The Collection of Fossil Plants from Perm Deposits of the Urals in the Museum of Karst and Speleology of the Mining Institute of Ural Branch of Russian Academy of Sciences

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Abstract. The article provides a brief description of the Permian fossil flora collection stored in the Karst and Speleology Museum of the Mining Institute of the Ural Branch of the Russian Academy of Sciences. Samples were collected in the Perm region and Tatarstan; they belong to the Kungur and Kazan tiers of the Perm system. The collection is dominated by imprints of peltaspermic and ginkgophytes, which corresponds to their prevalence in the studied locations. Among them are very attractive specimens. Unfortunately, the museum’s display capabilities are limited, and only a small part of the collection is available for inspection.

1. Introduction

The South-Eastern part of Perm region, that is located in the basin of the Sylva river, is rich in geological monuments mainly belonging to the lower part of the Perm system, many of them contain the remains of fossil biota.

Chekarda (a small village) occupies a special place among them. The small village in Suksun district of Perm region is situated at the confluence of the Sylva and the left bank of the river Chekarda. In the coastal outcrops of the Sylva, below and above the mouth of the Chekarda (the Chekarda-1 and the Chekarda-2), there are composed of lamellar, platy siltstone, mudstones, sandstones and marls of Koshelevskaya suite of Irensky horizon of Kungur, and many other varied prints of lower Perm plants and insects. In terms of species diversity and the degree of preservation of the material, this location has no equal one, and its importance for understanding of the Paleozoic evolution of higher plants and a lot of orders of insects is difficult to overestimate [1; 2; 3; 4]. This is the place where most of our collection of fossil Perm plants has come from.

2. Material and methods

A very small part of the paleontological collection of the Museum of Karst and Speleology consists of 39 samples of fossil plants (11.6%). 29 of them are collected in Chekarda, 5 in Mazuevka (Perm region, Kishert district, Kungur tier). 2 samples are found in Tarlovka (Tatarstan, the Kazan tier), and 3 samples from the memorial collection of the laboratory scientist E. P. Dorofeev which origin is unknown, they might have come from the upper basin of the Sylva river.

The collection is rather small but we have decided to characterize it as much as possible in order to make it familiar to specialists, as well as collections of Kungur flora, which are available today in Kungur [5; 6; 7; 8].
The main volume of the samples was being collected during the two field trips of the laboratory staff onto outcropping on the Chekarda-1 in August 2006 and in July 2010.

The Chekarda -1 is the coastal cliff of the Sylva, its length is about 500 m and its height is about 14-15 m. This outcrop is well-known and has been described in literature more than several times [3; 4; 5]. The outcrop of Mazuevka is situated on the Sylva in the suburbs of the village that has the same name in Kishert district of Perm region. Its length along the left bank of the Sylva is more than a kilometer, the total thickness of the outcropping rocks are more than 70 m. The outcrop is made of sandstones, siltstones and mudstones [9]. The age of the rocks – Kungur, as well as the Chekarda, are Koshelevskaya suite of Irensky horizon of Kungur. We worked here in April 2017.

Tarlova is located in Yelabuga district of the Republic of Tatarstan, on the right bank of the Kama river, in the outskirts of the sanatorium ”Tarlova”. The height of the coastal outcrops is from 2 to 20 m. It consists of sandstones, lime stones, siltstones, mudstones and clays of Baitugan and Kamyshlin slice of Kazan tier [10]. We were here in September 2018, but no plant prints were collected. Two large samples originated from there, were donated to the Museum of L. I. Krapivin (Naberezhnye Chelny). Some samples from Chekarda and Mazuevka were given to N. N. Kozlova and A. A. Dolgikh (Kungur). Three more samples were collected by laboratory scientist E. P. Dorofeev and were kept in his personal collection.

The samples originated from talus accumulation of outcrops, from the shore and even from the riverbed of the Sylva. Their processing was minimal - after washing and drying, some samples were impregnated with PVA glue. The museum dimensions (in mm) are indicated in the collection inventories: the maximum height, length, width of the entire sample (not the print). Plant remains are represented by phytolims and prints; there is also a sample of woody coal and the one that is rich in small fragmented micrinites that have no definition yet. The characteristics of other samples of higher plants are presented below. The nomenclature of taxa, including species’ names, and order of presentation are given according to prof. S. V. Naugolnykh [11].

3. Description of the collection

Group Equisetophyta. Class Equisetopsida. Order Equisetales. Family Tchernoviacae (figure 1, A-B). The remains of equisetum-like are represented by 9 samples (23.1%). These are mainly the fragments of shoots (maximum dimensions - up to 100 mm in length and 35 mm - in widths). Deciduous shoots are not among them, Taxonomically Paracalamites dominate Paracalamites frigidus Neub. and P. decoratus (Eichw.) Zal., the dominant aquatic and semi-aquatic paleophytenogenesis Kungur century of the Urals [12].

Group Polipodiophyta (figure 1, C-D). Remains of Fougères in the collection are rare, there are only three (7.7%), they are presented with sterile sheets mecopteroida morphology. It may turn out that our samples belong to Marattiales. Two samples are identified as Pecopteris cf. uralica Zal., and one – P. antriscifolia (Goepp.) Zal. In mesophilic and xeromesophytic communities of Kungur century of the Urals, Fougères occupied a subordinate position, giving the first place to peltaspermae and psigmophylloids [12].

