

## Mining and Geology Faculty

### Projects received by the Shota Rustaveli National Science Foundation grant

№	Name of the grant	Head of the Project	Years of project start and end	amount	Status completed/in progress	Grant code
1.	Development and testing of transformable system to save life in road tunnel in case of fire	Professor, Leon Makharadze	2019-2022	840 000	completed	AR 19-1936
2.	Study of critical velocity and fire-induced back-layering to save lives in road tunnels	Professor, Omar Lanchava	2023 - 2026	240 000	in progress	FR-22-12949
3.	Study of mineral and petrographic composition and manufacturing technology of old and new pitchers	Rusudan Metreveli (Nodar Foforadze)	20.01.2018 – 20.08.2018		completed	MR2017_7.1_4
4.	Ivrispireti in the Upper Miocene: A clarification of the fossil primate record in the South Caucasus	Maya Bukhsianidze	01.10.2016-30.09.2019		completed	№217626
5.	Detailed Geological Research of the Shale Gas Prospective Local Districts in the Kazbegi-Omaló Region	Olga Seskuria	12.12.2016 - 12.12.2018		completed	№217754

6.	Natural construction and paving stones of Georgia	Vazha Geleishvili	– 2017-2019 წწ.		completed	
7.	Assessment and analysis of the hydrogeological and engineering-geological conditions of the Tbilisi bypass railway	Niko Foforadze (Master)	January - August 2018 წელი		completed	
8.	Researching the mineralogical features of Georgian-Byzantine partition enamel using innovative methods	Ermile Maghradze	14.12.2018- 18.12.2020		completed	PHDF-18-449
9.	Sardine beads and pendants from Samravro Burials	Christine Shavlakadze	14.12.2018- 18.12.2021		completed	FR-18-663
10.	Structural model of the fold-creep belt in the Rion foreland and the southern slope of the Caucasus (Tekhur River Valley section)	Anzor Giorgadze (doctoral student)	01.10.2021 - 01.10.2023	41400	in progress	PHDF-21-087
11.	"Development, processes, management and control of an improved technological scheme for beneficiation of gold-polymetallic ores".	M. Gamtsemlidze; D. Talakhadze, R. Enageli	2019-2022	202 880.62 Gel	completed	FR-18-3398 საიდენტიფიკაციო კოდი 204862247
12.	Mathematical modeling of the vibratory technologic	V. Zviadauri	20.12.2017 – 20.12.2020	226000 Gel	completed	FR 17_292

	processes and design of the new, highly effective machines					
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2023

13.	Processing and testing of transformable systems for saving lives in a road tunnel under fire conditions.	Professor Leon Makharadze	2019-2022	840 000	completed	AR 19-1936
14	Study of critical velocity and fire-induced back-layering to save lives in road tunnels	Professor Omar Lanchava	2023 - 2026	240 000	in progress	FR-22-12949

1. **ABSTRACT.** The idea of the research is based on increasing the aerodynamic resistance of the tunnel with the help of a transformable system (TS), which will prevent the spread of combustion products without interfering with people's movement. As a result, in the critical sections of the tunnel, fresh air maintains longer, giving more time for evacuation. The marked event is

characterized by a clearly defined time interval, that is the key element to the success of the evacuation and which depends on many components. At the beginning of the 21st century, in newly built tunnels began to build fireproof barriers that can divide the tunnel into short sections. These barriers prevent the spread of fire, smoke and other products of combustion along the length of the tunnels. But this method is not the final decision, due to the fact that there is no place for its implementation in the "old" tunnels without sacrificing the underground space of the tunnel and its traffic capacity. It should be emphasized that the use of the method of dividing the tunnel into short sections is not envisaged in the design solutions in the tunnels being operated and under construction in Georgia. Based on this the issue of the development of this project is directly vital and very relevant for the conditions in Georgia. Thus, the technology that will be processed in this project is focused on improving safety and survival in the event of the fire in tunnels. The significant indicators of the use of TS will be investigated in according to theoretical and experimental researches provided by this project. In particular theoretical analysis is necessary for the connecting of critical velocity, back layering length and Froude and Richardson criteria to the fire indicators with and without the influence of TS.

