

## UPPER DEVONIAN MIOSPORE STRATIGRAPHY IN WESTERN POMERANIA (NW POLAND)

MARZENA STEMPIEŃ-SAŁEK

Institute of Geological Sciences, Polish Academy of Sciences, ul.Twarda 51/55, 00–818 Warszawa, Poland; e-mail: mstempie@twarda.pan.pl

**ABSTRACT.** Three local miospore zones have been distinguished in the upper Devonian (Frasnian to lower Famennian) of Western Pomerania. These are: *Cristatisporites deliquescens* – *Samarisporites triangulatus* (DT), *Membrabaculisporis radiatus* – *Tholisporites densus* (RD) and *Membrabaculisporis radiatus* – *Cymbosporites boafeticus* (RB) zones. Correlation of the higher two zones with the conodont faunas obtained from the same boreholes indicates that the RD zone equates with (possibly) Upper *hassi* or *jamae* Conodont Zones, and/or part of *rhenana* Zone. The RB zone spans the interval from Upper *rhenana* to *triangularis* Conodont zones. The proposed scheme can be correlated with that established for the Ardenne-Rhenish regions only on the basis of conodonts because palynological criteria are lacking. Miospore based equation with the Eastern European miospore stratigraphic scheme is possible.

**KEY WORDS:** Frasnian, Famennian miospores, conodonts, stratigraphy, Western Pomerania, Poland

### INTRODUCTION

The Frasnian and lower Famennian deposits of Western Pomerania (Kołobrzeg region) are composed of dark grey and black shales, shaly intercalations within limestones, marly limestone and marl.

These rocks are completely covered by younger sediments of considerable thickness and have been reached only by exploration drillings. The present-day occurrence of the Devonian sediments in Western Pomerania is an effect of Carboniferous tectonics and subsequent erosion.

The biostratigraphy of these deposits is based mainly on conodonts (Matyja 1993). Entomozoacean ostracodes (Żbikowska 1992) have also been studied.

The Frasnian and lower Famennian deposits from the Kołobrzeg region have been recognised in 4 boreholes: Strzeżewo 1, Gorzysław 8, Gorzysław 11 and Gorzysław 14 (Figs 1, 2).

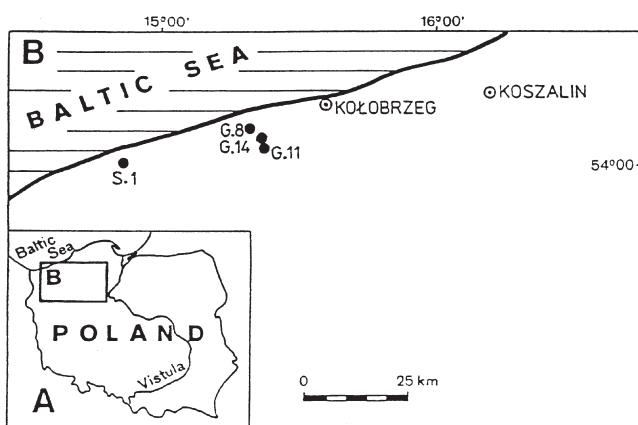
### TECHNIQUES

The palynological samples have been taken from the depth of about 3000–4000 m, from the dark grey and black shales (Fig. 2). Fifty samples (about 150 slides) have been investigated. The preparation of the samples was standard, using hydrochloric and hydrofluoric acids and heavy liquid flotation with zinc chloride followed by oxidation with fuming nitric acid.

