Palynological study of the Gurkovo Formation (Westphalian D/Cantabrian), Dobrudzha Basin, Bulgaria

Tatyana Dimitrova

Geological Institute, Bulgarian Academy of Sciences, Sofia 1113
(submitted: 15.09.2002; accepted for publication: 20.02.2003; revised manuscript received: 13.10.2004)

Abstract. The present paper contains the morphological remarks and stratigraphical analysis of microspores from the Gurkovo Formation, Dobrudzha Coal Basin, NE Bulgaria. The palynological data obtained from samples from the boreholes 172 and 191 near Gurkovo are systematically discussed for the first time in the present study. The litho- and biostratigraphical data for this region have been previously described in a number of publications. The absence of precise data from the most upper level of Gurkovo Formation is subject of further discussions about the boundary between Westphalian D and Cantabrian stages in regional aspect. The levels of the two boreholes studied for the purpose of this article, contain spores systematically described including the following species: Spinosporites spinosus, Thymospora pseudothiessenii, Angulisporites splendidus, Cadiospora magna, Candidispora candida; genus Latensina. The aim of this paper is to further examine the youngest sediments from the Gurkovo Formation on the basis of existing data systematically determined together with additional information, as yet unpublished.


Key words: Microspores, palynology, Westphalian/Cantabrian, Gurkovo Formation, Dobrudzha Coal Basin, systematics, taxonomic aspects.

Introduction

Abundant and well-preserved palynological assemblages have been recovered from coal-shale sequence in the Gurkovo Formation in Dobrudzha Coal Basin, Bulgaria (Fig.1). In this paper for the first time are selected and systematic described species of the microspores of the Westphalian/Cantabrian age, from coal and coal-shales sediments of the Gurkovo Formation.

For the study, the author has used the standard miospore zonal scheme instead of any of the local ones (Николов и др., 1989) for Western Europe (Clayton et al, 1977). The boreholes P-172 and P-191 were drilled in 1987-1988 and the material obtained is preserved in the Institute of Science and Mineral Deposits — a project of the Ministry of Geology/1982-1988. In addition, the spore content of several coals that had previously been fully investi-
nated is here given in detail. The new macer­
ation numbers indicate these remacerated
samples for spore taxonomy. Relatively thick
bench samples of the coals were taken because
the primary purpose of this study was corre­
lation of the coals rather than paleoecological
investigation of coal deposition and vegetation
change in the future study.

New information is provided on the selected
microspore which constitute the dominant
element and stratigraphical important for the
Gurkovo Formation.

All these studies include coal sediments
from the Gurkovo Formation excluding data
from the uppermost levels. They are system­
atically described in the present article with
the identification of the spores and pollen
content.

Geological setting
and previous studies

The first informal lithostratigraphic divisions
of the Late Carboniferous succession of the
Dobrudzha coal basin was proposed by Ten­
chov (Тенчов, Кулакъялов, 1972). The litho­
stratigraphic division adopted in this paper is
that by Nikolov et al., 1989 (Николов и др.,
1989). All earlier publications include a
variety of methods of investigation including
the following: the thickness of the formations
of Dobrudzha coal basin; the litho- and
biostratigraphic division (Николов и др.,
1988/89). Part of the formations is characte­
rised with specific conditions of the coal
seams. The distribution of the marsh-lake and
fluvial sedimentation is considered under sub­
aerial delta conditions (Tenchov, 1993). The
Westphalian D deposits are developed in va­
rious facies.

The palynological investigation of the
Carboniferous boreholes in NE Bulgaria was
made by Dimitrova (Димитрова в Николов и
analysis of the pollen assemblages of part of
the Westphalian in the above-mentioned
regions permits the palynostratigraphic subdi­
vision of this regional type as well as boreholes
172 and 191 (Kabalshki member) in the
Gurkovo Formation, in data on macro- and
microflora. The three members of the Gurkovo
Formation are distinguished and discussed by
Nikolov et al., 1989.

The results of palynological studies con­
cerning stratigraphic succession of Gurkovo
Formation were published in the earliest pa­
pers. The first account of the Late Westpha­
lian miospore assemblages from study area was by
Dimitrova (Димитрова, Попова, 1987), who
included the deposits from the Late Westpha­
lian coal-bearing sediments of the Dobrudzha
area. Lacheva and Dimitrova studied the
palynoflora in the coal seam p3 of the Gurkovo
Formation from different stratigraphic levels
(Лачева, Димитрова, 1984).

Biostratigraphy
and correlations

The coals from Gurkovo Formation are eco­
nomically the most important of the Dobru­
dzha Basin. The coal seams are markers for the
more swamped and drier areas during the coal
sedimentation of the microfloristical assem­
blages. The two very important palynological
correlation markers in the Westphalian D are
coal seams p1 and p3 (Gurkovo Formation),
which mark the change of the palynoflora.
Dimitrova established the Thymospora
Zone in Nikolov et al., 1989; 1992 (Николов и др.,
1989; 1992) for upper Westphalian coals in the
Gurkovo Formation and two microspore sub­
zones for Gurkovo Formation and for part of
the strata of the Nanevo drill.

