UNUSUAL BIOLOGICAL ASSOCIATION EVENT WITHIN THE LATE FRASNIAN CRISIS



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1. GEOLOGICAL SETTINGS

In the Namur-Dinant Basin (southern Belgium, Fig. 1), the Upper Frasnian is mainly represented by the three members of the Aisemont Formation. The lower member varies from argillaceous limestone with brachiopods to a biostrome with Alveolites, phillipstastreids and stromatoporoids. The middle member is a fossiliferous shale unit with a dysoxic level corresponding with the Lower Kellwasser Event. The upper member is a bioclastic limestone, with phillipsatreid corals and numerous oncoids (Fig 2). The Aisemont Formation recorded a third order trangressive-regressive cycle sequence (Poty & Chevalier, 2007) that fits with the first part of the IId cycle of Johnson et al. (1985, Fig. 2) and with the "semichatovae Trangression" (Alekseev et al. 1996). The sequence boundary is the last erosion surface capping the Aisemont Formation limestone on which the Upper Frasnian shale have deposited (Fig 2). The stratigraphic succession of rugose corals has permitted a local biostratigraphy ("Faune 1-2-3" of Coen et al. (1976), Fig. 2).

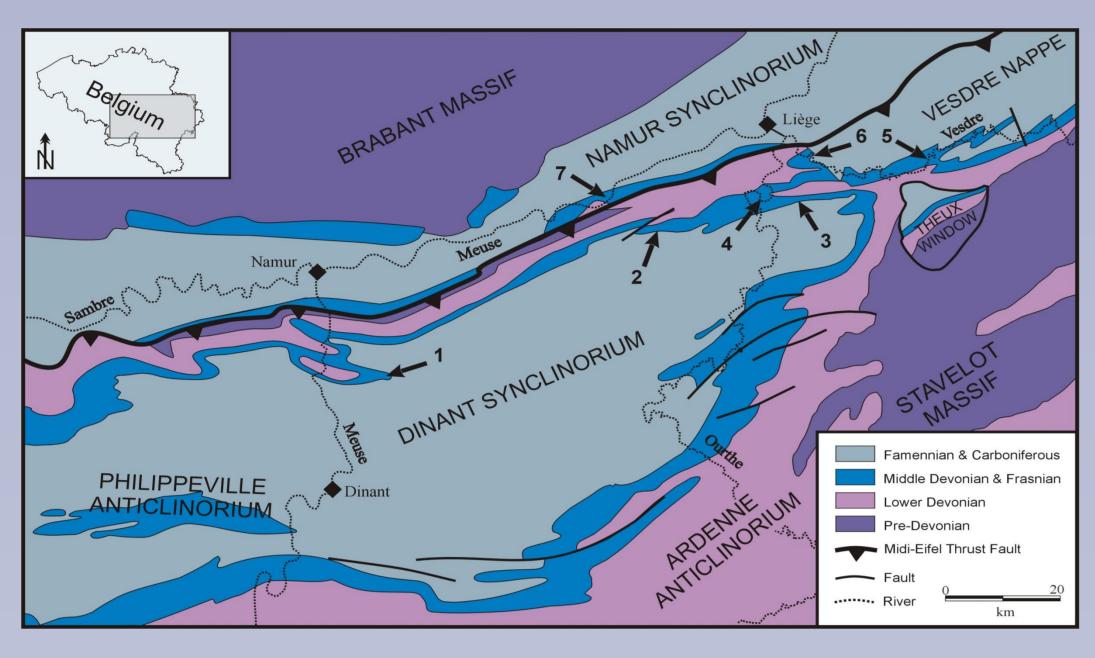


Fig. 1: Structural map of Belgium and neighbouring countries, with location of studied sections. Post-Carboniferous strata have been omitted of the map. 1: Bauche, 2: Baugnée, 3: Dolembreux, 4: Hony, 5: Lambermont, 6: Fond-des-Cris, 7: La Mallieue.