2. **Abstract.** Survival in tunnels in case of fires is a recognized international problem, on which many researchers and engineers work around the world. The focus on saving lives was especially strengthened after large fires in the tunnels, which resulted in human casualties. It should mention that in Georgia it is planned to build more than 50 road tunnels in the next 3-5 years. Inspecting the design decisions of these tunnels revealed that the only significant risk factor for them is the fire. Based on this the issue of the development of this project is directly vital and very relevant for the conditions in Georgia.

The mentioned problem also is recognized on the international level. After great fires that took place in the world tunnels the European Union made a special attention on the Trans-European Network (TERN) which places the safety of existing and under construction tunnels as the number one priority.

The critical velocity of ventilation and the opposite diffusion of smoke in the fresh air current (back-layering) are important technological values in emergency ventilation projects. The concept of critical velocity was introduced by Thomas as a semi-empirical formula that uses the critical value of the Froude number. The idea of using the critical Froude Number implies rapid mixing of equal amounts of flue gases and fresh air at the hearth of the fire, what is not always the case, particularly when the width of the tunnel carriageway significantly exceeds its height. Consequently, the geometry of the tunnel determines the use of the Froude criterion. It is therefore important to know when different ratios of clean and polluted air are mixed at the hearth of fire, what kind of correlation will be and if the Froude Number is applicable.

International recommendations to design emergency ventilation systems, as well as fire safety guidelines of the USA, one of the world leading countries, share the view that the critical velocity of a ventilation flow is an important technological parameter, which can be used to control smoke in traffic tunnels in case of any type of fire. Nowadays, accepting this view without criticism is a big mistake.

The essence of the problem lies in the critical analysis of the obsolete scientific concepts and in gaining novel results based on the concept introduced by us suggesting that fires cause dynamic pressure higher than the static pressure induced by tunnel fans is, as well as on the difference between the tunnel ventilation currents considering the seat of fire, the type of its spreading under the ground, fire strength, tunnel geometry and other typical parameters.

Therefore, in the present paper, we plan to conduct the studies, which will distinguish between the cases: 1. when, based on the available classical knowledge, it will be possible to develop emergency ventilation projects to save lives, and 2. when the available knowledge is no longer sufficient to realize the mentioned projects and novel study results are needed to develop a new approach to the problem.

The proposed project is socially oriented, aimed at improving emergency ventilation technology and thus increasing safety in case of fires in road tunnels, which is an important socio-political and public task.

3. The tradition of making Qvevri in our country dates back 8000 years, which is an inseparable part of the cultural identity of Georgians. It is worth noting that the technology of making a pitcher and the raw materials needed for its creation have remained practically the same during this time. Only the raw materials and the general processing technology differ according to the regions and deposits. At the 4th International Symposium of Qvevri Wine in Georgia, the issue of the need for a comprehensive study of Qvevri and its constituent raw materials was clearly raised. For Georgia, as a sovereign country, the export of qvevri wine is gaining great importance. Therefore, the demand for quality qvevri is increasing.

Thus, it is highly relevant today to study the clays used in the production of pitchers, the pitchers made from them, and the technology involved in their production, which is provided by the project.

The presented project aims to conduct comprehensive research on the raw materials of pitchers and their constituent clays, which holds significant practical and scientific value

4. This project was given an impetus by the National Museum of Georgia in 2012. The discovery of a primate mandible on the border of Sarmatian and Meotis in Chachuna, Ivrispireti (unpublished).

This is the first discovery of Colobinae belonging to the Anthrice family (Cercopithecidae) in the South Caucasus, and perhaps the oldest remains of a thin-skinned monkey in Eurasia.

