ISSN 0031-0301, Paleontological Journal, 2007, Vol. 41, No. 11, pp. 1190–1197. © Pleiades Publishing, Ltd., 2007.

Late Triassic Palynological Flora from Western Ciscaucasia

O. P. Yaroshenko
Geological Institute, Russian Academy of Sciences, Pyzhevskii per. 7, Moscow, 109017 Russia
e-mail: dinoflag@ok.ru

Received February 21, 2007

Abstract—A palynological flora from Pre-Cretaceous deposits of western Ciscaucasia is studied. Although these deposits were previously referred to the Paleozoic, comparison with the palynological floras of other regions has dated them to the Late Triassic. A hypothesis is proposed that during the Late Triassic time western Ciscaucasia constituted an ecotone with a temperate warm climate.

DOI: 10.1134/S0031030107110172

Key words: Late Triassic, palynological assemblage, western Ciscaucasia.

INTRODUCTION

The presence in western Ciscaucasia of Upper Triassic (Norian) deposits, which were earlier dated to the Paleozoic, was first revealed by L.D. Kiparisova (Egoyan et al., 1961) based on pelecypods of the genus *Monotis* (*M. salinaria* Schloth., *M. haueri* Kittl, and *M. tenuicostata* Kittl) found in carbonate-clay beds of the Berezanskaya Area (Fig. 1). In the same beds of the Nekrasovskaya Area, Dagys recorded the Norian–Rhaetian brachiopods *Oxylopella guseriplica* Dagys and *O. oxycolpos* Emmr. (*Explanatory*…, 1973). The finds of pelecypods and brachiopods substantiated the assignment of these beds to the Norian and Rhaetian (?) (*Resolutions*…, 1979). The correlation between these beds and underlying deposits is unknown. They are overlain by transgressive succession of Lower Cretaceous deposits. The Upper Triassic beds apparently constitute a single lithological assemblage that is characterized by both Norian and Carnian faunal remains. No reliable faunal remains are known from the Rhaetian of western Ciscaucasia, and deposits of this age have been thought to be absent in the region (Rostovtsev and Aladatov, 1964).

Farther north, Pre-Cretaceous sandy-clayey beds of the Staro-Minskaya area (borehole, no. 100, 3171–3176, 3219–3224, and 3265–3270 m) were assigned to the Jurassic on a palynological basis (Rimsha and Shevchenko, 1975). These authors substantiated their dating by the following list of miospores: *Calamospora* sp., *Selaginella* sp., *Leiotriletes* sp., *Coniopteris* sp., *Concavisporites* sp., *Clathropteris* sp., the Dipteridaceae, *Dictyophyllidites* sp., *D. vulgaris* (Mal.) Sem., *Matonisporites* sp., *Punctatisporites scabratus* (Mal.) Sem., the Caytoniaceae, *Ginkgocycadophytus* sp., *Classopollis* sp., *Inaperturopollenites* sp., the Podocarpaceae, *Podocarpus multicina* Bolch., *Piceites* sp., *Pinus* sp., Coniferales, and other miospore taxa of broad stratigraphic distribution.

In relation to the preparation of stratigraphic charts for the Caucasian Mesozoic, material from the same borehole was provided to the present author for refined dating.

PALYNOLOGICAL ASSEMBLAGE

The study of miospores from several intervals of sandy-clayey beds of borehole no. 100 (3007–3012, 3049–3054, 3171–3176, and 3265–3271 m) revealed sufficiently rich palynological assemblages (200–

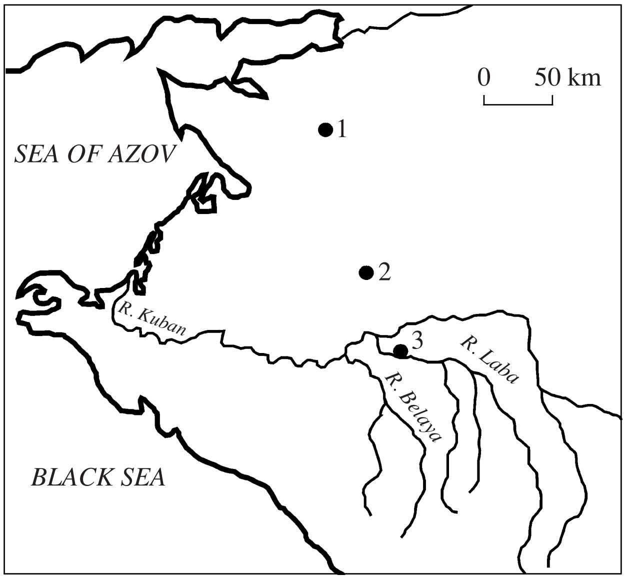


Fig. 1. Schematic map of exploration areas in western Ciscaucasia: (1) Staro-Minskaya, (2) Berezanskaya, and (3) Nekrasovskaya areas.

400 specimens) with similar taxonomic compositions. Although the degree of preservation of the miospores is insufficient, a representative palynological assemblage was revealed (Pls. 24, 25), which is constituted of miospores, acritarchs, dinocysts, and green algae.