The most complete account of the Dobru­
dzha Coalfield palynology is in unpublished
reports by Dimitrova (1999).

According to the study, the oldest part of the
sequence of Gurkovo Formation is probably no

Fig. 1. Map of Bulgaria showing the location of Dobrudzha
Coalfield
middle Westphalian D in age. The highest productive samples (last 220 m of the Gurkovo Formation) is probably no younger than early Cantabrian (Dimitrova et al., 2002). The palynology indicates that the base of the Gurkovo Formation is middle/late Westphalian D in age. This is indicated also by two of three index macrofloral species for the upper Lobatopteris vestita Zone (Cleal et al., 2003) and by abundant appearance of the spore species Thymospora pseudothiessenii, Angulisporites splendidus, Latensina sp., Radiospora magna and Candidispora candida.

The full analysis of the microflora present in the Westphalian — Stephanian boundary is still subject to discussion. A collective study presented by the Commission Internationale de Microflore du Paleozoie Working Group on Carboniferous Stratigraphical Palynology offers the most unified zonal scheme formulation to date that is available from the late Carboniferous deposits of Western Europe (Clayton et al., 1977; Decize (Alpern, Liaubeuf, 1969; Doubinger, 1974). Depending on the palynological assemblages present, the stratigraphical boundary Westphalian/Stephanian proposed by Clayton et al. (1977) can be divided into two major zones as follows: Thymospora obscura — T. thiesenii (OT); Angulisporites splendidus — Latensina trileta (ST).

Coquel and Rodriquez (1995) presented the upper part of Westphalian D and Stephanian A from the Puentelles formations in the Picos de Europa area (Northwest Spain). These two formations described from Northern Spain belong completely to the Cantabrian Zone. The work is part of a multidisciplinary research programmed in the framework of the Sub commission of Carboniferous Stratigraphy. In the associations, the pollen forms Potonieisporites and Florinites are very common. The taxa such as Candidispora sp. (Hacquebard, 1972, 1977), Angulisporites splendidus Bharadwaj (Clayton et al., 1977) and Latensina spp. are already present in the studied section. Across the Late Westphalian — early Stephanian boundary the microflora do not change a great deal, because this boundary is not readily defined by palynology by Coquel and Rodriquez.

Material and Methods

The drill P-172 from which the coals were sampled for systematic description is shown in Fig. 2.

Palynological data and systematic description

Thirty-eight genera were determined from a cored rock sequence, borehole 172. The description of the monolete spores group from all
formations was subject of previous discussions (Димитрова, 1993) whilst the trilete spores and pollen are mentioned for the first time in this paper.

The present paper deals with the taxonomic notice on the selected species, there have been arranged on the table. The palynological data from the samples have been reported in the Appendix.

The binominal nomenclature and genetic descriptions of the small spores of Schopf, Wilson and Bentall (1944) and the descriptions of the genera given by Potonie and Kremp (1954) are used in this report.


The variety of species and genera present in the Gurkovo Formation are described using a methodology for quick referencing with the authors of articles for the holotypes of the miospores or last revisions reflected in the relevant literature. All specific characteristics relating to specimens from the Dobrudzha coal basin are clarified in the 'Remarks' sections.

All species are most frequent in the Gurkovo Formation of the Dobrudzha Basin.

Aspects of taxonomy

Anteturma SPORITES H. Potonie 1893
Turma TRILETES (Reinsch) Dettmann 1963
Genus Leiotriliteles (Naumova) Potonie & Kremp, 1954
Type species. L. sphaeritriangulus (Loose) Potonie and Kremp, 1954.
Remarks. Potonie & Kremp (1954) have grouped within this genus triangulate forms having convex or concave sides. According to Potonie & Kremp (loc. cit.) the darkening in the intertectal zone is due to the flattening of a pyramidal elevation of the intertectum. Kosanke (1950) considers these as thickened exine forming a part of labra.

Leiotriliteles adnatoides Potonie & Kremp 1955
(p1.1, fig.16)
Holotype. Pot. & Kr. 1955, Pl.11, Fig. 112
Diagnosis. See Potonie & Kremp 1955, p. 38.
Description. Triangular microspores with broadly rounded corners and convex sides Y-rays usually ending a little before the equator but more than 3⁄4 the radius. Suture often opens up to the ray ends. Intertectum is darker in color and presumably thicker.

Occurrence: Gurkovo Formation, sample P-172, 1956 m.
Makedonka Formation in the coal seams m9-m11; Krupen Formation in the coal seems n1-n3; all samples of the Gurkovo Formation.

Genus Calamospora Schopf, Wilson and Bentall 1944
Type species. C. hartungiana Schopf in Schopf, Wilson, and Bentall 1944.
Remarks. An important characteristic of this genus is its spherical shape. However, in flattened condition the members of this genus assume various derived shapes such as polygonal, elliptical or spindloval that must be interpreted with respect to their original spherical shape.