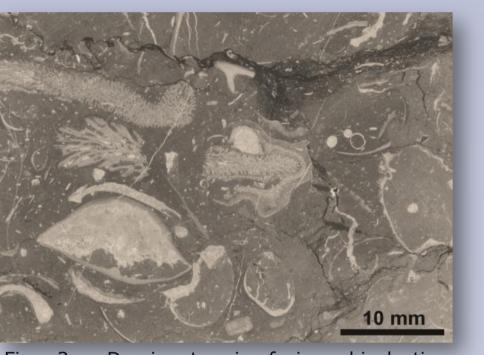


Fig. 3a: Dominant microfacies: bioclastic wackestone-packstone to floatstone. Baugnée section



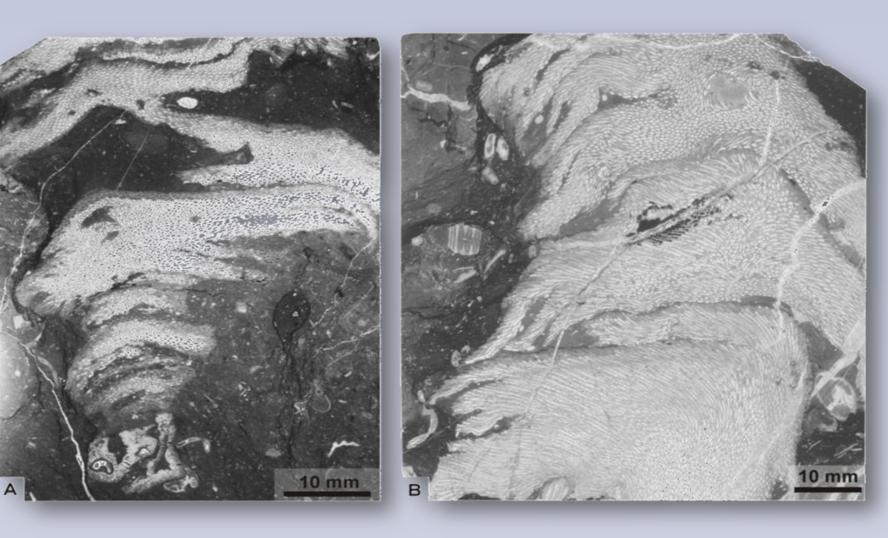
Fig. 3b: Biostrome with phillipsastreids and *Alveolites* colonies from the Hony section.

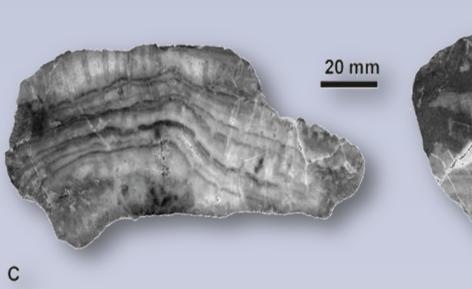
FSST UKW ES www. ES www ate rhenana "Faune 2" cycle MFS LKW "Faune 1 Figure 2: Belgian Late Frasnian bio- and sequence stratigraphy. LKW: Lower Kellwasser Event, UKW: Upper Kellwasser Event. HST: highstand systems tract. SB: sequence boundary. TST: Transgressive systems tract. MFS: maximum flooding surface FSST: falling stage systems tract. ES: erosion surface. ling.: linguiformis, triang.: triangularis. R: regression, T: transgression.

2. PALAEOENVIRONMENTAL CONTEXT AND DISCUSSIONS

2.1. Biostrome and corals

Within the dominant bioclastic wackestone-packestone to floatstone facies (Fig. 3a), one thin biostrome is made of a framestone with phillipstastreids and *Alveolites* (Fig. 3b). The phillipsastreid colonies are usually ragged and striated (Fig. 4) by regular light-dark levels. Each light-dark doublet can be considered as corresponding to one year: during the good season, the corals had formed a light lamina, during the bad season, they were fighting against burial and had decreased, forming a dark lamina. The poor extension of the biostrome witnesses that the good conditions have been short-lasting and this ecological niche was stable very shortly.





