

*Geology*

## **Problem of Stratigraphic Boundary between the Paleogene and Neogene Systems in the Eastern Paratethys**

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(Presented by Academy Member M. Kakabadze)

**ABSTRACT.** To clarify the problem of boundary between the Paleogene and Neogene Systems within the limits of the Eastern Paratethys on the territory of Georgia the sections represented by coastal and deep-marine facies were studied comprehensively (micro- and macrofauna, nannoplankton). The stratotype section represented by coastal facies is exposed in Eastern Georgia in the vicinity of the village of Uplistsikhe and it contains numerous (more than 10) mollusk forms of Aquitanian age (=Uplistsikhe stage). According to mollusk fauna preserved in this section the stratiform boundary in the above-mentioned sections is to be drawn between the Upper Oligocene (Pharekhi suite) sediments containing subsaline fauna and norm marine ones that are characterized by mollusk species of Aquitanian age (=Uplistsikhe stage). Good results were obtained during the study of carbonate nannoplankton when investigating the so-called mute clays of the Maikop series represented by deep-sea facies. Based on the data of this group we managed to draw the boundary between the Paleogene and Neogene sediments on the considerable territory of Georgia; NP25 (*Spenolithus ciproehsis*) nannoplankton zone of uppermost Oligocene and NNI (*Triquetrorhabdulus carinatus*), it pass between the nannoplankton zones - NP25 (*Spenolithus ciproehsis*) of uppermost Oligocene and the lowermost NNI (*Triquetrorhabdulus carinatus*) of the Miocene. © 2017 Bull. Georg. Natl. Acad. Sci.

**Key words:** Paleogene, Neogene, Miocene, section, stratotype section

The territory of Georgia occupies a central part of the Eastern Paratethys, where the Paleogene-Neogene sediments participate in all tectonic structures [1]. Since there occur complete, paleontologically (mollusks, foraminifers, ostracods, and nannoplankton) reliably dated sections in Georgia, it is clear that all disputable biostratigraphic issues, including the boundaries between the

Paleogene and Neogene, should be considered just in such areas.

One of such complete section fixed by many researchers and we among them [2], is located on the territory of Georgia, in the Eastern zone of subsidence (in the Mukhrani-Tiriphoni block, in the environs of Uplistsikhe village).

In this section on the basis of fairly convincing

paleontological data (more than 40 mollusk species), the stratigraphic analogue of the Aquitanian stage “the Uplistsikhe horizon” (later the stage) was identified for the first time within the Eastern Paratethys [3]. Therefore, the Uplistsikhe section should be considered as a stratotype for the oldest member of the Miocene of the Eastern Paratethys. So, there arose great interest in this section, especially since the volume and boundaries of this stage still remains disputable. Even the authors who singled out the mentioned straton changed their attitude towards the volume and boundaries of the stage for several times [3].

Below we shall not consider in detail the Uplistsikhe section, which has been repeatedly studied by various researchers as well as by us [2, 12], but there should be paid attention to some details. For example, it should be noted that a fairly rich mollusk fauna (more than 40 species) is found at two different stratigraphic levels: in the basal part of the section (packet 1) and 350 m above the base of the sequence. In early publications [3], mollusk complexes from both stratigraphic levels were considered to be of the same type and in view of their closeness to the Aquitanian fauna of the Aquitanian basin, were equated to the latter. Later on, T. Kurtskhalia [4,5], noting that *Glycymeris obovatus* Lam. and *Pitar beyrichi* Semp., found in the lower part of the stratum (packets 1 and 2) in the mollusk association, indicating the comparative antiquity of this complex with respect to fauna from the upper part of the strata, suggests a new stratigraphic scheme of Paleogene-Neogene sediments. In particular, the author to the Uplistsikhe stage attributes only the upper part of the section (packet 3), and in the lower part of the stratum T. Kurtskhalia distinguished two substages: the Lower Chattian (packet 4) - layer with *Turritella beyrichi* and the Upper Chattian (packet e) – layer with *Tympanotonos margaritaceus*.

Consequently, the mentioned author draws the stratigraphic boundary between the Paleogene and Neogene inside the Uplistsikhe stage, between prac-

tically the same type mollusk complexes.