Miospores include *Acanthotriletes varius* (Nilsson) Schuurman, *Alisporites* sp., *Annulispora* sp., *Aratrisporites* sp., *Camarozonosporites golzowensis* Schulz, *C. laevigatus* Schulz, *C. rudis* (Leschik) Klaus, *Carnisporites* sp., *Chasmatosporites apertus* (Rogalska) Nilsson, *Chordasporites* sp., *Cingulizonates rhaeticus* (Reinhardt) Schulz, *Classopollis* sp., *Conbaculatisporites mesozoicus* Klaus, *Concavisporites* sp., *C. crassexinus* Nilsson, *Convolutispora microrugulata* Schulz, *Corollina* sp., *Cyathidites* sp., *Cycadopites* sp. sensu Schuurman, 1977, *Deltoidospora auritora* (Reinhardt) Lund, *D. toralis* (Leschik) Lund, *Densosporites cavernatus* Orłowska-Zwolinska, *D. fissus* (Reinhardt) Schulz, *D. foveocingulatus* Schulz, *Dictyophyllidites* spp., *Duplexisporites* sp., *Enzonalasporites vigens* Leschik, *Granosaccus* sp., *Granuloperculatipollis rudis* Venkatachala et Góczán, *Kyrtomisporis laevigatus* Mädler, *K. speciosus* Mädler, *Limbosporites lundbladii* Nilsson, *Lunatisporites* sp., *Lycopodiumsporites austroclavatidites* (Cookson) Potonié, *Lycopodiacidites rugulatus* (Couper) Schulz, *Microreticulatus fuscus* (Nilsson) Morbey, *Minutosaccus* sp., *Monosulcites minimus* Couper, *Neochomotriletes triangularis* (Bolch.) Reinhardt, *Ovalipollis pseudoalatus* (Thiergart) Schuurman, *Paraklukisporites foraminis* Mädler, *Pinuspollenites* sp., *Platysaccus* sp., *Rhaetipollis* sp., *R. germanicus* Schulz, *Ricciisporites tuberculatus* Lundblad, *Stereisporites cicatricosus* (Rogalska) Schulz, *Tigrisporites rhaeticus* (Schulz) Schuurman, *Todisporites* sp., *Triancoraesporites ancorae* (Reinhardt) Schulz, *T. reticulates* Schulz, *Uvaesporites reissingeri* (Reinhardt) Lund, *Vesicaspora fuscus* (Pautsch) Morbey, *Vitreisporites* sp., *Zebrasporites interscriptus* (Thiergart) Klaus, and *Z. laevigatus* (Schulz) Schulz.

Acritarchs: *Micrhystridium* sp. and *Veryhachium* sp.

Dinocysts include *Dapcodinium priscum* Evitt and *Rhaetogonyaulax rhaetica* (Serjeant) Loeblich et Loeblich.

Green algae include *Tasmanites* sp.

The palynological assemblage is dominated by *Ricciisporites tuberculatus* (up to 60%). *Rhaetipollis germanicus* is prominent (up to 20%). Some characteristic Rhaetian taxa are present, although their proportions vary from solitary specimens up to 1–2%. These are *Camarozonosporites* spp., *Densosporites fissus, D. foveocingulatus, Kyrtomisporis laevigatus, K. speciosus, Microreticulatus fuscus, Paraklukisporites foraminis, Stereisporites cicatricosus, Tigrisporites rhaeticus, Triancoraesporites ancorae, T. reticulates, Uvaesporites reissingeri*, and *Zebrasporites* spp. *Cingulizonates rhaeticus* and *Limbosporites lundbladii* are prominent: up to 4% and 10%, respectively. Trilete, in particular, laevigate, and other spores also occur. These are *Concavisporites* spp., *Conbaculatisporites, Cyathidites* sp., *Deltoidospora* spp., *Dictyophyllidites*, and *Microreticulatisporites*, which constitute up to 25% or more. Pollen grains of gymnosperms (*Alisporites, Chordasporites, Cycadopites, Enzonalasporites, Granosaccus* sp., *Lunatisporites, Monosulcites, Ovalipollis*, and *Pinuspollenites*) are not numerous. *Vesicaspora fuscus* and *Vitreisporites* make 2–3% each. *Classopollis, Corollina*, and *Granuloperculatipollis rudis*, which are members of Circumpolles group, are present as solitary specimens or up to 1–2%. Apart from miospores, phytoplankton is recorded, which includes dinocysts of *Dapcodinium priscum* and *Rhaetogonyaulax rhaetica*, as well as numerous acritarchs of the genera *Micrhystridium* and *Veryhachium*, testifying to the marine sedimentation.

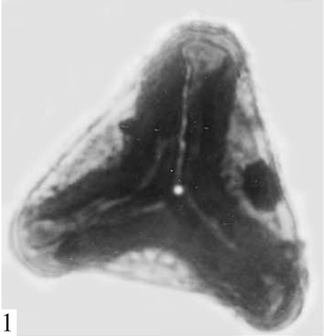
The abundant *Ricciisporites tuberculatus* and prominent contribution to the assemblage of the index species *Rhaetipollis germanicus* allowed Yaroshenko (2006) to define the assemblage as *Rhaetipollis germanicus–Ricciisporites tuberculatus* and date it to the Rhaetian.

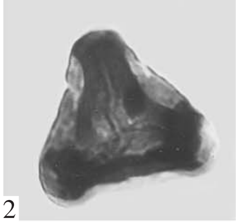
DISCUSSION

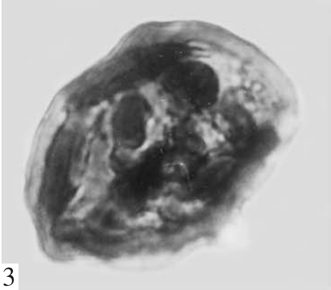
The above-listed composition of the assemblage *Rhaetipollis germanicus–R. tuberculatus* predetermines its distinctive aspect, being comparable with Late Triassic assemblages of other regions. The comparison with the palynological flora of eastern Ciscaucasia (Vakhrameev et al., 1977) shows a very close similarity both in the abundance of *R. tuberculatus,* presence of *R. germanicus*, some characteristic miospores (e.g., *Cingulizonates rhaeticus* and *Limbosporites lundbladii*), and numerous laevigate trilete spores, and the relative rarity of *Corollina* and *Granuloperculatipollis rudis.* Unlike the western Ciscaucasian assemblage, the eastern Ciscaucasian assemblage is characterized by more numerous pollen of *Disaccites*. The assemblage of eastern Ciscaucasia was extracted from plant-bearing beds and assigned to the Rhaetian–Norian. Vakhrameev et al. (1977) determined the following Upper Triassic plant macrofossils: *Dictyophyllum exile* (Brauns) Nath., *D. nilssonii* (Brongn.) Göpp., *Phlebopteris muensterii* (Schenk) Hirmer et Hoerh., *Anomozamites minor* (Brongn.) Nath., *Pterophyllum ptilum* Harris, *Baiera minuta* Nath., *Taeniopteris tenuinervis* Brauns, *Cycadocarpidium schwabii* Nath., and other species known from the Rhaetian of Germany, Sweden, and Greenland. Among Caucasian assemblages, a palynological assemblage from the Norian deposits with *Monotis* spp. of the western Caucasus should be mentioned. In this assemblage *Ricciisporites tuberculatus* is monodominant, which constitutes 87% of the total of miospores (Yaroshenko, 1978).

