MIOCERCRES IN GIVETIAN TO LOWER FRASNIAN SEDMENTS DATED
BY CONODONTS FROM THE BOUONNAIS, FRANCE

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ABSTRACT

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The Calcaire de Blacourt and the lower part of the Schistes de Beaulieu exposed in
the new railroad trench Caffiers-Ferques and in the Griset Quarry (Bouonnais, France)
contain well-preserved miospore assemblages which have been previously described from
continental beds in Scotland, Spitsbergen and the Canadian Arctic Islands.

Their distribution is presented in relation to a conodont zonation, ranging from the
Leriophyton obliquimarginatus Zone to the lower Polygnathus asymmetricus Zone, and
allows accurate correlations with the type sections of Givet and Frasnes in Belgium where
several optimal horizons could be selected to fix the Givetian/Frasian (Middle—Upper
Devonian) boundary.

INTRODUCTION

The Devonian sequence in the Bouonnais outcrops near Ferques between
Calais and Boulogne in the most northern area of France. This area is part of
a western extension of the Namur synclinorium. The 1/50,000 geological
map of Marquise (Bonte et al., 1971) gives the following succession from the
base to the top:

1) The Middle Devonian Poudingue de Caffiers, Grès et Schistes de
Caffiers with Aneurophyton germanicum (Corsin, 1933) and Calcaire de
Blacourt with Stringocephalus burtini.

2) The Upper Devonian Schistes de Beaulieu, Calcaire de Ferques, Schistes
d’Hydrequent and Grès et Psammites de Fiennes ou de Sainte Godeline.

Taugourdeau-Lantz (1960, 1967a, b and 1971) has described Frasian
miospores from this area. Most of her material belongs to the Schistes de
Beaulieu, Calcaire de Ferques and Schistes d’Hydrequent exposed in the
Tarstinkal quarries.

However, Taugourdeau-Lantz (1967a, 1971) also mentions five spore
Fig. 1. Lithological column composed from Brice et al. (1976, 1977); m.g.m. = micro-paleontological guiding mark (Namur symposium excursion guidebook, edited by Bouckaert and Streel, 1974).

