

## THE BIOSTRATIGRAPHIC SIGNIFICANCE OF OSTRACOD MICROFAUNAL REMAINS FROM THE EOCENE DEPOSITS OF THE NORTHERN FERGANA GOVA AND VARZIK SECTIONS

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### ABSTRACT

In world practice, the main task set before the science of geology is solved by enriching the country's minerals, determining the formation of associated minerals through biostratigraphic, lithological, stratigraphic and other methods, studying underground resources. Modern geology has been making high strides in the construction of prediction maps using the latest technologies. This increases the speed and efficiency of Geosciences. In this regard, biostratigraphy is of practical and theoretical importance, the lithological composition of Paleogene deposits, their thickness and the formation of fauna and flora found in them ensure the reliability of predicting mineral deposits from the unknown associated with them in the study of fauna remains in layers using modern methods.

In this article, the distribution of fauna remains in the maxillary suites of ostracoda, identified in the Eocene deposits of the Northern Fergana bottoms of the Uzbek territory of the Gowa and Varzik incisions, was studied. Based on the data identified, the stratigraphic position of each suite by the leading ostracoda species has been cited.

Ostracods belonging to the Eocene section of Northern Fergana were observed to be dispersed in Gowa and Varzik incisions, and scientific research was carried out. Scientific research revealed about 30 species and about 10 genera, and isolated species representatives belonging to the Eocene section in detailed stratigraphy.

**Keywords:** *Paleogene system, lower Eocene Subdivision, Alai Suite, sedimentation, nannoplankton, ostracod, microfauna, stratotype, foraminifera, Uzbekistan, Biostratigraphic, Fergana.*

### INTRODUCTION

The Paleogene deposits of Uzbekistan have long attracted researchers. In the northern regions, due to natural outcrops, they have been the object of study since the middle of the last century. Up to the present day, the number of published works related to the geology, stratigraphy, lithology, paleogeography, and oil and gas content of the studied area is very large, which indicates that extensive geological research has been carried out in this region.

In the 20th and early 21st centuries, the understanding of the Paleogene stratigraphy was repeatedly supplemented by paleontologists, and the boundaries of stratigraphic units were determined based on various types of fossils remains; their regional and interregional correlations were observed (Abduazimov *et al.*, 2007).

It can be seen that the lithological and complex organic fossil assemblages of the western and eastern sections of Uzbekistan differ sharply from each other. The issues of stratification of the Paleogene Eocene deposits of the Fergana depression have not yet been definitively resolved by paleontologists, and these stratigraphic subdivisions remain relevant.

In 1935, O.S. Vyalov, through the division and correlation of the Paleogene deposits of the Fergana Valley, proposed a definite conclusion and a scheme of layer subdivision (Vyalov, 1935). This scheme has been used by many geologists in Central Asia up to the present day. However, some parts of the scheme remain unclear; in particular, regarding the stage subdivision of Paleogene deposits according to O.S. Vyalov, several opinions and considerations have been expressed by scientists (Kushakov A.R *et al.*, 2021).

## **Research Article**

Ostracods are a very important group of organisms from a biostratigraphic and paleoecological point of view. Although ostracod fauna belong to benthic organisms, their role can be observed in distinguishing stratigraphic layers and in the formation of mineral deposits. They form complexes of different ages in closely related facies environments, which allows determining stratigraphic boundaries (Tesakova *et al.* 2024).

The first data on the study of ostracod remains in the Paleogene deposits of Central Asia and the Fergana depression were obtained by M.I. Mandelstam in 1958. Subsequent studies were conducted by N.I. Sakina in 1973 (Mandelstam *et al.*, 1959).

To this day, in Central Asia—particularly with the help of biostratigraphic methods—many debatable issues have accumulated that still need to be resolved. Therefore, in the Fergana depression, which is promising for oil and gas, ostracods, along with mollusks and foraminifera, should be re-examined (Kushakov A.R *et al.*, 2023).

## **MATERIALS AND METHODS**

Biostratigraphic studies were carried out to substantiate and distinguish the Paleogene of the Fergana depression in Eastern Uzbekistan on a monographic basis, including both field and laboratory work. Within the framework of the laboratory studies, paleontological materials were examined under laboratory conditions, and thematic sections and analytical works were performed.