Genus Punctatisporites (Ibrahim 1933) Potonie & Kremp, 1955
Type species. P. punctatus Ibrahim 1933.
Remarks. This genus is most abundant in the lower third, although it occurs through most of the seam of lower part of Gurkovo Formation.

Genus Granulatisporites (Ibrahim) Potonie & Kremp 1954, 1955
Type species. Granulatisporites granulatus Ibrahim 1933.
Remarks. Triangular miospores with broad, rounded angles but convex sides. Trilete mark distinct, rays 2⁄3 radius long.

Genus Cyclogranisporites Potonie & Kremp 1954, 1955
(pl.1, fig. 7)
Type species. Cyclogranisporites leopoldi (Kremp) Potonie & Kremp 1954.
Remarks. The sculpture of Cyclogranisporites (pl.1, fig. 7) mostly appears to consist of minute hemispherical granules regularly distributed all over but best seen along the margin in flattened spores. The species referable to this genus on the basis of the chief diagnostic characters such as the circular shape and granulate sculpture seem to show a wide range of variation.

Genus Verrucosisporites (Ibr.) Smith & Butterworth 1967
Type species. Verrucosisporites verrucosus (Ibrahim) Ibrahim 1933.
Remarks. Trilete isospores or microspores. The diagnoses of earlier authors (Ibrahim 1933, Potonie and Kremp, 1954) have been emended to cover the characters of the large number of recently published species of Verrucosisporites.
I. Dimitrova — Palynological study of the Gurkovo Formation...
Geologica Balcanica, 34, 3-4, 2004
PLATE I


All figures in the table × 900
The specimens from the Gurkovo Formations are very similar to taxa of the publications Smith and Butterworth, 1967 (Zone X) and Habib, 1966, Doubinger 1974, Pappers 1964.

Genus **Lophotriletes** (Naum.) Potonie & Kremp 1955
Type species. *Lophotriletes gibbosus* (Ibrahim) Potonie & Kremp 1954.

**Remarks.** Trilete isospores or microspores, of similar structure to *Apiculatisporites*. Triangular spores with broad angles and ± straight or slightly concave sides. Trilete mark has usually opened suture, labra thin.

Genus **Raistrickia** (S. W. & B.) Potonie & Kremp 1955

**Remarks.** Schopf et al. (loc. Cit.) created Raistrickia to include such spores which mainly show verrucose or spinose ornamentation, spines when present being generally heavy, abruptly truncate, blunt tipped or with the tips minutely dissected into two to six terminal papillae.

Genus **Spackmanites** Habib, 1966

**Remarks.** Loose (1934, p. 155) described the species *Reticulatisporites facierugosus* as having a granulate to reticulate surface and an irregular, crenate outline. Butterworth and Williams (1954, p. 754) assigned this species to *Verrocosisporites*. Habib (1966) erected the trilete genus *Spackmanites* to accommodate the species.

**Spackmanites cf. facierugosus** (Loose) Habib, 1966

**Holotype.** Habib 1966, pl. 106, fig. 19
**Diagnosis.** See Peppers 1970, p. 109
**Description.** The figured specimen of the Gurkovo Formation is radial, alate, and circular in transverse plane. The exoexine is composed of closely spaced club-shaped setae radially arranged outward from the endexine to which they are attached. A thinner equatorial zone extending beyond the endexine is produced where the setae are viewed lengthwise. The maximum diameter is 60 microns (9 specimens).

**Occurrence:** Gurkovo Formation, sample P-172, 1384,80 m.

In Dobrudza coal field: Gurkovo Formation, P-191, the samples between samples 1448, 20 m and 1615 m; P-172, 1384,80 m.

**Remarks:** The Illinois specimens of *Spackmanites* did not show any trilete suture except on possibly one specimen.

**Stratigraphical distribution:** Early Stephanian in Canada (Hasquebard, 1977); Spoon Formations (Pennsylvanian) of the Illinois Basin (Late Westphalian D, Cantabrian) by Peppers, 1964, 1970.

Genus **Microreticulatisporites** (Knox) Bharadwaj 1955.


Genus **Vestispora** (Wilson & Hoffm.) Wilson and Venkatachala 1963

**Remarks.** Spores with trilet dehiscence; generally discoid or oval; ornamentation is very deferent types: laevigate, reticulate, foveolate or scabrate. *Vestispora* is distinguished from other genera by the presence of an operculum on the proximal surface. These is the recognition as determined of *Cancellatisporites* Dybova and Jahowicz 1957, *Foveolatisporites* Bharadwaj 1955.

**Vestispora fenestral** (Kosanke & Brokaw) Wilson and Venkatachala 1963

**Holotype.** Kosanke 1950, pl. 2, fig. 10
**Diagnosis.** See Bharadwaj 1955, p. 126.
**Description.** The figured specimen of the Gurkovo Formation is with equatorial contour; Foveole 1 micron in diameter and 2-3 microns distant from each other.