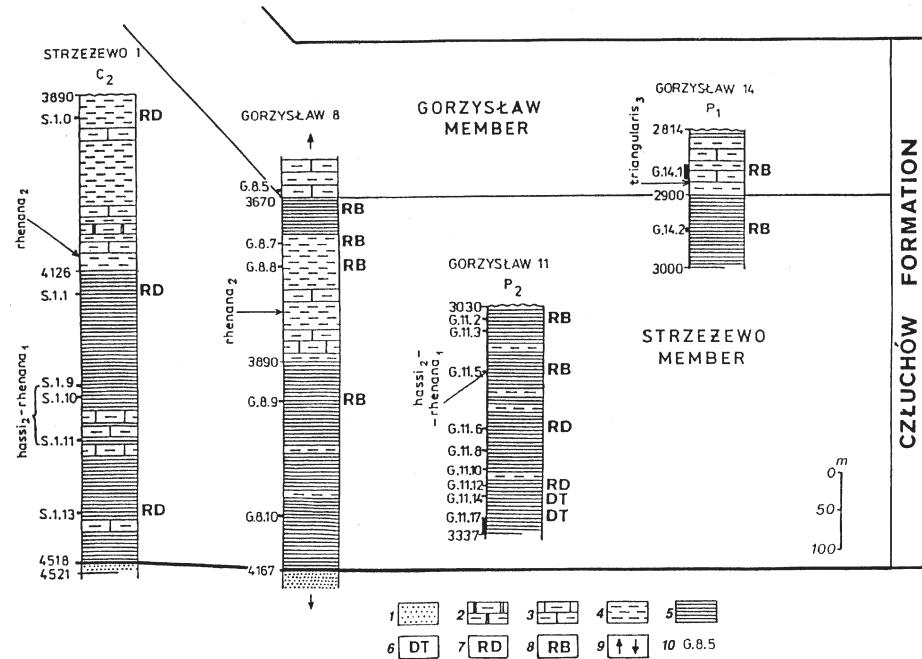
### BIOSTRATIGRAPHY

The miospore assemblages, which have been found in the Frasnian and lower Famennian deposits are poor in specimens but relatively well preserved (Pl. 1). Three local miospore zones have been distinguished (Figs 3, 4): *Cristatisporites deliquescens* – *Samarisporites triangulatus* (DT) miospore zone, *Membrabaculisporis radiatus* – *Tholisporites densus* (RD) miospore zone and *Membrabaculisporis radiatus* – *Cymbosporites boafeticus* (RB) miospore zone.

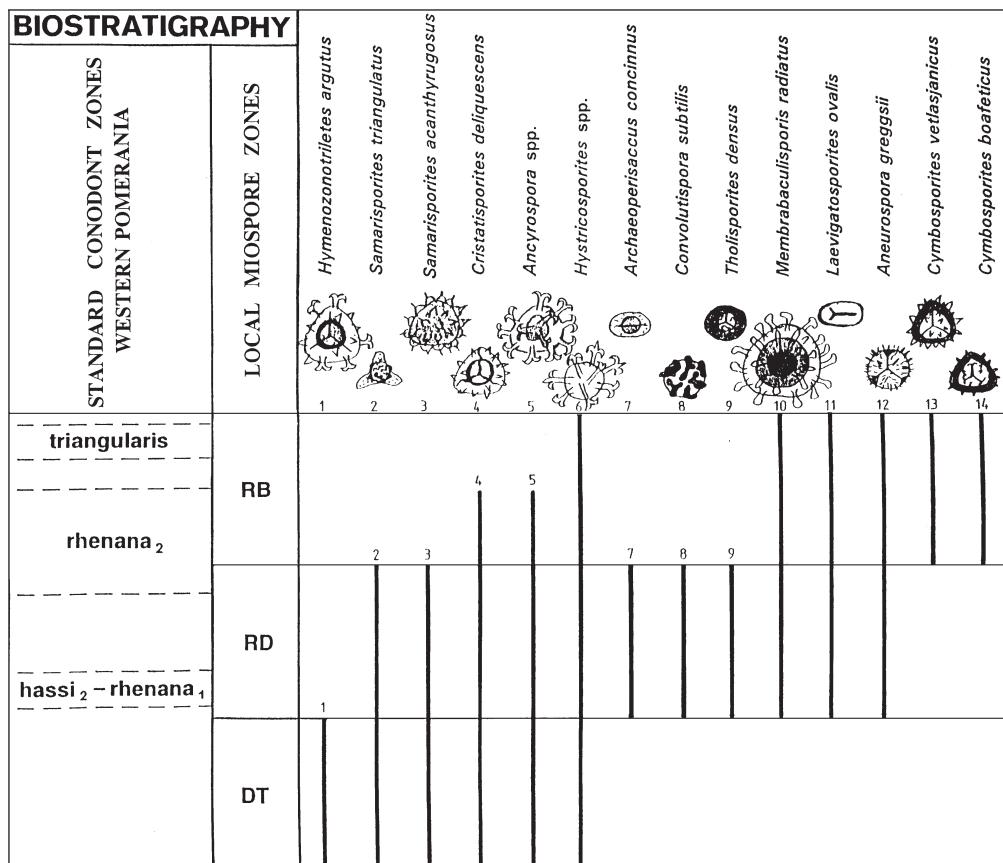
The assemblages of the *Cristatisporites deliquescens* – *Samarisporites triangulatus* (DT) zone are not diverse.