Group Pteridospermatophyta. Class Peltaspermopsida. Order Peltaspermae. Family Peltaspermaceae (figure 1, E-F). There are only two specimens in the collection (5.2%) Permacallipteris (al. Callipteris) sp., fragmentary prints up to 50 mm long.

Group Pteridospermatophyta. Class Peltaspermopsida. Order Peltaspermales. Family Angaropeltaceae. There are two samples of this family taken from Tarlovka (the Republic of Tatarstan) with leaves’ prints Phylladodermia sp. (figure 2 A).

Group Ginkgophyta. Class Ginkgoopsida. Order Ginkgoales. Family Psymophyllaceae. There are eight samples in the collection (20.5%). Three of them are from Mazuevka. It is a pity but there are no good leaves with the whole plate of a leaf, there are only fragmented prints of Psymophyllum expansum (Brongn.) Shimper (figure 2 B – P. intermedium).

Group Ginkgophyta. Class Ginkgoopsida. Order Ginkgoales. Family Karkeniaceae (figure 2 C). There are two samples (5.2%) that represent Chekarda – Kerpia macroloba Naug., they have
prints of long-haired, complex-bladed leaves of small size. Karkenias, like psigmophylloids, dominated in mesophilic and xeromesophilic paleophytocenosis of Kungur century.

**Group Pinophyta. Class Voivoskyopsida. Order Voinovskyales. Family Voinovskyaaceae (figure 2 D).** There are six examples in the collection (15.3%) with elongated lancet and scaly leaves with parallel veins. Our samples may represent *Rufloria derzavinii* (Neub.) S. Meyen, which is one of the most common sediments in the Kungur tier and often dominant in orictocenos [11]. Together with conifers, the wartorn sweds grew on higher ground, the most remote from the reservoirs, placorous and sub-placorous ecotops, where xerophilic paleophytocenosis appears to have prevailed.

**Group Pinophyta. Class Pinopsida. Order Walchiales. Emily Walchiaceae.** Two samples give the information about the description of two plant genus *Walchia* [11]: *W. bardaeana* Zal. and *W. appressa* Zal., reliably differing in size and shape of acicular leaves (figure 2, E-F). There are no prints of the generative organs of the *Walchia* in the collection. There are three specimens identified as shoots of coniferous genus *Tylodendron*. All in all, there are five samples of conifers in the collection (12.8%).

4. **Conclusion**

The size of the collection is very small and it is difficult to expect that the meronomical representation of its components will correspond to their real ratios identified today for the location of the Chekarda-1 [6; 11]. However, it turned out that the representation of macro remains of plants of the main groups listed above do not differ much.

The major part of the collection is presented by the family of Peltaspermaceae (without Angaropeltitaceae from Tarlovka) and Ginkgophyta – 12 (30.9%), then Equisetopsida – 9 (23.1%), Voinovskyaaceae (15.3%) and Walchiaceae (12.8%). Less in number is the group of Polipodiophyta [11], the second place of frequency in Chekarda is given to Voinovskyaaceae and the last position occupies the family of Coniferae. It may be explained by the fact that for the Museum we took only attractive and well preserved samples but they were few in number.

Nowadays 10 specimens with fossil plants are on display in the permanent exhibition of the Museum of Karst and Speleology (in the paleontological section). That is all the Museum can afford now but the number of our exhibits is even more saturated than in the Municipal Museum of Local Lore, which has more extensive collection of materials, including several hundred samples [5; 6; 7; 8]. The only way to solve the problem is to organize temporary theme exhibitions that sometimes take place in the museum. To sum up, it is evident that the creation of an excellent exhibition of kungur flora of the Urals is to occur.

5. **References**

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Acknowledgment

The author thanks his colleagues who helped him in this work: candidate of geology N. V. Lavrova, A. V. Krasikov and laboratory assistant O. I. Osetrova. The author thanks L. I. Krapivin, N. N. Kozlova and L. A. Dolgikh for the samples that were given to the museum. The author is sure that joint field trips with the staff of Kungur Historical, Architectural and Art Museum-reserve will remain in memory for a long time. Special thanks for the help in determining the samples and advice of doctor of geology, professor S. V. Naugolnykh (Geological Institute of RAS).
Figure 1. Samples of Perm fossils. The collection of the Museum of Karst and Speleology (MKS) of the Mining Institute of Ural Branch of Russian Academy of Sciences:

A – *Paracalamites decoratus*. (MKS 230/11); B – *Paracalamites* sp. (MKS 230/11a); C – *Pecopteris antriscifolia*. (MKS 154/1); D – *Pecopteris* cf. *uralica*. (MKS 84/2); E – *Permocallipteris* (al. *Callipteris*) sp. (MKS 84/7-8); F – *Permocallipteris* (al. *Callipteris*) sp. (MKS). Location: Chekarda. Photo by Ya. Nakaryakova
Figure 2. Samples of Perm fossils. The collection of the Museum of Karst and Speleology (MKS) of the Mining Institute of Ural Branch of Russian Academy of Sciences:

A – Phylladoderma sp. (MKS 18/8). Location: Tarlovka; B – Psygmophyllum intermedium (MKS 230/12). Location: Mazuevka; C – Kerria macroloba (MKS 154/10); D – Rufloria sp. (MKS 154/9); E – Walchia bardaeana (MKS 154/6); F – W. apressa (MKS 154/5). Location of samples C-F: Chekarda. Photo by Ya. Nakaryakova