Annales de la Société géologique de Belgique, T. 119, fascicule 2, 2e semestre 1996, pp.119-133 Août 1997

THE VIJLEN CHALK MEMBER (MAASTRICHTIAN, LATE CRETACEOUS) IN THE MEUSE-RHINE EUREGION

P.J. (Sjeuf) FELDER[1]

1. Services associés de Paléontologie, Université de Liège, Place du Vingt-Août, B-4000 Liège, Belgium.

[Contribution no. 5 of the 'Vijlen Werkgroep']

ABSTRACT. Samples of Vijlen Member chalks from a number of boreholes and outcrops have been analysed for their 1-2.4 mm bioclast content, in order to be able to present an overview of this deposit. The studied sections could be correlated mainly on the basis of foraminifera. Sections through the area reveal that tectonic movements in conjunction with marine regressions and transgressions determined the sedimentation/erosion patterns. During one of the regression phases (Bovenste Bos Horizon), deep (up to 50 m) channels developed in an extensive strand plain. These channels were filled during the subsequent transgression phase in the early Maastrichtian, which is why at the Lower/Upper Maastrichtian boundary another strand plain came into existence (Böckler Horizon). During the late Maastrichtian relatively pure chalks were laid down, which contain small flint nodules offshore.

KEY-WORDS: Bioclasts, sedimentation, Late Cretaceous, Maastrichtian, The Netherlands, Belgium, Germany.

RESUME. Le Vijlen Chalk Member (Maastrichtien, Crétacé supérieur) dans l'Euregio Meuse-Rhin. Des échantillons de craies du Membre de Vijlen provenant de nombreux sondages et affleurements ont été analysés pour leur contenu en bioclastes entre 1 et 2,4 mm afin d'être en mesure de présenter une vue d'ensemble de ce dépôt. Les sections étudiées ont pu être corrélées entre elles principalement sur la base des foraminifères. Des coupes au travers de la région révèlent que des mouvements tectoniques conjointement à des transgressions et des régressions marines ont déterminé les modèles de sédimentation/érosion. Pendant une des phases régressives (Horizon Bovenste Bos), des chenaux profonds (jusqu'à 50 m) se sont développés dans une plaine côtière étendue. Ces chenaux ont été comblés pendant la phase transgressive qui a suivi, au Maastrichtien ancien, ce qui explique pourquoi une autre plaine côtière étentue (Horizon Böckler) a pris naissance à la limite Maastrichtien inférieur/supérieur. Pendant le Maastrichtien tardif, des craies pures ont été déposées au large, qui contiennent de petits nodules de silex.

MOTS CLES: bioclastes, sédimentation, Crétacé récent, Maastrichtien, Pays-Bas, Belgique, Allemagne.

1. VIJLEN CHALK MEMBER

W.M. Felder (1975) coined the name 'Kalksteen van Vijlen' (Vijlen Chalk) for a portion of the chalks of the Gulpen Formation of late Cretaceous age, bounded by the Bovenste Bos and Wahlwiller Horizons, at the base and top, respectively. A comparison of lithostratigraphic nomenclature for the Upper Cretaceous of southern Limburg with the Geological Time Scale for the Netherlands/Sequence Stratigraphy (RGD & NOGEPA 1993) shows that some of the horizons correspond with marine regressions (Figure 1). Other horizons are only developed locally, e.g. the Wahlwiller Horizon, separating the Vijlen and Lixhe 1 Chalk Members. Such horizons are omitted from Figure 1.

The type locality of the Vijlen Member as described by W.M. Felder has recently been described in detail by P.J. Felder & Bless (1994).

The Vijlen Member is known in the Meuse-Rhine Euregion from many boreholes and outcrops/ exposures in a relatively limited area between the Roer Valley Graben and the Brabant Massif (Figure 2).

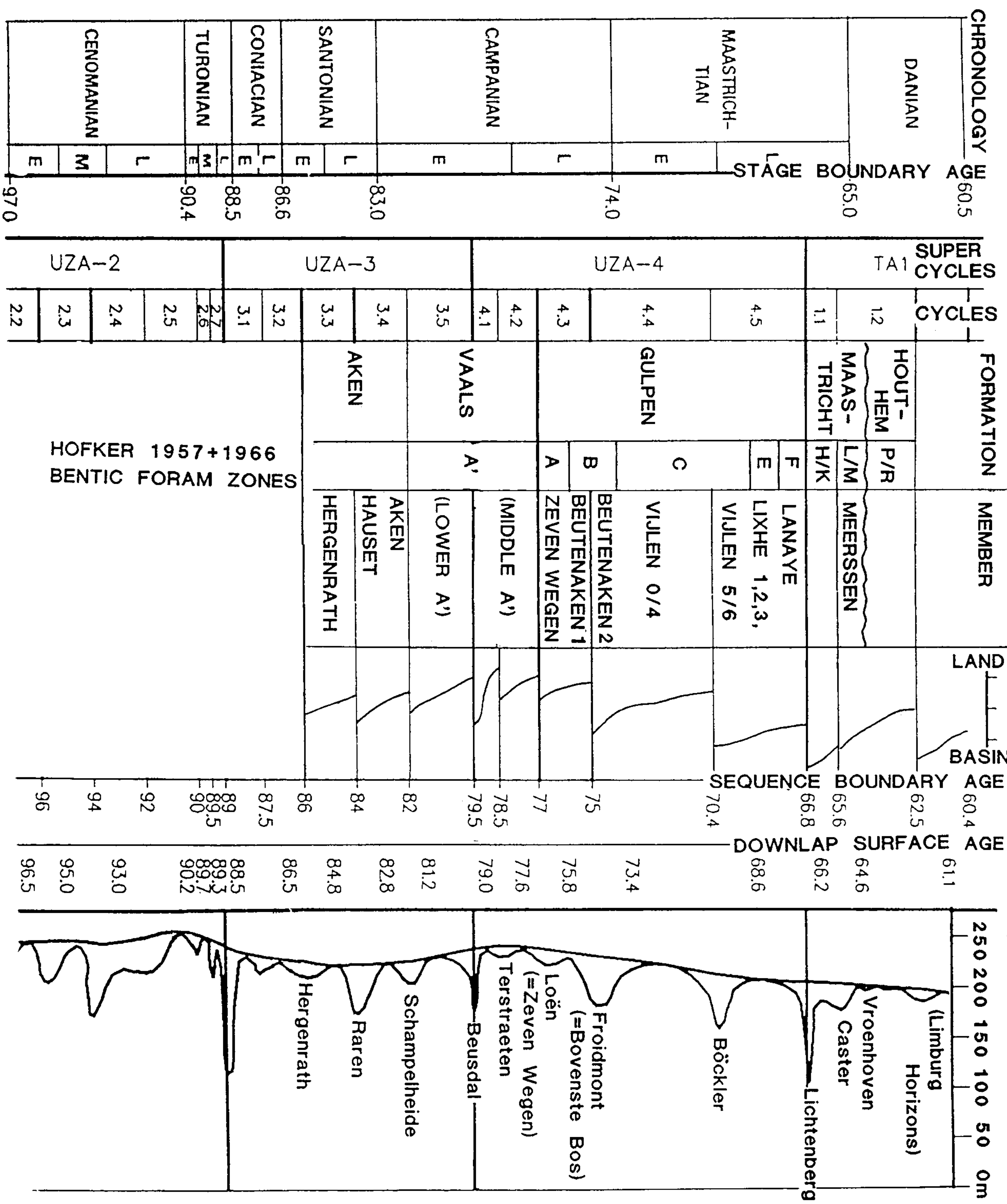

Figure 1. Comparison of lithostratigraphic nomenclature for the Upper Cretaceous of southern Limburg and the Geological Time Scale for the Netherlands/Sequence Stratigraphy (RGD & NOGEPA 1993).