1 = Aneurospora cf. heterodonta (Naumova) Streel 1972 (Plate II, 5).
2 = Archaeosonotriletes variabilis (Naumova) Allen 1965 (Plate II, 14).
3 = Brochotritiletes sp. (Plate II, 3).
4 = Convolutispora disparalis Allen 1965 (Plate I, 7).
5 = Convolutispora paraverrucula McGregor 1964 (Plate I, 6).
6 = Dibolisporites cf. gibberosus (Naumova) Richardson 1965 (Plate I, 9).
7 = Grandispora douglasitownense McGregor 1973 (Plate III, 8).
8 = Rhabdosporites langii (Eisenack) Richardson 1960 (Plate III, 2).
9 = Verruciretusispora paliida (McGregor) Owens 1971 (Plate I, 5).
11 = Aneurospora goensis Streel 1964 (Plate II, 7).
12 = Contagisporites optivus var. vorobjevensis (Chibrikova) Owens 1971 (Plate III, 1).
13 = Aneurospora ancyrea var. ancyrea Richardson 1962 (Plate IV, 7).
14 = Aneurospora ancyrea var. brevispinosa Richardson 1962 (Plate IV, 6).
15 = Aneurospora logani McGregor 1973 (Plate IV, 5).
16 = Auroraspora macromanifesta (Hacquebard) Richardson 1960.
17 = Auroraspora micromanifesta (Hacquebard) Richardson 1960 (Plate IV, 1).
18 = Bullatissporites bullatus Allen 1965 (Plate I, 11).
19 = Circratiradites dissitus Allen 1965 (Plate II, 10).
20 = Cymbosporites cf. cyathus Allen 1965 (Plate II, 15).
22 = Grandispora velata (Eisenack) McGregor 1973 (Plate III, 4).
23 = Samarissporites inaequus (McGregor) Owens 1971 (Plate II, 13).
24 = Aneurospora greggoi (McGregor) Streel in Becker et al. 1974 (Plate II, 6).
25 = Biornatispora reticulata Lele et Streel 1969 (Plate II, 2).
26 = Verrucosissporites premnus Richardson 1966 (Plate I, 3).
27 = Verrucosissporites cf. unactus (Naumova) Richardson 1965 (Plate I, 2).
28 = Dibolosporites echinaceus (Eisenack) Richardson 1965 (Plate I, 12).
29 = Emphasiosporites spp.
30 = Retusotriletes rugulatus Riegel 1973 (Plate i, 1).
31 = Aneurospora langii (Taugourdeau-Lantz) Allen 1965 (Plate IV, 4).
32 = Grandispora tomentosa Taugourdeau-Lantz 1967b (Plate III, 5, 6).
33 = Hystricosporites spp.
34 = Perotriletes ergatus Allen 1965 (Plate IV, 2).
35 = Rhabdosporites parvulus Richardson 1965 (Plate III, 3).
37 = Aneurospora angulata Tiwari et Schaarschmidt 1975 (Plate IV, 3).
38 = Cheilinospora concinna Allen 1965 (Plate II, 16).
39 = Circratiradites jekhowskyi Taugourdeau-Lantz 1967b (Plate II, 9).
40 = Geminospora lemurata Balme 1962 (Plate I, 8) (Syn.: G. maculata Taugourdeau-Lantz 1967b).
41 = Dibolosporites sp. cf. Lophotritiletes atratus Naumova sensu Streel in Becker et al. 1974 (Plate I, 8).
42 = Corystissporites multispinus Richardson 1965 (Plate I, 10).
44 = Verrucosissporites cf. grandis McGregor 1960, non (Naumova) Richardson 1965 (Plate I, 4).
species occurring in the Calcaire de Blacourt from three samples that she
collected in an otherwise unlocated "Calcaire bleu dur" of the Griset quarry.
These are Anapiculatisporites atrabatus Taugourdeau-Lantz, Endosporites
globosus Taugourdeau-Lantz, Samarispores inaequus (McGregor) Owens,
Ancyrostora langii (Taugourdeau-Lantz) Allen and Punctatispores duplex
Taugourdeau-Lantz. Another sample (No. 597), coming from the Banc
Noir quarry, has Ancyrostora langii as well, but also contains Hystricos-
spores strigosus Taugourdeau-Lantz, Geminospores maculata Taugourdeau-
Lantz and Rhabdosporites cuvillieri Taugourdeau-Lantz. The age of this
sample was regarded as (Early?) Givetian (Taugourdeau-Lantz, 1971, p.20)
or Early Frasnian (Taugourdeau-Lantz, 1971, table 1). Most of the "Lower
Frasnian" Schistes de Beaulieu investigated were core-drill samples in the
Tarstinkal quarries with no mention about their exact stratigraphical
position regarding the base of these beds. Therefore the delineation of the
Givetian/Frasnian boundary using miospores obviously could not be
attempted with this material. This was shown also the correlation chart
provided by Streel (1972, fig.1).

More recently a new railroad section near Ferques (Brice et al., 1976)
has shown the Calcaire de Blacourt and the Schistes de Beaulieu outcropping
in succession, with a fairly rich faunal documentation. This section is here
palynologically investigated as well as samples collected throughout the
Calcaire de Blacourt in the Griset quarry.

PLATE 1 (All photographs x 500, except where otherwise stated)
2. Verrucosisporites cf. uncatus Naumova. Slide 27, 06/95, level H, Calcaire de Blacourt.
3. Verrucosisporites prennus Richardson. Slide 2E, 26/91, level A, Calcaire de
Blacourt.
Beaulieu.
5. Verruciretusispora pallida (McGregor) Owens. Slide 2J, 11/78, level A, Calcaire de
Blacourt.
6. Convolutispora paraverrucata McGregor. Slide 2I, 29/41, level A, Calcaire de
Blacourt. 6a. Detail of 6, x 1000.
8. Dibolisporites sp. cf. Lophotriletes atratus Naumova. Slide K5—1, 27/02, level
K, Schistes de Beaulieu.
9. Dibolisporites cf. gibberosus (Naumova) Richardson. Slide 2K, 29/94, level A,
Calcaire de Blacourt. 9a. Detail of 9, x 1000.
10. Corysispores multispinosus Richardson. Slide 27, 16/56, level H, Calcaire de
Blacourt.
Detail of 11, x 1000.
12. Dibolisporites echinaceus (Eisenack) Richardson. Slide 2F, 18/17, level A, Calcaire
de Blacourt. 12a. Detail of 12, x 1000.
FAUNAL EVIDENCE

