

## The First Pollen Data from the Upper Sarmatian Deposits of the Chachuna 2 Section (Eastern Georgia)

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(Presented by Academy Member David Lordkipanidze)

**ABSTRACT.** This paper discusses the results of the first testing of the sediments on pollen content from the Chachuna fossil vertebrate site, Chachuna-2 section, the Upper Sarmatian s.l./Khersonian deposits. Palynological analysis showed that the pollen and spore composition varied in the marine and continental lithofacial units of the section. Mainly subtropical and warm-temperate plants (trees and ferns) were found in the samples from the lower, shallow marine part. Impoverishment of the subtropical hygrophilous plants, decrease of forest elements, and the expansion of herbaceous associations were observed in the upper, continental deposits of the Eldari Formation. Such change in pollen composition might be related with the regression of Kura Bay – a westward extension of the South Caspian Basin of the Eastern Paratethys, as well as with the general trend of aridification during the Late Miocene. However, we refrain from drawing far-going conclusions due to scarcity of data at this stage of research. © 2018 Bull. Georg. Natl. Acad. Sci.

**Key words:** Chachuna, Upper Sarmatian, Khersonian, Caucasus, pollen, spores, vegetation

The paper presents results of pollen analysis of a new fossil vertebrate site Chachuna (Kakheti, Eastern Georgia). The studied samples are from Chachuna 2 section, which is one of the most complete Upper Sarmatian s.l./Khersonian sections in the area. This data adds to the slowly accumulating pollen evidence of the Sarmatian stage in eastern Georgia, which eventually, will contribute to understanding of influence of global climatic changes on the evolution of flora in this part of the Southern Caucasus.

On the local scale paleobotanical evidence of the eastern Georgia is important for the following

reasons: (1) During the Late Miocene, at the end of the Middle Sarmatian s.l./Bessarabian, ca. 11-10 Ma climatic gradient appears between western and eastern Georgia as a result of the uplift of the Dzirula Massif; Since then humid and warm climate was maintained in the west (onset of the Colchis refugium dates back to these times), while relatively arid-continental climatic conditions started to develop in the east [1]. These vegetation changes have not been well documented so far in the eastern Georgia, while western part is relatively well studied. The Chachuna 2 section is essential because it enables observing changes of vegetation

through the uninterrupted and well constrained entire Upper Sarmatian deposits. (2) Vegetation history of the southern zone of the Late Miocene outcrops, that stretch from Udabno through Chachuna to Eldari fossil vertebrate sites along the r. Iori, is particularly important because all our knowledge concerning the terrestrial fauna of this period from the Southern Caucasus comes exclusively from this area. This fossil record captures the very last moment of a long-term regression of the Eastern Paratethys and among other diverse faunal remains counts a hominoid, the latest and the easternmost dryopithecine *Udabnopithecus garedziensis* Burchak-Abramovich et Gabashvili, 1945 [2,3].

#### Materials and methods

Entire Upper Sarmatian of the Chachuna 2 section (690 m) was sampled in order to identify the intervals with pollen content (in total 64 samples labelled as CH), besides, sediment collected during paleomagnetic sampling were also tested for pollen content (in total 58 samples, labelled as DE). Pollen and spores were found only in 10 samples from the both sets.

The Upper Sarmatian is unambiguously delimited by the 30 m thick petroliferous sandstones in the Iori Plateau, identified in the Chachuna 2 section as well. Two lithofacial units, shallow marine and continental (Eldari formation), were established in this section. They grade into the Meotian-Pontian Shiraki Formation above without unconformity. The limit between the Sarmatian and Meotian deposits passes on top of the series of massive cross-bedded sandstones containing malacofauna (*Mactra* sp.) and vertebrate fossils [4]. Interestingly, productive samples turned out to be from the clays of the sandstone dominated intervals of the marine Upper Sarmatian and from the continental deposits. Specifically, from the marine Upper Sarmatian: CH6, CH7, CH11 - from the interval 30-60 m; CH23, DE 54, H24 - 225-245 m; DE178 - 435m. From the continental deposits: DE 41.5, CH2-7, and DE55-570-590 m above the

section base (Fig. 1). Despite the poor outcome, the set of productive samples is important, because they embrace nearly the entire Upper Sarmatian. This paper discusses the results of this first testing of the sediments on pollen content. The discovered intervals will be the subject of a more detailed sampling.