This remains was found just 50-60 km away from the known site of the desert, where the last Dryopithecus in Eurasia, the human-like ape (*Udabnopithecus garedziensis*), dating to the beginning of the Meotis (ca. 8.0-8.5 million years ago) was found. .

The aim of the presented project is to determine the exact dates of the presence of late Miocene primates in the South Caucasus, their environment and biotic context, in order to support one of two working hypotheses: (H1)

Dryopithecus and thin-skinned monkeys coexisted in the South Caucasus or (H2) they replaced each other in the wake of general faunal changes, which in turn were caused by large-scale environmental changes in Western Eurasia at the end of the Miocene, which is known as the Valesian crisis (approx. 8.7 million years ago).

4. Nowadays shale gas rich reserves utilization aimed works are spread throughout the world. According to shale gas content the prospective ones are shales of various ages and contents developed in certain regions of the world. At this stage of research, taking into account a number of important details prospective shale districts of the Caucasus Folding System have been chosen. On the basis of analysis (tectonic conditions, mineralogical paragenesis, organic carbon content, catagenesis level) of the data obtained by laboratory researches (microscopic, chemical, X-ray diffraction, X-ray fluorescent, thermal) of clay shale samples that were taken from natural exposures and sections during the field-geological works carried out in previous years throughout the Kazbegi-Omallo zone (the Kazbegi region, the Piriqita and Tushetis Alazani, Stori rivers gorges) there have been distinguished local districts prospective by shale gas content; surely, the necessary requirements for the environmental security in future have been considered.

The preliminary conclusions on the Georgian shale-gas potential marketing are positive enough though all the results indicate the only the availability of it. Still there is much to be more precise and studied more thoroughly; its availability and reality in the distinguished prospective districts will be defined after further field and laboratory researches considering that the Jurassic shales of the Caucasian Folded System is the direct prolongation of the Caspian Sea basin and Dagestani formations of the same age.

5. In the master's thesis, based on field and camera material, it is concluded that the construction of the Tbilisi bypass railway should be carried out in a specific natural and anthropogenic environment, which will be associated with environmental issues. The aspects of the possible negative impact on the environment are described, and areas along the track where construction and subsequent operation require special protective measures are identified.
6. The paper describes the volume of research conducted for the first time in the non-metallic ore geological history of Georgia. An important database of natural building and paving stones has been created, showcasing their locations, rock designations, physical and mechanical properties, mineral and chemical compositions, as well as industrial and application areas