**Occurrence:** Gurkovo Formation, sample P-172, 1596 m: upper part of Makedonka, Krupen and Gurkovo Formation.

**Vestispora pseudoreticulata** Spode 1968

**Holotype.** Kosanke 1950, pl. 2, fig. 10
**Diagnosis.** See Bharadwaj 1955, p. 126.
**Description.** The figured specimen of the Gurkovo Formation is with equatorial contour; Foveole 1 micron in diameter and 2-3 microns distant from each other.

**Occurrence:** Gurkovo Formation, sample P-172, 1596 m: upper part of Makedonka, Krupen and Gurkovo Formation.
and Gurkovo Formation, Dobrudzha coal basin.

Genus Dictyotriletes (Naumova) Potonie & Kremp 1954
Type species. Dictyotriletes bireticulatus (Ibrahim) Potonie & Kremp, 1954.

Remarks. The taxa of the Gurkovo Formation are similar to the specimen illustrated by Smith & Butterworth 1967; Potonie & Kremp 1954.

Pottonie and Kremp (p. 144, 1954) in their emendation of Dictyotriletes failed to mention the absence of a reticulum on the proximal surface. Smith and Butterworth (1967) emended Dictyotriletes to include many species of Reticulatisporites that possess a wide cingulum.

Genus Knossisporites (Pot. & Kr.) Neves 1961
Type species. Knossisporites hageni Potonie and Kremp, 1954.

Remarks. The taxa of the Gurkovo Formation are like that shown by Hoffmeister, Staplin & Malloy 1955 (pl. 37, fig.13). They accordingly emended the diagnosis of Potonie and Kremp (1954, p. 147) to restrict the genus to forms closely resembling the type of construction found in the type species K. hageni.

Genus Polymorphysporites Alpern 1958
Type species. Polymorphysporites densus Alpern 1958.

Polymorphysporites densus Alpern 1958 (pl. 1, fig. 19).
Holotype. Alpern, fig. 232.

Diagnosis. See Alpern 1958, p. 151.
Description. The figured specimen of the Gurkovo Formation is very similar to holotype, Alpern 1958 (from Decize-Varieux couche 1.).
Occurrence: Gurkovo Formation, sample P-172, 1384,80 m; Gurkovo Formation; P-191, samples 1448, 20 m, 1615 m; P-172, 1384 m.

Genus Triquitrites (Wilson & Coe) Potonie & Kremp 1954
Type species. Triquitrites arcualatus Wilson and Coe 1940.

Remarks. The taxa of this genus of the Gurkovo Formation are similar to the specimens illustrated by Potonie & Kremp 1954; Bharadwaj, 1957; Peppers, 1964, 1970; Agrali & Konyali, 1969. Potonie and Kremp have emended Triquitrites to include such triangular spores as they have angular thickenings (valvae) or small angular projections (auriculae).

Triquitrites sculptilis Balme 1952 emend. Smith and Butterworth 1967

Remarks. The specimens of the Gurkovo Formation are similar to the specimens illustrated by Balme 1952. Balme did not recognize the laevigate character of the proximal surface.

Triquitrites novicus Bharadwaj 1957 (pl. 1, fig. 2).
Holotype. Bharadwaj 1957, pl. 25, fig. 22
Diagnosis. See Bharadwaj 1957, pp. 95, 96.
Description. The figured specimen of the Gurkovo Formation is with auriculae cup-shaped, sides straight, trilete mark usually distinct, rays straight and up to 2/3 radius length.
Occurrence: Gurkovo Formation, sample — P-172, 1506,30 m.

Triquitrites subspinosus Peppers 1970 (pl.1, fig 21)
Holotype. Peppers 1970, pl. 11, fig. 8
Diagnosis. See Peppers 1970, p. 118
Description. The figured specimen of the Gurkovo Formation is with the distinct trilete rays, straight, and extend up to, or nearly up to, the auriculae. The distal surface is with low, rather indistinct, sharp spines.
Occurrence: Gurkovo Formation, sample P-172, 1479,15 m; Gurkovo Formation, upper part (coal seams p3 — p6).

Genus Mooreisporites inusitatus (Kosanke) Neves 1961
Type species. Mooreisporites fustis Neves 1958.

Remarks. The coal seam p3 is rich of the specimens of this genus. Bacule or cones are commonly dispersed irregularly over both proximal and distal surfaces of the spore.

Genus Lycospora (S. W. & B.) Potonie & Kremp 1954
Type species. Lycospora. micropapillata (Wilson and Coe) Schopf, Wilson and Benton 1944.
Remarks. The structure of Lycospora is discussed by Bharadwaj (1957, p. 101) and comparison is made with genera of somewhat similar construction. Some 50 morphographic species are described in the literature.

The nature of the cingulum in Lycospora shows the following range of variation: it is of the nature of a low, dense as L. brevijugas Kos, L. parva Kos.; it consists of a perforated yet continuous, membranous flange as in L. punctata Kos.; with continuous membranous flange but lacks a crassitudinous base of the ridge, as in L. pseudogranulata Kos.;
In comparison to this, most of the other species of Lycospora are triangulate, oval or roundly triangulate. Even the most rounded of all these e.g. L. pusilla is more triangulate than L. rotunda.