The palynological flora from the Salgir Formation of the Crimean Peninsula (Bolotov et al., 2004), which is dated to the Norian on the basis of *Monotis*, shows significant similarities to those of western and eastern

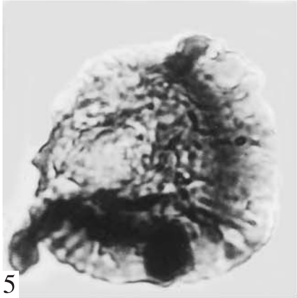
Plate 24

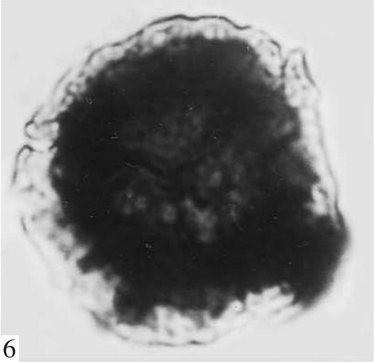

1

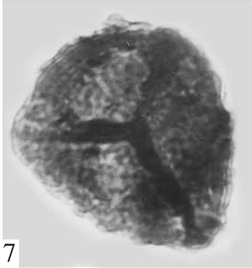

2

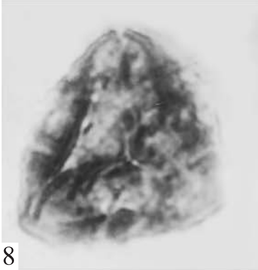

3

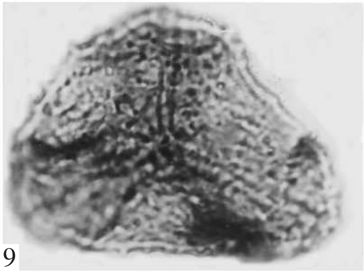

4

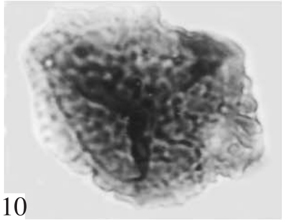

5

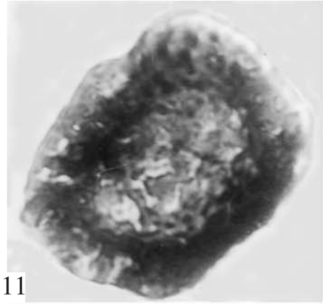

6

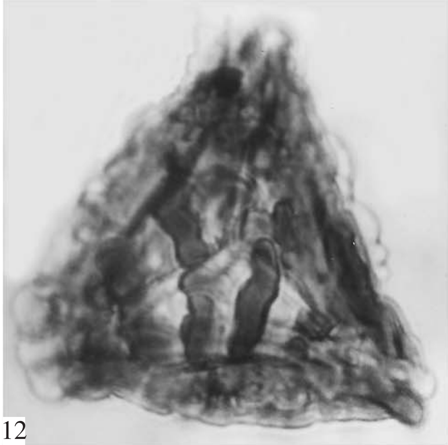

7

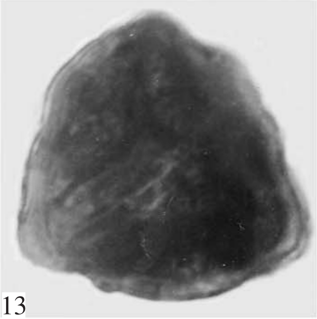

8

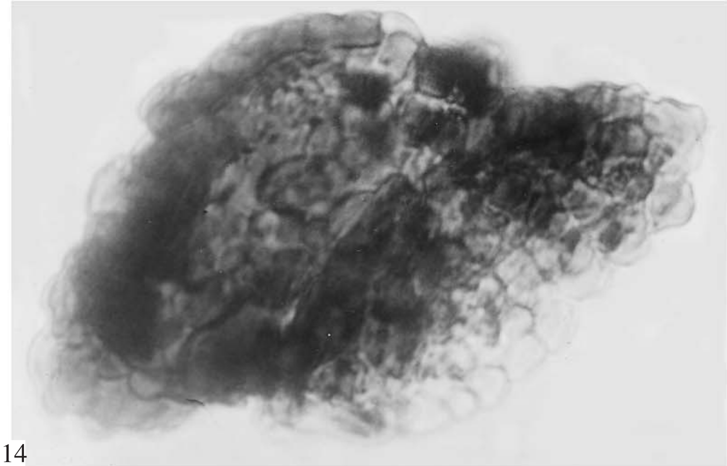

9

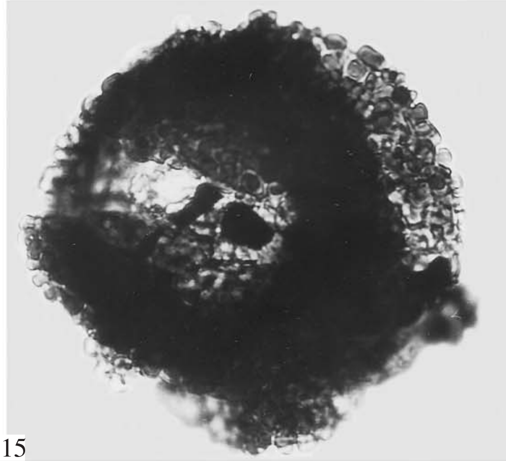

10


11


12


13


14


15

Ciscaucasia. It is also dominated by *Ricciisporites tuberculatus*; *Rhaetipollis germanicus* is common; characteristic *Kyrtomisporis* spp., *Limbosporites lundbladii, Triancoraesporites ancorae, Perinosporites thuringiacus* Schulz, and *Semiretisporites gothae* Reinhardt are present; and pollen grains of Circumpolles are in small amounts. The Crimean locality was dated to the Norian mostly on the basis of faunal remains, whereas the deposits of eastern Ciscaucasia were dated to the Rhaetian–Norian on the basis of plant macrofossils; however, both palynological assemblages indicate a Rhaetian age and, similarly to western Ciscaucasia, are designated by the characteristic taxa *Rhaetipollis germanicus* and *Ricciisporites tuberculatus.* These palynological floras are obviously similar to the palynological assemblage of the European type from the plant-bearing beds of the Novoraiskaya Formation in the Donets Basin (Semenova, 1971); plant macrofossils from these beds belong to the lepidopterid flora.