7. With the data obtained as a result of the research, it will be possible to receive Bringing the information into the system and forming it into one work, which will allow scientists and restaurateurs on solidly demonstrated, substantiated, scientific conclusions based on scientific observations and restoration-conservation activities. This will greatly contribute to the national cultural heritage maintenance of unique monuments. Permanent production of research conducted with modern equipment will be created a solid and reliable information base, through which will be an argumentative and qualified conclusions , which will become the basis for forming valid opinions with the mentioned studies. We will have news in the direction of the received solid Scientific results will make Georgian and Byzantine jewelry schools and traditions separated from each other more clearly. We will get it eventually a whole chain of scientific justifications, which will be a completely new word In the field of traditional Georgian partition enamel research.
8. on the archaeological monuments of Georgia, like other contemporaries of the world in cultural centers, wide exploitation of agate-chalcedony group mineral starts from the III millennium BC And its popularity in India is related to the origin of Harappan civilization. Necklaces of the quartz group are represented different types such as: sardion, chalcedony, agate, jasper. Sardine is of the agate-chalcedony group half transparent or translucent mineral. It has quite a large distribution in the area of Georgia. This mineral is distinguished by visual, highly decorative appearance and good Physical properties: with quite high strength and stability towards environmental conditions , as well as an attractive color. Extraction and use of minerals of the agate-chalcedony group started from ancient times with different purposes in the territory of Georgia, to which it testifies a lot of jewelry made from them that was found in the Samarovna
9. The goal of the project is the fold-creep belt of the Rion foreland and the Caucasus deep structure of the southern slope, Structural style of deformation and Kinematics. In order to achieve the set goal, it is planned to: 2-dimensional cuts building on the stratigraphic data of existing drills, Also based on the geological field new material received from the works, 3-dimensional structural model build on a based of structural cuts. It is planned as part of the project purchase of the inventory material and technical means necessary for research, 2 Participation in an international scientific conference and publish at least 1 scientific article in a peer-reviewed journal.
10. **Abstract.** Useful minerals (gold, lead, zinc) are included in the fragments of Bektakari gold-polymetallic ore with grains of fine and uneven size. For the effective enrichment of such ore, it was pre-processed to separate a certain amount of barren rock (waste). From the point of view of preliminary preparation of the material for enrichment, crushing and grinding was carried out to the extent that ensured the maximum opening of useful and barren minerals and, as a result, the maximum extraction of useful components in the enrichment product. The studies carried out on enriching ability included crushing and precipitation operations. Enrichment on the diaphragm precipitating machine made it possible to remove a large amount of barren rock, increase the content of useful components in the concentrate and reduce losses. A certain amount of the finest class (as a dust) was obtained in the crushed product. The leaching method was used to extract them. Along with it at milling at classifier in closed circle, in circulatory loading the gold-containing particles were collected by freeform. The researches were carried out on the enrichment of sands and sludges by selective and collective methods. As a result, high-quality lead-zinc concentrates and gold-containing product were obtained. Based on the experimental data obtained during the

period of research carried out for the automation of key processes, the couple as well as multiple relationships were constructed between the controlling actions and the enriching indices; the measuring means were selected; mathematical models of processes were constructed, on the basis of which the control methods were elaborated. Obtained as result of the studies, an optimal qualitative-quantitative technological scheme of enrichment was elaborated. The results obtained on the basis of research allow to increase the extraction of lead-zinc concentrates and gold-containing products up to 3%. The experience gained in the project can be used in enrichment of other refractory fine size impregnated ores.

11. **Abstrakt.** As a research object was chosen a vibratory transportation and technologic (VTT) machine for vibratory transportation and processing of materials of various types. The project proposal aims were: Development of the generalized mathematical model of the VTT machine and process; The complex research (mathematical modeling) of the VTT process; Designing of new, highly productive VTT machines; Fabrication and tests of laboratory samples of the machines. **The grant project was realized in the following succession:** A generalized dynamical model of the vibratory technologic machine with the load was developed on the base of systemic approach. A mathematical model of spatial movement of the system "vibrodrive – working member – technologic load" in the form of the system of differential equations was developed. A systemic approach ensures to describe both, the independent movement of masses and their interconnection and consequently their mutual influence. The mentioned interconnection was realized by nonlinear terms in the form of products of coordinates, velocities and accelerations retained in the systems of equations. A complex study of the friable material vibratory technologic process (transportation velocity, intensity of the load movement relative the working member surfaces, mutual dynamical influence of the material and working member etc.) was carried out. The modeling was carried out at variation of the constructional and physical (rheologic) parameters of the mentioned system in the wide range and under real laws of the vibro-excitation. The graphs of the material dynamical characteristics depending on variation of various parameters were plotted, whose analysis showed tendencies towards improvement of the technologic process. The shop drawings were developed and new electromagnetic vibratory feeders were fabricated: 1) with rigid bottom having independent rotary movement; 2) with vibrodrive having a variable mode; 3) with the bottom having elastic plates with independent movements. The numerical and physical experiments showed advantage of the new original designs in comparison with the existent ones that reveals the real prospects of their use in local, as well as foreign enterprises. From the reviews of our reports to the international scientific conferences and publications in the highly rated journals appeared the real reasonings for widening and deepening the international collaboration.

## ABSTRACT

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