Annales de la Société géologique de Belgique, T. 109 - 1986, pp. 573-577 Mai 1987

THE OCCURRENCE OF A CRYPTALGAL REEF STRUCTURE IN THE UPPER VISEAN OF THE VISE AREA (THE RICHELLE QUARRIES)[1]

by

Philippe MUCHEZ[2-3] & Carry PEETERS[2]

(4 figures and 1 plate)

RESUME.- A Visé, un récif s'est développé pendant le «V3by». Le développement du récif a commencé sur une surface de calcaire lithoclastique. Le coeur du récif est formé d'un calcaire crypto-algaire, qui a été lithifié très précocement. Sa croissance a été limitée par l'action des vagues et par une subsidence relativement lente. Les couches, qui flanquent le récif, sont formées par des mudstones, des rudstones, des wackestones et des packstones bioclastiques. Elles sont plus volumineuses que le coeur.

ABSTRACT.- During the «V3by», a reef developed in the Visé area. The initial growth of the reef started on a lithoclastic limestone surface. The reef core is built up of early lithified cryptalgal limestones. Its growth was limited by wave action and a relatively low subsidence rate. The flanking beds consist of mudstones, bioclastic wackestones and packstones and rudstones. They are volumetrically more important than the core.

I.- INTRODUCTION

The Visé area forms the eastern extension of the Campine-Brabant Basin (fig. 1). The Visean carbonates of this area are known by several outcrops, ancient quarries and some boreholes. In this study 35,5 m of «V3by» of the Richelle F, G and H quarries are investigated. These quarries are situated between the town of Visé and Argenteau along the river Meuse (fig. 2).

The biostratigraphy and the lithology have been studied by Pirlet (1967), Kimpe *et al.* (1978) and Poty (1982). In this paper, the environment and the facies of the «V3by» limestones are deduced from sedimentpetrographical investigations.

II.- MACROSCOPIC AND FIELD INVESTIGATIONS

The «V3b» strata of the Richelle F, G and H quarries form a more or less massive, domal structure (fig. 3). In the G quarry, the rare bedding planes show a dip of 10° to 20°. Geopetal infillings in the lower «V3by» limestones of the G quarry reveal a dip of 10° in the opposite direction (Pl. 1 : 1). This indicates sedimentation on a slope of 20° to 30° (fig. 3).

The «V3by» unit was deposited on a lithoclastic and bioclastic limestone which is probably of «V3a-3b» age (Pirlet, 1967 and Kimpe *et al.*, 1978). The lithoclasts are partly derived from local Middle Frasnian highs (mogotes and lapies; Poty, 1980) and partly from submarine erosion.

Pirlet (1967) subdivided the «V3by» interval into five lithological units : d_5, d_4, d_3, $d_2$and d_1 in stratigraphical order. This subdivision is used in the macroscopic and sedimentpetrographical descriptions (fig. 4).

The unit d_5 is a massive, micritic limestone, 3,5 m thick. Fossils are rare, only brachiopods, corals and gastropods were found. A characteristic

1. *Revised manuscript received on 9 September 1986.*

2. *Katholieke Universiteit Leuven, Fysico-chemische geologie. Celestijnenlaan 200C, B-3030 Heverlee (Belgium).*

3. *Research assistant NFWO.*

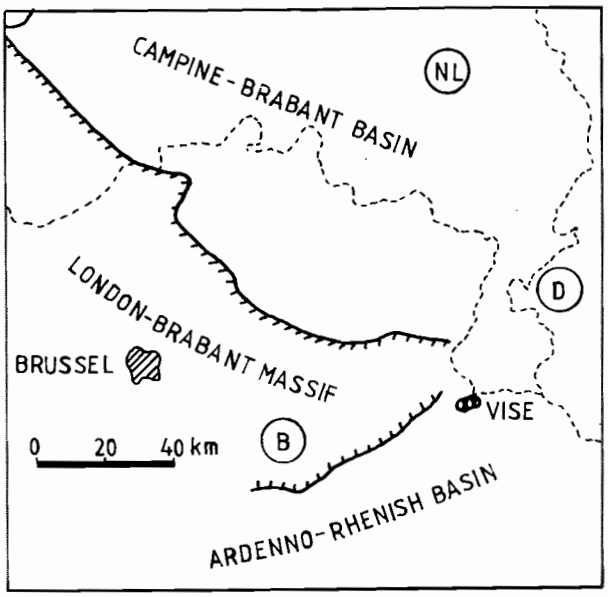


Fig. 1.- Location of the Visé area.