The railroad section near Ferques is located and described by Brice et al. (1976, 1977, 1978, 1979) who also summarize the faunal evidence. The succession of conodont faunas provides the most accurate bio-stratigraphical framework available in that section. These data are here condensed in the upper part of Fig.1 where our sampling numbers are compared to Bultynck's 1976 and 1978 sampling numbers (in Brice et al., 1976, 1977). Most of the productive spore samples are associated with conodont faunas ranging from the varcus to the asymmetricus zones. These conodont zones are known (Bultynck, 1975) in the Fromelennes Formation (upper part of the Calcaire de Givet, Errera et al., 1972), a key lithological unit in the Ardennes for delimiting the Givetian/Frasian boundary. This boundary (and consequently the Middle/Upper Devonian boundary) has received several different definitions.

(1) The boundary given in the Prodrôme (Fourmarier, 1954) and in the Lexique Stratigraphique International (Waterlot, 1957) is below the "Assise de Fromelennes". This formed the base for code letters for the Frasnian subdivisions (Fla, etc.; Mailleux and Demanet, 1929) which obviously are of a more lithological than bio-chronological nature and therefore should be abandoned. To define this boundary, Bultynck (1975, and in Brice et al., 1976, 1979) has used the evolutionary characters of two groups of conodont species. The successive incoming of Icriodus gr. eslaensis-brevis and I. latercarinatus on the one hand and of Polygnathus pseudofoliatus and P. denis-

PLATE II (All photographs x 500, except where otherwise stated)

2. Biornatispora reticulata Lele et Strelc. Slides 02, 10/77, level H, Calcaire de Blacourt.
briceae on the other, define a useful limit between faunas IV and V within a few meters of the lowest part of the Fromelennes Formation as well as in the basal layers of unit H of the Ferques trench. Occurring probably in the late varcus Zone, this limit could be a lateral equivalent of the Pharciceras lunulicostata (Ia) base which is "the historic base of the Upper Devonian for German stratigraphers and forms the base of the Manticoceras Stufe and of the Adorfian in its chronostratigraphic usage" (House and Ziegler, 1977, p. 92). However, it must be noted that an accurate definition of the base of this goniatite zone in terms of conodonts, is still lacking in the Martenberg type section.

(2) Two possible boundaries have been proposed (Bultynck, 1975; Streeel et al., 1975) very near to the top of the Fromelennes Formation (top of the Calcaire de Givet):

(a) A boundary at the base of the Ancyrodella biozone, starting with A. binodosa found in the lowermost part of the unit "F2a" in Belgium (Mouravieff, 1970). The first occurrence of Ancyrodella corresponds to the base of the lower asymmetricus Zone sensu Ziegler 1971 (not to be confused with the base of the lowermost asymmetricus Zone sensu Ziegler 1971). A. binodosa has not been found in the Ferques trench but occurs at the base of the Schistes de Beaulieu in the Banc Noir and Griset quarries (Faune VII of P. Bultynck, pers. comm.).

(b) A boundary drawn a few meters higher at the transition A. binodosa/A. rotundiloba as proposed by Coen (1973, p.243) and which might have a better phylogenetical support. The Fauna VIII with transitional specimens between binodosa and rotundiloba occurs a few metres higher than the base of the Schistes de Beaulieu in the Ferques trench (Brice et al., 1976).

Both boundaries which have a rather clear definition in terms of conodonts, appear to correlate with levels before the incoming of Manticoceras cordatum (Iβ) of the goniatite zonation. However, the second limit is probably nearer the base of Iβ than the first one.