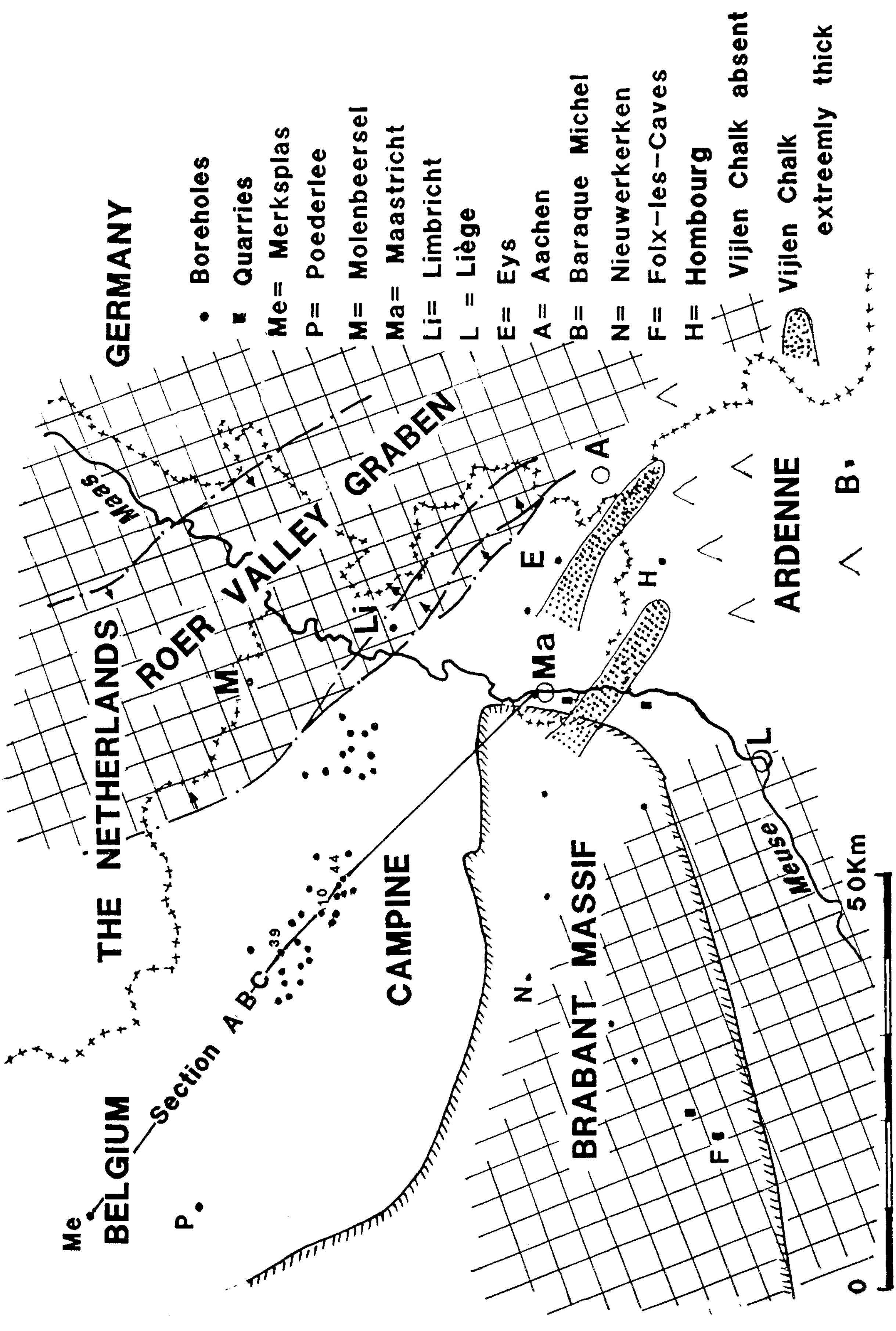

Figure 2. Tectonic map illustrating boreholes and exposures studied as well as sections A, B and C, Merksplas-Maastricht.

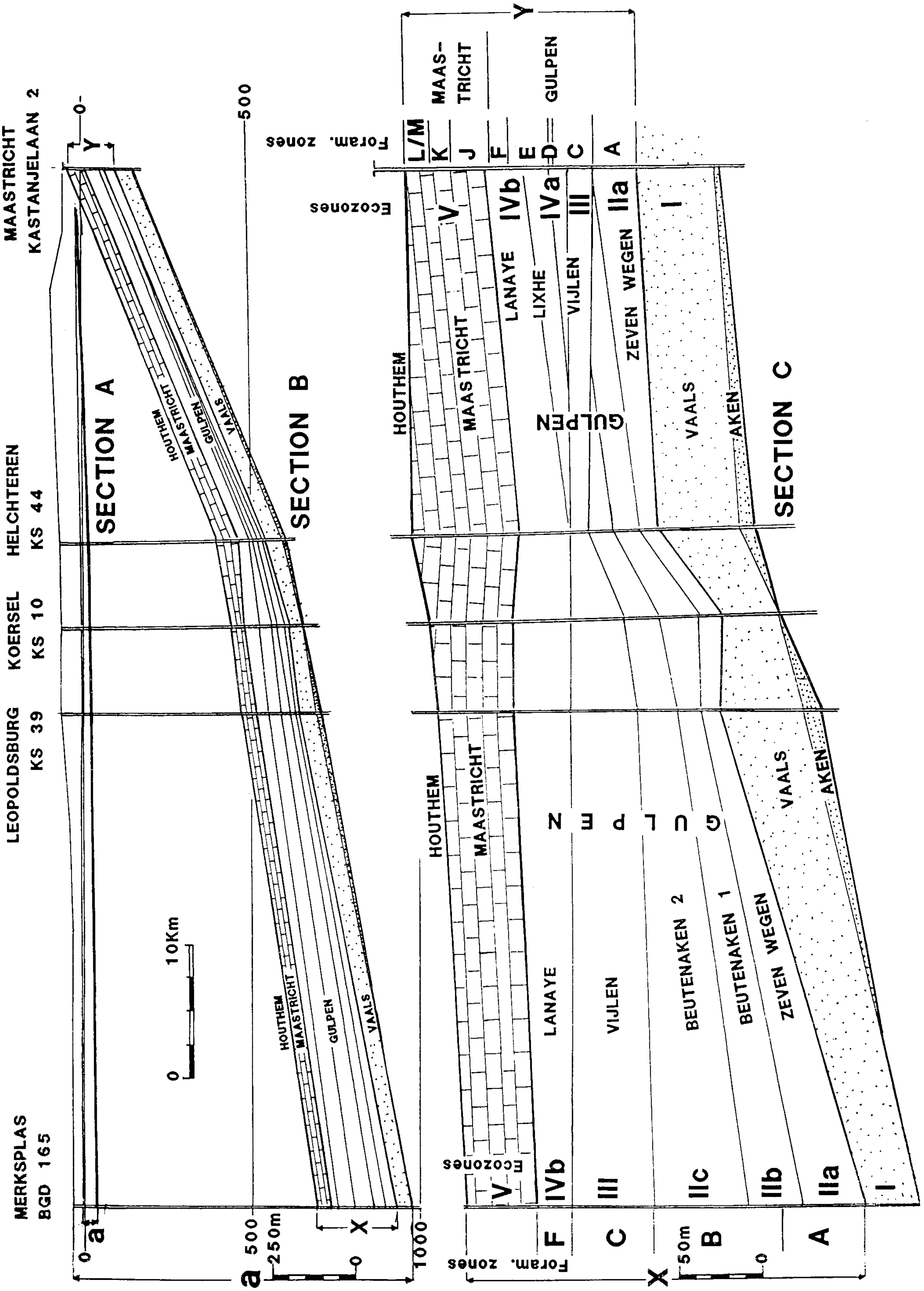

Figure 3. Sections A, B and C, Merksplas-Maastricht. Scale A: length = height, scale B: height exaggerated 20x and scale C: height exaggerated 100x.