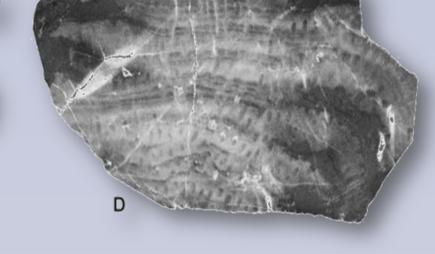
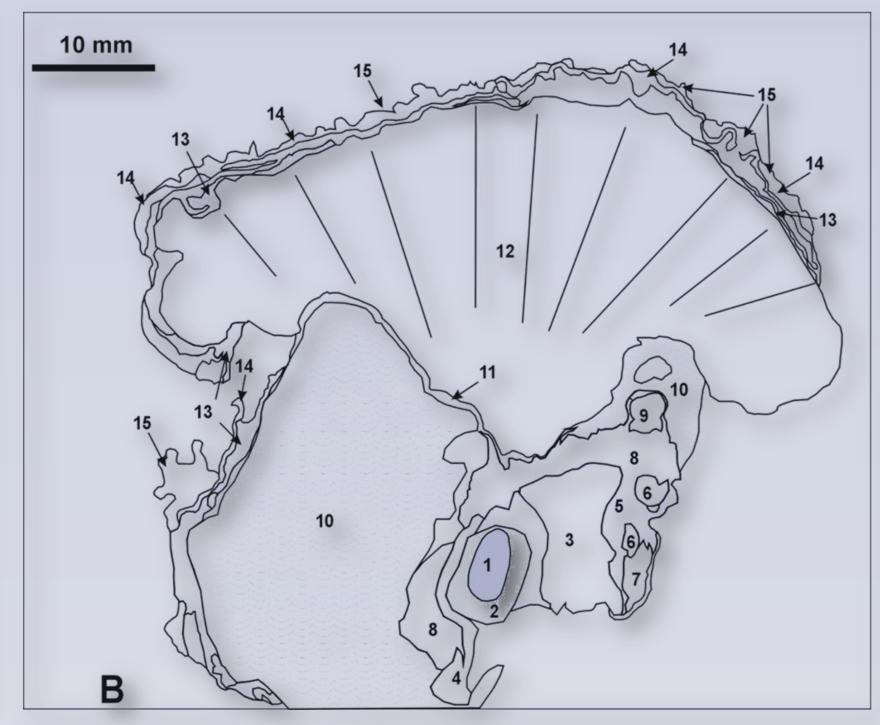


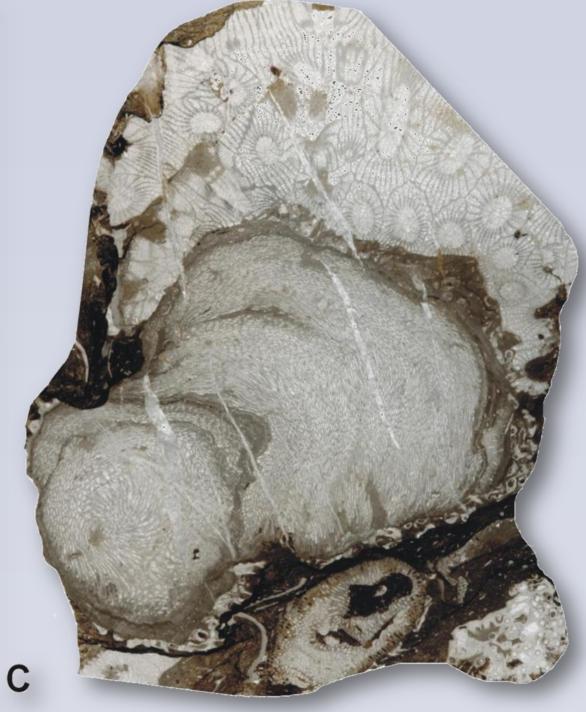
Fig. 4: Ragged colonies of corals. A: irregular *Alveolites suborbicularis*, witnessing a very variable sedimentation rate. Baugnée section. B: Much regular A. suborbicularis with a domal shape allowed by a growth rate higher than sedimentation. Baugnée section. C & D: Polished slabs of *Frechastraea pentagona* and *Phillipsastrea ananas* colonies showing dark-light lines corresponding to densely-normally packed dissepiments alternation. Fond-des-Cris section.

2.2. Multi-encrusted bodies

The complex oncoids and multi-encrusted bodies consist of nuclei coated by micritic microbial laminae ("Girvanella") and encrusting organisms (Alveolites, Sphaerocodium, stromatoporoids, Cyclotrypa, auloporids and serpulids worms). They represent micro-environments favorable to the development of organisms within unfavorable facies. Each solid particle may constitute the starting point of growth for the organisms that might result in "micro-patch-reefs" scattered on the soft muddy sea floor. These bodies has also recorded the different steps of colonization, encrustation, growth, waxing, waning, overturning and death of the organisms (Fig. 5).