The main goal of the fieldwork was to collect paleontological materials from the least studied parts of the Paleogene section and to process the collected materials during the laboratory stage. The main content of the laboratory research consisted of conducting analyses of ostracod microfauna, and these analyses served as the primary scientific tool for obtaining accurate and detailed stratigraphic conclusions.

The research work was carried out by the author from 2020 to 2025 in the “Lithology and Stratigraphy” laboratory on an annual basis. It was conducted based on the description of paleontological collections collected during the sample study process (Sokolov, 1999). About 400 lithological and stratigraphic observation points were taken from the Paleogene deposits exposed within the Fergana depression area. Ostracod fauna remains were separated from these samples, and more than 250 of them were subjected to paleontological description.

The description of the sections was carried out by precisely linking the paleontological materials to the layers. The fossil materials mainly consisted of fauna remains. Biostratigraphic analysis included methods for distinguishing and correlating layers based on paleontological data. The paleontological study of fossilized remains of fauna organisms was carried out in accordance with the “Guidelines for Describing Fossil Plant and Animal Organisms in Paleontological Works” following the plan of I.A. Korobkova (Korobkov, 1971).

In general, the research utilized commonly accepted paleontological, lithological, and stratigraphic methods, as well as a genetic approach in identifying strata. The comprehensive application of biostratigraphic methods in studying sections, stratigraphic layering, and correlation of strata is considered one of the most effective approaches. To determine and compare taxonomic unit relationships, data on ostracods obtained from sections of other regions of the world were widely used.

## **RESULTS AND DISCUSSION**

The species composition of ostracod microfauna in the Northern Fergana sections has been identified, and their distribution areas have been determined. At the same time, the vertical distribution of ostracods was established, their assemblages were distinguished, and on this basis, the Paleogene deposits of the Fergana depression were stratified.

Ostracods possess the ability to serve as biostratigraphic indicators. Some of their representatives appeared and became extinct during specific geological periods, which allows them to be regarded as index species for those times. Others, which developed rapidly across wide regions, make it possible to correlate layers between distant areas.

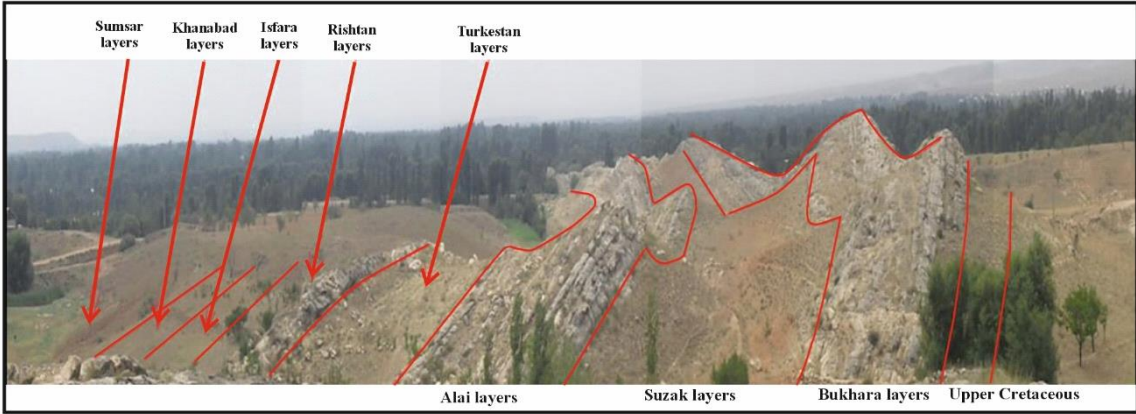
In addition, ostracods are sensitive to environmental changes such as salinity, depth, and temperature. Among the representatives examined by the researcher, there are stenobiotic, euryhaline, pelagic, and

benthic ostracod species. This suggests that fossilized ostracod remains play a crucial role in reconstructing paleoenvironments.

The main significance of ostracods in geology lies in determining the age of stratigraphic layers. Their quick sensitivity to environmental changes demonstrates their important indicative ability in distinguishing local layers. Furthermore, their shells participate in the formation of limestones and other carbonate rocks, influencing the mineral composition and texture of these rocks (Tesakova 2024).