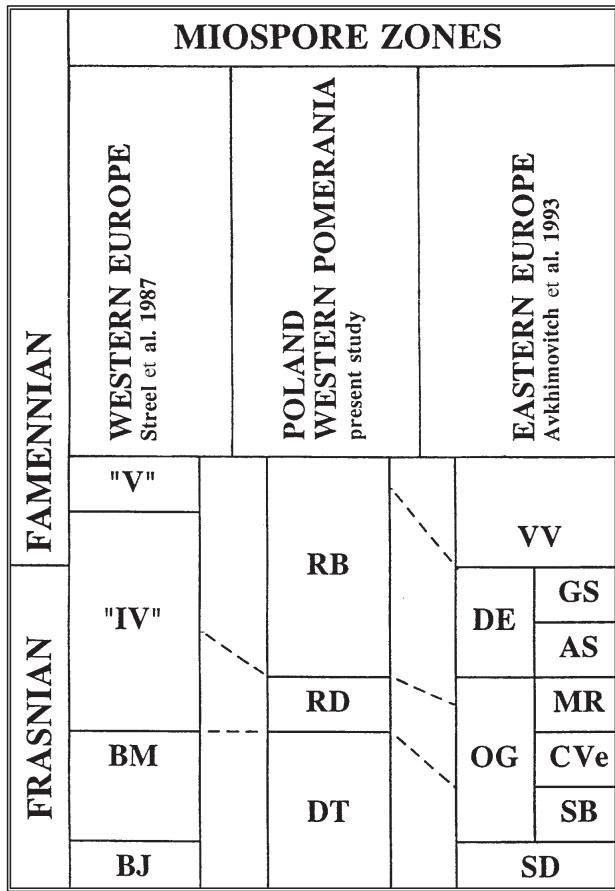
**Fig. 1.** Position of Western Pomerania (A) and location of studied boreholes (B)



**Fig. 2.** Lithology, lithostratigraphy and stratigraphic biozonation (conodont and palynological zones) of studied boreholes. 1 – fine-grained quartz sandstone, 2 – marly dolomite, 3 – marly limestone, 4 – marl, 5 – marly shale, 6 – miospore zone *Cristatisporites deliquescens* – *Samarisporites triangulatus* (DT), 7 – miospore zone *Membrabaculisporis radiatus* – *Tholispores densus* (RD), 8 – miospore zone *Membrabaculisporis radiatus* – *Cymbosporites boafeticus* (RB), 9 – continuation of Devonian deposits (upwards or downwards), 10 – palynological sample numbers



**Fig. 3.** Range chart of stratigraphically important Frasnian – lower Famennian miospore species from Western Pomerania, and relation of conodont and miospore zones



**Fig. 4.** Correlation of miospore zonations of Northwestern Europe, Poland (Western Pomerania) and Russian Platform. BJ – *Verrucosporites bulliferus* – *Cirratriradites jekhovsky* miospore zone, BM – *Verrucosporites bulliferus* – *Lophozonotriletes media* miospore zone, "IV" – miospore zone "IV", "V" – miospore zone "V", DT – *Cristatisporites deliquescens* – *Samarisporites triangulatus* miospore zone, RD – *Membrabaculisporis radiatus* – *Tholischporites densus* miospore zone, RB – *Membrabaculisporis radiatus* – *Cymbosporites boafeticus* miospore zone, SD – *Geminospora semilicensa* – *Perotrilites donensis* miospore zone, OG – *Archaeoperisaccus ovalis* – *Verrucosporites grumosus* miospore zone; SB – *S. bellus* miospore subzone, CVe – *Cymbosporites vetlasjanicus* miospore subzone, MR – *Membrabaculisporis radiatus* miospore subzone, DE – *Cristatisporites deliquescens* – *Verrucosporites evlanensis* miospore zone; AS – *Auroraspora speciosa* miospore subzone, GS – *Grandispora subsuta* miospore subzone, VV – *Corbulispora vimineus* – *Geminospora vasjamica* miospore zone