Genus Densosporites (Berry) Potonie & Kremp 1954
Type species. Densosporites covensis Berry 1937.
Remarks. Infrequent to abundant in the Assemblages of the coal sample with durain. The emendation by Potonie and Kremp (1954, p. 160) is not practicable because it excludes the type Densosporites covensis (mistakenly believed to be similar to Radiizonates faunus), and other unornamented species, which these authors would place in the genus Anulatisporites (Loose) Potonie and Kremp 1954.

Genus Cristatisporites Potonie & Kremp 1954
Type species. Cristatisporites indignabundus (Loose) Potonie and Kremp 1954.
Remarks. From a critical study of the species from Gurkovo Formation it is evident that this spores are cingulate having narrow and in organisation to the cingulum of Densosporites and Lycospora. The basis for the emendation is the distinction between proximal and distal sculpture, as well as the two-layered exine.

Genus Cirratriradites Wilson & Coe 1940
Type species. C. saturni (Ibrahim) Schopf, Wilson and Bentall 1944.
Remarks. The continuation of the trilete rays over the flange suggests that it is a part of the germinal features and is a modification of the arcuate ridges in the Dobrudzha specimens. Only by C. annulatus Kosanke and Brokaw 1950 (in Kosanke 1950) the distal foveae are enclosed by thickened ridges.

Genus Westphalensisporites Alpern 1958
Type species. Westphalensisporites irregularis Alpern 1958.
Remarks. The genus Westphalensisporites was interpreted as genus Murospora Somers, 1952 (by Alpern, 1958; Alpern & Liabeuf, 1969; Barss, 1967; Barss & Hacquebard, 1967).

Westphalensisporites irregularis Alpern 1958 (pl. 1, fig. 24)
Holotype. Alpern 1958, fig. 188, Borehole Bois-Dore (Lorraine).
Diagnosis. Alpern 1958, p. 149.
Description. The figured specimen of the Gurkovo Formation is with the large cingulum.
Occurrence: Gurkovo Formation, P-172, 1593 m.

Genus Angulisporites (Bhardwaj 1954)
Bhardwaj 1957
Type species. Angulisporites splendidus Bhardwaj 1954.
Remarks. The specimens of the upper part of the Gurkovo Formation are rare and very similar to taxa in Bhardwaj, 1954.

Genus Cadiospora (Kos.) Venkatachala & Bhardwaj 1964
Type species. Cadiospora magna Kosanke 1950.
Remarks. Bhardwaj (1955, p. 129) distinguished Gravisporites by its “massive equatorial crassitudo” and considered that Cadiospora had a cingulum of the type present in Lycospora Schopf, Wilson and Bentall 1944.

The species is irregularly distributed through the thickness of the coal seams up number p3 in the Gurkovo Formation.

Cadiospora magna Kosanke 1950
Locality in the Dobrudzha Basin in the coal seams p3-p7, Gurkovo Formation.

Turma MONOLETES Ibrahim 1933
Infraturma LAEVIGATOMONOLETES Dybova and Jahovicz 1957

The different genera of the Monoletes group are described in the paper of Dimitrova (1993).

Genus Laevigatosporites Ibrahim 1933
Type species. Laevigatosporites vulgaris Ibrahim 1933.
Remarks. The spores of this genus are all laevigate by definition. The larger specimens are referred to Laevigatosporites vulgaris Ibrahim, originally given a size range of 56-80 microns. The Westphalian D coals from the Gurkovo Formation yielded assemblages of a very small species 15-30 microns. Spores with a length less than 35 microns are referred to Laevigatosporites minimus (Wilson & Coe) Schopf, Wilson & Bentall. Some Westphalian D coals yielded assemblages of a very small species 30 microns.

Laevigatosporites minimus (Wilson and Coe) Schopf, Wilson and Bentall 1944 (pl. 1, fig. 10)
Holotype. Wilson 1958, pl. 1, fig. 5 after Wilson and Coe (1940).
Diagnosis. Amb oval, shape in equatorial view phaseolate. Laesura simple, exine very thin.
**Comparison.** Distinguished from other species by its smaller size.

**Occurrence:** Gurkovo Formation, P-172, sample 1596 m. Upper Westphalian sediments in the Dobrudzha basin.

**Laevigatosporites minor** Loose 1934


**Laevigatosporites vulgaris** Ibrahim 1933

Holotype. Potonie & Kremp 1956, pl. 19, fig. 429, after Ibrahim 1933.

Diagnosis. See Ibrahim 1933, p.39.

Remarks. In practice forms of Laevigatosporites between 65 and 100 microns are attributed to L. vulgaris (Potonie & Kremp, 1956).

**Occurrence:** Gurkovo Formation, sample P-172, 1596 m. Westphalian sediments in the Dobrudzha basin.

Genus **Punctatosporites** Ibrahim 1933

Type species. Punctatosporites minutus Ibrahim 1933.

Remarks. The genetic name is not apt and does not describe the type of ornament that characterizes the members of the genus. No doubt this led Dybova and Jachowicz (1957) to adopt the name Granulatosporites (already used by Imgrund in his thesis 1952) for monoilete spores with an ornamentation of grana. Potonie and Kremp 1956 this species are designated to the type of Punctatosporites.