The western Ciscaucasian palynological assemblage is indisputably comparable with coeval European palynological floras. The prevalence of *Ricciisporites tuberculatus* and the presence of *Rhaetipollis germanicus*, other diagnostic species, and abundant laevigate trilete spores make the assemblage under description similar to the *Ricciisporites tuberculatus* Zone of Poland, dated to the Rhaetian (Fijalkowska-Mader, 1999) and earlier dated to the Late Rhaetian (Orłowska-Zwolinska, 1983). The presence of *Convolutispora microgranulata* Schulz, *Densosporites fissus, Limbosporites lundbladii, Cingulizonates rhaeticus, Stereisporites cicatricosus, Triancoraesporites* spp., *Zebrasporites laevigatus, Rhaetipollis germanicus, Ovalipollis pseudoalatus*, and *Ricciisporites tubercularus*, makes the assemblage closer to phase 3 of the *Rhaetipollis germanicus* Assemblage Zone of the Rhaetian in the Limestone Alps of Austria and southern Germany (Schuurman, 1979), differing from it in the insignificant number of *Ovalipollis pseudoalatus* and *Corollina*. The western Ciscaucasian assemblage is comparable with approximately the same subzones of the stratotype section of the Rhaetian of Kendelbachgraben facies in Austria, to which phase 3 is referable (Morbey, 1975). The assemblage from the Kossen facies of Hungary, which also belong to the Alpine area (Venkatachala and Góczán, 1964), is significantly different from the western Ciscaucasian assemblage in the lower diversity of miospores and dominating Circumpolles (40–94%), which is low in number in the assemblages of western and eastern Ciscaucasia and the Crimean Peninsula. Numerous members of Circumpolles characterize an assemblage from northeastern Spain (Baudelot and Taugourdeau-Lantz, 1986), which was assigned to phase 3 (Schuurman, 1979). *Classopollis* and *Corollina* are the most numerous members of palynological assemblage 1 from the Rhaetian deposits of northern Spain (Barrón et al., 2006), as well as in assemblages of France, Portugal, and Luxembourg (Adloff and Doubinger, 1975, 1978). The maximal differences are observed in Late Triassic assemblages of the more southern Mediterranean: assemblages of Libya, Algeria, and Tunisia show a low taxonomic diversity, numerous *Classopollis* and *Corollina*, and the remarkable absence of Rhaetian indicators *Rhaetipollis germanicus, R. tuberculatus, Triancoraesporites ancorae*, and *Zebrasporites laevigatus* (Adloff et al., 1986). The comparison between the assemblage from western Ciscaucasia and the Late Norian assemblage of the Syrian Mediterranean revealed the same differences in the amount of Circumpolles, which dominated along with common *Deltoidospora, Dictyophyllidites, Concavisporites, Todites, Duplexisporites, Kyrtomisporis laevigatus, K. speciosus, Enzonalasporites, Ovalipollis*, and dinocysts of *Rhaetogonyaulax rhaetica. Rhaetipollis germanicus*, *Ricciisporites tuberculatus*, and other European taxa were not reliably recorded (Yaroshenko et al., 1995).

Among the palynological zones established by Lund (1977) for southern Denmark, Scania, and northwestern Germany, the *Rhaetipollis-Limbosporites* Zone, which is dated to the Middle Rhaetian, shows the closest similarity in the presence of characteristic miospores, planktonic *Dapcodinium*, acritarchs *Micrhystridium* sp. and *Veryhachium* sp., and *Tasmanites*

◄

Explanation of Plate 24

Fig. 1. *Deltoidospora toralis* (Leschik) Lund, 1977; 3171–3176 m.

Fig. 2. *Deltoidospora auritora* (Reinhardt) Lund; 3171–3176 m.

Fig. 3. *Duplexisporites* sp.; 3265–3270 m.

Fig. 4. *Stereisporites cicatricosus* (Rogalska) Schulz; 3007–3012 m.

Figs. 5 and 11. *Limbosporites lundbladii* Nilsson; 3265–3270 m.

Fig. 6. *Cingulizonates rhaeticus* (Reinhardt) Schulz; 3049–3054 m.

Fig. 7. *Uvaesporites reissingeri* (Reinhardt) Lund; 3265–3270 m.

Fig. 8. *Zebrasporites interscriptus* (Thiergart) Klaus; 3007–3012 m.

Fig. 9. *Microreticulatisporites fuscus* (Nilsson) Morbey; 3007–3012 m.

Fig. 10. *Camarozonosporites golzowensis* Schulz; 3265–3270 m.

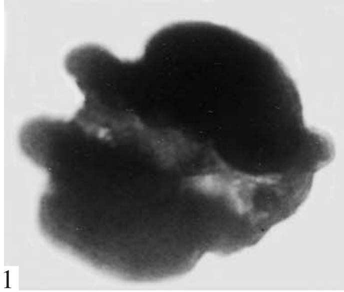
Fig. 12. *Kyrtomisporis speciosus* Mädler; 3049–3054 m.

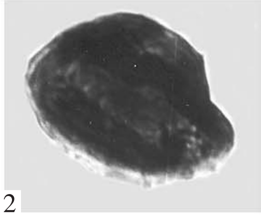
Fig. 13. *Camarozonosporites laevigatus* Schulz; 3171–3176 m.

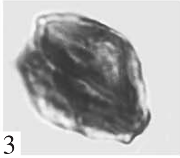
Figs. 14 and 15. *Ricciisporites tuberculatus* Lundblad: (14) 3049–3054 m; (15) 3171–3176 m.