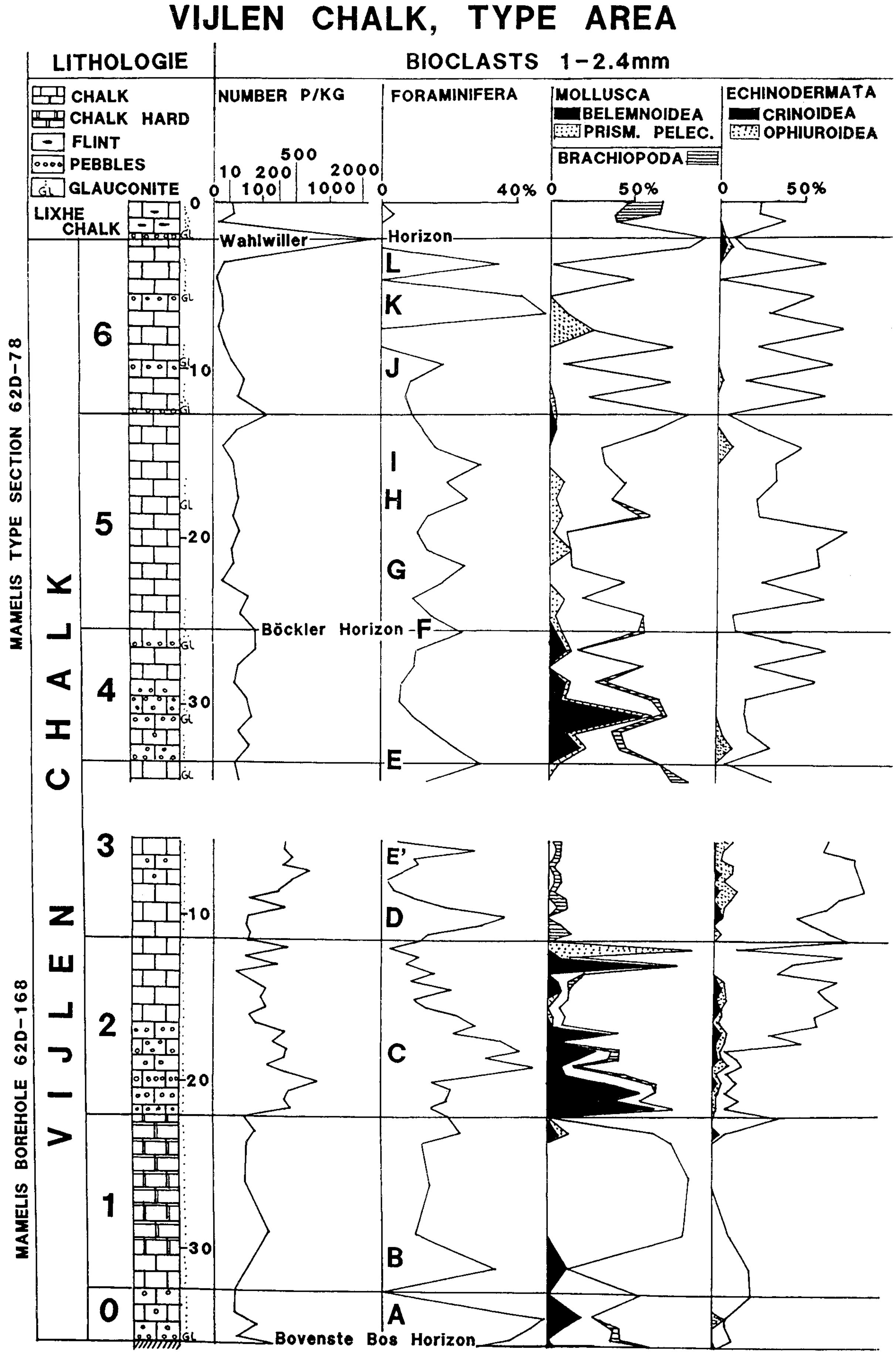

Figure 4. Lithologic section and bioclast content of the Vijlen Member in its type area at Mamelis, Vijlen.

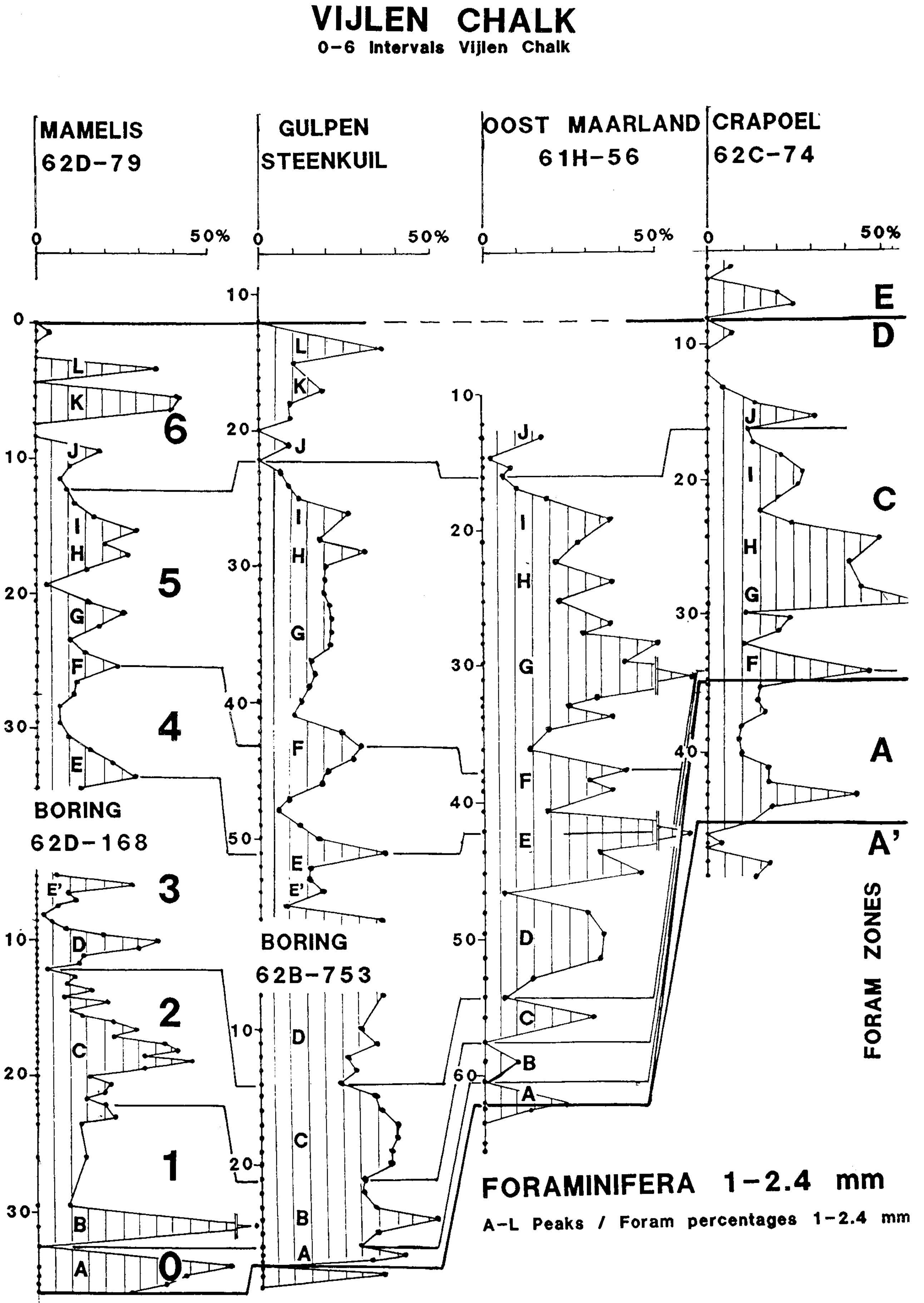

Figure 5. Percentage of foraminifera (1-2.4 mm sieve fraction) in the various boreholes (for location of boreholes see Fig. 7).