They include among other forms: *Ancyrospora fidus*, *A. furcula*, *A. langii*, *Apiculiretusispora nitida*, *Cristatisporites deliquescens*, *Geminospora nalevkinii*, *G. notata*, *G. rugosa*, *Hymenozonotriletes argutus*, *Hystricosporites furcatus*, *H. multifurcatus*, *H. porrectus*, *Velamisporites magnus*, *Samarisporites acanthyrugosus*, *S. triangulatus* and *Verrucosporites cf. evlanensis*. The index species of the DT zone are *Cristatisporites deliquescens*, *Samarisporites triangulatus* and *Hymenozonotriletes argutus*. The base of the DT miospore zone is not defined.

The characteristic assemblage of the *Membrabaculisporis radiatus* – *Tholischporites densus* (RD) zone includes: *Samarisporites triangulatus*, *S. acanthyrugosus*,

*Cristatisporites deliquescens*, *Ancyrospora spp.*, *Hystricosporites spp.*, *Archaeoperisaccus concinnus*, *Archaeozonotriletes variabilis*, *Convolutispora subtilis*, *C. crassitunicata*, *Cymbosporites acanthaceus*, *C. eximus*, *Diaphanospora platyrugosa*, *Geminospora notata*, *G. notata* var. *microspinosa*, *Hystricosporites corystus*, *H. reflexus*, *Tholischporites densus*, *Membrabaculisporis radiatus*, *Laevigatosporites ovalis*, *Verrucosporites grumosus* and *Aneurospora greggsii*. The base of the RD zone is marked by the appearance of *Membrabaculisporis radiatus*. *Archaeoperisaccus concinnus*, *Convolutispora subtilis*, *Tholischporites densus*, *Laevigatosporites ovalis* and *Aneurospora greggsii* also appear at this base.

The *Membrabaculisporis radiatus* – *Cymbosporites boafeticus* (RB) zone is defined on the occurrence of the following species: *Cristatisporites deliquescens*, *Ancyrospora spp.*, *Hystricosporites spp.*, *Membrabaculisporis radiatus*, *Laevigatosporites ovalis*, *Aneurospora greggsii*, *Cymbosporites vetlasjanicus*, *C. boafeticus*, *Apiculiretusispora nitida*, *Diducites radiatus*, *D. mucronatus*, *Retusotriletes planus*, *R. incohatus*, *R. pychovii*, *Velamisporitesites magnus*, and *Geminospora spp.* The base of this zone is marked by the first appearance of *Cymbosporites boafeticus* and *C. vetlasjanicus*.

Conodont faunas were obtained from the same boreholes by Matyja (1993) which is shown in Figs. 2, 3. The data obtained concern only the two higher miospore zones. The *Membrabaculisporis radiatus* – *Tholischporites densus* (RD) zone is associated with conodont faunas indicative of the Upper hassi, jamiae or Lower rhenana zones and those indicative of the rhenana Zone. The *Membrabaculisporis radiatus* – *Cymbosporites boafeticus* (RB) zone miospore associations are associated with the Upper rhenana and Upper triangularis Conodont Zones.

The Late Devonian miospore assemblages from Western Pomerania do not contain stratigraphically useful species which would allow correlation with the miospore zonal scheme of Strel et al. (1987) established for the Ardenne-Rhenish regions. But this scheme is also keyed to the standard conodont zonation. Relying on the conodont data, it is suggested that the distinguished zones correspond to the *Verrucosporites bulliferus* – *Cirratriradites jekhovsky* (BJ), *Verrucosporites bulliferus* – *Lophozonotriletes media* (BM), "IV" and "V" zones of the Ardenne-Rhenish division (Fig. 4).

The miospore associations described contain numerous species which are common to the East European Platform and Western Pomerania. It is possible to correlate the Pomeranian scheme with that proposed by Avkhimovitch et al. (1993). The key species are *Membrabaculisporis radiatus* and *Cymbosporites boafeticus*. The proposed correlation is shown in Fig. 4. The East European miospore zones have a direct conodont

control. The conodont data confirm the proposed palynological correlation.