*Description of the reference sections of Gova and Varzik in Northern Fergana.*

The Govasoy Paleogene section is located on the southeastern slope of the Kurama Range, on the northern edge of the northeastern part of the Govasoy Graben. Here, all layers (stages) of the Paleogene deposits are fully exposed as natural outcrops, which provides an opportunity for detailed study.



**Figure 1: Open outcrop of the Paleogene in the eastern part of the Gowa section Paleogene System, Lower Eocene Subdivision, Alai Suite ( $P_2^1$  al).**

**Table 1: Table of stratigraphic and geographical distribution of ostracod remains in sections of the Fergana Basin. (Alai Formation)**

System	Paleogene	
Section	Eocene	
Tier	Rage	
Sub-section	Medium	
Retinue	Alai	
Species names	No. No. incision	
	Varzik	Gova
1	2	3
<i>Cytherelloidea vallis</i> Mandelstam	+	+
<i>Cytheridea spicula</i> Mandelstam	+	
<i>Trachyleberis</i> (Tr.) <i>vialovi</i> Mandelstam	+	+
<i>Trachyleberis</i> (Tr.) <i>vialovi</i> var. <i>alaiensis</i> Mand.		+
<i>Paijenborchella tricostata</i> (Lienenklaus)	+	+
<i>Loxoconcha involute</i> Mandelstam	+	+
<i>Loxoconcha lenticulatis</i> Mandelstam	+	+
<i>Eocytheropteron sphaeroidale</i> Mandelstam	+	+

The ostracod fauna of the Alai Suite was studied based on the natural outcrops of the Gova and Varzik sections of the Fergana Basin. In the Alai deposits, the species representatives listed in Table 1 were identified.

Among the species listed below, *Paijenborchella tricostata* (Lankester) was first described from the Upper Eocene layers of Northern Germany (Wolmirsleben and Eggersdorf). *Trachyleberis bassleri* (Ulrich), on

the other hand, was first identified in the Eocene deposits of North America (Aquia Formation, Maryland) and in Mexico (Mactezum River) (Mandelstam 1959).

In 1959, M.I. Mandelstam studied sections in Central Asia, including the Aruk-tau Range, Shirabad, Khochlyor, Istim-tau, and Terklin-tau of the Tajik Depression; the Isfara, Chaur, Tishiktosh, and Uroteppa sections of the Fergana Valley; Kaskasu in the Tashkent region; and the Zeddi and Kashgar sections of the Hissar-Zeravshan mountain ranges. In these sections, the following species were identified: *Cytheridea fucosa* sp. n., *Trachyleberis vialovi* var. *alaiensis* var., *Trachyleberis bassleri* (Ulrich), *Cytherella virgulata* sp., *Eocytheropteron sphaeroidale* sp., and *Cytherelloidea vallaris* sp. He emphasized that these faunal remains are considered the most characteristic for the Alai Suite.

In the sections studied by us, the most characteristic ostracod species for the Alai Suite were identified: *Trachyleberis* (Tr.) *vialovi* var. *alaiensis* Mandelstam, *Trachyleberis* (Hermanitas) *bassleri* (Ulrich), *Cytherella virgulata* Mandelstam, *Eocytheropteron sphaeroidale* Mandelstam, and *Cytherelloidea vallaris* Mandelstam (Aripova M.K et al.,2022).

In this layer, A.R. Kushakov identified nannoplankton (NP) remains of *NP13 Discoaster lodoensis*, *Coccolithus eopelagicus*, *Braarudosphaera bigelovii*, *Transversapontis pulcher*, and *Neococcolithus dubius* (Kushakov et al.,1999).



**Figure 2: Light gray sandstone, weakly cemented**



**Figure 3: Trachyleberis pachyodonta Mandelshtam, photographed with an MBS-10 binocular**

**Paleogene System, Middle Eocene Subdivision, Turkestan Suite ( $P_2^{2tr}$ ).** In the northern sections of the Fergana Basin, studies have been conducted, and the ostracod species identified are presented in the table below.