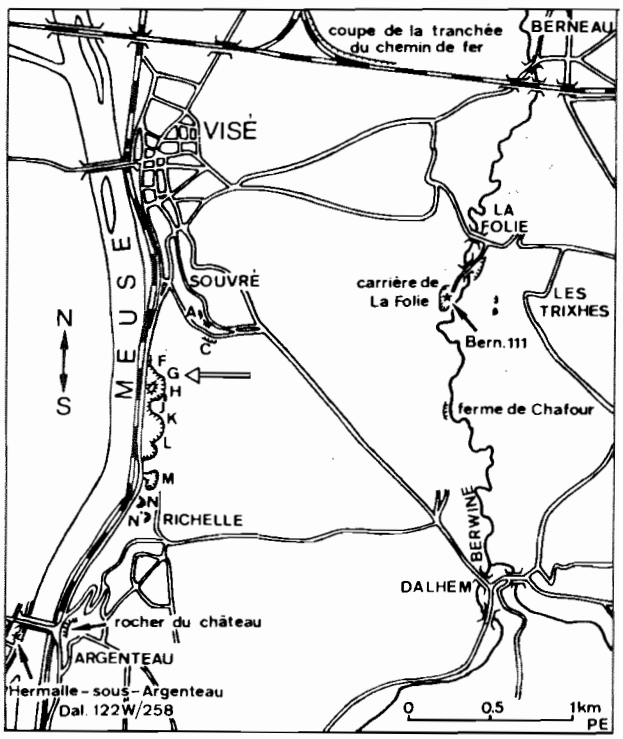


Fig. 2.- Location of the Richelle quarries between Visé and Argenteau (Poty, 1982).

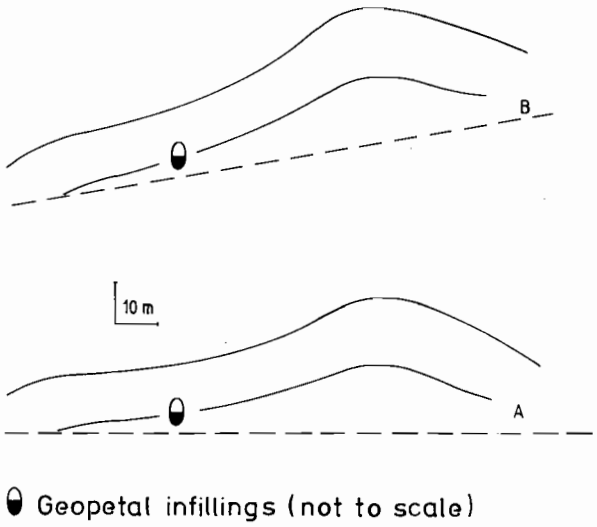


Fig. 3.- Domal structure of the «V3by» strata in the Richelle G and H quarries
A. Actual domal structure; B. Structure during deposition.

feature of this unit is the occurrence of very large stromatactis (30 cm by 6 cm). They contain two calcite cement generations (pl. I : 2), i.e. a dark cement and a white blocky cement. The stromatactis are frequently parallel to the bedding plane. Polished and etched surfaces very often reveal an irregular pattern in the micritic limestone (pl. I : 3), suggesting organic growth structures.

The unit d_4 is formed by 6,5 m massive, fine-grained limestone. The fossil content is restricted to brachiopods, crinoids and corals. Stromatactis with two cement generations occur. As in the unit d_5, an irregular pattern is observed on etched surfaces.