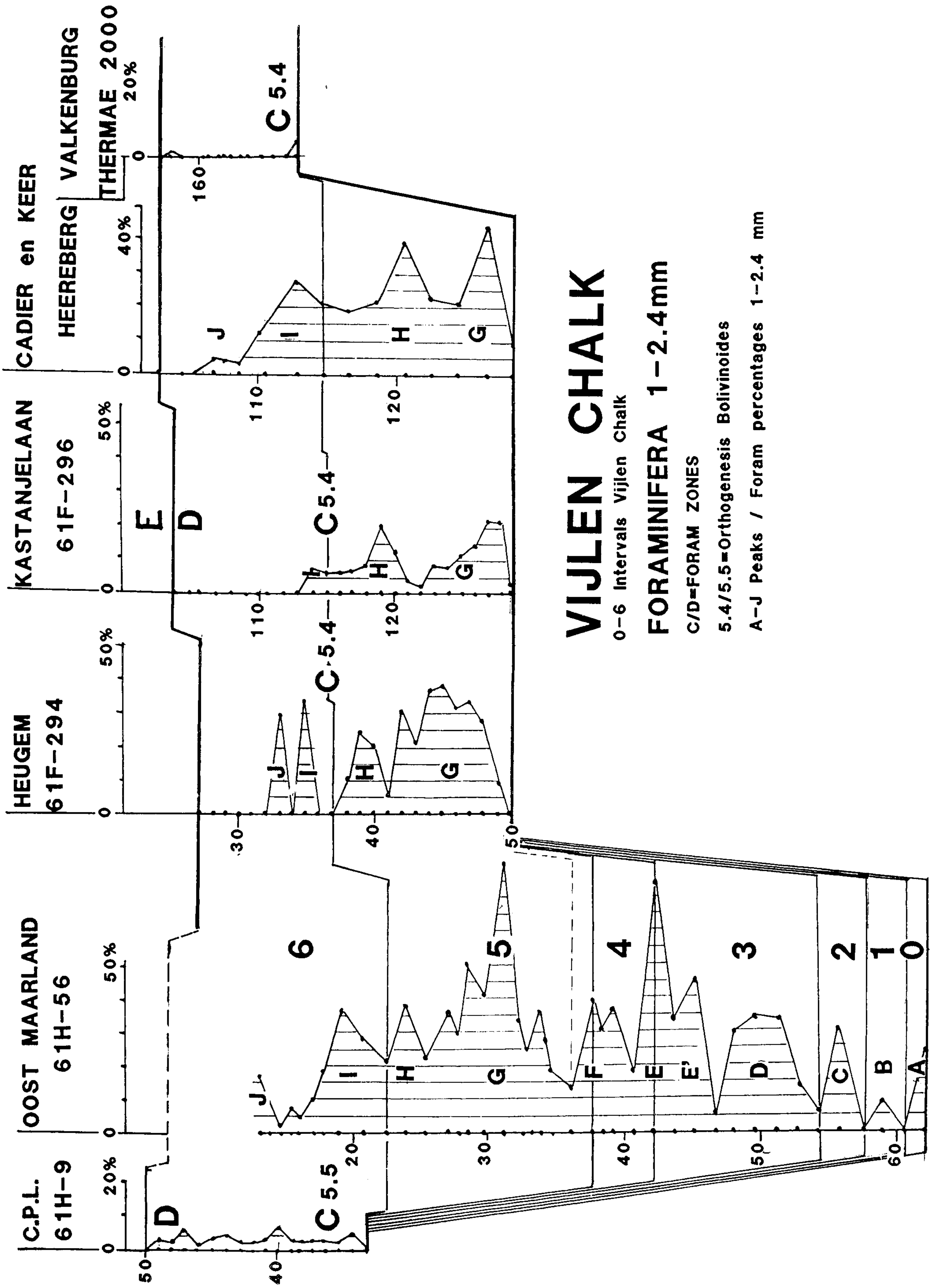

Figure 6. Percentage of foraminifera (1-2.4 mm sieve fraction) in the various boreholes (for location of boreholes see Fig. 7).

One of the striking features of the Vijlen Member are the large differences in thickness encountered. This member is absent from the Roer Valley Graben, from the area northeast of this graben, and from Brabant Massif. In contrast, in a few narrow strips, running more or less parallel to the Roer Valley Graben (Figure 2), occur thicknesses of up to 70 m. Beyond these strips the thickness generally varies between 0 and 30 m. An exception to this rule is the area of the western Campine where on average 50 m of Vijlen Chalk is known. Thickness increase towards the west (Figure 3) correlates with a strong subsidence in the area during deposition of the Beutenaken and Vijlen members. During the next phase subsidence was strongest in the east (Lixhe 1-3 and Lanaye members and Maastricht Formation).

Lithologically the Vijlen Member is very variable (Figure 4). On the one hand are more or less glauconitic chalks with or without pebbles, and on the other pure white fine-grained white chalk-like chalks with small flint nodules. In places indurated portions occur, which in the past have often been referred to as 'Bakovensteen'. Such differences in lithology appeared to occur locally only. Beds extending over large distances were not found. The 'Bakovensteen' of Gulpen and Lemiers turned out to be different and not correlatable. Neither could the glauconitic layers be traced over large distances.

2. SUBDIVISION OF THE VIJLEN MEMBER

The Vijlen Member was subdivided on the basis of bioclasts, foraminifera and ostracods into seven intervals (Figure 4). The forminifera (1-2.4 mm sieve residue) show a few distinct peaks in distribution (marked by A-L in Figure 4). These foraminifera peaks were found in various exposures and boreholes, making possible correlations between exposures (Figures 5, 6).

On the basis of foraminiferal assemblages Hofker (1966) was able to subdivide the Upper Cretaceous chalky strata of Limburg into zones. The Vijlen Member comprised zones C and D, and possibly (locally ?) the lowermost part of zone E (Albers & Felder 1979). Hofker had earlier (1958, 1961) described the orthogenetic development of pustules in the benthic foraminifer genus *Bolivinoides*. In the Vijlen Member this development proceeds from 5 to 6 pustules.

3. AGE OF THE VIJLEN MEMBER

Only two isotopic age assignments based on glauconites from the Vijlen Member are available to date (Priem *et al.* 1975). Sample 71 Lim 2, from the Bovenste Bos quarry yielded an age of 66.7 Ma ± 2.0 Ma and sample 71 Lim 3, from a road cut at Mheer 69.9 Ma ± 2.1 Ma.

