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THE MAASTRICHTIAN SEA LEVEL RISE[1]

by

Frans GULLENTOPS[2]

(2 figures)

RESUME.- L'hypothèse d'un maximum eustatique Maastrichtien de plus de 500 m n'est pas supportée par les faits géomorphologiques et sédimentologiques en Ardenne.

ABSTRACT.- The maximum sea level rise during the Maastrichtian has been much less than the 500 m claimed by some recent authors on this subject.
Sedimentological and geomorphological arguments against such an hypothesis are forwarded.

The unique nature of the Upper Cretaceous deposits was recognized very early. Lyell (1874) stressed the astonishing uniformity of the chalk facies in Europe from Ireland to the Crimea. Suess (1883) added a dimension in relating it to a worldwide transgression due to a uniform sealevel change for which he coined the term eustasy.

As worldwide events are of prime importance for better understanding of geologic history, refining of the resolution of these eustatic sea level changes remains a major research goal.

Hancock & Kauffman (1979) have shown that the Cenomanian transgression (Gignoux, 1943) reached in fact its highest sea level during the early Turonian. They also show that the North-western - European Campanian - Maastrichtian transgression is completely different from the overall retreat of the sea in the interior U.S.A. Nevertheless they used the European situation for a calculation of the absolute height of the Maastrichtian sea level and the resulting rates of rise and fall of the same.

In their opinion, the residual mid-Maastrichtian deposits on the north-eastern Ardenne (Hautes Fagnes) form a cornerstone for these calculations which yielded a Maastrichtian sea level rise of some 500 m! F. Robaszynski (1981) has allready recalled that the Hautes Fagnes can not be advanced as an example of a stable massif. We propose here to revise the arguments.

1.- ACTUAL CHARACTERISTICS OF THE TRANSGRESSION SURFACE

The Hautes Fagnes, culminating part of the Ardennes, form a flat-topped, elongated plateau on which the mid-Maastrichtian deposits are preserved as a residual flint layer resting on some (Campanian) glauconitic sands and a basal gravel over the Cambrian basement.
The highest known occurrence is at Mont Rigi (Renier, 1925 and Bourguignon, 1956) at 670 m (Hancock & Kauffman, 1979, relied on earlier finds reaching only 560 m!).

In Hockay (554 m) Felder & Albers (1980) recognized in the 10 m thick flint eluvium the normal stratigraphic succession of the Maastrichtian. They calculated that this eluvium represented an original sequence of 49 m. Thus these

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2 *Instituut voor Aardwetenschapen (K.U.L.), Redingenstraat 16 bis, B-3000 Leuven, Belgium.*

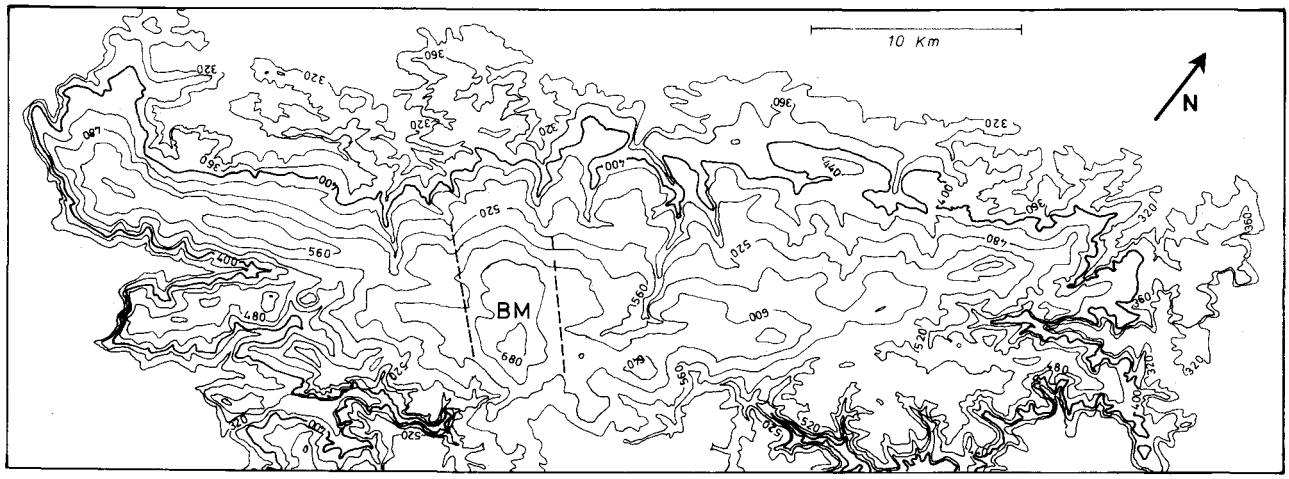

Fig. 1.- The elongated structure of the Hautes Fagnes is not yet dissected. The transverse Baraque Michel (BM) Horst stands out clearly.