The unit d_3 is 12,5 m thick and consists of a bioclastic, sometimes brecciated limestone. Micritic clasts are bound together by a dark cement. Also later brecciation through dissolution processes has been recognized. Corals, crinoids, mollusks and brachiopods occur as broken fragments.

The unit d_2 (4,5 m thick) contains broken mollusks, crinoids and accumulations of brachiopods in a coarse-grained matrix. Sometimes, this unit is micritic.

The uppermost unit d_1 (8,5 m thick) is characterized by an accumulation of fossils (brachiopods, corals, crinoids), intraclasts, oncoids and large fragments of stromatolites.

III.- SEDIMENT PETROGRAPHY

In the sediment petrographical study, special attention has been given to the irregular structures in the units d_5 and d_4.

The unit d_5 consists of a clotted, peloidal lime mudstone (pl. I : 4-5) which may contain interparticle and tiny fenestral pores. These fenestrae are either formed by the bridging of voids by algal mats or by the decay of algal material (Monty, 1976). The peloidal and clotted texture and the

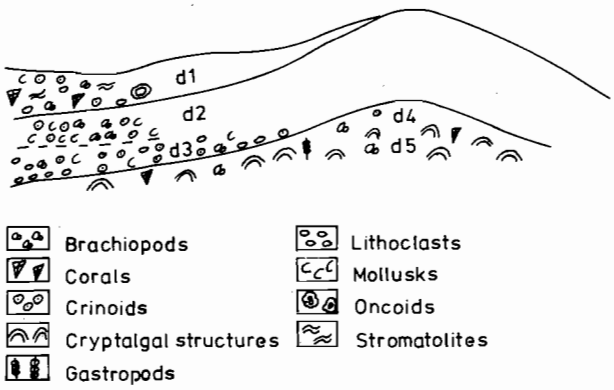


Fig. 4.- Distribution of the lithological units of the «V3by».

cryptalgal structures are characteristic for non-laminated cryptalgal bodies (thrombolites, Aitken, 1967). They occur in Phanerozoic shallow water reefs (Pratt & James, 1982) as well as in deeper water mud-mounds (Pratt, 1982; Tsien, 1985; Lees & Miller, 1985). The stromatactis contain a fibrous radiaxial cement and a blocky cement.

The sediments of the unit d_4 show the same cryptalgal structures as those of the unit d_5. Fenestrae in a cryptalgal boundstone are filled with a pelleted lime mudstone (pl. I :6).

Bioclastic wackestones and packstones occur in the unit d_3. Cryptalgal clasts and a large quantity of crinoids, foraminifers, moravamminids and sponge spicules have been recognized.

The carbonates of the d_2 and d_1 units consist of rudstones, packstones and mudstones. The fossil content is made up of crinoids, foraminifers, green algae, ostracods, calcispheres, corals, brachiopods, mollusks and bryozoa. In the d_1 unit, ostracods, mollusks and brachiopods are thick-shelled. The bioclasts are often micritized. In contrast with the d_5 and d_4 units, the diversity of the fauna is very high. Peloidal textures still occur in the units d_3, d_2 and d_1 but they never form a framework.

IV.- INTERPRETATION

Based on the rare bedding planes and the geopetal infillings, the depositional slope in the units d_5 and d_4 dips 20° to 30°. The domal structure was formed by the activity of cryptalgae. According to Bathurst (1982), stromatactis indicate an early submarine lithification. This process is important for the formation of the shallow water thrombolite bioherms (Pratt, 1982). These data indicate that the units d_5 and d_4 represent a reef mound and more specifically the core of the reef mound.

The units d_2 and d_1 comprise an accumulation of brachiopods, mollusk and crinoids along with a high quantity of early lithified lime mudstones (lithoclasts). These lithoclasts point to a high energy environment during the deposition of the d_2 and d_1 units. The units d_3, d_2 and d_1 form the reefcap of the reefmound. Volumetrically, these flank beds are more important than the core.

