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Geology

New Data on Tbilisi Olistostromes

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In recent years, new and interesting geological material has appeared in Tbilisi and its adjacent areas, including those related to the Middle Eocene "Tbilisi Olistostromes" ("conglomerates of entangled bedding"). One of such interesting areas is an exposure of Mirza-Shafi street in "Abanotubani", which is 180-200 m in length and 40-65 m in height. Lithological and structural diversity of the Tbilisi Olistostromes, as well as sedimentation and tectonic processes of that time, are well represented here. In the exposure two facies are clearly distinguished: the lower one – stratified volcanic-sedimentary and normally stratified deposits and the upper – olistostromes. The latter differs from other exposures situated in the environs of Tbilisi by a number of signs. Here, on the one hand, olistostromes are represented by tuff-breccias and block-breccias, and on the other hand – only by olistoplaques, sometimes they reach several hundreds and sometimes thousands of cubic meters in size. The latter occupies 80-85% of the whole exposure. The article also deals with the "Abanotubani" olistostromes of the Legvta-khevi river, which are a continuation of the lower part of the Mirza-Shafi street section and are characterized by differing facies. The obtained new factual material, in particular the abundance and large size of the olistoplaques, has strengthened our notion about the tectonic origin of the Tbilisi Olistostromes. *© 2020 Bull. Georg. Natl. Acad. Sci.*

Olistostromes, olistoplaques, Event deposits, Middle Eocene, Trialetian folding

The territory of Tbilisi is a part of the eastern termination of Adjara-Trialeti and includes Paleogene and Neogene volcanogenic-sedimentary and normally stratified sedimentary formations. Among them, by a number of signs the Middle Eocene chaotically built specific formations attracted the attention from the very beginning, which [1] distinguished as "conglomerates of entangled bedding". Later, the abovementioned formations were the object of study of many researchers. Nevertheless, a number of issues remain disputable up to now. In particular, there are completely different ideas about their genesis, such as landslide phenomena [2, 3], cordillera washout [4], tsunami [5], volcanism [6, 7], tectonics [8, 9] and so on.

Among the chaotically built sediments, these formations belong to typical submarine olistostromes and are distinguished as "Tbilisi Olistostromes" [8].

In recent years, as a result of construction works in the vicinity of Tbilisi and in its adjacent territories some interesting geological exposures were viewed revealing a new interesting geological material. One of such examples is Mirza-Shafi street, which is located in Abanotubani, the historic old district of Tbilisi, on the right slope of Legvta-Khevi (Dabakhana River) in a photo of 2015,

presented in the article (Fig. 1), which depicts an interesting exposures of the Tbilisi Middle Eocene Olistostromes visible on Mirza-Shafi street. The exposure is 180-200 in length and 40-65 meters in height, due to the complex of buildings that is under construction at present, the outcrop will be completely covered and the presented photo (Fig. 1) will become of historical significance.

is crossed with a submeridional fault. The latter is well expressed in relief in the vicinity of the Metekhi church in the form of a vertical wall on the left bank of the Mtkvari River, which is entirely built of Tbilisi Olistostrome. The presence of this fault besides the geomorphological data is well documented by hydrogeological and geophysical data [10].