**Punctatosporites granifer** Potonie & Kremp 1956

Description in Dimitrova (Димитрова, 1993).

**Punctatosporites minutus** Ibrahim 1933

Holotype. Ibrahim 1933, pl. 19, fig. 439

Diagnosis. See Potonie and Kremp 1956, p. 143.

Description. Some forms from Gurkovo Formation included in this species have a nearly rounded shape in polar view.

**Occurrence:** Gurkovo Formation, sample P-172, 1506,30 m.

Late Westphalian sediments in the Dobrudzha basin: from upper part of the Mogiliste Formation by jungles coal seams in the Gurkovo Formation.

**Punctatosporites rotundus** Bharadwaj 1957

Holotype. Bharadwaj 1957, pl. 29, fig. 16

Diagnosis. See Bharadwaj 1957, p. 111.

Description. In the specimens of Dobrudzha coal field shape in polar or equatorial longitudinal view very similar.

Remarks. Granulatosporites altus Dybova and Jachowicz 1957 (p. 192, pl.64) is probably synonymous with P. rotundus.

**Occurrence:** Gurkovo Formation, sample P-172, 1479,15 m.

**Punctatosporites oculus** Smith & Butterworth 1967

Description by Dimitrova (Димитрова, 1993).

Genus **Thymospora** Wilson & Venkatachala 1963

Type species. Thymospora thiessenii (Kosanke) Wilson & Vencatalacha 1963.

Remarks. Thymospora replaces Verruososporites. Wilson and Venkatachala (1963, p. 75) consider V. tuberculatus to be a nomen ambiguum and they contend, therefore, that the use of Verruososporites by Potonie and Kremp for monoilete verrucate spores is illegitimate. They accordingly propose Thymospora as a new name for spores of this kind and designate Laevigatosporites thiessenii Kosanke 1943 as the type.

**Thymospora obscura** (Kosanke) Wilson and Venkatachala 1963

Description by Dimitrova (Димитрова, 1993).

Remarks. Although Kosanke describes the exine as punctate the ornament is sufficiently coarse to modify the outline of the spore.

**Thymospora thiessenii** (Kosanke) Wilson and Venkatachala 1963

(1, fig. 18)

Description by Dimitrova (Димитрова, 1993).

**Thymospora pseudothiessenii** (Kosanke) Wilson and Venkatachala 1963

(1, fig.23)

T. pseudothiessenii such as T. verrucosa Alpern 1959.

Holotype. Kosanke 1950, pl. 5, fig. 10.

Diagnosis. See Kosanke 1950, p. 30.

Remarks. T. pseudothiessenii is generally larger and possesses a coarser form of ornament than T. obscura.

**Occurrence:** Gurkovo Formation, sample P-172, 1384 m.
Genus *Torispora* (Balme) Alpern, Doubinger and Horst 1965

*Type species.* *Torispora securis* Balme 1952.


*Remarks.* Since Balme described *Torispora*, several authors (Horst 1957, Guennel and Neavel 1961, Artuz 1962) have investigated its structure and origin. As a result Doubinger and Horst have found it necessary to emend Balme’s diagnosis of the spore.

*Torispora securis* Balme 1952

*Description by Dimitrova* (Димитрова, 1993).

*Remarks.* Although *Torispora securis* is referred to above as a spore it is uncertain whether it functioned as such in view of the special position which cells of this type have been shown to occupy in the sporangium.

Genus *Speciososporites*

*Type species.* *Speciososporites laevigatus* Alpern 1958.

*Remarks.* The species described by Alpern (1958), *Speciososporites minor, S. minutus, S. triletoides* are apparently gradational with *Punctatosporites obliquus* or *Laevigatosporites globosus* (Peppers 1970).

*Speciososporites laevigatus* Alpern 1958

*Remarks.* Holotype. Alpern 1958, pl. 2, fig. 43. *Diagnosis and description for the specimens of the Dobrudzha Basin see by Dimitrova* (Димитрова, 1993).

Genus *Spinososporites* Alpern 1958

*Type species.* *Spinososporites spinosus* Alpern 1958.


*Description.* Monosaccate pollen grain. Central body circular; outline vague. Trilete mark confined to area of central body. Size range 60-85 microns (of this specimen — 72 microns).

*Remarks.* Our specimen corresponds to the species description by the exception of the following morphologic characters: according to

*Occurrence:* Gurkovo Formation, sample P-172, 1384.80 m. Quite frequent in the cycle of the coal seam p3.

*Guthörlisporites* sp. (Bharadwaj 1954)

*Remarks.* This species of Gurkovo formation is distinguished from *Guthörlisporites magnificus* Bharadwaj, the type species, by the triangular margin of central body; folds commonly continue the trace of sutures; saccus covers most of proximal surface of central body.

*Occurrence:* Gurkovo Formation, sample P-172, 1384.80 m.

Genus *Wilsonites* Kosanke 1950

*Type species.* *Wilsonia vesicatus* Kosanke 1950.