Using belemnites Keutgen & van der Tuuk (1990) worked out a biostratigraphic scheme for the Vijlen Member. The glauconit-rich layers directly above the Bovenste Bos Horizont yielded belemnite species of early Early (*obtusa* Zone) and earliest late Early (lower *sumensis* Zone) Maastrichtian age at the type locality of the Bovenste Bos Horizon (exposure 62D-27). The type locality at Mamelis (exposure 62D-79) yielded belemnites typical of the latest late Early (*cimbrica* Zone) and earliest early Late (basal *junior* Zone) Maastrichtian.

Jagt & Kennedy (1994) recorded the scaphitid ammonite *Jeletzkytes dorfi* Landman & Waage 1993 from the lower metres of the Vijlen Member as exposed at the CPL quarry, Haccourt (Belgium), typical of the lower Upper Maastrichtian.

An extensive study into the fossil contents of the Vijlen Member as exposed at the disused Altembroeck quarry (exposure 108 E 119) resulted in the rich collections of macro- and microfossils (Jagt *et al.* 1995). Belemnites collected indicate correlation with the middle *sumensis* Zone (late Early Maastrichtian).

4. SECTIONS

The results from boreholes and exposures in the Liège-Limburg area (Figure 7) were used to compose a number of sections (Figures 3 and 8-12). Sections A, B and C (Figure 3) clearly illustrate the varying sediment thicknesses in the western and eastern areas. The other sections also show the differences in thickness of the Vijlen Member (Figure 8, section D, Halembaye-Valkenburg). In Figure 9, section E (Rullen-Eyserbos) two irregularities in thickness are apparent, which are also recognised in Figure 10, section F, Halembaye-Mamelis. In Figure 11, section G, Merckhof-Mamelis, however, only one of these irregularities is recognised. Such thickness variations are here interpreted as strand plain channels.

5. INTERPRETATIONS

5.1. STRAND PLAIN GULLEY DEPOSITS

During the present study a number of irregularities in the Vijlen Member were recognised (Figures 9, 10 and 11), which are here considered to represent strand plain gulleys. These gulleys developed during a marine regression (Bovenste Bos

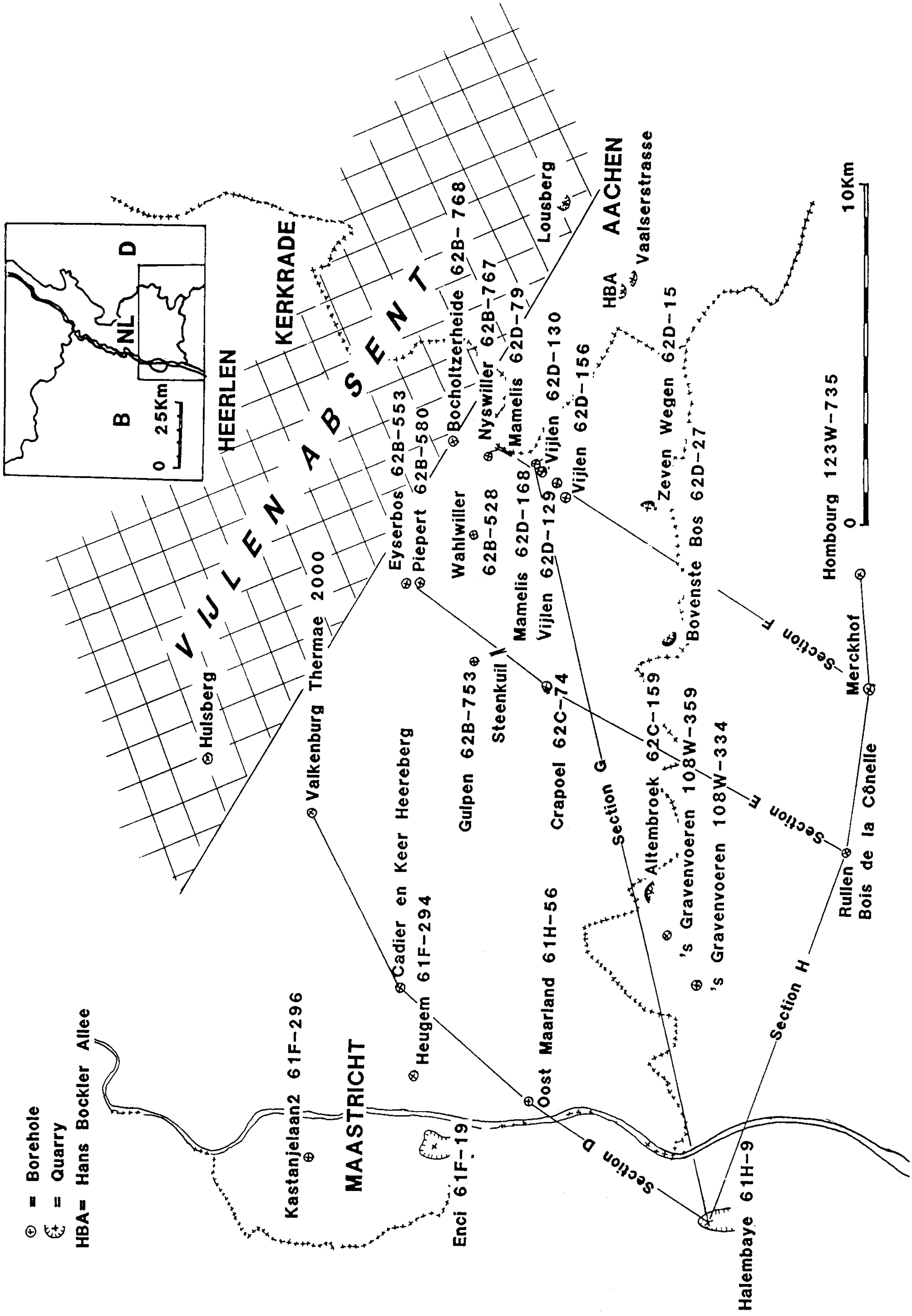

Figure 7. Boreholes and exposures in southern Limburg and the location of sections D, E, F, G and H (Figures 8-12).