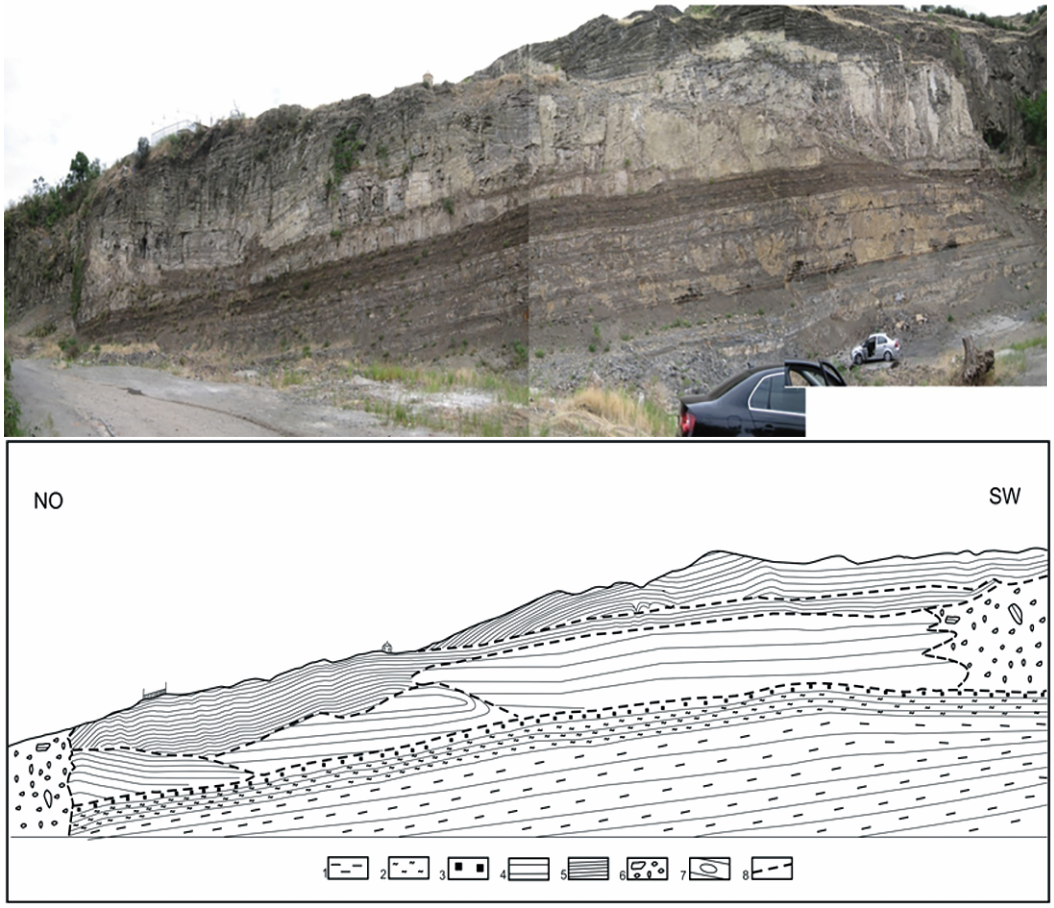

Fig 1. Mirza-Shafi street exposure. Photo of 2015 and a scheme of its geological structure.
1 – lower layered pack; 2 – upper layered pack; 3 – tuff key bed; 4 – olistoplaques of lower order; 5 – olistoplaques of higher order; 6 – tuff-breccias and block breccias; 7 – key bed; 8 – the border of olistoplaques.

The exposure of Mirza-Shafi street is interesting for well observed diversity of lithological and structural make-up of the Tbilisi Olistostrome (Fig. 1), as well as the results of sedimentation and tectonic processes of that time.

Structurally, this segment is the arched part of the northeastern margin of the Mamadaviti anticline, gradually subsiding to the north-east and

In the exposure of Mirza-Shafi street, two facies are clearly distinguished: the lower one – stratified volcanic-sedimentary and the upper – olistostromes (Fig. 1). Stratified deposits along strike extend continuously throughout the entire outcrop. In turn, two strata of lithologically differing stratified rocks are distinguished, which are visually well distinct. The lower stratum is dark in color and is represented by

alternation of dense argillites (5-30 cm) and carbonaceous aleurolites (5-10 cm). Along with them intercalations of schistose argillites (20-25 cm), clays of dark coloring (5-10 cm) and altered tuffs of banded texture (10-15 cm). In the argillites rarely well-rounded inclusions of carbonate clays and dense marls are observed, sometimes they reach 10×70 cm in size. Visible thickness of the stratum is 15-19 m.

In ascending section the described rocks are directly continued by alternation of strongly schistose, relatively dense mudstones of chocolate color (20–25 cm) and loose litho-crystalloclastic and, to a lesser extent crystalloclastic, altered tuffs (50–60 cm). 20-25 cm thick interlayers of dark colored strongly schistose carbonate argillites are observed in less quantity.

The chocolate colored stratum in the uppermost part is terminated light grey dense rudaceous crystalloclastic and litho-crystalloclastic tuff layer, which sometimes pass intotuff-gravellites. Its thickness varies within 0.8-1.5 m. The base of the aforementioned layer is straight and the roof is uneven and often has an undulated surface. It is a kind of key layer and represents the boundary between the stratified rocks and olistostromes. The chocolate colored stratified stratum is 3-6 m in thickness.

The abovementioned stratified rocks in the ascending section, as already mentioned, are immediately followed by structurally and facially differing formations in the form of olistostromes, which for a number of signs differ from similar outcrops present in the vicinity of Tbilisi. In particular, in the exposure of Mirza-Shafi street, we have, on the one hand, olistostromes represented by tuff-breccias and block-breccias, and on the other hand olistostromes built only by olistoplaques. The latter occupies 80-85% of the whole exposure (Fig. 1).