(3) Other possibilities, based on conodonts for a Middle/Upper Devonian boundary within the Fromelennes Formation time equivalent, will not be considered here. Characterized by the first occurrences of either Schmidtognathus

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PLATE III (All photographs x 500, except where otherwise stated)

3. Rhabdosporites parvulus Richardson. Slide 26, 19/41, level H, Calcaire de Blacourt. 3a. Detail of 3, x 1000.
hermanni (Ziegler, 1971) or Spathognathodus insitus, a possible ancestor of A. binodosa (Bultynck, 1975), they have the same disadvantage of an erratic occurrence in many parts of the world, including the Boulonnais area.

The Griset quarry section is described by Brice et al. (1977). The lithology is here simplified in the lower part of Fig.1, where the position of the only productive spore sample (G–02) is shown immediately below the productive conodont samples (G–2 and G–3). These last samples belong to the Icriodus obliquimarginatus Zone, a typical Givetian biostratigraphical unit. Sample G–3 contains I. eslaensis which occurs in the Gic lithological unit of the Givet type section (P. Bultynck, pers. comm., and in Brice et al., 1978a, 1979). The succession of faunas I (G–2) and II (G–3) in the basal layers of the Calcaire de Blacourt enables us to correlate them with a late Early to early Middle Givetian timespan.

MIOCSPORES EVIDENCE

The whole assemblage containing 44 miospore species is listed in the legend to Fig.1. The assemblage is characterized throughout by the occurrence of Samarispores triangulatus and Ancyrospora langii. Also characteristic, but much more restricted in distribution, are Contagisporites opticus var. vorobjensis and Archaeozonotriletes variabilis. These miospores obviously represent the triangulatus assemblage described by Allen (1965, 1967, 1973) and more recently retained by Richardson (1974).

Eleven species are in common with the Spitsbergen assemblage (Vigran, 1964; Allen, 1965, 1967, 1973). They are Archaeozonotriletes variabilis, Convoluitispora disparalis, Rhabdospories langii, Bullatisporites bullatus, Cirratiradites dissutus, Grandispora inculta, Ancyrospora langii, A. ancyrea, Perotrilites ergatus, Samarispores triangulatus and Chelinospora concinna. All but two (B. bullatus and C. dissutus) were only found in the triangulatus assemblage.

The Spitsbergen sediments are dated Early to Late Givetian by Tarlo (1964) comparing psammootid faunas with equivalents in the Baltic area.

PLATE IV (All photographs x 500, except where otherwise stated)

5. Ancyrospora logani McGregor. Slide 2H, 30/08, level A, Calcaire de Blacourt.
7. Ancyrospora ancyrea var. ancyrea Richardson. Slide 26, 11/84, level H, Calcaire de Blacourt. 7a. Detail of 7, x 1000.
Thirteen taxa are in common with the Orcadian basin of northeast Scotland (Richardson, 1965). They are *Dibolisporites* cf. *gibberosus*, *Rhabdosporites langii*, *Acanthotriletes* cf. *horridus*, *Ancyrospora ancyrea* var. *ancyrea*, *A. a*, var. *brevispinosa*, *Auroraspora macromanifesta*, *A. micromanifesta*, *Grandispora velata*, *Verrucosisporites prennus*, *V*. cf. *uncatus*, *Dibolisporites echinaceus*, *Rhabdosporites parvulus* and *Corystisporites multispinosus*. None of them belongs to those species which are restricted to the Eifelian–Givetian transitional layers (Richardson, 1965, fig.9). Most of the Orcadian species range up to the Givetian Eday Group, but four (*A. cf. horridus, R. parvulus, V. prennus, V. cf. uncatu*) are restricted to that level. The Eday Group is placed in the lower part of the *Microbranchius*–*Tristichopterus* fish zone of Westoll (1951). Following Richardson (1974), the Eday Group contains the *Densosporites devonicus* assemblage zone which is supposed to underly the *triangulatus* assemblage, although both assemblages have never been cited in a same section.