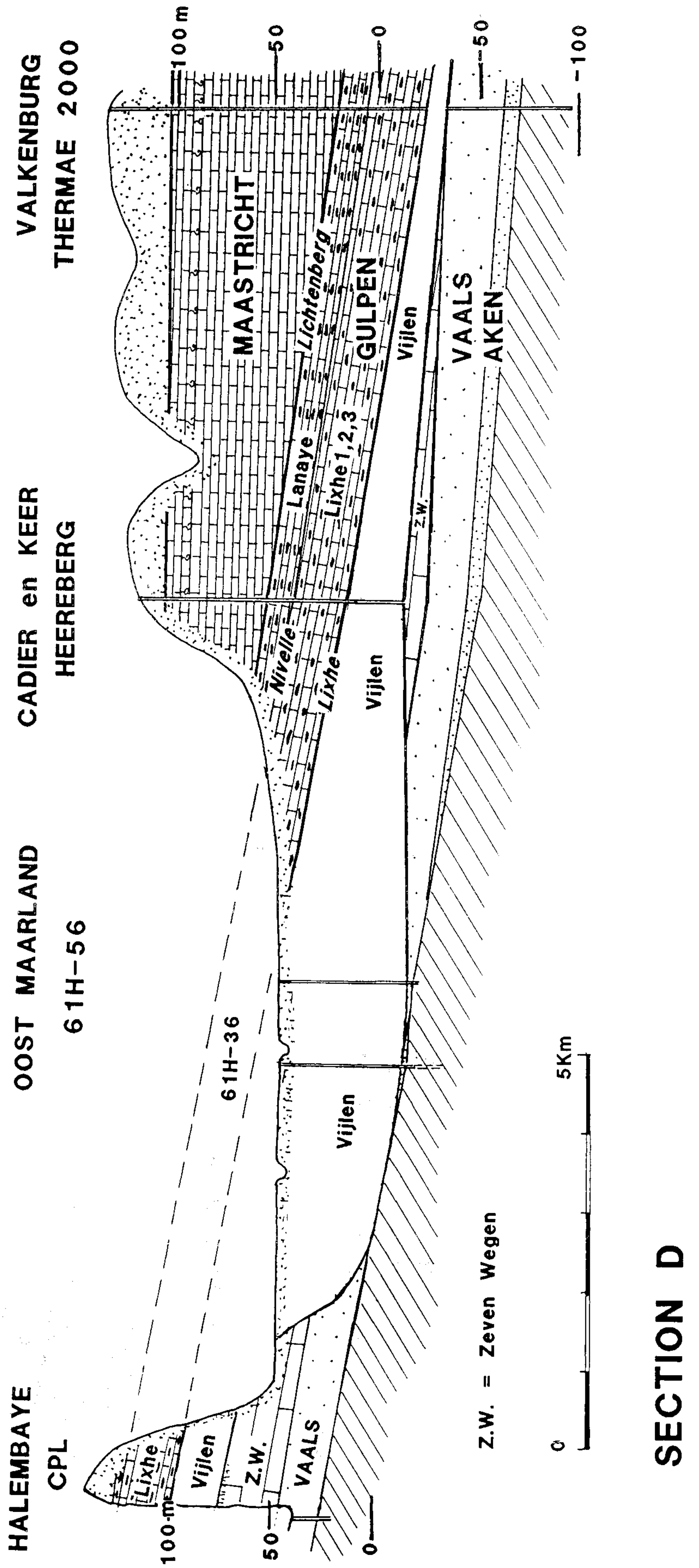

Figure 8. Section D, Halembaye-Valkenburg, height exaggerated 25x.

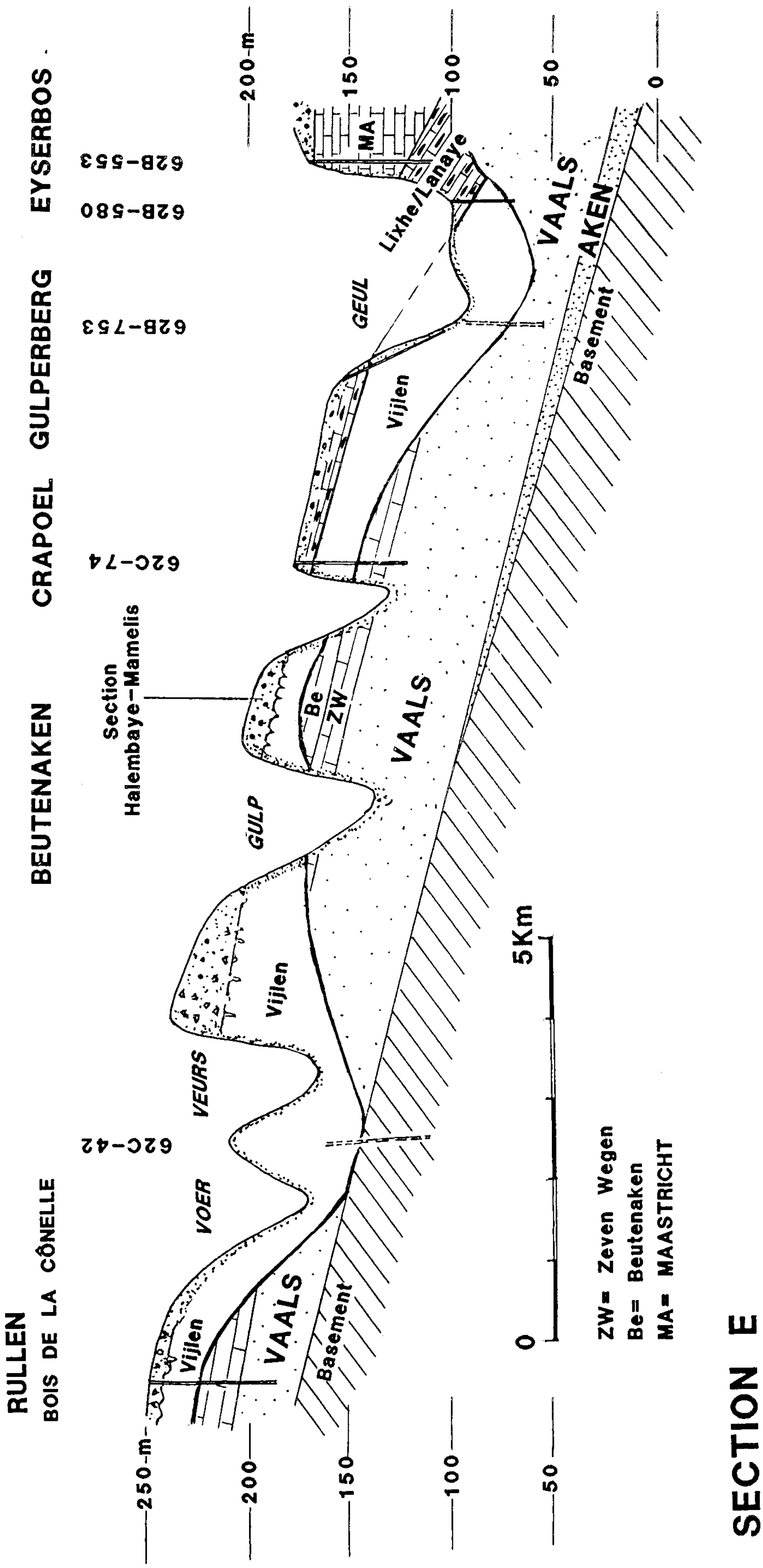

Figure 9. Section E, Rullen-Eyserbos, height exaggerated 25x.