**Table 2: Table of stratigraphic and geographical distribution of ostracod remains in sections of the Fergana Basin. (Turkestan formation)**

System	Paleogene	
Section	Eocene	
Tier	Lutet - Barton	
Sub-section	Medium	
Retinue	Turkestan	
Species names	No. No. incision	
	Varzik	Gova
1	2	3
<i>Cytherelloidea vallaris</i> Mandelstam	+	+
<i>Schuleridea ampula</i> Mandelstam	+	+
<i>Cytheridea tonsa</i> Mandelstam	+	+
<i>Cytheridea reticulata</i> Mandelstam	+	+
<i>Cytheridea khanabadensis</i> Mandelstam	+	
<i>Cytheridea asiatica</i> Mandelstam	+	+
<i>Trachyleberis</i> (Tr.) <i>vialovi</i> Mandelstam	+	+
<i>Tr.</i> ( <i>Trachyleberis</i> ) <i>bucera</i> Mandelstam	+	+
<i>Tr.</i> ( <i>Echinocythereis</i> ) <i>ferganensis</i> Mandelstam		+
<i>Tr.</i> ( <i>Hermanitas</i> ) <i>bassleri</i> (Ulrich)	+	+
<i>Pterygocythereis cornuta</i> (Roemer)		+
<i>Paijenborchella tricostrata</i> (Lienenklaus)	+	+
<i>Loxococoncha involute</i> Mandelstam	+	+
<i>Eocytheropteron sphaeroidale</i> Mandelstam	+	+



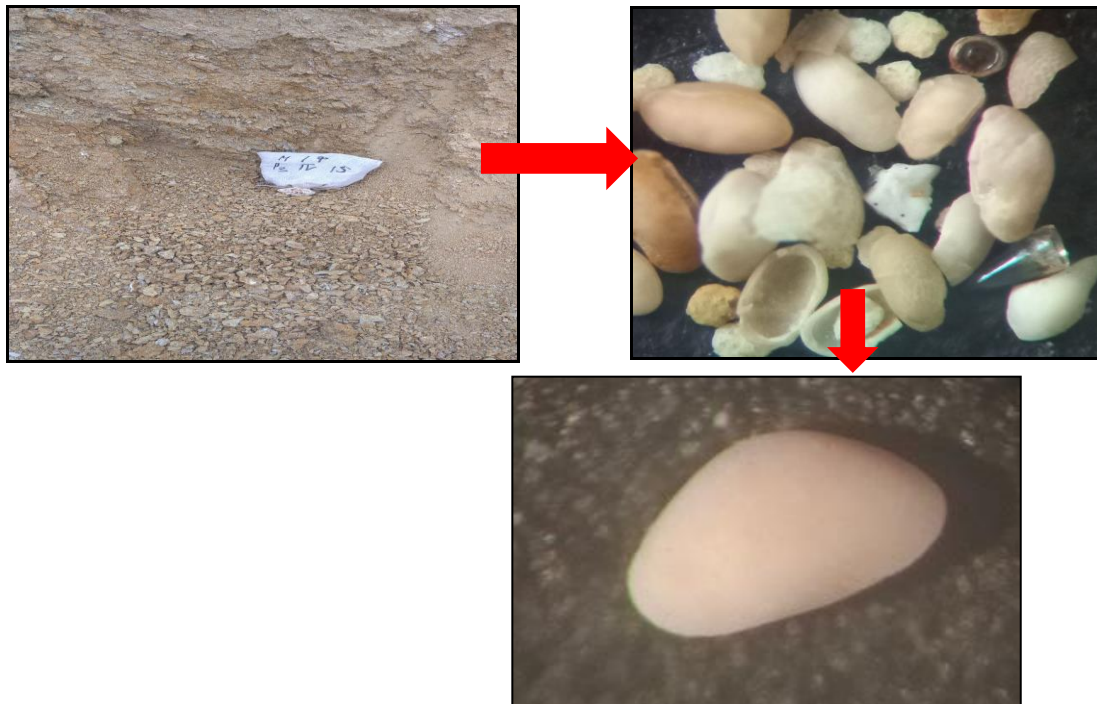
## Research Article

Among the identified ostracod species, the following were determined as characteristic for the Turkestan Suite: *Pterygocythereis cornuta* (Roemer), *Cytheridea reticulata* Mandelstam and *Cytheridea asiatica* Mandelstam.