The question of the base of the *triangulatus* assemblage has been raised by Allen (1973) who subdivides the Spitsbergen assemblage into a lower one dominated by patinate spores and an upper one dominated by *Hystricosporites*. Allen (1973) argues that “the variation between the two *triangulatus* sub-assemblages is most probably due to differences in lithology of the rock specimens, rather than in stratigraphy” (see also Alpern and Streele, 1973, fig.11). This of course could also be true for the change from the *eximius* to the *triangulatus* assemblages in the Fiskekløfta or West-Lagercrantzberget sections although the abrupt replacement of about two thirds of the species is more suggestive of a major break.

An analysis of the miospore content of the Calcaire de Blacourt, part of our *triangulatus* assemblage, suggests that it occupies an intermediate stratigraphical position between Allen’s *triangulatus* assemblage and the Orcadian *Densosporites devonicus* assemblage zone. A study of the species distribution (Fig. 1) emphasises this point, for in sample G—02, at the base of the Calcaire de Blacourt, Givetian species like *Aneurospera* cf. *heterodonta* (Panther Mountain Formation, New York State; Streele, 1972) and *Convolutispora paraverrucata* (Ghost River Formation, Alberta; McGregor, 1964), are still present along with the Orcadian Givetian species *Dibolisporites gibberosus* and *Rhabdosporites langii*. Again, near the top of the Calcaire de Blacourt two other Givetian species disappear, namely *Aneurospera goensis* and *Biornatispora reticulata* (Goé, Belgium; Lele and Streele, 1969) along with most of the Orcadian Givetian species like *Acanthotriletes* cf. *horridus*, *Ancyrospora ancyrea* var. *ancyrea*, *A. ancyrea brevispinosa*, *Auroraspora macromanifesta*, *A. micromanifesta*, *Grandispora velata*, *Verrucosisporites prennus* and *V*. cf. *uncatus*.

Since the limestone samples from units A to M in the Griset quarry and from units I and J in the Ferques trench (where spore sample 33 is poorly preserved) have not provided good miospore assemblages greater accuracy is not possible.

The occurrence of *Archaeozonotriletes variabilis* at the lowest level does
not contradict the transitional character of the lower part of our assemblage as this species has also been recorded with many Orcadian Givetian spores (but without S. triangulatus) in the Escuminac Formation of Quebec (Brideaux and Radforth, 1970).

The miospore content of the Schistes de Beaulieu is impoverished in species. This seems related to more homogeneous miospore sizes, dominance of Geminospora lemurata or single laevigate species not recorded in Fig.1, and abundance of acritarchs. Disappearance of Dibolisporites echinaceus and Retusotriletes rugulatus as well as the first occurrence of Convolutisporina cf. subtilis and Verrucosisporites cf. grandis should be ascertained by studying more samples.

More reliable are the following species occurring within unit H, particularly in sample 26, in the Ferques trench because their incoming is observed in a sequence of seven closely spaced samples of similar lithofacies: Cirratriradites jekhowskyi, a very distinctive species with a narrow zone; Geminospora lemurata, one of the most abundant spores of the so-called Givetian—Frasnian assemblages published throughout the world; Chelinospora concinna, a typical species characteristic of the lower of the two triangulatus sub-assemblages described by Allen (1973). The appearance of these species in the stratigraphic sequence just above the succession of conodont faunas IV and V, a possible lateral equivalent of the Pharcieras lunulicostata (la) base, may well be useful for correlation. Other characteristics might of course correlate with the faunal evidence in the higher parts of the sequence, but they cannot be demonstrated in our sections due to unfavourable lithofacies.

Considering again the miospore distribution chart of Taugourdeau-Lantz (1971, table 1) and providing the synonymy listed below is accepted, we may note the following points:

1. Ancyrospora langii, Grandispora tomentosa and Samarisporites triangulatus (syn. : S. euglyphus) are not restricted to the Frasnian but range at least from the Middle Givetian.

2. The disappearance of Samarisporites inaequus and Grandispora inculta (syn. : Endosporites globosus) does not precede but follows the incoming of Cirratriradites jekhowskyi and Geminospora lemurata (syn. : G. maculata); they move or less serve to delineate the Givetian/Frasnian boundary within the lithological unit H of the Ferques trench, a lateral equivalent of the lower part of the Fromelennes Formation in the Ardennes type area.

REFERENCES


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