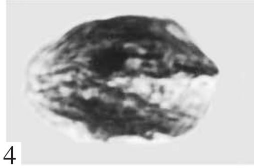
Late Triassic of western Ciscaucasia, Staro-Minskaya area, borehole 100: (1–15) ×1000.

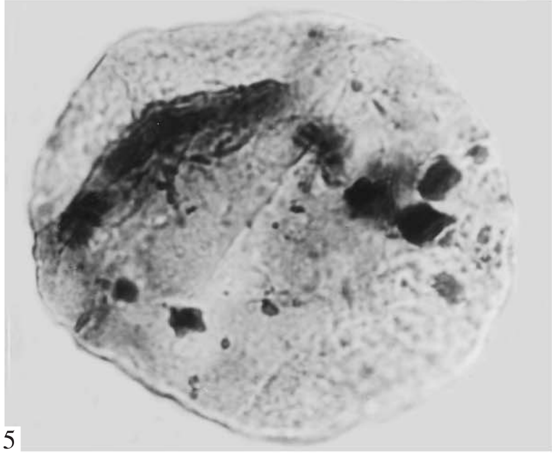
Plate 25


1

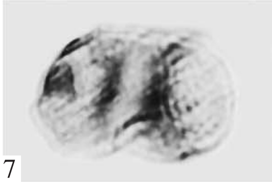

2

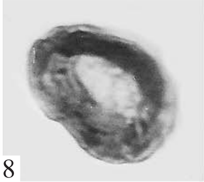

3

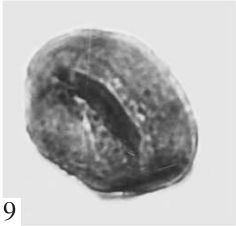

4

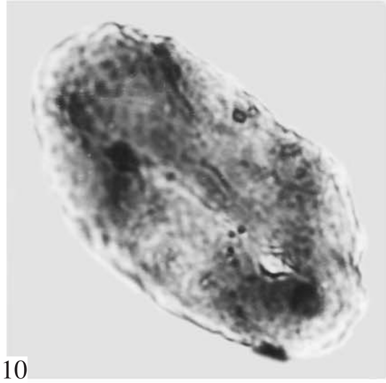

5

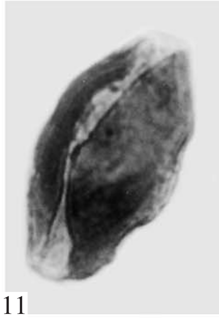

6

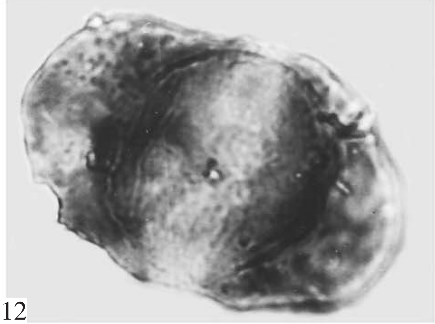

7

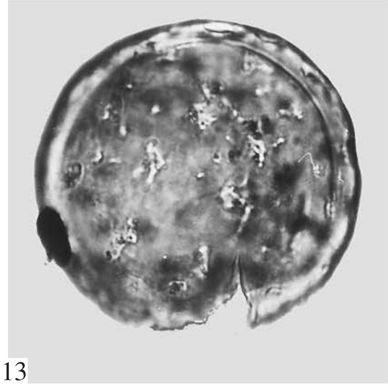

8

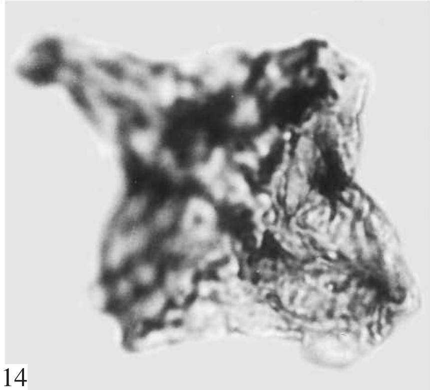

9

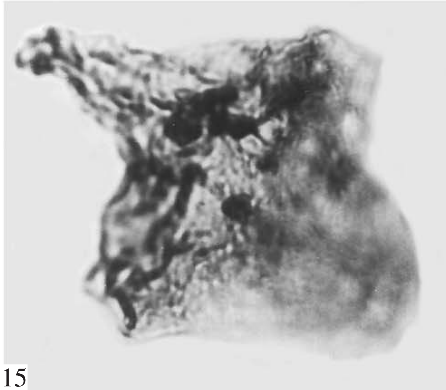

10


11


12


13


14


15

sp. Lund (1977) correlated this zone with a Middle Rhaetian palynological assemblage from the central area of the German Basin, assigning the assemblage to *Rhaetipollis-Limbosporites* Zone (Schulz, 1967). The assemblages from western Ciscaucasia and the Middle Rhaetian of western Thuringia (Schulz, 1995) share the following taxa: *Triancoraesporites ancorae, Triancoraesporites reticulatus, Zebrasporites interscriptus, Densosporites fissus, Convolutispora microrugulata, Limbosporites lundbladii, Camarozonosporites rudis, Cingulizonates rhaeticus, Ovalipollis pseudoalatus, Corollina, Granuloperculatipollis rudis, Chasmatosporites apertus, Ricciisporites tuberculatus, Rhaetipollis germanicus, Dapcodinium priscum, Rhaetogonyaulax rhaetica, Micrhystridium, Veryhachium*, etc.