In the scientific work “Les Ostracodes de la falunière de Grignon (Lutétien du Bassin de Paris): implications stratigraphiques,” published by Claude Guernet, Damien Huyghe, Franck Lartaud, and other researchers from Pierre and Marie Curie University in Paris, it was also noted that the ostracod microfauna *Pterygocythereis cornuta* (Roemer) belongs to the Lutetian stage (Gerne *et al.* 2012). This serves as further evidence of the stratigraphic significance of this microfauna for the Turkestan Suite and its applicability as an indicator.

Lithologically, the lower and upper parts of the suite are mainly composed of carbonate clays with a greenish-yellow hue and mollusks (oysters). Limestones and calcareous sandstones represent the middle part. In the Ghova area, the upper part of the suite mainly consists of limestones and sandstones.

These species were identified and described for the first time in the Gova and Varzik sections of northern Fergana. In addition, within the strata, A.R. Kushakov identified nannoplankton (NP) remains belonging to NP-14, including *Discoaster sublodoensis*, *Discoaster lodoensis*, *Coccolithus eopelagicus*, *Braarudcsnera bigelovi*, *Transversapantis puleher*, *Neococcolithus dubius*, *Microntolithus attenuatus*, *Coccolithus formosus*, and *Rhabdosphaera hercules*.



**Figure 5: The remains of the ostracod *Pontocypris elongatissima* Mandelstam are identified in greenish-brown clay, photographed with the MBS-10 binocular microscope.**

***Paleogene System, Middle Eocene Series, Bartonian Stage, Rishtan Formation (P<sub>2</sub><sup>2tr</sup>).***

Lithologically, the suite is mainly composed of light gray clays and limestones. Gypsum interlayers can be observed within the strata. Scientific research was conducted in the sections mentioned above. Ostracod microfauna remains listed in Table 3 were identified in the strata.

In 1959, M.I. Mendelstam, in his scientific studies, noted that only some elements of the Turkestan fauna were preserved in the Rishtan deposits of the Fergana Depression (Mandelstam *et al.* 1959).

In the Northern Fergana-type sections, A.R. Kushakov identified NP-16-17 nannoplankton (NP) remains, including *Reticulofenestra umbilica*, *Coccolithus eopelagicus*, *Braarudcsnera bigelovi*, *Neococcolithus dubius*, *Reticulofenestra umbilica*, and *Transversopantis*.

The conducted studies show that, despite the lithological composition of the Rishtan stage deposits of the Fergana Depression being diverse, the ostracod fauna remains in the studied sections do not differ significantly in terms of quality and quantity.

**Table 3: Table of stratigraphic and geographical distribution of ostracod remains in sections of the Fergana Basin. (Rishton Formation)**

System	Paleogene	
Section	Eocene	
Tier	Rage	
Sub-section	Medium	
Retinue	Rishton	
Species names	№.№ incision Varzik	Gova
1	2	3
<i>Clithrocytheridea scrobiculata</i> Mandelstam	+	+
<i>Cytheridea tonsa</i> Mandelstam	+	+
<i>Cytheridea reticulata</i> Mandelstam	+	+
<i>Trachyleberis (Tr.) vialovi</i> Mandelstam	+	+
<i>Tr. (Trachyleberis) bucera</i> Mandelstam	+	+
<i>Tr. (Echinocythereis) ferganensis</i> Mandelstam		+
<i>Paijenborchella tricostrata</i> (Lienenklaus)	+	+
<i>Loxoconcha lenticulatis</i> Mandelstam	+	+

**Paleogene System, Upper Eocene Subseries, Priabonian Stage, Isfara Formation ( $P_2^3$ is).**

Lithologically, the lower part of the Isfara Formation consists of greenish siliceous clays, while its upper part is represented by green-brown clays with traces of oxidation and gypsum along fissures. The fact that the Isfara deposits of the Fergana depression are composed of siliceous clays generally has a negative effect on the development of ostracods. For this reason, ostracods are very rare and poorly preserved in the Isfara deposits of Fergana.

