

Late Miocene Vertebrate Site of Chachuna (Iori valley, Georgia, Southern Caucasus)

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ABSTRACT. Chachuna (Gare Kakheti, Georgia) is one of the fossil vertebrate sites in the Kura foreland of the Eastern Paratethys, alongside the better known Upper Sarmatian s.l. (Khersonian) Eldari, Udabno and Iagljaja (idem Rustavi) sites. We describe the geological setting of the Chachuna site and provide a preliminary list of vertebrate fauna. The site is located on the right bank of the Iori River and occupies a large area with an extent of 16 km in EW direction on the Aktakhta-tapa antycline. Remarkable concentrations of terrestrial vertebrate remains were encountered in three localities so far. Stratigraphically, they follow one another in the following order (from bottom to top): Chachuna 3, Chachuna 2, Chachuna 1. Specifically, Chachuna 3 is found at the upper limit of the shallow marine interval of the Upper Sarmatian, Chachuna 2 within continental Eldari Formation and Chachuna 1 near the upper limit of the Eldari Formation. The biostratigraphic distribution of the land mammalian taxa of the Chachuna 2 indicates an age of MN11-MN12, the Upper Sarmatian age of the Eldari Formation supports its inclusion in the Early Turolian (MN11). Two lithofacial units, shallow marine and continental, were established in the Upper Sarmatian interval of the Chachuna 2 section, which grades into the Meotian-Pontian Shiraki Formation above without unconformity. Total thickness of the measured section is 880 m. The section reveals a cyclic changes of the basin depth, which can be due to climatic fluctuations or localized tectonics.
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Key words: Chachuna, Late Miocene, Upper Sarmatian, Khersonian, Eastern Paratethys, Kura foreland

Chachuna is a fossil vertebrate site from the Upper Sarmatian s.l. (Khersonian) of the Iori valley (Dedoplistskaro region, Gare Kakheti, Georgia). The first publication about the Chachuna site dates back to 2000 [1]. V. M. Chkhikvadze, as a member of the NACRES (the Centre for Biodiversity Conservation and Research) expedition explored Chachuna, published a brief paper about the fossil

herpeto-fauna [1] and greatly emphasized the paleontological importance of this area [2].

In addition to the mentioned publications, in the vertebrate paleontology collections of the S. Janashia Museum of Georgia (Georgian National Museum) a small collection is stored, dating back to 1979, collected by E. Gabashvili and labeled as Chachuna.

In general, finds of Late Miocene land mammalian fossils in the variegated clays of the Eldari Formation (continental Formation correlated with the Upper Sarmatian s. l. - Khersonian) along the right bank of the Iori river are rather frequent. The first information about fossils presumably from the Chachuna area dates back to 1913 [3]. A. Riabinin [3] who conducted a geological survey of the Shiraki and Eldari steppes in 1910, mentions that the outcrops with red clays, with an extent of about 23 km, on the right bank of the Iori from the Eldari oil wells in the village of Kasaman, Azerbaijan, to the ravine Kara-su, the left tributary of the Iori River, Georgia. The outcrops of Ellyar-Ougi and Akhtakhta-tapa ranges were the richest in respect of the fossil vertebrate remains.

All the above mentioned motivated the team of the Museum of Georgia, GNM to resume explorations of the area in October 2008. During the first brief, 3 day trip a *Choerolophodon* site (locality Chachuna 1, see below) was found, later the same year in November, V. Chkhikvadze kindly guided us to the more Eastern part of the area (referred as Chachuna 2 in this paper), from where he mentions new localities: Tsitelkuda and Zemo Qvishaqvebi [1]. In the following years yet another fossil bearing locality (Chachuna 3) was uncovered. Unfortunately, we cannot be sure that the site, where the Chachuna 1979 Museum collection comes from, was relocated because several places bear the toponym Chachuna in the Iori valley.

Fieldwork Methodology. The section at Chachuna 2 was measured using Jacob's staff and Brunton compass. Principal features of sedimentary rocks (bedding, sedimentary structures and textures, composition and color) were recorded and depositional environments were interpreted through facies analysis. The location and occurrence of terrestrial and marine fossils within the sedimentary section was recorded and plotted on the lithological graphic log. For the purpose of accurate stratigraphic correlations several key horizons were identified (red clays - E, F; thick,

cross-laminated sandstone beds - G, D). GPS data were collected for the vertebrate fossils. Toponyms are according to A. Javakhishvili map [4]. The numbering of the fossil localities follows the sequence of discoveries.