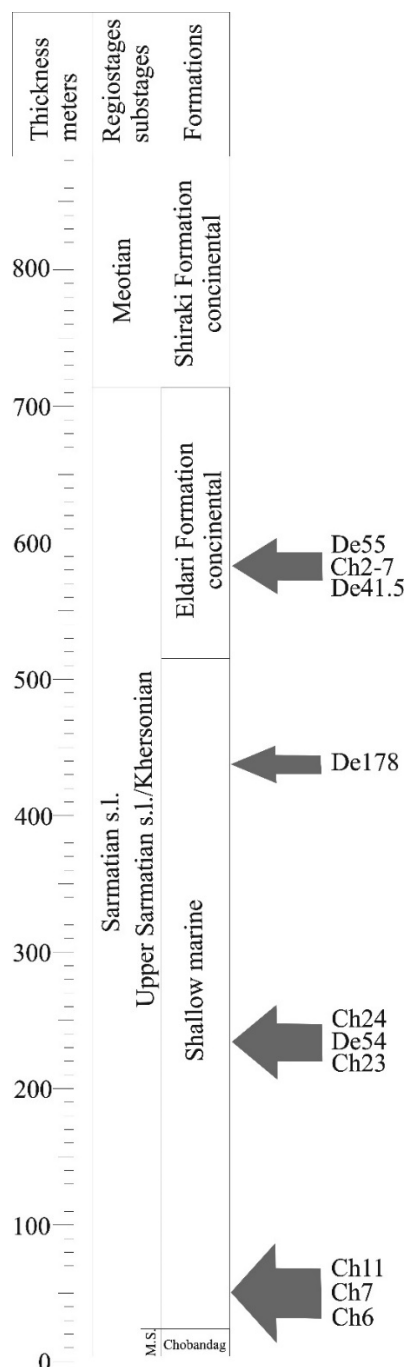


Fig. 1. Position of productive palynological samples, Chachuna-2.

Samples were subjected to the standard lab processing. 50g of each sample was taken for the analysis and boiled in KOH solution; then the material was placed in 10% solution of HCl; in the following step samples were centrifuged in the heavy liquid (CdJ2+ KI) with specific weight 2.2 for 20 minutes; Pollen grains were acetolysed in the mixed solution of acetic and sulphuric acids. Samples were studied under the microscope „AmScope MT1“ with magnification of 600x and 1000x. Pollen diagrams were drawn with „Tilia“ software.

### Results

Pollen analysis revealed 54 elements of flora, seven of them belong to cryptogams, eleven to gymnosperms and the rest to angiosperm plants, represented by trees and grasses.

The assemblage from the Upper Sarmatian lower, shallow marine interval of the Chachuna 2 differs from the one obtained from the continental deposits of the Eldari Formation. Specifically, samples from the shallow marine interval (Figs. 2, 3) contained the comparably diverse pollen assemblages composed of cryptogams belonging to the following genera: *Lycopodium*, *Selaginella*, *Schizaea*, *Gleichenia*, *Polypodium*, *Dicksonia*, *Lygodium*, *Cyathea*; gymnosperms: *Ginkgo*, *Podocarpus*, *Cedrus*, *Keteleeria*, *Abies*, *Picea*, *Pinus*, representatives of families Cupressaceae and Taxodiaceae. Only the genus *Sequoia* was identified among Taxodiaceae due to bad preservation in spite of a rather large number of their pollen grains. Angiosperms are represented by the genera *Myrica*, *Platycarya*, *Engellardtia*, *Juglans*, *Carya*, *Alnus*, *Carpinus*, *Fagus*, *Quercus*, *Castanea*, *Castanopsis*, *Zelkova*, *Ulmus*, *Magnolia*, *Liquidambar*, *Ilex*, *Tilia*, *Sterculia*, *Nyssa*, *Alangium*, *Symplocos*, the representatives of families Icacinaceae, Myrtaceae, Cornaceae, Araliaceae and Arecaceae. Today the mentioned taxa inhabit subtropical and warm-temperate zones. Presence of the Icacinacea pollen grains is of a great interest. Until now this family was known only by