Olistostromes represented by tuff-breccias and block-breccias occupy the extreme south-western and north-eastern parts of the exposure. Fragments of different rocks participate in their composition, the size of which varies from a few centimeters to 1-1.5 m blocks. Inclusions of big size are present in lesser amounts and are mainly found in the south-eastern part of the outcrop. Most of these inclusions represent rocks of below located Dabakhana suite. Along with the volcanite fragments, there is also 40-50 cm dense marl olistolite as well, which is poorly rounded. The space between the olistolites is filled with fine-detrital tuff-breccia with the altered litho-crystalloclastic tuff cement.

The second facies of olistostromes is entirely built up of olistoplaques (included blocks), the size of which varies from a few hundred cubic meters to several thousand cubic meters. Olistoplaques are represented by stratified rocks with the traces of tectonic movements. Studies have shown that in the olistoplaques submarine landslide folds, including lying overfolds are marked, in the eastern part of the exposure tectonic displacement between the olistoplaques is well observed (Fig. 2) that is expressed in angular unconformity between the olistoplaques and in the undulated surface of the displaced olistoplaques' basal part.

Fig. 2. Tectonic contact between the olistoplaques (south-western part of the exposure).

Olistoplaques are chaotically disposed, however, in a vertical direction, there are two strata, where the olistoplaques of the lower part are represented by more thick-layered normally stratified sedimentary and volcanogenic-sedimentary rocks. There are also

some differences between individual blocks. For example, one of the large-volume olistoplaques (up to 1500 m^3), which occupies the central part of the exposure, is built mainly of thick-bedded (1-1.5 m) carbonate argillites and carbonate clays alternation, where interlayers of altered crystalloclastic tuffs are found. Carbonate rocks also contain small amount of microfauna. On the olistoplaque's underlying side a small submarine landslide fold (Fig. 3) that at the same time points to the direction of its movement is well observed.

Fig. 3. Submarine fold in the underlying part of olistoplaque (south-western part of the exposure)

Hypsometrically higher located olistoplaques, as already mentioned, built of thin-layered (20-40 cm) rocks, where normally stratified sedimentary rocks (sandy and carbonate argillites, marls) prevail. As to the volcanogens, occur in less quantity and are represented by altered rudaceous litho-crystalloclastic tuffs, which in some areas pass into tuff-gravellites.

It is noteworthy that most of the lower part olistoplaques in the basal part are represented by 0.3-0.7 m thick altered litho-crystalloclastic tuffs. The lower part appears to have been relatively labile, contributing to the movement of olistoplaques in the sedimentary basin during submarine landslide processes. In the olistoplaques contact areas squeezing out of the labile mass takes place. Similar picture is observed in the western part of the exposure. vertical thickness of the Mirza-Shafi street exposure is 25-36 m.

Results of microscopic study and chemical analysis (by XRF method) of tuffs present in the composition of stratified rocks and olistoplaques plotted on the classification diagram by M. Leba et al [11], indicate that these volcanites belong to basaltic group rocks.

The continuation of the lower part of the geological section of Mirza-Shafi street after a 10-12 m break (Fig. 4) on both slopes of the Legvta-Khevi river continues nearby the "Chreli Abano" bathhouses, where olistostromes of differing nature are present. Mainly rudaceous tuffs and tuff-gravelites are present here and their thickness varies within 1-3 m. Often they contain well-rounded inclusions of rocks of various size (0.3-1 m) and composition (marls, argillites, tuffs, etc.). Along with thick-layered rocks less amount of packets of thin-layered crystalloclastic tuff are also observed. Along with thick-layered rocks, in less quantities strata of thin-layered crystalloclastic tuff are also observed.

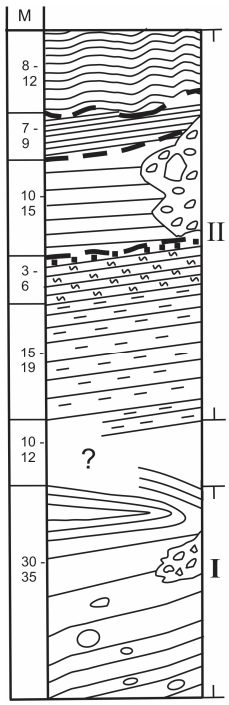

Fig. 4. Structural-stratigraphic section of the right slope of the river Legvta-Khevi. I – Dabakhana river gorge (Abanotubani section); II – Mirza-Shafi street; (Symbols see in Fig. 1).

Fig. 5. Submarine landslide folds (Tbilisi – Rustavi motorway).