During Visean time, the Visé area was situated near the London-Brabant massif and some smaller positive areas (Poty, 1982). The cryptalgal reef was formed near these smaller paleoreliefs of Middle Frasnian age and is probably related with them (Poty, 1986, personal communication). The «V3by» reef is situated on top of a bioclastic, lithoclastic limestone. Many thrombolites started to grow on limestone pebble conglomerates or coarse biocalcarenites (Aitken, 1967). So the underlying strata were favourable for the colonization by cryptalgae. However, the Visé area was not suitable for the development of a large reef. The high energy environment and the relative low subsidence rate, which both can be related to the paleogeographical position of the Visé area, limited the reef growth; this indicates that the paleogeographical position had a major influence on the development of the reef.

V.- CONCLUSION

The «V3by» limetones of the Richelle quarries form a reef structure. The development of the reef started on a lithoclastic limestone. The basal 10 m of early lithified cryptalgal limestones represent the reef core. Its growth has been limited by the high energy of the environment and the relative low subsidence rate. The flank beds (24 m thick) are volumetrically more important than the core.

ACKNOWLEDGEMENTS

We thank Prof. Dr. W. Viaene, who supervised this work for his encouragement and stimulating discussions. We are grateful to Dr. E. Poty for introducing us to many aspects of the stratigraphy of the Visé area and to Dr. H. H. Tsien for sharing his experience of cryptalgal textures with us. Ph. M. thanks Dr. T. Ford for a field trip on the Derbyshire Platform which led to a better insight in the paleogeography of Visean reefs. Ms. M. Van Steenwinkel made helpful suggestions in the preparation of this text, Mr. C. Moldenaers and Ms. A. Van Espen are thanked for their technical assistance.

BIBLIOGRAPHIE

AITKEN, J.D., 1967.- Classification and environmental significance of cryptalgal limestones and dolomites, with illustrations from the Cambrian and Ordovician of south-western Alberta. *Jour. Sed. Petrology,* 37 (4) : 1163-1178.

BATHURST, R.G.C., 1982.- Genesis of stromatactis cavities between submarine crusts in Palaeozoic carbonate mud buildups. *J. geol. Soc. London,* 139 : 165-181.

KIMPE, W.F.M., BLESS, M.J.M., BOUCKAERT, J., CONIL, R., GROESSENS, E., MEESSEN, J.P.M.Th., POTY, E., STREEL, M., THOREZ, J. & VANGUESTAINE, M., 1978.- Paleozoic deposits east of the Brabant Massif in Belgium and the Netherlands. *Meded. Rijks Geol. Dienst,* 30 (2) : 37-103.

LEES, A. & MILLER, J., 1985.- Facies variation in Waulsortian buildups, Part 2; Mid-Dinantian buildups from Europe and North America. *Geol. Journ.,* 20 : 159-180.

MONTY, C.L.V., 1976.- The origin and development of cryptalgal fabrics. *In :* Walter, M.R. (ed.) : Stromatolites : *Developments in Sedimentology,* 20, Amsterdam, Elsevier : 193-249.

PIRLET, H., 1967.- Nouvelles interprétations des carrières de Richelle : le Viséen de Visé. *Ann. Soc. géol. Belg.,* 90 (4) : B299-328.

POTY, E., 1980.- Evolution and drowning of paleokarst in Frasnian carbonates at Visé, Belgium. *Meded. Rijks Geol. Dienst,* 32 (7) : 53-55.

POTY, E., 1982.- Paléokarst et brèches d'effondrement dans le Frasnien moyen des environs de Visé. Leur influence dans la paléogéographie dinantienne. *Ann. Soc. géol. Belg.,* 105 (2) :315-337.