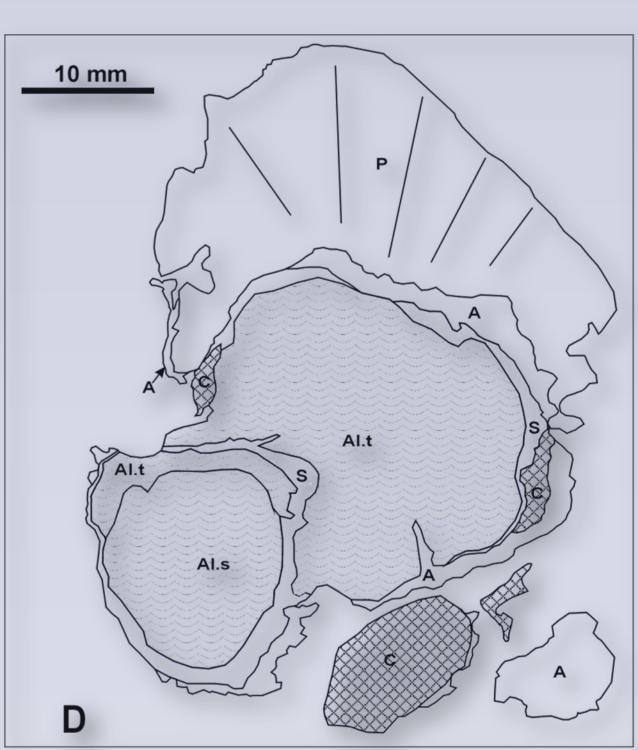
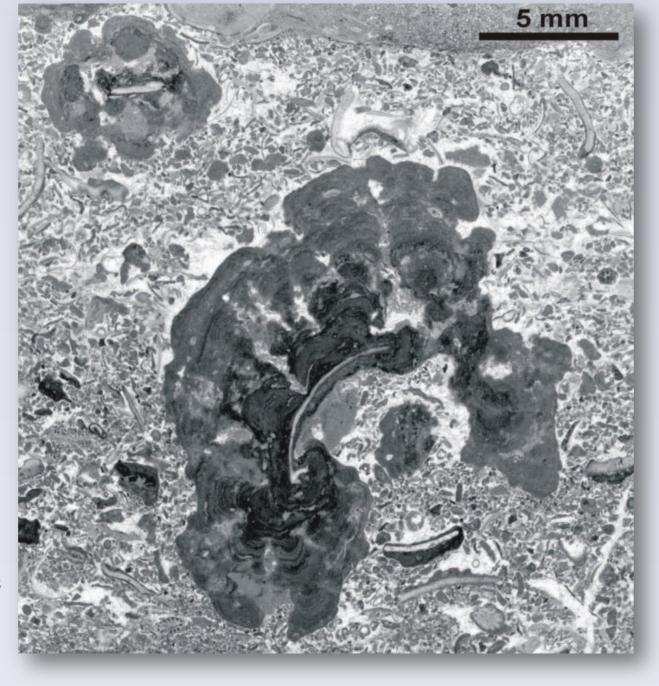


Fig. 5: A & B: "Micro-patch-reef" with encrusting organisms, Baugnée section. (1) Scoliopora branch as nucleus, (2) microbial coating forming an first oncoid. Encrusting organisms: (3) tabulate coral, (4) stromatoporoid, (5) microbial coating, (6) spirorbiform serpulid worm, (7) Alveolites, (8) microbial level, (9) Spirorbis, (10) Alveolites. After an overturn, (11) stromatoporoids and (12) Phillipsastrea has grown up and been covered by (13) microbial coating, (14) stromatoporoids, (15). The body was finally turned and buried in muddy sediment. C & D: Irregular domain multi-encrusted body involving a bulbous Alveolites suborbicularis (Al.s), A. tenuissimus (Al.t), stromatoporoids (S) and auloporids (A). Cyclotrypa (C). Phillipsastrea (P) has finally grown on this overturned body, in a ragged colony itself encrusted by auloporids (A). Lambermont section.

2.3. Oncoids and microbialites

Regular oncoids formed in turbulent environment. Irregular oncoids formed in a calmer water where microbialites have preferentially developed on one side of the nucleus, forming asymmetric, cauliflower-shape oncoids (Fig. 6). The abundance of oncoids is remarkable. Shi & Chen (2006) and Shapiro & West (1999) consider that oncoid-rich deposits result of a drop in sea level that produces shallow water high energy environment, associated with the proliferation of microbialites. Both are usually associated with biologic crisis. Microbialites have been documented for the five main extinction events of the Phanerozoic and for several minor crisis (Calner, 2005). In comparison, the omnipresence of oncoids in the upper member of the Aisemont Formation and its lateral equivalent could be an evidence of the environmental change within the Kellwasser events.



3. Conclusions

In Southern Belgium, the Late Frasnian crisis is progressive and recorded extinction events ranging from the Middle-Late Frasnian boundary to the Frasnian-Famennian boundary. This onset might be correlated with the first transgressive pulse in the Early *rhenana* Biozone ("*semichatovae* Transgression" and the base of the "Aisemont sequence")

More than sudden mass extinction, the Late Frasnian Crisis has led to the weakening of ecosystems in a damaged environment. The upper member of the Aisemont Formation is such an environment where opportunistic organisms have constituted a remarkable association of common Devonian fauna in an unusual facies.

4. REFERENCES

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