Considering the generic and species similarity of the macro- microfauna and nannoplankton in the packs 2 and 3 of the Uplistsikhe section and their apparent relation to the Aquitanian (=Uplistsikhe) stage, we also share the stratigraphic scheme proposed earlier by T. Kurtskhalia [4], Paleogene-Neogene boundary is drawn between the Corbulian sandstones (the Pharekhi suite) characterized by scarce, subsaline, often monomorph fauna (forming lenses of Corbulian lumachelles) of the Upper Oligocene and under the Uplistsikhe layers by diverse, rich polyhaline complex of macro- and microfauna in the lower part of the sequence (packets 1 and 2).

Above follow medium-layered sandstones alternating with the beds of clayey sandstones and Maikop clays (thickness 100 m); they contain the richest complex of the Lower Miocene flora (packet 7).

Stratigraphically higher medium-layered sandstones with intercalations of sandy clays and gravelites (350 m thick packet 8,) comprise the association of Sakaraulian mollusks: *Nucula burdigalica* Coss. et Peyr., *Arca turonica* Duj., *Telina planata* L., *Fossularca (Striarca) miocenica* C. et P., *Parallelepipeum* cf. *shafarziki* Horusitzky, *Glycymeris deshayesi* Mayer, *Modiola* cf. *hoernesi* Reuss, *Modiolaria (Planimodiola) saucatensis* C. P., *Cotalliophaga transilvanica* (Hoern.), *Meretrix gigas* Lam., etc.

The age of the packet 1 in the above described Uplistsikhe section is defined as the Upper Oligocene [6,7], often consisting of corbules (corbulian layers of the Pharekhi suite) only.

Nannoplankton biocenosis from the packet 1 and the zonal species *Sphenolithus cyperoensis* among them undoubtedly points to the Upper Oligocene age of the layers containing them, corresponding to the uppermost C P 19 Zone or to the lowermost parts of the Zone Np 25 by E. Martini [8].

Appearance of zonal Early Miocene species

*Triquetrorhabdulus carinatus* Mart. and incomplete disappearance of *Sphenolithus ciperoensis* Bram. et Wilc. (Upper Oligocene species) in the overlying packet 2 (45 m thick) allows Ts. D. Minashvili [2] to identify transitional Upper Oligocene - Lower Miocene layers corresponding to an undivided NP 25 - NN1 Zone of E. Martini [8].

Almost all mollusk species present in packet 4 are also found in the stratotype of the Sakaraulian stage. In the same packet together with mollusk fauna nannofossils were discovered; among them presence of the Lower Miocene index-species *Triquetrorhabdulus carinatus* Mart. should be noted especially.

The Sakaraulian stage is represented mainly by the sediments of the same type (450-470 m.) as the Uplistsikhe ones and contains a rather rich complex of foraminifers (26 species), among which occur many index forms of this straton.

In the eastern direction, Uplistsikhe sediments, as in the entire Maikop series, can be traced as an uninterrupted strip along the southern side of the Tiriphoni-Mukhrani depression. Just in this strip (in the segment of Gori-Kaspi) in complete sections of the Maikop series L.Sh. Davitashvili [9] identified the Sakaraulian and Kotsakhuri stages, which subsequently received universal recognition acceptance.

The deposits of the Maikop series are most widespread in the Norio-Khashmi anticline, in the Iori river basin, in the environs of the village of Patardzeuli. In southeastern direction they occur in the vicinity of the villages Malkhazovka, Taurtapa, Baidachatma [7, 11, 12]. In almost all these points, the series under consideration is represented by typical Maikop clays with rare intercalations of carbonate clays, where Ts.D. Minashvili found species of nannoflora and among them *Sphenolithus ciperoensis* - the Upper Oligocene index-species.

Consequently, the stratigraphic boundaries in the deep-water facies of the Uplistsikhe stage are rather conventional: the lower boundary is drawn at the level where in the complete sections of the Maikop

series the Upper Oligocene representatives of the nanoplankton zone of *Sphenolithus ciperoensis* disappear, and the upper one where the Sakaraulian foraminifera appear first: *Entosolenia ovatum* Subb. et Chutz ., *Nonion umbilicatum* (Mont.), *N. sakaraulensis* Djan., *Buliminella schinschinskaya* (Sam.), *Lagena squamosa* Will. and many others.