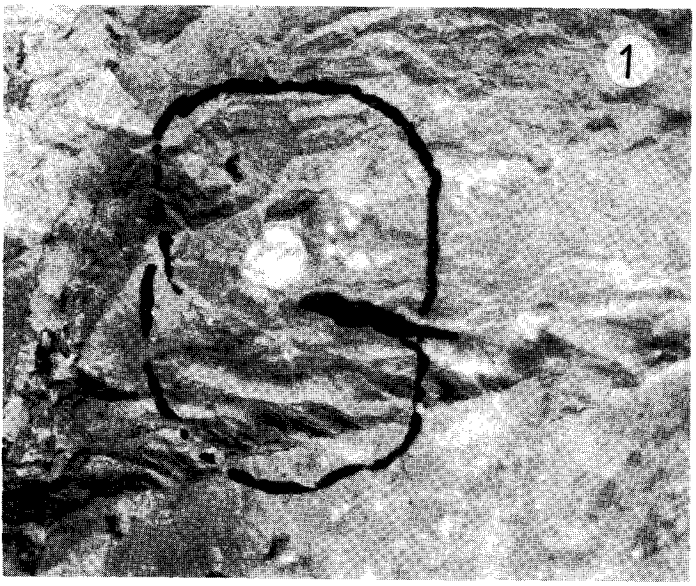
PRATT, B.R., 1982.- Stromatolitic framework of carbonate mud-mounds. *Jour. Sed. Petrology,* 52 (4) : 1203-1227.

PRATT, B.R. & JAMES, N.P., 1982.- Cryptalgal-metazoan bioherms of early Ordovician age in the St. George Group, western Newfoundland. *Sedimentology,* 29 : 543-569.

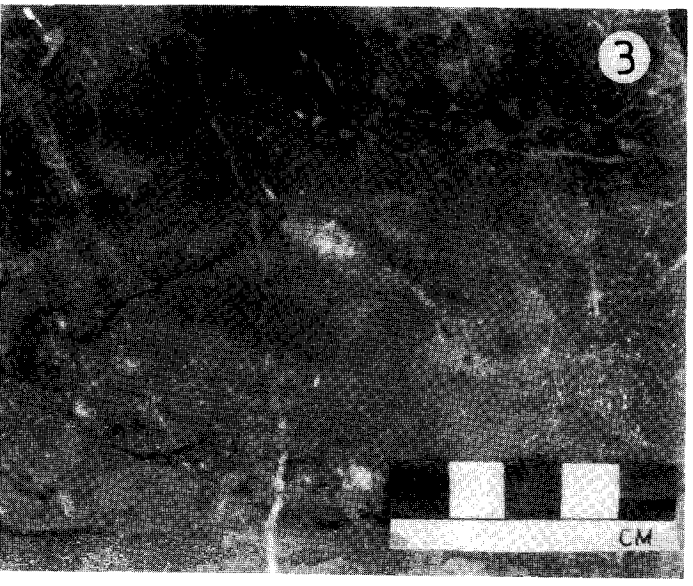
TSIEN, H.H., 1985.- Algal-bacterial origin of micrites in mud mounds. *In :* Toomey, D.F. & Nitecki, M.H. (eds) : Paleoalgology, contemporary research and applications, Springer-Verlag Berlin Heidelberg New-York, Tokyo : 290-296.

