

Palynomorphs from Stoilovo Formation, Veleka Group (Triassic), Strandža Mountain, Southeast Bulgaria

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Г. Чаталов, Х. Виссер — Палиноморфы Стойловской свиты, Велекская группа (триас) Странджа-планина, Юго-Восточная Болгария. Стойловская свита сложена из филлитовидных глинистых сланцев, филлитов, метасаммитов, мраморов, основных и кислых метавулканитов.

Исследовано 30 образцов, распределенных по всей территории, образованной из пород Велекской группы. Результаты были получены только из трех проб. Подходящей для определения возраста палиноморфов оказалась только одна проба.

Определены полые споры, которые могут быть отнесены к форменному роду *Densoisporites*. Вид *Densoisporites nejburgii* был распознан. Он встречается в большом количестве раннетриасовых сукцессий во многих частях света (Европе, Азии, Австралии). Было установлено не менее трех различных типов акритархов. Исследованные формы рода *Veryhachium* могут быть сравнены с *Veryhachium valensii*.

Считается, что комбинированная находка *Densoisporites nejburgii* или морфологически связанных полых форм *Veryhachium* в ассоциациях с оскудным разнообразием является одним из точных свойств морских раннетриасовых ассоциаций.

Abstract. Stoilovo Formation comprises phyllitoid slates, phyllites, metapsammites, marbles, basic and acid metavolcanics. Thirty samples throughout the whole area made of Veleka Group were studied. Only three samples yielded results. Only one sample contains palynomorphs suitable for age determination.

Cavate spores were identified and referred to the formgenus *Densoisporites*. The species *Densoisporites nejburgii* was also found. It is characteristic of many Early Triassic successions in different parts of the world (Europe, Asia, Australia). At least three different types of acritarchs were established. The forms of g. *Veryhachium* may be well compared to *Veryhachium valensii*.

It is assumed that the combined occurrence of *Densoisporites nejburgii* or morphologically related cavate forms of *Veryhachium* in low diversity assemblages is one of the most striking features of marine Early Triassic assemblages.

Introduction

The age of the low-grade metamorphic rocks of Veleka Group is controversial and poses a difficult problem. Recently, both Bulgarian and foreign authors have published contradictory ideas and facts, proving different ages for identical rocks — from Late Proterozoic to Tithonian inclusive (Savov et al., 1971; М а л я к о в, 1976; Č a t a l o v, 1977; Č a t a l o v, B u d u r o v, 1978; Н а ч е в, М а л я к о в, 1979; С е р г е е в а et al., 1979; Č a t a l o v, 1980; M a l j a k o v et al., 1982; D o d e k o v a, Č a t a l o v, 1982; Ч а т а л о в, 1985 — see discussion).

The aim of this paper is to report the first of finds of Early Triassic palynomorphs in the lowgrade metamorphic rocks of Stoilovo Formation. Our data, obtained from palynolo-

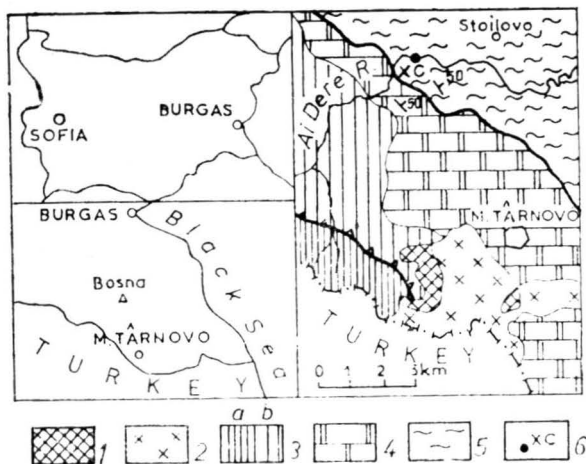


Fig. 1. Review sketch

1 — contact-metamorphic rocks; 2 — Malko Târnovo pluton — Upper Cretaceous; 3a — East Thracian Group — Lower and Middle Jurassic; 3b — Malko Târnovo and Lipačka Formations — Middle-Upper Triassic; 4 — Malko Târnovo Formation — Middle Triassic; 5 — Stoilovo Formation — Lower Triassic; 6 — hydrogeological borehole — location of samples 3-XC and 5-XC

hydrogeological borehole in the area of Dokuzaški dol, south of Stoilovo village, directly near the motor road (fig. 1). Sample 3-XC yielded only *Veryhachium*.

The palynomorphs described in this paper were found in sample 5-XC only. All photographs shown in plate I are from the same sample.

Stratigraphic and petrographic notes

The hydrogeological borehole in the area of Dokuzaški dol is located at 1750 m (straight line) north of the branch road Malko Târnovo — Stoilovo and at 2 km (straight line) south—southwest of Stoilovo Village. The borehole lies about 850 m north of the boundary between Malko Târnovo and Stoilovo Formations. It was planned to penetrate into Malko Târnovo marbles in depth (fig. 1). However, the project depth (1150 m) was reached but the marbles were not drilled. These details are given in order to show what part of the section of Stoilovo Formation has been exposed since we do not know the depth from which the samples were collected. It is evident, however, that the borehole intersects only rocks of Stoilovo Formation.