Schulz (1995) considered the index species *Rhaetogonyaulax rhaetica* and *Rhaetipollis germanicus* as the best indicators of marine deposits of the Rhaetian. The Norian assemblage of Thuringia is characterized by a 95% prevalence of *Corollina* and *Classopollis* (Schulz, 1996). The western Ciscaucasian assemblage is similar in its diagnostic palynomorphs to Rhaetian spectra from England, although they are dominated by *Classopollis* and *Corollina* (Warrington and Harland, 1975). The comparison with the palynological flora from the Kap Stewart Scoresby Sund Formation of eastern Greenland reveals a similarity to zone 1 (1L and 1M) of the Rhaetian, corresponding to the *Lepidopteris macrofloristic* Zone (Pedersen and Lund, 1980). The assemblage of western Ciscaucasia and this zone are similar in the increased percentage of *Ricciisporites tuberculatus* and *Limbosporites lundbladii*, presence of *Rhaetipollis germanicus, Chasmatosporites apertus, Conbaculatisporites mesozoicus, Deltoidospora* spp., *Densosporites cavernatus, Lycopodiumsporites austroclavatidites, Stereisporites cicatricosus, Triancoraesporites ancorae, Uvaesporites reissingeri, Vesicaspora fuscus*, and *Zebrasporites interscriptus*, and in the low abundance of *Corollina* and *Classopollis*.

All above-mentioned points suggest that the western Ciscaucasian assemblage contains palynomorphs that are characteristic of Rhaetian assemblages and palynological zones of Europe, differing from most of them in the lower percentage of pollen grains belonging to the Circumpolles group. However, the same diagnostic taxa are known in Norian palynological spectra from the beds with *Monotis* of the Sverdrup Basin (Fisher and Bujak, 1975) and the Norian and Rhaetian of other islands of the Canadian Arctic Archipelago (Fisher, 1979). This means that many palynomorphs from this pool appear in the Norian deposits characterized by ammonoids of the *Columbianus* Zone, pass to the Rhaetian, and are traceable in the basal Jurassic, where they are of minor importance (Fisher and Dunay, 1981). Since the consideration of the status of the Rhaetian stage is beyond the scope of this paper, and it is impossible to trace changes in the composition of palynomorphs on the basis of the available material, I date with certainty the assemblage of western Ciscaucasia to the terminal Triassic.

As was said above, pollen grains of *Classopollis* and *Corollina* prevail in most assemblages, reflecting the dominance of a dry climate in Europe and, in particular, in the Mediterranean (Venkatachala and Góczán, 1964; Adloff et al., 1975, 1978, 1986; Baudelot and Taugourdeau-Lantz, 1986; Yaroshenko et al., 1995; Schulz, 1996; Barrón et al., 2006; etc.). In contrast, the palynological zone of eastern Greenland contains the lowest percentage of such pollen, which is explained by the more northern position of the region and its humid climate in the Late Triassic (Pedersen and Lund, 1980). Such distribution conforms to traditional ideas about the distribution of *Classopollis*, which was produced by thermophilic drought-resistant plants of the Cheirolepidiaceae, and to the application of this pollen as a climatic indicator. Vakhrameev (1981) noticed that the abundance of this xeromorphic pollen decreases remarkably northward. However, the opinion that xeromorphic communities, such as those formed by gnetophytes, supposed producers of *Classopollis*, do not always indicate a dry climate (Krassilov, 1997, 2006) should be taken into consideration.

←

Explanation of Plate 25

Figs. 1 and 2. *Rhaetipollis germanicus* Schulz: (1) 3007–3012 m; (2) 3171–3176 m.

Fig. 3. *Rhaetipollis* sp.; 3265–3270 m.

Fig. 4. *Rhaetipollis* sp.; 3265–3270 m.

Fig. 5. *Vesicaspora fuscus* (Pautsch) Morbey; 3171–3176 m.

Fig. 6. *Chasmatosporites apertus* (Rogalska) Nilsson; 3007–3012 m.

Fig. 7. *Vitreisporites* sp.; 3171–3176 m.

Fig. 8. *Corollina* sp.; 3265–3270 m.

Fig. 9. *Classopollis* sp. (3171–3176 m).

Fig. 10. *Ovalipollis pseudoalatus* (Krutzsch) Schuurman; 3171–3176 m.

Fig. 11. *Monosulcites minimus* Couper; 3265–3270 m.

Fig. 12. *Alisporites* sp.; 3171–3176 m.

Fig. 13. *Tasmanites* sp.; 3171–3176 m.

Figs. 14 and 15. *Rhaetogonyaulax rhaetica* (Sarjeant) Loeblich et Loeblich; 3007–3012 m: (14) antapical part is in focus; (15) apex is in focus.

Late Triassic of western Ciscaucasia, Staro-Minskaya area, borehole 100: (1–12, 14, 15) ×1000, (13) ×600.

The minor role of *Classopollis* and *Corollina* in assemblages of the southern areas of western and eastern Ciscaucasia, Crimean Peninsula, and eastern Greenland, which are situated in different paleolatitudes, rather contradicts the conventional idea about the correlation between this pollen and a dry climate. It is believed that the Late Triassic and Early–Middle Jurassic are characterized by humidification of the climate. The southern regions of the northern extremity of the Tethys probably belonged to the ecotone with a temperate-warm climate described by Krassilov (1981) for the Early Jurassic, which was apparently inherited from the terminal Triassic. The prevalence in the assemblages of these regions of spores of *Dictyophyllidites* spp. and *Deltoidospora* spp., produced by dipteridaceous ferns, testifies to the existence of humid conditions (Brik et al., 1955; Pedersen and Lund, 1980). The similar small number of *Classopollis* and *Corollina* in the palynological assemblages of southern regions with temperate-warm and wet climates, on the one hand, and Greenland with a humid climate, on the other hand, is apparently caused by both similar climatic conditions and lithology, which is mostly represented by sandy-clayey, clayey, and other terrigenous deposits. A Norian–Rhaetian assemblage was studied from lithologically similar, predominantly clayey, deposits of the Cis-Caspian syneclise, which contained solitary pollen grains of *Corollina* and *Granuloperculatipollis rudis*, numerous trilete spores of *Acanthotriletes varius, Concavisporites* sp., *Conbaculatisporites mesozoicus, Dictyophyllidites*, as well as *Limbosporites lundbladii, Kyrtonisporis* spp., *Zebrasporites* spp., *Perinosporites thuringiacus* Schulz, *Neochomotriletes triangularis, Densosporites cf. fissus, Stereisporites cicatricosus, Chasmatosporites apertus, Ovalipollis* spp., and others (Yaroshenko et al., 2001).