*Remarks.* Kosanke supposed that this genus is related to *Endosporites* from which it differs in having an indistinct body.

*Wilsonia kosankei* Bharadwaj 1957

*Remarks.* *Holotype.* Bharadwaj 1957, pl. 1, fig. 22.

*Diagnosis.* See Bharadwaj 1957, p. 115.

*Description.* Spherical spore with bladder translucent, laevigate on the surface but the under surface reticulate.

*Remarks.* *W. vesicata* distinguishes itself by its smaller size in the Gurkovo Formation and almost round in Makedonka Formation (Димитрова, 1997).

*Occurrence:* Gurkovo Formation, sample P-172, 1506.30 m.

*All Late Westphalian sediments in the Dobrudzha Basin.

Genus *Florinites* Schopf, Wilson and Bentall 1944


*Florinites antiquus* Schopf in Shopf, Wilson and Bentall 1944

*Remarks.* *Holotype.* Schopf in Shopf, Wilson and Bentall 1944, fig. 3.

*Diagnosis.* Size 78 microns, central body sub-circular, tetrad mark is sometimes indeterminate.
Occurrence: Gurkovo Formation, sample P-172, 1506,30 m, Krupen and Gurkovo Formation.

Florinites minutus Bharadwaj 1957
(pl. 1, fig. 5)
Holotype. Bharadwaj 1957, pl. 31, fig. 6.
Diagnosis. Oval miospore having a central body to which an annulate bladder is attached.
Occurrence: Gurkovo Formation, sample P-172, 1384,80 m.

Genus Endosporites Wilson & Coe 1940
Type species. Endosporites ornatus Wilson and Coe 1940.
Remarks. The distribution of this genus in Gurkovo Formation is very rare between coal seams p1 and p3.

Genus Potonieisporites (Bharadwaj 1954) Bharadwaj 1964
Type species. Potonieisporites novicus Bharadwaj 1954.
Some species of the genus are geographically widely distributed, being most plentiful in the Lower Autunian, scarce in the Upper Carboniferous (Иносова и др., 1976).
Remarks. Bharadwaj 1964 discusses the morphology, systematics and stratigraphy of Potonieisporites.

Potonieisporites novicus forma grandis Kalibova 1978
(pl. 1, fig. 29)
Remarks. The germinal feature of the material studied exhibits considerable variation in form (for description — see Dimitrova, 1999; Kalibova 1978; Coquel et al., 1976; Bars, 1967).
P. novicus and other species since assigned to the genus all show a series of folds which, broadly speaking may be resolved into two separate sets.
Occurrence: Gurkovo Formation, sample P-172, 1384,80 m.

Genus Latensina Luber 1953
Type species. Latensina trileta Alpern 1958.

Latensina sp.
(pl. 1, fig. 25)
Remarks. The diagnosis of this miospore like as well as L. trileta Alpern 1958.
Description. See Alpern, 1958; Doubinger, 1974.
Occurrence: Gurkovo Formation, sample P-172, 1384,80 m.

Genus Candidispora Venkatachala 1961
Type species. Candidispora candida Venkatachala 1961.
Remarks. This genus is abundant in the upper part of the Gurkovo Formation (p3-p7 coal seams).

Subturma DISACCITES Cookson 1947
Genus Vesicaspora (Schemel) Wilson & Venkatachala 1963
Remarks. From the emended diagnosis by the authors it is not clear that Vesicaspora can by well distinguished from other genera.

Genus Illinites Kosanke 1950
Type species. Illinites unicus Kosanke 1950.

Illinites unicus Kosanke 1950
(pl. 1, fig. 12)
Remarks. This bisaccate miospore is smaller and has distinct trilete mark. Bladders are intrareticulate. The emendation of Potonie and Kremp (1954) emphasizes the inequality of the length of the arms of the tetrad scar, not evident from the original diagnosis of Kosanke (1950).
Occurrence: Gurkovo Formation, sample P-172, 1384,80 m.

Upper part of the Makedonka Formation, upper part of the Krupen Formation, all samples of the clastic sediments of the Gurkovo Formation.

Subturma STRIATITI Pant 1964
1963 Striatiites Pant emend. Klaus, pl. 17, figs. 79-82
1963 Striatiites Pant; Schaarschmidt, pl. 14, figs. 3-7
Genus Protohaploxypinus (Samoilovich) emend. Hart 1964
Type species. Protohaploxypinus (al. Pemphygaletes) latissimus Luber and Waltz 1941.