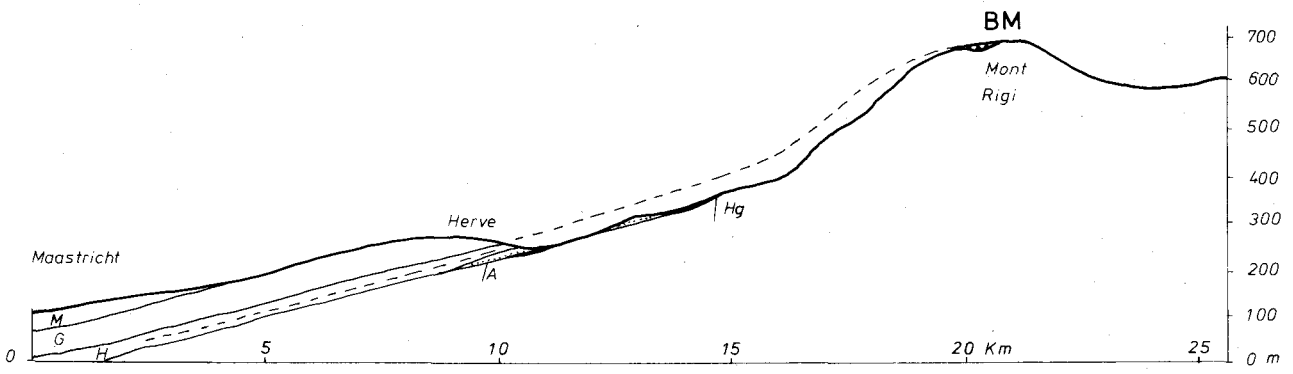

Fig. 2.- The profile of the basement demonstrates the bulging up of the Hautes Fagnes massif. The original peneplain was covered by the Cretaceous *trangressive wedge*: *Hg: lagoonal Hergenrath clay*, A: Aken, coastal tidal sands, H: Herve-Vaals glauconite, G: Gulpen and M: Maastricht chalks.

remnants, preserved on rather flat segments of the plateau, are clearly «in situ». But the topography shows some other significant features.

1) From the North the plateau presents a barrier-like relief. Fig. 1 and 2 show how the Devonian foreland is truncated by a surface sloping about or less than 1° between 320 and 440 m. From there to the toprim the slope steepens to more than 2°. Only strong later uplift can explain such features. As this slope is nearly untouched by riverincision this upwarping must be very recent (Gullentops, 1980).

2) The elongation of the plateau coincides with a complex anticlinal structure of the underlying Cambrian. Long relief trends are formed by thick Revinian quartzites, while large intervening depressions correspond to slates. Probably part of this differential relief existed allready on the infra-Cretaceous peneplain (Baulig, 1926). Essentially Quaternary erosion by the Roannay and the upper reaches of the Hoëgne and the Helle rivulets certainly increased it. In our opinion however this coincidence is due to the exageration of the underlying folds by the recent uplifting : because of their larger bases the anticlines were somewhat pushed out.

3) On the northeast end the contourlines show clearly how the plateau is cut off by the young faults of the Rhine Graben. R. Müller (1983) describes the steplike axial slope of the plateau compartmented by faults or flexures.

The most conspicuous feature however is represented by the summit block of the Baraque Michel. This block is individualized by contourlines perpendicular to the elongation. The abrupt slopes can only the explained as fault steps delimiting a Baraque Michel Horst. The western fault has a throw of about 75 m. These faults were drawn by M. Meyer *et al.*, (1983) and probably meant in an abstract by Demoulin (1985).

The bulge in the contourlines of the foreland shows that these accidents continue towards the northwest. The height difference between the Cretaceous flintlayers at Mont Rigi and Hockay is for the greater part due to this posterior faulting.

On the other hand the lack of freshness of the fault scarps dates the faulting well before the Quaternary.

These structures represent the western limit of the Rhine-Roermond fault system together with the Rauw-fault in the Campine and the alignation of the Western Eifel volcanic activity from Ormont to Bad Bertrich. The earliest activity along this line seems to be Miocene and this would well suite the Hautes Fagnes situation.

For all these reasons it is evident that the Maastrichtian transgression invaded a flat peneplain and that the actual height situation of its remnants is due to faulting and later strong differential upwarping which still continues.

2.- LATE CRETACEOUS SEDIMENTS

If the actual difference in height above sea level between South Limburg and the Hautes Fagnes (some 500 m!) would have existed during the Late Cretaceous, this should have been reflected somehow in the sediments.

The basal (Santonian?) lagoonal Hergenrath Clay (Breddin, 1932) bears only a very fine sand admixture (Vandenberghe, 1984). The following Santonian Aachen Sand and Lower Campanian Vaals (or Herve) Sand and Clay (all representing an onlapping marine shore wedge) contain only a few gravel layers, whereas the sands have a mature quartz mineralogy and do not contain notable rock fragments derived from the Ardennes. The following chalk sedimentation excludes evidently the existence of a strong continental relief in the immediate neighbourhood. Contrary to the typical chalks the Maastrichtian calcarenites were sorted by waves and wavecurrents and hence deposited in shallow seas. There is no indication that the sea was any deeper over the Maastricht type area than over what is now the Fagnes Plateau. The sediments thus show that the Campanian-Maastrichtian transgression encroached on a rather flat peneplain that was easily drowned without supplying much detrital materials.

3.- CONCLUSIONS

The actual relief of the Northern Ardennes is the result of important post-Cretaceous tectonic activity. Therefore the height of its residual Cretaceous deposits cannot be used for the calculation of the late Cretaceous sea level position.

The Devon situation (the other cornerstone for Hancock and Kauffman's 1979 calculations) should also be reexamined. Its situation in between another rift system makes its stability very doubtful. Differential subsidence of sedimentary basins is very obvious nowadays (Ziegler, 1978). We should be aware however that upheaval of erosional blocs may be also differential, as the Ardennes prove.

New finds of flint (Altmeyer 1982, Negendank 1983) indicate that the Maastrichtian transgression penetrated much further to the South in the Eifel. It may be surmised that this deep transgression is not due to a universal sea level rise but to a local subsidence in relation with the southward progression of the North Sea rifting into the Lower Rhine Embayement.

Therefore it is assumed that the Upper Cretaceous eustatic sea level reached its maximum height during the Cenomanian-Turonian and not during the Campanian-Maastrichtian. This idea also better fits with the Pitman curve (Pitman, 1978).

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