Unlike other analogous assemblages, some European assemblages from carbonate deposits, especially in the Mediterranean, are abundant in *Classopollis* and *Corollina*, which often prevail. Discussing the percentage of such pollen, Vakhrameev (1981) emphasized the necessity to take into account the lithology of the enclosing deposits. The local paleoecology, which is predetermined by the paleogeographic settings of the regions, also should be considered.

In summary, the western Ciscaucasian assemblage and Rhaetian palynological zones of the German Basin and Alpine area are shown to have a very similar taxonomic composition. However, as far as the diagnostic palynomorphs occur both in the Rhaetian and Norian assemblages of the Arctic Archipelago of Canada, the assemblage under description is assignable both to the Rhaetian and Rhaetian–Norian. The assemblages of western and eastern Ciscaucasia and the Crimean Peninsula reflect the terminal phase in the evolution of the Late Triassic palynological flora. The post-Carnian palynological flora is relatively uniform in both Europe and America, varying in higher or lower diversity of the taxa and their percentages. Members of this palynological flora are found in Asia as well. Thus, Norian and Rhaetian assemblages of Siberia were characterized by typical members of European genera *Cingulatizonates, Chasmatosporites, Lycopodiumsporites, Ovalipollis, Tigrisporites, Zebrasporites, Aratrisporites*, and *Triancoraesporites ancorae*, along with numerous saccate pollen grains of gymnosperms (Odintsova, 1977).

Some stratigraphically significant palynomorphs have an even broader geographic range, that is exemplified by an assemblage of *R. germanicus* from the Rhaetian–Hettangian of India, which contains *Rhaetipollis germanicus, Aequitriradites, Classopollis, Convolutispora, Dictyophyllidites*, and *Concavisporites* (Tiwari, 1999).

Dinocysts also show a broad geographical range in the Late Triassic, such as a species of the *Schublikodinium–Rhaetogonyaulax* plexus recorded for the first time in Antarctica (Foster et al., 1994), and *Rhaetogonyaulax rhaetica* from Iran (Ghasemi-Nejad et al., 2004), thus confirming the hypothesis of Rostovtsev and Aladatov (1964) of unimpeded contact between the seas of western Ciscaucasia and the western areas of the Tethys.

ACKNOWLEDGMENTS

I am grateful to Alexey Herman (GIN) for valuable discussion and suggestions during the preparation of the manuscript and to Galina Aleksandrova (GIN) for technical assistance.

The study is financially supported by Scientific School 372.2006.5.

REFERENCES

1. M. C. Adloff and J. Doubinger, “Observations palynologiques dans le Rhétien du Plateau d’Antully (bordure N-E du Massif Central Français),” Extrait Bull. Soc. d’Hist. Nat. d’Autun, No. 73, 1–5 (1975).
2. M. C. Adloff and J. Doubinger, “Associations palynologiques du Trias et du Lias inférieur de l’Ouest de l’Europe (Luxembourg, France, Portugal): First Int. Palynol. Conf.,” Palinologia, Número extraordinário 1, 21–25 (1978).
3. M. C. Adloff, J. Doubinger, D. Massa, and D. Vachard, “Trias de Tripolitaine (Libye). Nouvelles données biostratigraphiques et palynologiques,” Rev. Inst. Français du Pétrole **41** (1), 27–72 (1986).
4. E. Barrón, J. J. Gómez, A. Goy, and A. P. Pieren, “The Triassic–Jurassic Boundary in Asturias (Northern Spain): Palynological Characterization and Facies,” Rev. Palaeobot. Palynol. **138**, 187–208 (2006).
5. S. Baudelot and J. Taugourdeau-Lantz, “Découverte d’une microflore dans les Pyrénées catalanes attribuable au Norien-Rhétien,” Rev. Paléobiol. **5** (1), 5–9 (1986).
6. S. N. Bolotov, D. I. Panov, and O. P. Yaroshenko, “New Data on the Palynological Characterization of the Triassic and Liassic Deposits of the Bodrak River Basin (Crimea),” Byull. Mosk. O–va Ispyt. Prir., Otd. Geol. **79** (3), 3–19 (2004).