macro-remains from the flora of Goderdzi (southern Georgia), represented by *Citronella* aff. *mucronata* (Ruiz Lopez & Pavon) D. Don, *Icacinoxylon goderdzicum* Schilkina, *I.citronelloides* Schil. 1958 [5]. The Icacinaceae pollen grains were first determined from the Sarmatian deposits of the Gombori section [1]. Today this family embraces 58 genera that are widely distributed in subtropical and tropical regions, in the mountain forests up to 2000-2500 m asl [6]. Thus, the pollen assemblage from the lower, shallow marine interval indicates presence of forest formation, mainly consisting by the subtropical and warm-temperate plants.

The picture changes abruptly in the consequent layers from the Eldari Formation. The number of pollen grains of Chenopodiaceae, Poaceae and *Artemisia* increase. In total, the sum of grasses prevails over the sum of trees; (Figs. 2, 3), which are represented by *Pinus* and deciduous trees. Probably, this pollen assemblage reflects the stage, when the plains of the Eastern Georgia were covered by herbaceous vegetation; impoverished forest formations were developed on the higher altitudes of mountain slopes. Remarkably, Evergreen broad-leaved subtropical trees absent from its composition.

### Discussion

Until recently, most of our knowledge about the Sarmatian flora and vegetation of Eastern Georgia was based on macrobotanical remains [7, 8], while pollen analysis was conducted only for few core samples from Kartli [9]. In spite of paucity of fossil material, three sub-stages of the evolution of flora were distinguished during Sarmatian. Among them, the pollen assemblages from the Upper Sarmatian deposits indicated development of steppes or semi-deserts on the territory of Kartli.

Recently five Sarmatian sections, besides Chachuna, were studied palynologically in eastern Georgia, Aragvi, Nadebazevi, Udabno, Uplistsikhe and Gombori [1] (the bio- and lithostratigraphic arguments of their subdivision see in [1, 10, 11]).

These sections embrace entire Sarmatian s.l. and provide a general overview of the evolution of flora in eastern Georgia. Among the mentioned sections the Upper Sarmatian is represented only in Aragvi, Nadarbazevi, Udabno, where in contrast with Chachuna-2 only the continental facies is present.

fluctuation of humidity was the main factor causing vegetation changes. The first wave of aridification, reflected on the share of herbaceous plants took place in the middle part of the Middle Sarmatian (the third palyno-zone). Forests enlarged again in the following stage (the fourth palyno-zone),