In the layer, ostracod remains are almost absent, and the few ostracod fossils encountered are poorly preserved. In the Vazrik section, a single microfossil of *Cytheridea asiatica* Mandelstam was found.

In 1959, M.I. Mandelstam reported that in the Isfara deposits of the Fergana region, a single ostracod species, *Cytheropteron ispharaensis* sp. n., had a wide vertical distribution.

**Paleogene System, Upper Eocene Subseries, Priabonian Stage, Khonobod Formation ( $P_2^3$ hn).**

The formation was studied in the northern sections of the Fergana Depression. Lithologically, the suite consists of greenish-gray clayey and siltstone layers. Black spots are observed in the cracks of the massive clays. Detritus and small thin pelecypod remains are found within the layer.

As a result of the study, ostracod fauna remains listed in Table 4 were identified.



**Figure 6: *Pterygocythereis affabillata* Mandelstam, photographed with an MBS-10 binocular**

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The following ostracod fauna remains are considered characteristic of the Khonobod Formation: *Clithrocytheridea innae* Mandelstam, *Paracytheridea frivolis* Mandelstam, *Henrichovella mikluchai* Mandelstam, *Cytheretta circumspecta* Mandelstam, *Cytheretta insinuata* Mandelstam, *Pterygocythereis affabilata* Mandelstam, and *Cytherelloidea probate* Mandelstam.

**Table 4: Table of stratigraphic and geographical distribution of ostracod remains in sections of the Fergana Basin. (Khanabad Formation)**

System Section Tier Sub-section Retinue Species names	Paleogene	
	Eocene	
	Priabon	
	High	
	Khanabad	
No. No. incision	Varzik	Gova
	2	3
<i>Cytherella evexa</i> Mandelstam	+	
<i>Cytherelloidea probate</i> Mandelstam		+
<i>Cytheridea lata</i> Mandelstam		+
<i>Cytheridea reticulata</i> Mandelstam	+	+
<i>Cytheridea khanabadensis</i> Mandelstam	+	
<i>Cytheridea asiatica</i> Mandelstam	+	+
<i>Cytheretta insinuata</i> Mandelstam	+	
<i>Cytheretta circumspecta</i> Mandelstam		+
<i>Clithrocytheridea innae</i> Mandelstam	+	
<i>Trachyleberis</i> (Tr.) <i>vialovi</i> Mandelstam	+	+
<i>Tr. (Trachyleberis) buccera</i> Mandelstam	+	+
<i>Tr. (Echinocythereis) ferganensis</i> Mandelstam		+
<i>Tr. (Henrichovella) mikluchai</i> Mandelstam	+	+
<i>Pterygocythereis cornuta</i> (Roemer)		+
<i>Pterygocythereis affabilata</i> Mandelstam		+
<i>Paijenborchella tricostata</i> (Lienenklaus)	+	+
<i>Loxoconcha lenticulatis</i> Mandelstam	+	+
<i>Loxoconcha uncata</i> Mandelstam	+	+
<i>Loxoconcha laculata</i> Mandelstam	+	+
<i>Paracytheridea frivolis</i> Mandelstam		+

**Paleogene System, Upper Eocene Series, Rupelian Stage, Sumsar Formation ( $P_2^3sm$ ).**

The formation was studied based on the sections of the Fergana depression. During the research, the following faunal remains were identified in the deposits of the Sumsar Formation.

The ostracod fauna remains *Paracytheridea frivolis* Mandelstam, *Schizocythere appendiculata* Triebel, *Loxoconcha involuta* Mandelstam, *Loxoconcha laculata* Mandelstam, and *Cytherella oraria* Mandelstam are considered characteristic fauna for the Sumsar Formation deposits.