The section of the borehole is made of black phyllitoid slates, banded silty-clayey rocks and re-crystallized clayey limestones. The same rocks are exposed on the surface south of the borehole. North of the latter crop out greenschists. Thus, we are sure that the studied samples belong to the section between the borehole and Malko Târnovo marbles (fig. 1). In fact, palynomorphs could be detected in thin section from phyllitoid slates on the surface. In this way the studied palynomorphs from sample 5-XC originate from the "lowermost" or southernmost parts of Stoilovo Formation.

Under the microscope the phyllitoid slates show microlepidogranoblastic and microlepidoblastic texture. The mineral composition is: white mica, quartz and rare chlorite, hydrobiotite (?), rutile and pyrite. Apart from dispersed organic matter, there are also black fragments of plants and palynomorphs.

gical studies of metapelitic rocks, support the results of Savov, Čatalov and Budurov who established Lower Triassic conodonts in recrystallized limestones of Zaberska Formation (Savov et al., 1971), a lateral equivalent of Stoilovo Formation (Čatalov, 1985).

Material. Thirty samples were collected from different localities and levels mainly of Stoilovo and Zaberska Formation. The samples are grey and black phyllitoid slates and clay-silty rocks. They were sent to H. Visser for palynological studies in the Laboratory of paleobotanics and palynology, University of Utrecht, the Netherlands. Only three samples yielded results (3-1547, 3-XC and 5-XC). The first sample is from Zaberska Formation (borehole 1547, the area of Dedo Todoraki, east of Gramatikovo village). Only acritarchs were detected which do not allow a more precise dating of the rocks. The other two samples are from the core of the

Description of palynomorphs

The samples yielded poorly preserved low-diversity assemblages of recognizable palynomorphs. Palynomorphs of uncertain affinity (acritarchs) seem to be dominant in the assemblages found; they are indicative of marine depositional environments. In only one sample (5-XC) rare spores of land plants could be detected with certainty. In general the palynomorphs are highly fragmented. The best-preserved specimens so far encountered are pictured in Plate I.

Acritarchs. At least three different types of acritarchs have been found: (1) Highly folded, relatively thin-walled bodies with no clear ornamentation and openings, showing a more or less clearly delimited central inclusion. The forms may be included in the genus *Nucellospira* Timofeev, but it should be realized that in the extensive Soviet literature on sphaeromorphic acritarchs a number of other names have been applied to distinguish spheroidal bodies with a central inclusion. (2) Finely spinulate bodies with no apparent openings. These forms are here assigned to *Conaletes*, a formgenus originally thought to include spores rather than acritarchs (Reinhardt, Schöen, 1967); it is obvious, however, that in literature many alternatives can be found for naming finely spinulate palynomorphs lacking other differential characteristics. (3) Triangular vesicles with spines extending from the angles constitute the most dominant element in the assemblages found. They can be clearly assigned to *Veryhachium*, the most well-known genus of polygonomorphic acritarchs. The forms studied can be well-compared with *Veryhachium valensii* Downie & Sarjeant emend. Sarjeant, 1970.

Cavate spores. The only recognizable morphological group of spores or pollen grains is that of the cavate spores, probably representing microspores of lycopodiophytic affinity. The spores consist of a smooth inner wall which is more or less loosely enveloped by a relatively thin infrastructured outer wall showing no apparent ornamentation. Tetrad scars usually distinct, frequently accentuated by heavy plicate labra. The forms found can be reasonably classed as species of the formgenus *Densosporites*. These species may include *Densosporites nejburgii* (Schulz) Balme, 1970.

Age determination

When it comes to an age determination of the rocks, at first sight the limited palynological information now available would seem to be highly insufficient. However, despite the restricted nature of the assemblages, it is thought that the following qualitative and quantitative characteristics are strongly indicative of an Early Triassic (Scythian) age:

1. Cavate spores assignable to the formgenus *Densosporites* are known to range from the Upper Paleozoic into the Cretaceous. However, only in the Lower Triassic they may constitute a dominant element in low diversity palynological assemblages.

2. The species *Densosporites nejburgii*, originally described as *Lundbladispora nejburgii* from the Middle Buntsandstein of GDR (Schulz, 1964) has subsequently been recognized in a large number of other Early Triassic successions in Europe, Asia and Australia. These successions include ammonoid-controlled strata in the Salt Ridge of Pakistan (Balme, 1970), the Caspian region (Борачева, Виноградова, 1973) and the Italian Alps (Visscher, 1974) representing the upper part of the Scythian Series (Spathian, Olenekian Stages). Furthermore, it is interesting to note that *Densosporites nejburgii* could well represent the microspores of the well-known lycopodiophytic plant genus *Pleuromeia* which has been found in the Lower Triassic of widely separated parts of the world (compare Ярошенко, 1975). In Southeastern Europe, *Densosporites nejburgii* is known to occur abundantly in the Lower Triassic of Rumania (Venkatachala et al., 1968; Antonescu et al., 1976).