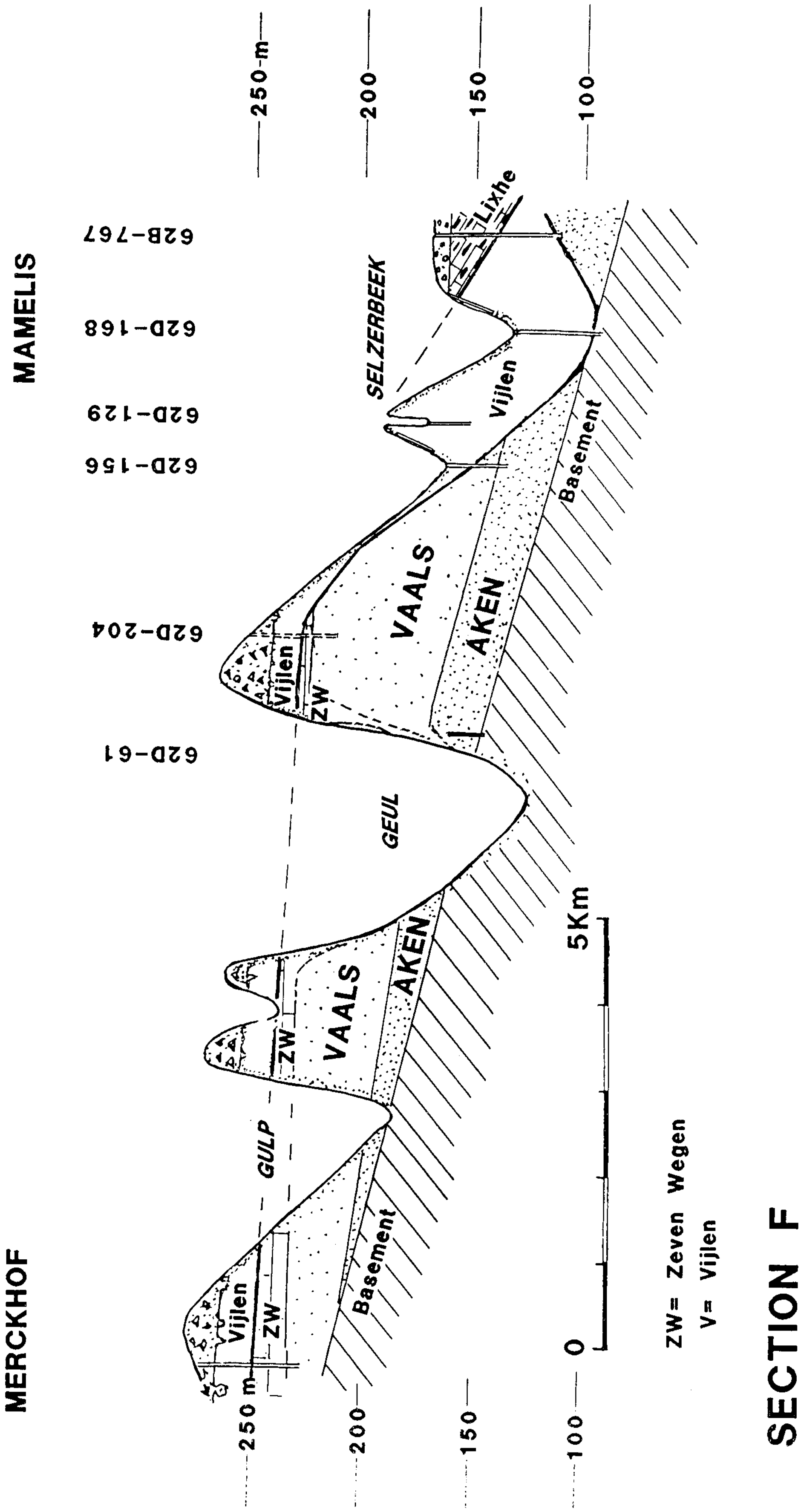

Figure 10. Section F, Halembaye-Mamelis, height exaggerated 25x.

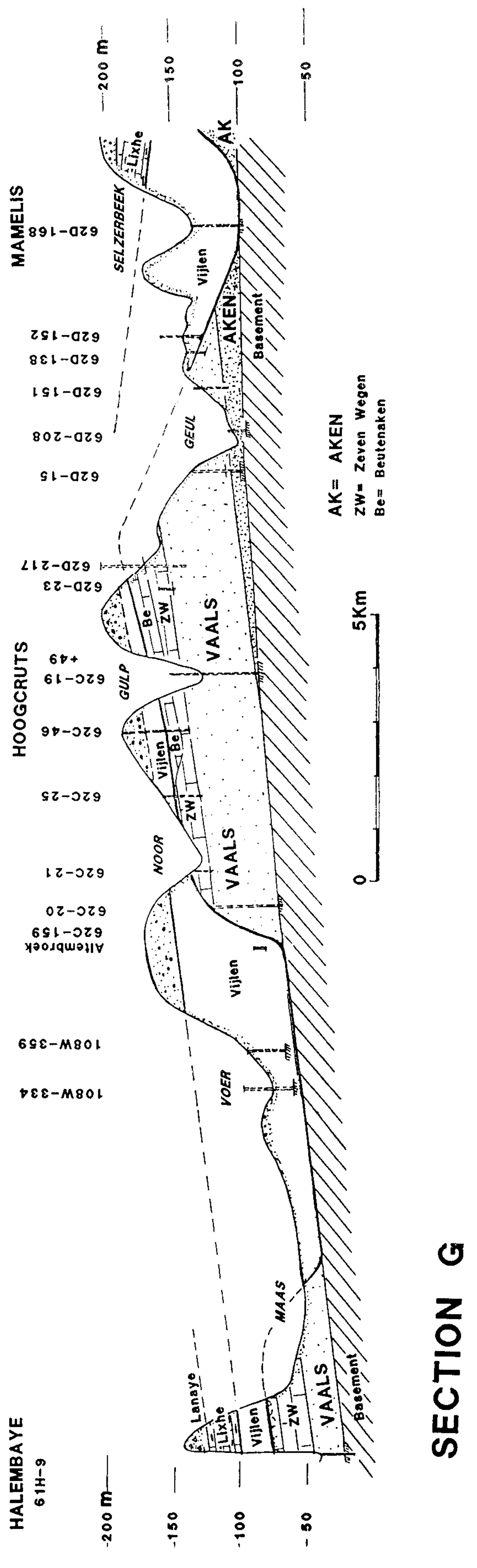

Figure 11. Section G, Merckhof-Mamelis, height exaggerated 25x.