## APPENDIX

List of spore species from the Frasnian and Lower Famenian deposits (Western Pomerania).

*Ancyrospora fidus* (Naumova) Obukhovskaya: Avkhimovich *et al.*, 1993

*Ancyrospora furcula* Owens, 1971

*Ancyrospora langii* (Taugourdeau-Lantz) Allen, 1965

*Aneurospora greggsii* (McGregor) Streel: Becker *et al.*, 1974

*Apiculiretusispora nitida* Owens, 1971

*Archaeoperisaccus concinnus* Naumova, 1953

*Archaeozonotriletes variabilis* Naumova, 1953

*Convolutispora crassitunicata* (Obukhovskaya) Obukhovskaya, 1986

*Convolutispora subtilis* Owens, 1971

*Cristatisporites deliquescens* (Naumova) Arkhangelskaya, 1987

*Cymbosporites acanthaceus* (Kedo) Obukhovskaya, 1986

*Cymbosporites boafeticus* (Tchibrikova) Obukhovskaya, 1986

*Cymbosporites eximus* (Obukhovskaya) Obukhovskaya, 1986

*Cymbosporites vetlasjanicus* Medianik *et al.* Obukhovskaya: Avkhimovich *et al.*, 1993

*Diaphanospora platyrugosa* (Naumova) Obukhovskaya, 1986

*Diducites mucronatus* (Kedo) Van Veen, 1981

*Diducites radiatus* (Kedo) Obukhovskaya: Avkhimovich *et al.*, 1993

*Geminospora nalevkinii* (Naumova) Obukhovskaya, 1986

*Geminospora notata* (Naumova) Obukhovskaya: Avkhimovich *et al.*, 1993

*Geminospora notata* var. *microspinosa* Tchibrikova, 1962

*Geminospora rugosa* (Naumova) Obukhovskaya: Avkhimovich *et al.*, 1993

*Hymenozonotriletes argutus* Naumova, 1953

*Hystricosporites corystus* Richardson, 1962

*Hystricosporites furcatus* Owens, 1971

*Hystricosporites multifurcatus* (Winslow) Mortimer et Chaloner, 1967

*Hystricosporites porrectus* (Balme et Hassel) Allen, 1965

*Hystricosporites reflexus* Owens, 1971

*Laevigatosporites ovalis* Kosanke, 1950

*Membrabaculisporis radiatus* (Naumova) Arkhangelskaya, 1985

*Retusotriletes incohatus* Sullivan, 1964

*Retusotriletes planus* Dolby et Neves, 1970

*Retusotriletes psychovii* Naumova, 1953

*Samarisporites acanthyrugosus* (Tchibrikova) Streel: Becker *et al.*, 1974

*Samarisporites triangulatus* Allen, 1965

*Tholischporites densus* McGregor, 1960

*Velamisporites magnus* (Hughes et Playford) Playford, 1971

*Verrucosisporites cf. evlanensis* (Naumova) Obukhovskaya, 1986

*Verrucosisporites grumosus* (Naumova) Sullivan, 1964.

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**P L A T E**

## Plate 1

All figures  $\times 750$

1. *Tholischporites densus* McGregor, Gorzysław 11.12
2. *Cymbosporites boafeticus* (Tchibrikova) Obukhovskaya, Gorzysław 11.3
3. *Aneurospora greggsii* (McGregor) Streel: Becker *et al.*, Gorzysław 8.5
4. *Hystricosporites corystus* Richardson, Gorzysław 8.5
5. *Cristatisporites deliquescens* (Naumova) Arkhangelskaya, Gorzysław 11.14
- 6, 7. *Samarisporites triangulatus* Allen, Gorzysław 11.8
8. *Samarisporites cf. triangulatus* Allen, Gorzysław 11.8
9. *Archaeoperisaccus concinnus* Naumova, Gorzysław 11.12
10. *Membraculisporis radiatus* (Naumova) Arkhangielkaya, Gorzysław 14.2
11. *Ancyrospora furcula* Owens, Gorzysław 11.10
12. *Samarisporites cf. acanthyrugosus* (Tchibrikova) Steel, Gorzysław 11.12