**Table 5: Table of stratigraphic and geographical distribution of ostracod remains in sections of the Fergana Basin. (Sumsor Formation)**

System	Paleogene	
Section	Eocene	
Tier	Rage	
Sub-section	High	
Retinue	Sumsor	
Species names	№.№ incision	Varzik Gova
1	2	3
<i>Cytherella evexa</i> Mandelstam	+	
<i>Cytherelloidea probate</i> Mandelstam		+
<i>Pontocypris elongatissima</i> Mandelstam		+
<i>Cytheridea lata</i> Mandelstam		+
<i>Cytheridea khanabadensis</i> Mandelstam	+	
<i>Cytheretta insinuata</i> Mandelstam	+	
<i>Cytheretta circumspecta</i> Mandelstam		+
<i>Trachyleberis (Tr.) vialovi</i> Mandelstam	+	+
<i>Tr. (Trachyleberis) bucera</i> Mandelstam	+	+
<i>Tr. (Echinocythereis) ferganensis</i> Mandelstam		+
<i>Tr. (Henrichovella) mikluchai</i> Mandelstam	+	+
<i>Pterygocythereis cornuta</i> (Roemer)		+
<i>Pterygocythereis affabilata</i> Mandelstam		+
<i>Paijenborchella tricostrata</i> (Lienenklaus)	+	+
<i>Schizocythere appendiculata</i> Triebel	+	+
<i>Loxoconcha involute</i> Mandelstam	+	+
<i>Loxoconcha lenticulatis</i> Mandelstam	+	+
<i>Loxoconcha uncata</i> Mandelstam	+	+
<i>Eucytherura dentate</i> (Lienenklaus)		+

In this very layer, A.R. Kushakov identified the following nannoplankton (NP) remains : *NP-19-20 Istmolithus recurvus*, *Coccolithus eopelagicus*, *Braarudosphaera bigelovii*, *Neococcolithus dubius*, *Rhabdosphaera spinula*, *Rhabdosphaera cebrata*, and *Reticulofenestra umbilica*.

## CONCLUSION

The results obtained from the study of ostracod fauna show that the Paleogene deposits of the Northern Fergana sections fully correspond to the results of studies on other groups of fossil organic remains—gastropods, pelecypods, and foraminifera—among which species characteristic of particular stratigraphic units of the Paleogene have also been identified.

Although the Paleogene ostracod fauna of the studied sections of the Fergana Depression is endemic, it still provides opportunities for use in detailed stratigraphic subdivision. The ostracods encountered in the stratigraphic units studied above include a number of characteristic species.

For the Alay Formation deposits, the ostracod fauna remains *Argilloecia ampulloida* Mandelstam, *Loxoconcha lenticulatis* Mandelstam, *Eocytheropteron sphaeroidale* Mandelstam, and *Trachyleberis bassleri* (Ulrich) are considered characteristic.



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For the Turkestan Formation, the characteristic fauna remains include *Pontocypris elongatissima* Mandelstam, *Cytheridea scruposa* Mandelstam, *Cytheridea reticulata* Mandelstam, *Cytheridea khanabadensis* Mandelstam, *Cytheridea asiatica* Mandelstam, *Trachyleberis buccera* Mandelstam, *Trachyleberis (Echinocythereis) ferganensis* Mandelstam, *Pterygocythereis cornuta* (Roemer), and *Eocytheropteron vesiculosum* Mandelstam.

For the Rishton Suite, M.I. Mendelshtam, in his scientific works, considered the ostracod microfaunal remains *Cytheridea schirabadensis* sp. and *Cytheropteron ispharaensis* sp. to be characteristic of the Paleogene Rishton Suite of Central Asia. These ostracod microfaunal remains were not identified in the Gova and Varzik reference sections in northern Fergana.

In the Isfara Suite, ostracod remains are very poorly preserved. In the Varzik section, a single microfaunal specimen of *Cytheridea asiatica* Mandelst. was identified.

For the Khanabad Formation, the characteristic ostracod fauna remains include: *Cytherella evexa* Mandelstam, *Cytherelloidea probata* Mandelstam, *Clithrocytheridea innae* Mandelstam, *Cytheridea lata* Mandelstam, *Cytheretta insinuata* Mandelstam, *Cytheretta circumspecta* Mandelstam, *Pterygocythereis affabilata* Mandelstam, *Loxoconcha uncata* Mandelstam, *Loxoconcha laculata* Mandelstam, and *Paracytheridea frivolis* Mandelstam.

The Sumsar Formation can be distinguished from other deposits by the presence of ostracod remains such as *Cytherella oraria* Mandelstam, *Schizocythere appendiculata* Triebel, and *Eucytherura dentata* (Lienenklaus).

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