3. The polygonomorphic acritarch genus *Veryhachium* is known to range from the Lower Paleozoic into the Cretaceous. However, acritarch assemblages dominated by the small and morphologically simple forms assignable to *Veryhachium valensii* are characteristic of the

Upper Permian — Jurassic interval of widely separated parts of the world. On the basis of the results of his study of Early Jurassic assemblages Wall (1965) suggested that *Veryhachium* favoured an open-sea environment.

4. Throughout the world, the combined occurrence of *Densoisporites nejbürgii* or morphologically related cavate forms of *Veryhachium* in low diversity assemblages is one of the most striking features of marine Early Triassic assemblages.

Because of the abundance of *Veryhachium* in both Zaberska Formation (D-formation, Kalvacheva, Čatalov, 1974) and Lipačka Formation (B-formation, Kalvacheva, Čatalov, 1974) a comparable age of the latter sequences should not be excluded (according to G. Čatalov, this assumption of H. Visscher is very likely all the more that he is not acquainted with the most recent results from the studies of A-formation which turned out to be of Middle Triassic age). The forms identified in B-formation (Kalvacheva, Čatalov, 1974, fig. 1, p. 1420, pl. I, p. 1421) may be well included in *Verihachium valensii*. Unfortunately, the forms found in B-formation are still not identified, nevertheless that one of the figured species (Kalvacheva, Čatalov, 1974, fig. 6, pl. I, p. 1421) may well be an internal body of a cavate spore.

Discussion

The problem of the age of the oldest lithological units of Veleka Group or the so-called Strandža facial type Triassic is evidently difficult to resolve. The main difficulties are related to the allochthonous position of the rocks which form this Group, the intensive deformations and the low-grade metamorphism. These difficulties hamper the stratigraphic studies also in other similar terrains in the Alpine-Himalayan orogen.

So far only the age of Stoilovo, Zaberska and Stravnica Formation remains controversial. They are the units which make up the lowermost parts of Veleka Group. In the other five units of Veleka Group sufficient amount of conodonts and foraminifers have been found which prove Spathian, Anisian, Ladinian, Carnian and Norian age (Čatalov, 1985).

Recently, two concepts on the age of Stoilovo (as well of Zaberska and Stravnica) Formations were published. The first group of authors assume an age from the Late Proterozoic to the Carboniferous inclusive (Hachev, 1972; Cepreeva et al., 1979; Maljakov et al., 1982). One of the authors of the present paper (G. Čatalov) is of the opinion that for the time being there are reliable proves only for a Lower Triassic age but he does not exclude the possibility part of the rocks of Stoilovo and Zaberska Formations to be of Paleozoic age (Čatalov, 1988). This idea is supported also by other authors (Dobovskii, Savov, 1988). In this respect an important fact is that there are lithological transitions between Gramatikovo Formation (Spathian) and Zaberska Formation which are in superpositional relationships. The possibility for the Paleozoic age of part of the rocks of Stoilovo and Zaberska Formation is based on indirect data: the extremely large thickness of this unit (up to about 2800 m) and the hypothesis that they were formed in the confines of the Paleotethys. For this reason the existence of a gradual transition between the Triassic and the probable Paleozoic part of the succession is a logical consequence of this hypothesis. For the time being, however, there are only proofs for an Early Triassic age.

The doubts about the Paleozoic palynomorphs reported by Cepreeva et al. (1979) are based on the fact that in some of the occurrences of these fossils G. Čatalov found Triassic conodonts and foraminifers and in others — Jurassic fauna (ammonites, bivalves, dinoflagellates) (Čatalov, 1985; Dodekova, Čatalov, 1982). Nevertheless, more data are required for a final resolution of the age problem of the above mentioned formations. For the time being the Early Triassic age of at least part of the rocks of Stoilovo and Zaberska Formations remains an unquestionable fact.

PLATE I

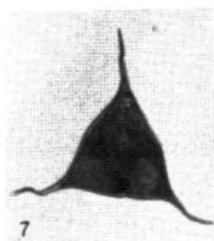
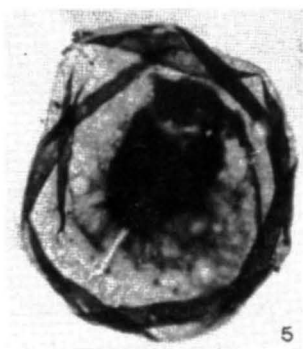


PLATE I

Selection of relatively well-preserved palynomorphs from Stoilovo Formation, Dokuzaški dol, hydrogeological borehole, sample 5-XC, magnification approx. $\times 750$

1 — *Densoisporites nejburgii*; 2 — inner body of cavate spore, probably *Densoisporites*; 3 — *Densoisporites* sp.; 4 — *Conaletes* sp.; 5 — *Nucellosphaeridium* sp.; 6, 7 — *Veryhachium valensii*

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