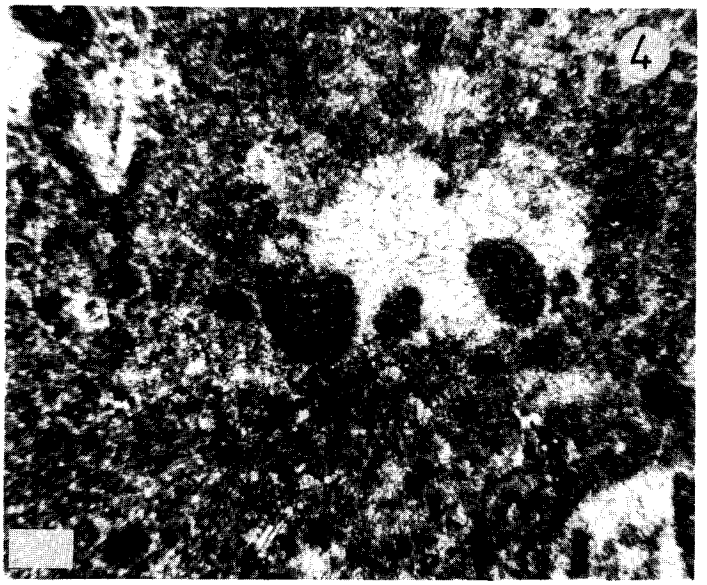
PLATE 1

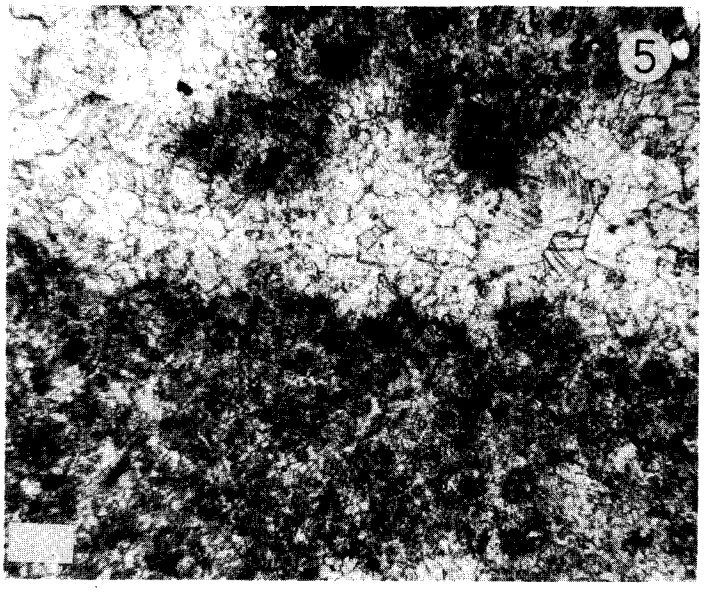
1. Geopetal infilling in unit d_4.
2. Stromatactis cavity with two cement generations : a dark cement and a white blocky cement.
3. Polished and etched surface of a sample of the d_5 unit : irregular pattern in the micritic limestone.
4. Thin section photomicrograph of a clotted, peloidal lime mudstone (unit d_5). Scale bar is 240 μm.
5. Thin section photomicrograph of a clotted, peloidal lime mudstone with a fenestral pore (unit d_4). Scale bar is 240 μm.
6. Thin section photomicrograph of a cryptalgal boundstone filled with a pelletal lime mudstone (unit d_4). Scale bar is 1 mm.

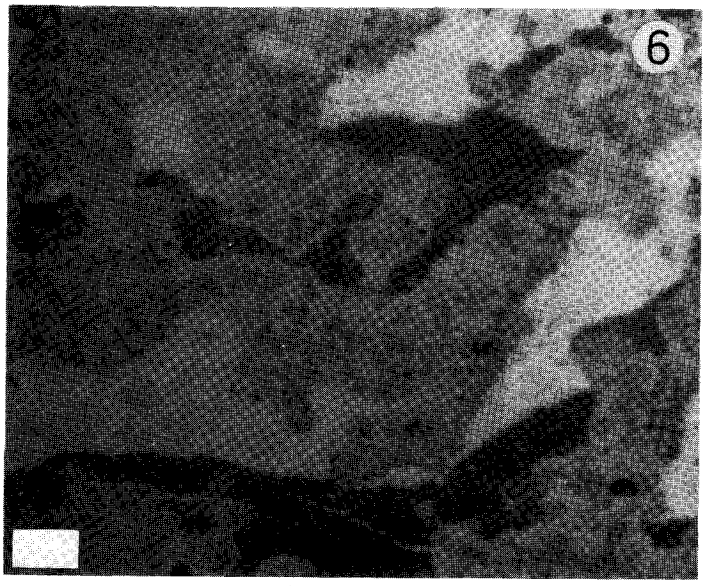

1


2


3
CM


4


5


6