Site Location and localities. The Chachuna site is located on the right bank of the Iori River on the Akhtakhta-tapa (the same as Akhtatapa [5]) and Djighati ranges (the same as Kanly range and m. Vosegevamta on the topographic maps by the Genshtab) and occupies a large area with an extent of 16 km in EW direction on the Aktakhta-tapa antycline. Remarkable concentrations of terrestrial vertebrate remains were encountered in three points so far:

(1) Chachuna 1 (41°13'18.87"N; 45°55'34.49"E) - the remains of *Choerolophodon* sp., most probably an articulated skeleton, but still unearthed, were found in the gray siltstones of the Eladri Formation.

(2) Chachuna 2 (41°12'14.43"N; 45°58'9.43"E) - in the surroundings of the right tributary of the Iori River, which starts between the Aktakhta-tapa and Djighati Ranges, located 4.5 km east from the former locality; fossils are found in the continental Eldari Formation;

(3) Chachuna 3 (m. Djighati) (41°11'43.56"N; 45°59'41.55"E) - 2 km east of the Chachuna 2 locality. Fossils here are found in the lens-like accumulation in the marine Upper Sarmatian sandstones near the base of the Eldari Formation.

Geological Setting. Vertebrate fossil remains of the Chachuna site are found within the Upper Sarmatian layers exposed on the northern slopes of the Aktakhta-tapa anticline (extending along Aktakhta-tapa and Djighati ranges). Two lithofacial units, shallow marine and continental, were established in the section. They grade into the Meotian-Pontian Shiraki Formation above without unconformity. The total thickness of the measured section is 880 m (https://www.researchgate.net/publication/326033249_Fig_1_Lithostratigraphic_section_of_Chachuna_2).

Unit 1 – Upper Sarmatian shallow marine and coastal environments: a 495 m thick unit (between 20-515 m on the lithostratigraphic column) starts from the base of the so called “30 m thick sandstones”. The 30 m thick sandstones, though with laterally variable thickness in different sections, is one of the key horizons in the study area and represents the base of the Upper Sarmatian [5]. It overlies the succession of alternating dark-gray clays and sandstones of Chobandag Formation, which constitute the uppermost facies of the Middle Sarmatian strata [5].

The lower 270 m of the Upper Sarmatian succession (between 20-290 m on the lithostratigraphic column) is represented by alternation of massive coarse-grained sediments with yellowish weathered surfaces, grey thin-bedded clays and marls. The rocks are rich in bivalve fossils and intercalation of coal layers.

The following 115 m of the strata (290-405 m) is made up of grayish-bluish siltstones and clays intercalated with subordinate sandstone beds. In contrast to the lower part of the unit 1 malacofauna is less abundant here. The lithofacies association of this unit probably represents a shallow marine environment.

In the end of the Upper Sarmatian marine interval massive, coarse-grained sandstones with large-scale cross-bedding are formed (total thickness 110 m, 405-515 m). They comprise fragments of macroflora and oxidized nodules. Coloration of clays changes and becomes rusty-yellowish. All these indications point towards change of shallow marine and coastal conditions to continental environments.

Unit 2 – Upper Sarmatian continental and coastal environments. A 195 m thick unit (515-710 m) is introduced by alternation of red, violet, grayish, brownish wax-like clays and thin, fine-grained sandstones. The upper planes of sandstone beds exhibit small-scale wave and current ripples and trace fossils. Clays contain fossil mammal fragments. Several lignite layers (five) and dark

gray clays with freshwater gastropod remains are remarkable. It is important that bivalve (*Mactra* spp.) containing horizons were distinguished in this interval at different levels, never before mentioned for any other section of the Eldari Formation. At the end of the Eldari Formation in the Chachuna 2 section there are series of massive cross-bedded sandstones containing malacofauna (*Mactra* sp.), vertebrate fossils and plant remains.