It is not devoid of interest to characterize in brief the deposits of the Maikop series in the Western submergence zone, in particular in the northern periphery of the Odishi block, in the vicinity of the village Dzhgali, along the river Chanistskali. At this point, Upper Eocene foraminifera marls are overlapped by the deposits of Maikop series, in the lower part of which Ts. Minashvili [2] succeeded in subdividing the mentioned series into smaller stratigraphic units according to nannofossils. In the lower part of the unit (90-100 m thick), a complex of algophlora (18 species) was found and among them index-species - the *Coccolithus subdistichus* of the CP-16a Subzone that corresponds to the Lower Oligocene - the lowermost part of NP-21 Zone of E. Martini's [8] international standard scale.

In the overlying packet (15-20 m thick) in the nanoplankton complex *Zigodiscus vialovi* Andr. - Grig. is most important; it is considered to be an index-species for the Polbinian layers of the North Caucasus. The sediments comprising the last species are correlated with the standard NP-23 Zone, belonging to the Middle Oligocene and corresponding to the volume of the Rupelian stage of Belgium and Northern Germany.

Stratigraphically higher in carbonate clays (75 m thick) in the complex of nannoflora index-species are missing. Despite this, the presence in the layers of such characteristic forms as *Helicospaera bramletti* Muller and *H.recta* (Haq) Jaf. et Mart., quite convincingly determine the Late Oligocene (Chattian) age of the enclosing layers.

The entire overlying stratum (150-200 m) is represented by typical non-carbonate, mute Maikop clays. Stratigraphically higher the lithology changes sharply

and the stratum consists of coarse-grained carbonate sandstones with partings of sandy clays and rarely Maikop clays with plant remains (175-190 m). Mollusk fauna is concentrated in sandstones in the basal part of the sequence and consists of species characteristic of the Sakaraulian: *Glycymeris deshayesi* Mayer, *G. cor* Lam., *Nucula burdigalica* Cossm. et Peyr., etc. From the same level, O. Djanelidze [11] defined a rich complex of foraminifers that confirm the Sakaraulian age of the layers.

The stratum above 150-200 m thick of typical Maikop clays conformably superposed between the paleontologically (mollusks, foraminifers) dated sediments of the Sakaraulian and Upper Oligocene (according to the nannoplankton), in the section occupies the position of the Uplistsikhe stage, under which the boundary between the Paleogene and Neogene should be assumed.

Summarizing all the above data, the authors came to the following conclusions: The shallow-water facies of Maikop sediments both on the territory of the Transcaucasian intermountain area and throughout the Eastern Paratethys are extremely rare. However, in Georgia well-exposed complete sections are known: in the Tiriphoni-Mukhrani subzone, in the Uplistsikhe-Cheratkhevi strip, in the vicinity of Mtskheta and the village of Chkumi. In these sections the Upper Oligocene-Lower Miocene sediments are represented by typical shallow-water sediments - coarse-grained, thick-layered quartz sandstones with intercalations of gravelstones and argillaceous

sandstones and Maikop clays. In sandstones, concentrations of corbules often form lumachelle beds, characteristic of Upper Oligocene deposits of Eastern and Southern Georgia. The corbulian layers are traced at the same level along the whole Eastern Paratethis, right up to Central Asia.

Directly over the Corbulian layers lie lithologically absolutely similar strata of the rocks, with the above-described norm marine representatives of fauna (more than 50 forms), among which there are many mollusk index-species of the Uplistsikhe (=Aquitania) stage. In these sections, the boundary we are looking for must pass just between the Corbulian layers of the Upper Oligocene and the Lower Miocene Uplistsikhe layers.

In the deep-water areas where the Maikop series occur, the Upper-Oligocene as well as the overlying layers are represented by typical non-carbonate, leaf clays with jarosite and gypsum nodules. In such facies, establishment of stratigraphic boundary between the Paleogene and Neogene is connected with great difficulties, since the boundaries of the Uplistsikhe stage have not been paleontologically verified up to now. The lower boundary of the Uplistsikhe layers (as well as the boundary between the Paleogene and Neogene) is conventionally conducted at the level where the Upper Oligocene *Spenolithus cyperoensis* species disappears in the sections and the Lower Miocene form -*Triquetrorhabdulus carinatus* Mart. appears.