Along the strike the layers with the inclusions, in some spots pass into typical olistostromes or massive layers. A similar picture is observed near the waterfall on the right slope of the river Legvta-Khevi. In the upper part of the exposure also a lying overfold is recorded. Visible thickness of the Legvta-Khevi river exposure amounts 30-35 m. It is noteworthy that this old district of Tbilisi, the described Legvta-Khevi river gorge inclusive is a popular touristic route. If we consider as a whole the exposure of Mirza-Shafi street and the Legvta-Khevi river (total thickness of the exposure varies between 83-108m) and if subject to new factual material, we can conclude that these olistostromes are distinguished in facies and structural variety. First of all, this is manifested in the abundance of olistoplaques (Mirza-Shafi street) and their large volumes, which is not observed anywhere in the Tbilisi Olistostromes. The lower part of olistostromes also differs. Here, along with typical tuff-breccias and block-breccias, also thick-layered tuffs with inclusions that occupy the main part of the outcrop are observed. New examples of submarine landslides events of Tbilisi Olistostrome in the form of various type folds are also well observed along the Tbilisi-Rustavi motorway (Fig. 5).

As for the reconstruction of the paleo-geographic picture of the origin of the Tbilisi Olistostromes and elucidation of the issues of their genesis, because of the volume of the paper we cannot discuss them. However, a number of issues require clarification and further study (specification of the age of limestones and inclusions of acidic volcanites, determination of the composition and location of the feeding source of terrigenous material, etc.). Finally, we would like to note that the new factual material has strengthened our hypothesis that the major factor for the appearance of the Tbilisi Olistostrome must have been the strong tectonic events that accompanied the Trialetian orogenic phase in the end of the Middle Eocene. Submaridional deep fault also appears to have played an important role in their formation, indicated by spread in its proximity large size inclusions (olistoplaques) in the Mirza-Shafi street olistostromes. Tbilisi Olistostromes, by their geological structure and genesis are typical “event deposits” [12].

გეოლოგია

ახალი მონაცემები თბილისის ოლისტოსტრომების შესახებ

ფ. მაისაძე

აკადემიის წევრი, ა.ჯანელიძის სახ. გეოლოგიის ინსტიტუტი, თბილისი, საქართველო

ბოლო წლებში თბილისისა და მის მიმდებარე ტერიტორიებზე გამოჩნდა ახალი საინტერესო გეოლოგიური მასალები, მათ შორის შუაეოცენური „თბილისის ოლისტოსტრომების“ („არეულშრეებრივი კონგლომერატები“) შესახებ. ერთ-ერთ ასეთ სიახლეს წარმოადგენს აბანოთუბანში მირზა-შაფის ქუჩის გაშიშვლება, რომელიც სიგრძეში 180-200, ხოლო სიმაღლეში - 40-65 მეტრია, აქ კარგად გამოჩნდა თბილისის ოლისტოსტრომების როგორც ლითოლოგიური და სტრუქტურული მრავალფეროვნება, ასევე იმდროინდელი სედიმენტაციური და ტექტონიკური პროცესები. გაშიშვლებაში მკაფიოდ გაირჩევა ორი ფაციესი: ქვედა – შრეებრივი ვულკანოგენ-დანალექი და ნორმულ-დანალექი და ზედა – ოლისტოსტრომები. ეს უკანასკნელი მთელი რიგი ნიშნებით განსხვავებულია თბილისის მიდამოებში არსებულ სხვა გამოსავლების-გან. აქ ოლისტოსტრომები აგებულია, ერთი მხრივ, ტუფ-ბრექჩიებითა და ლოდ-ბრექჩიებით, ხოლო მეორე მხრივ, მხოლოდ ოლისტოპლაკებით, რომელთა ზომები რამდენიმე ასეულ და ზოგჯერ, ათას კუბურ მეტრს აღწევს და მათ მთელი გაშიშვლების 80-85% უკავია. სტატიაში განხილულია ასევე „აბანოთუბნის“ ოლისტოსტრომებიც მდ. ლელვთა-ხევში, რომლებიც მირზა-შაფის ქუჩის ჭრილის ქვედა ნაწილის გაგრძელებაა და განსხვავებული ფაციესით ხასიათდება. მოპოვებულმა ახალმა ფაქტიურმა მასალამ, კერძოდ, ოლისტოპლაკების სიმრავლემ და დიდმა ზომებმა განამტკიცა ჩვენი წარმოდგენა თბილისის ოლისტოსტრომების ტექტონიკური წარმოშობის შესახებ.

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