7. M. I. Brik, E. A. Kopytova, and A. I. Turutanova-Ketova, “Some Mesozoic Ferns of the Southwestern Cis-Urals and Their Spores,” in *Materials to Geology of Ore Minerals, Part 2, Issue 9, New Series* (Gosgeoltekhizdat, Moscow, 1955), pp. 131–177 [in Russian].
8. V. L. Egoyan, V. A. Ermakov, and K. I. Kiiko, “On the Discovery of the Marine Upper Triassic in the Eisk–Berezanskaya Region of Southwestern Ciscaucasia,” Dokl. Akad. Nauk SSSR **138** (6), 1417–1420 (1961).
9. *Explanatory Note on the Proposed Stratigraphic Schemes of the Triassic Deposits of the Caucasus Mountains*, Ed. by L. D. Kiparisova (Vses. Geol. Inst., Leningrad, 1973) [in Russian].
10. A. Fijalkowska-Mader, “Palynostratigraphy, Palaeoecology, and Palaeoclimatology of the Triassic in South-Eastern Poland,” Zbl. Geol. Paläontol., Part 1, Issues 7–8, 601–627 (1999).
11. M. Y. Fisher, “The Triassic Palynological Succession in the Canadian Arctic Archipelago,” Am. Assoc. Stratigr. Palynol. (AASP), Contrib. Ser. 5B, 83–100 (1979).
12. M. Y. Fisher and J. Bujak, “Upper Triassic Palynofloras from Arctic Canada,” Geocience and Man **11**, 87–94 (1975).
13. M. Y. Fisher and R. E. Dunay, “Palynology and the Triassic/Jurassic Boundary,” Rev. Palaeobot. Palynol. **34**, 129–135 (1981).
14. C. B. Foster, B. E. Balme, and R. Helby, “First Record of Tethyan Palynomorphs from the Late Triassic of East Antarctica,” AGSO J. Austral. Geophys. **15** (2), 239–246 (1994).
15. E. Ghasemi-Nejad, A. Agha-Nabati, and O. Dabiri, “Late Triassic Dinoflagellate Cysts from the Base of the Shemshak Group in North of Alborz Mountains, Iran,” Rev. Palaeobot. Palynol. **132**, 207–217 (2004).
16. V. A. Krassilov, “Syngenesis of Xeromorphic Plant Communities in the Late Paleozoic to Early Cenozoic,” Paleontol. Zh., No. 2, 3–12 (1997) [Paleontol. J. **31** (2), 125–134 (1997)].
17. V. A. Krassilov, “Changes of Mesozoic Vegetation and the Extinction of Dinosaurs,” Palaeogeogr. Palaeoclimatol. Palaeoecol. **34**, 207–224 (1981).
18. V. A. Krassilov, “Mesozoic Gnetophytes and the Advent of Angiosperms,” in *Progr. Abstr. 7th European Palaeobot.–Palynol. Conf., September 6–11, Prague, Czech Republic* (National Museum, Prague, 2006), p. 166.
19. J. J. Lund, “Rhaetic to Lower Liassic Palynology of the Onshore South-Eastern North Sea Basin Danmark,” Geol. Surv. Danmark, Ser. 11, No. 109, 1–128 (1977).
20. S. Morbey, “The Palynostratigraphy of the Rhaetian Stage, Upper Triassic in the Kendelbachgraben, Austria,” Palaeontographica **152**, 1–75 (1975).
21. M. M. Odintsova, *Palynology of the Early Mesozoic of the Siberian Platform* (Nauka, Novosibirsk, 1977) [in Russian].
22. T. Orłowska-Zwolinska, “Palynostratigraphy of the Upper Part of Triassic Epicontinental Sediments in Poland,” Prace Inst. Geol. Warszawe **104**, 1–89 (1983).
23. K. R. Pedersen and J. J. Lund, “Palynology of the Plant Bearing Rhaetian to Hettangian Kap Stewart Formation, Scoresby Sund, Eastern Greenland,” Rev. Palaeobot. Palynol. **31** (1–2), 1–69 (1980).
24. *Resolution of the 2nd Interdepartmental Regional Conference on the Mesozoic of the Caucasus Mountains (Triassic), 1977* (Vses. Geol. Inst., Leningrad, 1979) [in Russian].
25. L. A. Rimsha and T. V. Shevchenko, “On the Stratigraphic Position of the pre-Cretaceous Strata in Western Ciscaucasia,” Izv. Akad. Nauk SSSR, Ser. Geol., No. 8, 125–130 (1975).
26. K. O. Rostovtsev and G. M. Aladatov, “Triassic Deposits of Western Ciscaucasia,” Dokl. Akad. Nauk SSSR **156** (4), 830–833 (1964).
27. E. Schulz, “Sporenpaläontologische Untersuchungen rhätoliasischer Schichten im Zentralteil des Germanischen Beckens,” Paläontol. Abt. B **2** (3), 543–633 (1967).
28. E. Schulz, “Palynologische Untersuchungen des marinen Mittelrhäts im Creuzburger Graben bei Eisenach (W-Thüringen),” Berliner Geowiss. Abh. Reihe E **16**, 427–437 (1995).
29. E. Schulz, “Eine Microflora aus dem Steinmergelkeuper vom SW-Hang der Wachsenburg bei Gotha (Thüringen),” N. Jb. Geol. Paláontol. Abh. **200**, 75–86 (1996).
30. W. N. L. Schuurman, “Aspects of Late Triassic Palynology: 3. Palynology of Latest and Earliest Jurassic of the Northern Limestone Alps in Austria and Southern Germany, with Special Reference to a Palynological Characterization of the Rhaetian Stage in Europe,” Rev. Palaeobot. Palynol. **27**, 53–75 (1979).
31. E. V. Semenova, “Correlation of the Upper Triassic of the Donets Basin and Some Regions in Europe Based on Miospores,” Problemy Palinol., No. 1, 92–99 (1971).
32. R. S. Tiwari, “The Palynological Succession and Spatial Relationship of the Indian Gondwana Sequence,” Proc. Nat. Acad. Sci. India, Issue 65A, No. 3, 329–375 (1999).
33. V. A. Vakhrameev, “Pollen *Classopollis*: Indicator of Jurassic and Cretaceous Climates,” Palaeobotanist **28/29**, 301–307 (1981).
34. V. A. Vakhrameev, I. A. Dobruskina, E. A. Zhat’kova, and O. P. Yaroshenko, “Upper Triassic Flora-Bearing Deposits of Eastern Ciscaucasia,” Izv. Akad. Nauk SSSR, Ser. Geol., No. 3, 62–72 (1977).
35. B. S. Venkatachala and F. Góczán, “The Spore-Pollen Flora of the Hungarian 'Kossen Facies’,” Acta Geol. **8** (1–4), 203–228 (1964).
36. G. Warrington and R. Harland, “Palynology of the Trias and Lower Lias of the Larne Borehole,” Bull. Geol. Surv. Great Britain **50**, 37–50 (1975).
37. O. P. Yaroshenko, *Miospore Assemblages and Stratigraphy of the Triassic of the Western Caucasus Mountains: Proc. Geol. Inst. Acad. Sci. USSR, Issue 324* (Nauka, Moscow, 1978) [in Russian].
38. O. P. Yaroshenko, “Triassic Palynostratigraphy of the East European Platform and Adjacent Regions,” in *Boreal Triassic. Norsk Geol. Forening. Abstr. Proc. Longyearbyen, August 16–19, 2006* (2006), No. 3, pp. 144–147.
39. O. P. Yaroshenko and I. Bash Imam, “Age Variability of Palynomorph Compositions of the Middle and Late Triassic of Syria and Their Relation to Climate and Facies,” Stratigr. Geol. Correlation **3** (4), 375–392 (1995).
40. O. P. Yaroshenko, I. S. Makarova, G. M. Romanovskaya, et al., “Palynological Assemblages from the Middle–Upper Triassic Deposits of the Caspian Sea Lowland,” Nedra Povolzh’ya i Prikaspiya, Issue 26, 10–18 (2001).