## გეოლოგია

## პალეოგენურ და ნეოგენურ სისტემებს შორის საზღვრის საკითხი აღმოსავლეთ პარატეთისში

### ც. მინაშვილი და გ. ანანიაშვილი

ივანე ჯავახიშვილის სახ. თბილისის სახელმწიფო უნივერსიტეტი. ალ. ჯანელიძის გეოლოგიის ინსტიტუტი, თბილისი, საქართველო

(წარმოდგენილია აკადემიის წევრის მ. კაკაბაძის მიერ)

საქართველოში პალეოგენურ და ნეოგენურ ნალექებს შორის საზღვრის გატარების საკითხი დღემდე გადაუჭრელია. ამ პრობლემის გარკვევის მიზნით ჩვენ მიერ კიდევ ერთხელ კომპლექსურად იქნა შესწავლილი აკვიტანური სართულის სტრატოტიპული ჭრილი სოფ. უფლისციხის მიდამოებში. იგი აღმოსავლეთ დაძირვის ზონის ტირიფონ-მუხრანის ბლოკის ფარგლებში მდებარეობს და სანაპირო ფაციესებით არის წარმოდგენილი. ამ გაშიშვლების უკიდურეს ქვედა ნაწილში მდებარე სქელშრეებრივი ქვიშაქვებისა და თიხების დასტაში არსებული მიკროფაუნისა და ნანოპლანქტონის მიხედვით შემცველი შრეების ასაკი აშკარად ზედაოლიგოცენურია. ზევით თანხმობით განლაგებულ სქელშრეებრივი ქვიშაქვების, გრაველიტებისა და მაიკოპური თიხების დასტაში (700მ) ნაპოვია მდიდარი (40–ზე მეტი), ნორმულზღვიური მოლუსკური ფაუნა, რომელიც აკვიტანიის აუზის აკვიტანური (უფლისციხის სართულს) ასაკის კომპლექსის იდენტურია. ამ დასტის ფუძეში ნაპოვნი ორიოდე ფორმაზე (*Glycymeris obovatus* Lam. და *Pitar beirichi* Semp.) დაყრდნობით, რომლებიც ოლიგოცენურშიც გვხვდება, ზოგი ავტორი აღნიშნული შრენარის ქვედა ნაწილს ზედაოლიგოცენურად ათარიღებს და შესაბამისად საზღვარს პალეოგენურ და ნეოგენურ სექციებს სისტემებს შორის მსგავსი ფაუნის შემცველ უფლისციხის სართულის შუაში ატარებს. ჩვენი მონაცემებით, ამ დასტაში დაცული რამდენიმე ათეული მოლუსკური გვარი და სახეობა სრულიად შეესაბამება აკვიტანური სართულის დამახასიათებელ კომპლექსს და ამიტომ საზღვარი პალეოგენსა და ნეოგენს შორის მომარილიანო აუზის, მონომორფული ფაუნის შემცველ შრეებსა (ზედა ოლიგოცენი, ფარეხას წყება) და ნორმულზღვიური, მდიდარი მოლუსკური სახეობებით დახასიათებულ ნალექებს შორის (უფლისციხის სართული) ტარდება. ღრმა ზღვის ფაციესებით წარმოდგენილ მაიკოპური სერიის თიხებს, მთელ აღმოსავლეთ პარატეთისში ბევრად მეტი ფართობი უჭირავს, ვიდრე სანაპიროს და თავისი სრული შემადგენლობით რამდენიმე ასეული მეტრის სიმძლავრისაა. ამ სერიის ნალექებს ბოლო დრომდე მუნჯ წყებას უწოდებდნენ მასში ორგანული ნაშთების არარსებობის გამო. კარგი შედეგები გამოიღო აღნიშნული ნალექების ნანოპლანქტონურმა კვლევებმა. ამ ჯგუფის მონაცემებზე დაყრდნობით სამეგრელოში ოლიგოცენური სამად დანაწილდა, მოხერხდა ზედა ოლიგოცენის საზღვრის დადგენა. ამრიგად, აღნიშნული საზღვარი გატარებულია ზედაოლიგოცენურის სულ ზედა NP25 (*Spenolithus ciperoensis*) და მიოცენურის სულ ქვედა NNI (*Triquetrorhabdulus carinatus*) ნანოპლანქტონურ ზონებს შორის.

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