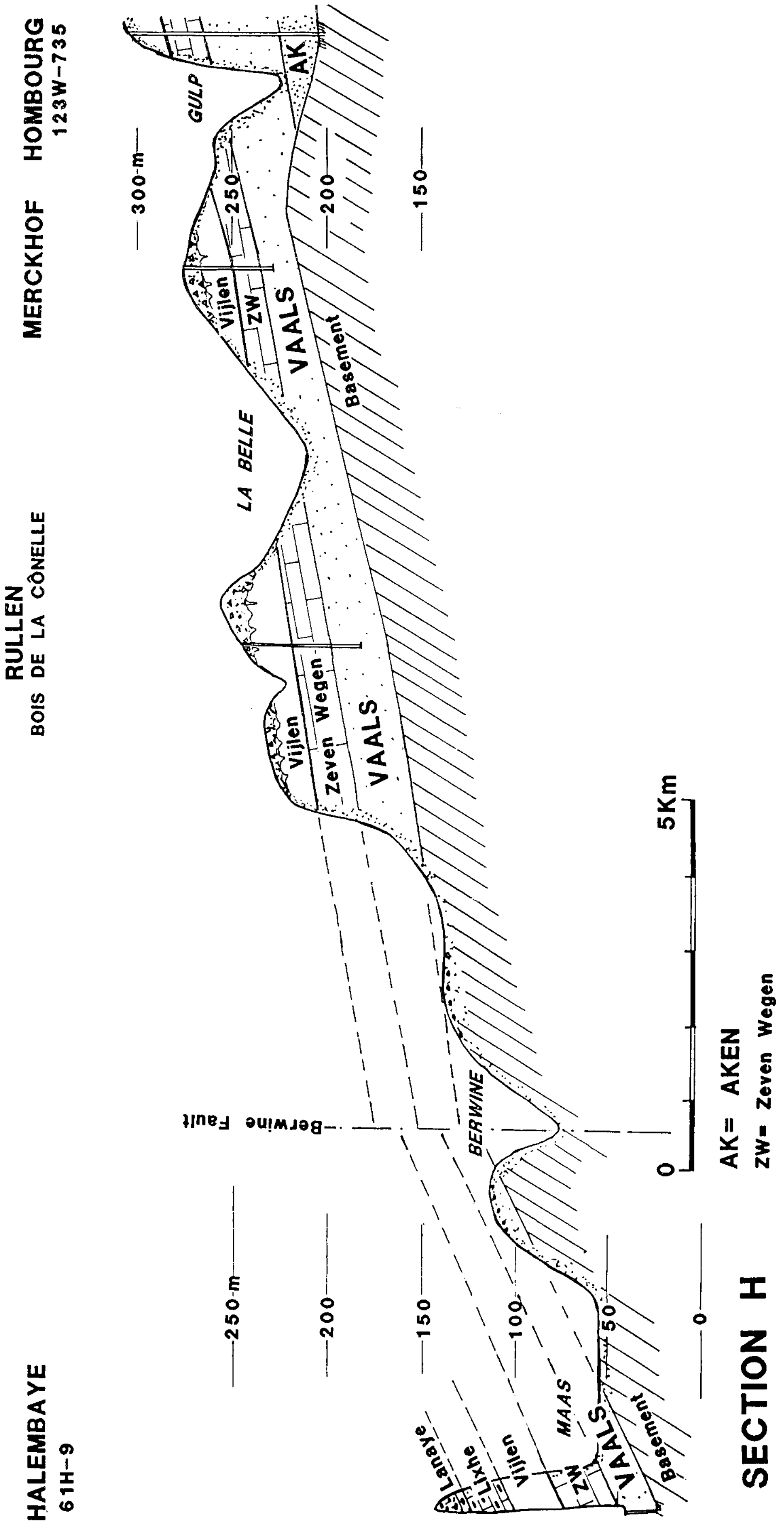

Figure 12. Section H, Halembaye-Hombourg, height exaggerated 25x.

Horizon at the base of the Vijlen Member). This marine regression is characterised by the absence of deposits in the eastern part of the Meuse-Rhine Euregion and by the presence of thicker strata in the western part (Beutenaken 2 Member, see Figure 3). During the regressive phase, sea level dropped to ca. 50 m and strand plain gulleys were eroded in an otherwise fairly flat beach area. As a northwest oriented subsidence took place during this phase, deposits were laid down in that northwesterly area, here referred to as Beutenaken 2 Member (Figure 3). Since the Vijlen Member is also thicker in the western part, it follows that this subsidence continued during deposition of that member. Only during deposition of the Lixhe Member did subsidence change and become stronger in the east.

Deposition of the Vijlen Member started during marine transgression, at first in the strand plain gulleys. The sediments generally contain many bioclasts of Belemnoidea and pebbles (Figure 4). This is an indication of higher water energy. The strand plain gulleys were largely filled with deposits carried from the coast via rip currents. In less turbulent water the amount of Belemnoidea bioclasts and pebbles decreased and sediments are richer in bioclasts of Echinodermata (see Felder & Bless 1994, fig. 19).

5.2. STRAND PLAIN DEPOSITS

Following upon the next marine regression (Böckler Horizon) all strand plain gulleys were filled. The Böckler Horizon was first encountered in the Hans-Böckler-Allee at Aachen by Keutgen & van der Tuuk (1990). Strata below this horizon contain fairly many Belemnoidea and pebbles, while above the horizon Belemnoidea decrease strongly (Figure 4).

During the subsequent transgression a new strand plain came into existence, which was inundated. The chalky deposits laid down on this inundated strand plain in general contain few contaminations. In the northern part of Liège province even white chalk-like deposits with small flint nodules accumulated. Only along the Roer Valley Graben, which probably was still a horst at the time and represented the coastline, did sediments with coarse-grained elements (pebbles) and occasionally many Belemnoidea (Wahlwiller Horizon) accumulate.

During the next phase subsidence in the eastern part was stronger than in the western part (Figure 3). This explains why in the former area thicker sediment bodies accumulated (Lixhe and Lanaye members and Maastricht Formation).

6. ACKNOWLEDGEMENTS

I wish to express my gratitude to the quarry owners for granting access to their property and for the supply of samples from the various boreholes to the 'Kempense Steenkolenmijnen', to Michiel Dusar (Belgische Geologische Dienst) and to Werner Felder (formerly Afdeling Kartering, Rijks Geologische Dienst). Lou Boonen, Hugo Kohnen and Mart Deckers are thanked for assistance during collection of samples, and John Jagt for translation of the manuscript.

7. REFERENCES

ALBERS H.J. & W.M. FELDER, 1979. Litho-, Biostratigraphie und Palökologie der Oberkreide und des Alttertiärs (Präobersanton-Dan/Paläozän) von Aachen-Südlimburg (Niederlande, Deutschland, Belgien). *Aspekte der Kreide Europas, IUGS Series A*, 6: 47-84.

FELDER P.J. & M.J.M. BLESS 1994. The Vijlen Chalk (Early Early to Early Late Maastrichtian) in its type area around Vijlen and Mamelis (Southern Limburg, The Netherlands). *Ann. Soc. géol. Belg.*, 116: 61-85.

FELDER, W.M., 1975. Lithostratigrafie van het Boven-Krijt en het Dano-Montien in Zuid-Limburg en het aangrenzende gebied. *Toelichting bij geologische overzichtskaarten van Nederland*: 63-72, Haarlem.

HOFKER J., 1958. Foraminifera from the Cretaceous of Limburg, Netherlands. XXXVIII, The Gliding change in Bolivinoides during time. *Natuurhistorisch Maandblad*, 1958(11-12): 145-159.

HOFKER J., 1961. Foraminifera from the Cretaceous of Limburg, Netherlands. LII Stratigraphy of the Gulpen Chalk in South Limburg, established by means of the Orthogenesis of *Bolivinoides*. *Natuurhistorisch Maandblad*, 1961(3-4): 37-41.

HOFKER J., 1966. Maestrichtian, Danian and Paleocene Foraminifera. The Foraminifera of the type-Maastrichtian in South Limburg, Netherlands, together with the Foraminifera of the underlying Gulpen chalk and the overlying calcareous sediments, the Foraminifera of the Danske kalk and the overlying greensands and clays as found in Denmark. *Palaeontographica*, Suppl. 10: 1-375.

JAGT J.W.M. & W.J. KENNEDY 1994. *Jeletzkytes dorfi* Landman & Waage 1993, a North American ammonoid marker from the lower Upper Maastrichtian of Belgium, and the numerical age of the Lower/Upper Maastrichtian boundary. *N. Jb. Geol. Paläont. Mh.*, 1994(4): 239-245.

JAGT J.W.M., M. DECKERS, A.V. DHONDT, R.W. DORTANGS, P.J. FELDER, W.M. FELDER, M. JÄGER, N. KEUTGEN, M. KUYPERS, G. MICHELS, J. REYNDERS, E. SIMON, R. VAN DER HAM, P. VAN KNIPPENBERG & R. VAN NEER. 1995. Preliminary report of field work at Altembroeck (NE Belgium, Early Maastrichtian). *Prof. Paper Belgische Geologische Dienst*, 1995/1, N. 276: 1-20.

KEUTGEN N. & L.A. VAN DER TUUK 1990. Belemnites from the Lower Maastrichtian of Limburg, Aachen and Liège. *Meded. Rijks Geol. Dienst*, 44(4): 1-39.

PRIEM H.N.A, N.A.I.M. BOELRIJK, E.H. HEBEDA, B.J. ROMEIN, E.A.Th. VERDURMEN and R.H. VERSCHURE. 1975. Isotopic dating of glauconites from the Upper Cretaceous in Netherlands and Belgian Limburg, 1. *Geologie en Mijnbouw*, 54(3-4): 205-207.

RGD & NOPEGA 1993. Geological Time Scale for the Netherlands, Stratigraphic Nomenclature of the Netherlands, revision and update by RGD and Nopega. *Meded. Rijks Geol. Dienst*, 50, Enclosure A.