Protohaploxypinus sp. A
(pl. 1, fig. 20)
Sample — 1384,80 m, Pr. 6b
Description: striate miospore, pollen disaccate, haploxylonoid or slightly diploxylonoid. Corpus circular to oval, mostly longitudinally elongated (polar view); outline usually distinct. Taeniae distinctly and finely infrareticulate; sacchi greater than semicircular in polar exine 2 microns thick; bronchi 0,5-1,5 microns in diameter; sacci infra-sculpture is a well-defined microreticulum without a radial pattern being developed. Sacci attachments distally show a crescent-shaped thickening which rarely extends to the equator.
Dimensions: 8 specimens in the sample; size — 98 microns in the fig. 20.
Occurrence: Gurkovo Formation, sample P-172, 1384,80 m, Pr. 6b;
scarce in the sample in depth 1384,80 m; upper part of the Gurkovo Formation.
The type species (by original designation): *Protohaploxypinus latissimus* (Luber) Samoilovich 1953; USSR, Western Cis-Urals; Permian has indicated that *Lueckisporites* of Balme & Hennely, 1955; *Taeniasporites* Leschik, 1955 emended.

Turma PLICATES Potonie 1960
Subturma PRAECOLPATES Potonie and Kremp 1954

Genus Schopfipollenites Potonie and Kremp 1954
Type species. *Schopfipollenites ellipsoides* Ibrahim 1933.
Remarks. The name Monoletes was proposed by Ibrahim in 1933 and subsequently adopted by Schopf (1938) as the generic name for spores of the above type.

The characteristics of the palynoflora in the new interpretation of the age

The palynoflora recovered from the upper member (neostratotype in Nikolov et al., 1989, P-191) of the Gurkovo Formation is dominated by trilete and monolete spores and monosaccate pollen grains). All taxa are components of the Spinospories spinosus subzone Nikolov et al., 1989. Stratigraphically the borehole 172 belongs to the Gurkovo lithological level and is believed to be Upper Westphalian D/Cantabrian age. The upper part of the sediments of the type borehole P-191 contents the important for stratigraphic level the taxa such Spinospories, Cadidispora, Angulisporites and corresponds to Early Cantabrian in age (Report of 276 NATO Project).

In brief, a critical age-diagnostic feature of the undoubted Late Westphalian D/Cantabrian age of the Upper part of Gurkovo Formation is the appearance of the genera Spinospories, Cadidispora and Angulisporites. The oldest sediments were supposed to belong to Early and Middle Westphalian D and followed in the upper part of the coal Formation by Late Westphalian D and possibly Cantabrian (Cleal et al., 2003).

Appendix

<table>
<thead>
<tr>
<th>MIOSPORE</th>
<th>sample</th>
<th>1596</th>
<th>1593</th>
<th>1506,3</th>
<th>1479,1</th>
<th>1384,8</th>
</tr>
</thead>
<tbody>
<tr>
<td>borehole 172</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Lycospora</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>L. pellicida</em></td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>L. pusilla</em></td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>L. granulata</em></td>
<td></td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>L. punctata</em></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>L. rotunda</em></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td><strong>Densosporites</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>D. sphaeritriangularis</em></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>D. triangularis</em></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Leiotritletes</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>L. adnatus</em></td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td><em>L. adnatoïdes</em></td>
<td></td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td><strong>Punctatisporites</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>P. punctatus</em></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

39
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Polymorphisporites</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>------------------------</td>
<td>----------</td>
<td>----------</td>
<td>----------</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>P. densus</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Torispora</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>T. securis</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>T. laevigata</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thymospora</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>T. obscura</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>T. thiessenii</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>T. pseudothiessenii</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Laevigatosporites</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>L. vulgaris</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>L. minor</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>L. desmoinesensis</td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Punctatosporites</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>P. granifer</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>P. minimus</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>P. rotundus</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Speciososporites</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S. laevigatus</td>
<td>X</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spinosporites</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S. spinosus</td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S. exigus</td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spinosporites sp.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Columninisporites sp.</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Savitrisporites sp.</td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lundbladispora sp.</td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gauthorlisporites</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>G. magnificus</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gauthorlisporites sp.</td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Endosporites</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>E. zonalis</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>E. globiformis</td>
<td>X</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Florinites</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F. antiquus</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F. minutus</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F. pumicosus</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F. ovalis</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wilsonites</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>W. kosankei</td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Latensina</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Latensina sp.</td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Candidispora</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C. candida</td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Schopfipollenites</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S. elipsoides</td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Potonieisporites</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>P. novicus</td>
<td>X</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>P. novicus f. grandis</td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Illinites</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>L. unicus</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vesicaspora sp.</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Protohaploxipinus</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Protohaploxipinus sp.</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Acknowledgments. This work was carried out in the Geological Institute. The author wishes to thank the National Science Fund of the Ministry of Education and Science (Project 1303) for the possibility to these study. Thanks go to Dr Chris Cleal, who is supervisor of IGCP 469 and discussed with me the problem on the age of the Gurkovo Formation.

References


Alpern, B., 1958. Description de quelques microspores du Permo-Carbonifere francais. — Rev. Micropaleont. 1, 2; 75-86.


Wilson, L. R., Popova, T. D. 1989. Подъябла и кореляция на Гуровската свита от карбона в Добруджанското въглено поле. — Сп. Бълг. геол. д-во, 50; 1; 1-14.

Wilson, L. R., Popova, T. D. 1992. Тополашки член на Гуровската свита, ново име на Тополашки член на Гуровската свита. — Сп. Бълг. геол. д-во, 53; 2; 119.