Unit 3 – Shiraki Formation, continental environment. The transition to the Shiraki Formation (Meotian-Pontian continental Formation) is gradual; the sandstones become increasingly massive, structureless, though less compact and more leucocratic. Sandstones are rich with carbonized vegetal fragments (plant debris, trunks and leaf impressions), gypsum veins and concretions, do not contain fauna, and clays become more light colored. The limit between Eldari and Shiraki Formations in the section passes at 710 m, along the upper bedding plane of the last mollusc-bearing sandstone. The total thickness of the measured Shiraki Formation is 170 m. The association of lithofacies of the Shiraki Formation is interpreted as formed by a laterally migrating river system on a flat extensive foreland plain.

Chachuna Vertebrate Fossils. The Chachuna 1 locality is remarkable by find of *Choerolophodon* sp. It is highly probable that a complete articulated skeleton is buried here and if so then this fossil has an outstanding scientific importance because such complete remains of this mastodont is not known. This fossil is not yet unearthed.

There is no fossil accumulation found at the Chachuna 2 locality, rather fossils are scattered randomly and are usually associated with clays and siltstones. The preliminary faunal list from the Chachuna 2 comprises 11 mammalian taxa: Castoridae indet., Ictitheriidae indet., *Hipparion* sp., Rhinocerotidae indet., *Microstonyx major* Gervais, 1851, *Procapreolus* sp.; *Lucentia* sp.,

Muntiacinae indet., Sivatheriinae indet., Bose-laphini indet., Antilopini indet. In addition remains of several species of fish, reptiles and a bird (Falconiformes indet.) were also found. Chkhikvadze and Petrov [1] list the following herpetofauna from Tsitelkuda (that corresponds to the marker horizon E in Chachuna 2): *Tronyx* sp., *Mauremys sarmatica* (Purschke, 1885), *Melanochelys* sp., *Testudo burtschaki* Chkhikvadze, 1975; and from Zeda-Qvishaqvebi (that corresponds to the marker horizon G in Chachuna 2): *Mauremys* sp., *Emydoidea* sp., *Testudo* sp. In the faunal assemblage of Chachuna 2 deer are the dominant and most diverse group (*Procapreolus* sp., *Lucentia* sp., Muntiacinae gen.), while bovid remains are mostly absent from the site – which is an exceptional case for the Late Miocene in the Southern Caucasus. The Chachuna deer collection represents more than half of the cervid specimens found in the entire Late Miocene of Georgia. This assemblage most likely reflects a very brief time interval and a local biotope.

At the Chachuna 3 locality, the lens with a concentration of large mammalian fossils was discovered recently, in November 2017; it is not yet excavated. Diverse mammalian remains (Cervidae, Giraffidae, Bovidae, Equidae, Rhinocerotidae) were exposed on the surface, bone distribution pattern is elongated, with the long axis running in an EW direction. The completeness of the fossils is remarkable, some of the limb bones were articulated, some though disarticulated, however corresponding bones were rather close to each other (e.g. humerus, radius-ulna, metacarpal, phalanges of a giraffid).

Discussion and Conclusions. A robust biostratigraphic framework of the Chachuna site is provided by existing stratigraphic works of the area [5,6,7] and they unambiguously point to the Upper Sarmatian (Khersonian) age of the sediments. The Upper Sarmatian stage spans from ca. 9.4.0 Ma, with upper boundary between 8.6-8.1 Ma. or slightly above (combination of magnetostratigraphic and biostratigraphic data of Vangengeim et al. [9,10] and

Vasiliev et al. [8]). The mentioned fossil land mammalian localities are found in different stratigraphic levels and follow one another in the following order (from bottom to top): Chachuna 3, Chachuna 2, Chachuna 1. It is remarkable that they are at the upper limit of the shallow marine (Chachuna 3), within continental Eldari Formation (Chachuna 2) and near the upper limit of the Eldari Formation (Chachuna 1). The Biostratigraphic distribution of the land mammalian taxa of the Chachuna 2 indicates an age of MN11-MN12, the Upper Sarmatian age of the Eldari Formation supports its inclusion in the Early Turolian (MN11).