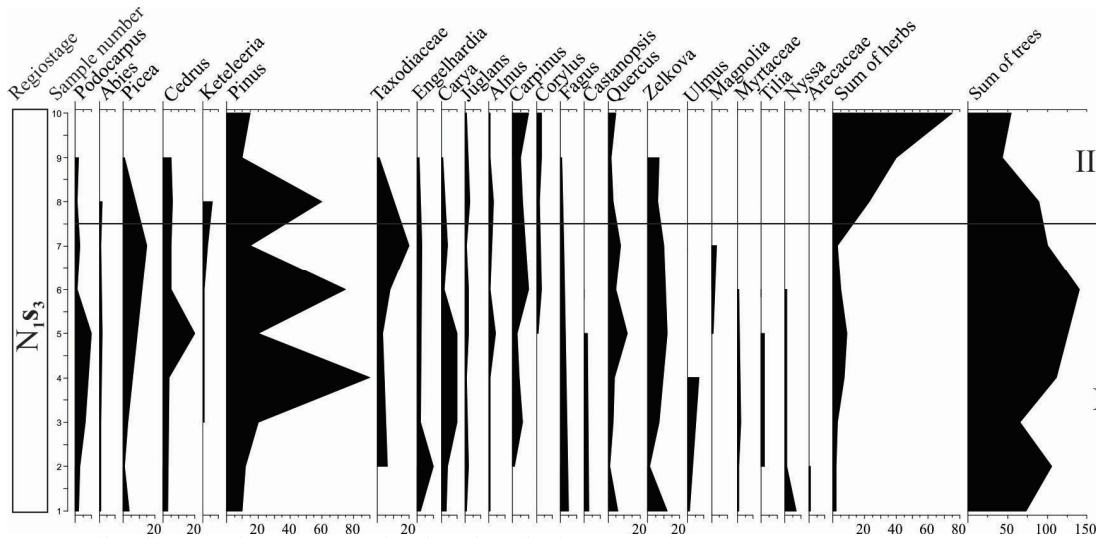


Fig 2. Pollen diagram of Upper Sarmatian deposits, Chachuna-2 section.

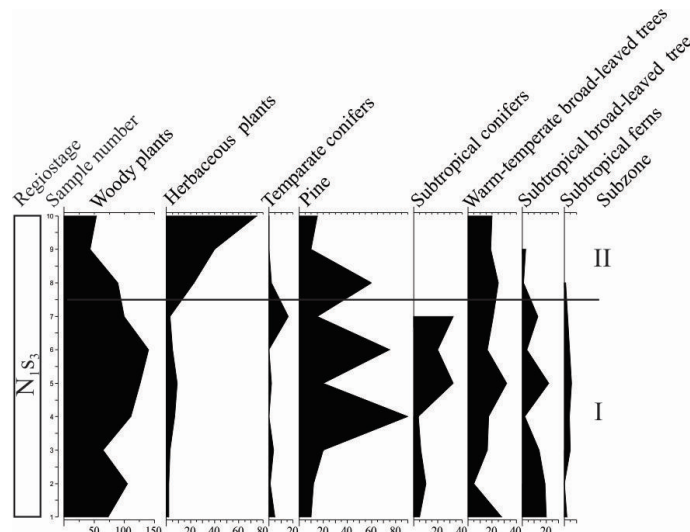


Fig. 3. Fluctuation in pollen percentages indicating changes in composition of separate plant communities during the Upper Sarmatian, Chachuna-2 section.

On the bases of the pollen data of the mentioned sections, five palyno-zones were identified in the Sarmatian s.l. [1]. Forest was the main plant community, during the first four palyno-zones, corresponding to the Lower and Middle Sarmatian, but its area and composition was not stable. The

coinciding with the end of the Middle Sarmatian, though their composition was poorer than previously. The character of vegetation sharply changed during the fifth stage, which corresponds to the Upper Sarmatian: the share of xerophytes increased and open communities occupied large

territories, although this process did not have a linear character, oscillations are noticeable e.g.: Nadarbazevi and Aragvi sections.

Stratigraphically the studied interval of the Chachuna-2 section corresponds to the fifth palynozone, which is divided into two sub-zones in this section. It is remarkable, that prevalence of herbaceous communities coincides with the onset of continental regime, while shallow marine interval points to the existence of forests. Interestingly, in the Udabno section (some 55 km East of Chachuna) the Upper Sarmatian, which is entirely represented by continental deposits of the Eldari Formation, starts with the appearance of open landscapes. The WE migration of the lithofacieses, namely the transition of the continental Eldari formation into marine deposits are well observable in the sections of the southern Kakheti [10] and indicates that the palynologically studied Upper Sarmatian interval of the Udabno section (pollen samples come from the lower part of the Upper Sarmatian) stratigraphically/chronologically is older than the continental deposits of the Chachuna-2. This might mean that the presence of forests with subtropical elements in the Upper Sarmatian shallow marine interval of the Chachuna-2 is due to the vicinity to the Kura Bay, westward extension of the South Caspian Basin of the Eastern Paratethys, and consequent change of vegetation cover is in relation to its retreat on the background of general trend of aridification of climate during Late Miocene. This idea is supported by the appearance of herbaceous vegetation in the lower part of the Upper Sarmatian of the Udabno section and the composition of the Katar Flora (Katar section, on the Bator range, 24 km west of the Chachuna-2 section) known by macro-remains and pollen data from the lower, marine Upper Sarmatian deposits. According to Fataliev [12] the Katar flora, like pollen data of the

