m.- Flint with 53 moulds (36 bivalves, 6 echinoderms, 9 bryozoans, 1 serpulid). Predominance of bivalves points to the interval of foramin zones A-E.

7.6 - 9.6 m.- Small assemblages of predominantly bivalve clasts (and rare brachiopods, cirripeds and echinoid spines; the last two only in the 0.25 - 1.0 mm sieve fraction) point to foramin zones C-E (low number of bioclasts, dominance of bivalves; cf. Felder, 1988; Krings et al., 1987).

4.- CONCLUSIONS

The Late Cretaceous succession at Hockai consists of:

- a maximum 1 m thick Early Campanian (foram zone A'-lower) conglomerate, upward passing into a coarse sand with coarse gravel (0.0 - 1.0 m).

- 2.6 m Late Campanian deposits (1.0 - 3.6 m; foram zone A), with at the base a 0.6 m thick glauconitic sand (equivalent of the "craye glauconifère" of Halembaye), overlain by a 2.0 m thick residual loam with black, cavernous flint (equivalent of the "craye blanche" in Halembaye). The thickness of the "craye blanche" is about 30 m in Halembaye, Hombourg or Diets-Heur (cf. fig. 7). Presuming a similar original thickness for the flint eluvium of unit 9 (1.6 - 3.6 m), and assuming that 50 % of this eluvium consists of flint, we may calculate the original flint content in the "craye blanche" at Hockai. This would have been in the order of about 3 %, whereas the sand, silt, clay content would have been also some 3 % (compare with the 2.5 % sand, silt and clay observed in samples from the "craye blanche" in Halembaye).

- 7 m Late Maastrichtian deposits (3.6 - 10.6 m), consisting of a residual sandy loam to loamy sand with varying amounts of grey flint (equivalent of the "craye grise" and perhaps base of "craye tigrée" in Halembaye; foram zones C to base of E). The thickness of foram zone C (= "craye grise" or Vijlen Chalk) varies from some 15 m in Halembaye to locally about 70 m in the SE of South Limburg. Usually, the "craye grise" contains but a few, insignificant flint horizons. However, if we assume that e.g. units 11, 12 and 13 (total thickness 5 m) form the residual deposit of the "craye grise", and if we presume an original thickness of 40 m for the same (somewhere halfway between 15 m and 70 m), and if we furthermore accept that 25 % of the residual deposit consists of flint, then the original flint content in the "craye grise" would have been only 3 %, whereas the sand, silt, clay content would have been 9 % (compare with the 7 to 15 % sand, silt and clay observed in samples from the "craye grise" in Halembaye). This means that the relatively thick residual deposit representing foram zone C at Hockai may have been derived from a chalk similar to that of the "craye grise".

- Unit 14 is provisionally assigned to the base of foram zone E (="craye tigrée" or Lixhe Chalk in Halembaye), although it might also represent the top of foram zone C. We have not detected (at least at this location) a residual deposit representing the younger foram zones F, J, K, L or M.

The succession of strata belonging to foram zones A', A, C and presumably E matches the succession observed in, e.g., Halembaye, Hom-
Figure 7: Selected sections with Late Cretaceous strata in NE Belgium and SE Netherlands, showing variation in thickness and relative position of major sedimentary gap. Detailed age of Campanian and Maastrichtian strata is shown in terms of Hofker’s (1957, 1966) foraminiferal zonation, also in those cases where (part of) section had been dated by other methods.

The Late Cretaceous foram assemblages (with frequent Bolivinoides) and ostracode faunas (with frequent Cythereelloidea and Bythoceratina) of Hockai closely resemble those of the «craie gluconifère/craie blanche» facies of Halembeaye, Hombourg, Kastanjelaan and Diets-Heur, and differ from those of the sandy marls of the «Pre-Valkenburg» facies in Gruitrode or the Kunrade area. Thus, the Hockai region was at the same distance from the influx of siliciclastics as were Halembeaye, Hombourg, Diets-Heur or Kastanjelaan. At the same time, abundance and diversity of lithistid sponge spicules in the Hockai section suggest that the depositional environment was relatively shallow. This is also indicated by the ostracode genus Cythereelloidea (cf. Bless, 1989).

The absence of Early Maastrichtian strata in the sections of Hockai, Halembeaye, Diets-Heur, Hombourg and Kastanjelaan points to a short-lived phase of relative tectonic upwarp. This gap cannot be explained by an eustatic sea level fall (as for example the gap between Early and Late Campanian in this area), since the Early Maastrichtian is well-represented in the Campine (e.g. Gruitrode, Oostham; cf. fig. 7). This means, that the tectonic movements of the Hautes Fagnes were similar to those in South-Limburg and contiguous areas to the south in Belgium (e.g. Kastanjelaan and Halembeaye; cf. fig. 8), and different from those in the Campine to the NW. This observation supports the hypothesis forwarded by Robaszynski (1981) and Gullentops (1987), and underlines the «stable massif»-theory of Hancock & Kaufman (1979).

Finally, it is emphasized that the Late Cretaceous succession at Hockai is not necessarily representative of the whole Hautes Fagnes area. There are indications, that Campanian deposits are either missing or very condensed further to the east, e.g. at Beaulou (about 6 km to the ENE of Hockai).

BIBLIOGRAPHY