Paleogeographically, the Chachuna site is found at the coast of the Kura paleobay. The described section of Chachuna 2 reveals alternation of depositional environments: the terminal Middle Sarmatian is represented by silts and clay deposits indicating shallow marine environment, it is followed by the long interval dominated by the coarse-grained sandstones, indicating coastal environment, very close to the shore-line, then follows a long interval dominated by siltstones – shallow marine environment, followed by continental variegated clays, which are again followed by coastal environment. A similar picture of alternation of basin depth is depicted also at the Akhtakhta-tapa section, which is located somewhat west of the Chachuna 2 section [6]. Remarkable cyclicality of the basin depth changes can be due to climatic fluctuations or localized tectonics. These aspects are unexplored in the region. The fossil and geological record of long, uninterrupted outcrops of the Chachuna site together with other outcrops along the southern shore of the Kura Bay have great potential to uncover the Late Miocene evolutionary history of terrestrial life in this part of the Southern Caucasus.

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პალეონტოლოგია

**ჭაჭუნას გვიან მიოცენურ ხერხემლიანთა
ადგილსაპოვებელი (ივრის ზეგანი, საქართველო,
სამხრეთ კავკასია)**

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წარმოდგენილ სტატიაში აღწერილია ჭაჭუნას ადგილსაპოვებლის გეოლოგიური ჭრილი და მოყვანილია ნამარხ ხერხემლიანთა ფაუნის წინასწარი სია. ჭაჭუნას ნამარხ ხერხემლიანთა ადგილსაპოვებელი (გარე კახეთი, საქართველო) ერთ-ერთია აღმოსავლეთ პარატეთის მტკვრის ფორლანდური აუზიდან შედარებით უკეთ ცნობილ გვიან სარმატულ ადგილსაპოვებლებს შორის, მაგალითად: ელდარი, უდაბნო და იაღლუჯა (იგივე რუსთავი). ჭაჭუნას ადგილსაპოვებელი მდებარეობს მდინარე იორის მარჯვენა ნაპირზე, ის ახტახტატაპას ანტიკლინის ჩრდილოეთ ფერდობზე, დიდ ფართობზე ვრცელდება, დაახლოებით 16კმ სიგრძეზე აღმოსავლეთ-დასავლეთის მიმართულებით. ჯერჯერობით, ნამარხ ხერხემლიანთა მნიშვნელოვანი კონცენტრაცია აღმოჩენილია სამ ადგილას სხვადასხვა სტრატиграფიულ დონეზე, შემდეგი თანმიმდევრობით (ქვევიდან ზევით): ჭაჭუნა 3, ჭაჭუნა 2 და ჭაჭუნა 1. კერძოდ, ჭაჭუნა 3 სტრატиграფიულად მდებარეობს მარჩხი ზღვიური ზედა სარმატის ზედა ნაწილში, ჭაჭუნა 2 – კონტინენტური წარმოშობის ელდარის წყებაში, ხოლო ჭაჭუნა 1 ელდარის წყების ბოლო მონაკვეთში. ჭაჭუნა 2-ის ხმელეთის ხერხემლიანთა ფაუნის ბიოსტრატиграფიული გავრცელების დაიპაზონი შეესაბამება MN11-MN12-ს. ამავდროულად, ელდარის წყების ზედა სარმატული ასაკი მეტყველებს იმაზე, რომ აღნიშნული ფაუნა ადრეთუროლიურია (MN11). ჭაჭუნა 2-ის ჭრილში, რომელიც შედარებით დეტალურადაა შესწავლილი, გამოიყოფა ზედა სარმატული მარჩხი ზღვისა და კონტინენტური ლითოფაციალური ერთეულები, ზედა სარმატი კუთხური უთანხმოების გარეშე თანდათან გადადის მეოტურ-პონტური ასაკის კონტინენტურ შირაქის წყებაში. აღნიშნული ჭრილის სიმძლავრე 880 მეტრია. ჭრილში სედიმენტაციურ გარემოს, კერძოდ კი, აუზის სიდრმის ცვალებადობას ციკლური ხასიათი აქვს, რაც კლიმატური ფლუქტუაციებით ან ლოკალური ტექტონიკით შეიძლება იყოს გამოწვეული.

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