shallow marine interval of Chachuna-2, reflects the presence of gallery and coastal forests with subtropical elements.

However, due to scarcity of paleobotanical data, as well as poor resolution of stratigraphic correlations between the discussed sections, at this stage of research we refrain from drawing far-going conclusions. Hopefully, the future studies will enable us to learn more details about the evolution of flora and climate on the Iori Plateau.

**Conclusions.** Palynological analysis of the Upper Sarmatian deposits of the Chachuna 2 section revealed 54 elements of flora, seven of them belong to crytogams, 11 to gymnosperms and the rest to angiosperm plants, represented by trees and grasses.

Stratigraphically the studied interval of the Chachuna-2 section corresponds to the fifth palynozone identified for the eastern Georgia, which is divided into two sub-zones in this section: forest in the lower, shallow marine interval and herbaceous communities in the upper, continental deposits. Possibly, presence of forests with subtropical elements in the shallow marine interval is due to the vicinity to the Kura Bay, and consequent appearance of open landscapes is in relation to its retreat on the background of general trend of aridification of climate. However, at this stage of research we refrain from drawing far-going conclusions due to scarcity of paleobotanical data, as well as poor resolution of stratigraphic correlations between studied Upper Sarmatian sections of Eastern Georgia.

The authors are thankful to Dr. Angela Bruch (Senckenberg, Frankfurt, Germany) for critical reading of the manuscript and to Eva Tsereteli-Novitska for editing the text.

This research was funded by the Shota Rustaveli Georgian Science Foundation, projects #11/05 and #217626.

პალეობიოლოგია

პირველადი პალინოლოგიური მონაცემები  
ზედასარმატული ნალექებიდან, ჭაჭუნა 2-ის ჭრილი  
(აღმოსავლეთ საქართველო)

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სტატიაში განხილულია ჭაჭუნას ნამარხ ხერხემლიანთა ადგილსაპოვებლიდან აღებული საცდელი პალინოლოგიური ნიმუშები (ჭაჭუნა-2-ის ჭრილი, ზედასარმატული/ხერსონული მონაკვეთი). ანალიზმა გვიჩვენა, რომ პალინოფლორის შემადგენლობა განსხვავებული იყო ჭრილის მარჩხ ზღვიურ და კონტინენტურ ლითოფაციურ ინტერვალებში. ქვედა, მარჩხ ზღვიურ დანალექ ქანებში ძირითადად სუბტროპიკული და ზომიერი სარტყლის, თერმოფილური მცენარეების (ხემცენარეები და გვიმრები) მტვრის მარცვლები/სპორები აღმოჩნდა; სუბტროპიკული ტენის მოყვარული ფორმების გაღარიბება, ტყის ელემენტების შემცირება და ბალახეული ასოციაციების გავრცელება დაიკვირვება ელდარის წყებიდან აღებულ ნიმუშებში. ფლორის შემადგენლობის ამგვარი ცვლილება შესაძლოა დაკავშირებული იყოს აღმოსავლეთ პარატეთისის სამხრეთ კასპიური აუზის დასავლეთ განშტოების, მტკვრის ყურის რეგრესიასა და ასევე, გვიან მიოცენში კლიმატის საერთო არიდოზაციასთან. თუმცა, კვლევის ამ ეტაპზე არსებული მონაცემების სიმწირის გამო თავს ვიკავებთ დასკვნების გაკეთებისგან.

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*Received June, 2018*