MINERALOGICAL SOCIETY
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POWER OF GEOLOGY IS THE PRECONDITION FOR REGENERATION OF ECONOMICS

BOOK OF ABSTRACTS

4th International Scientific-Practical Conference
on Up-to-date Problems of Geology

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The conference is dedicated to the 130th anniversary of Alexsandre Janelidze and Kalistrate Gabunia and 110th anniversary of Giorgi Zaridze and Ioseb Buachidze - famous Georgian geologists and public figures.

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ASSESSMENT OF GEOECOLOGICAL SITUATION OF THE LAKE PALIASTOMI

G. ABRAMIA, M. GVERDSITELI, D. ERISTAVI
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In 1996, Georgia joined the Ramsar "Convention on Wetlands of International Importance especially as Waterfowl Habitat."

Kolkheti wetlands are represented by water regulators and habitats for waterfowls.

The rural areas of Kolkheti lowland have been declared as the object of the Ramsar Convention: namely the Churia wetlands, the Nadar wetlands, the Pichora-Paliastomi marshes, the Paliastomi lake and the Black Sea waters, as well as the Ispani wetlands in Kobuleti. The Convention provides for the Contracting Parties the obligations to ensure the protection of the wetlands and the sustainable use of the entire territory of the country. Governments should take into consideration the need for the protection of water reservoirs in state planning for land use [1].

International Watershed criteria that respond to object are as follows: Group-A of the Criteria, the object consists of rare and unique types of swamps and answers 9 criteria, including: the object has international importance for conservation of biological diversity; encourage biodiversity species of animals, provide shelter for resident birds and regularly provide 20,000 waterfowls.

The birds living on the lake are included in the Annex I and II of the Convention for the Protection of Migratory Species Convention (CMS - Bonn Convention) and the African-*Eurasian Migratory Waterbird Agreement* (*AEWA*).

The lake Paliastomi may be considered as an active geological site where geochemical and biological processes occur.

The lake Paliastomi is included in the Kolkheti National Park, with a total area of 44599.8 hectares. Area of Paliastomi Lake Area - 18 km^2 Water volume - 40 million m^3, medium depth - 2.2 m.

In the Kolkheti National Park and its surroundings is described as 300 species and 91 species of Javakheti species, half of which are migratory species [2].

During the existence of the lake Paliastomi, 3 stages of development have passed. In the the beginning, it had its cobbled form; at the next stage, it was slaughtered and completely wiped out and the lake appeared on the swamp site at the end of the modern stage.

The turbulence of the horizontal views of the other bridge (lake, lagoon, swamp and sea origin) of the Lake Paliastomi 12-15 m depth indicates that the lake has been undergone sea breeze, lagoon, freshwater lake and mud [3].

Since the lake on the coastline near the mirror almost sea level layout and given the lake basin at different times from each other severe different ponds and wetlands in existence, can be concluded that Lake Paliastomi formation-development, its water active together with the balance, mainly due to the average sea-level change, which is going on simultaneously in the ocean level.

The horizons of different types of shapes in the vertical geological cloth under the Lake Paliastomi indicate suspiciously that the sediments of the aforementioned sediments were carried out in different physical-geographical environments. Special attention is attributed to the fact that the horizons of these precipitations are depressed, and in terms of depth and transient extensions, and is continuous horizons.

The location of the lake Paliastomi near the coastline and its insignificant depth gives a reason to suggest that one of the causes of different types of rainfall under the lake is the medium-sized variation of the Black Sea.

Such an opinion is based on the following grounds. Even the sea level 1-2 m would be enough to completely lower the low dunes built by the lake in the lake, in such a way the sea would be connected to the lake and the latter's water will occupy the sea bay.

Since the Ramsar Convention states that wetland areas have fundamental ecological functions, it is necessary to develop possible mechanisms for harmonizing bacterial and chemical imbalances from anthropogenic geochemical and biological processes on these objects.

According to the World Health Organization (WHO), 844 million people lack even a basic drinking-water service, including 159 million people who are dependent on surface water [4].

Pollutants with water pathogens are contaminated and their diseases are a major problem in today's world. One of the main goals of sustainable development is the improvement of water quality.

Management of bacterial pollution of water bodies of international importance must meet the requirements of international, regional and national requirements. EU-Georgia Association Agreement sets out requirements on integrated approach for the management of water bodies [5].

Accordingly will be required to make: review of existing sanitary biological research of flowing waters; definition of dynamics of background sanitary-microbial indicators; study of biological characteristics of secreted pathogenic agents; study the spreading and die off pathogen organisms in relation to physical-chemical factors like light, salinity, temperature, sedimentation rates etc [5].

Therefore, the study and modeling of pathogenic bacteria on the ecological condition of the Paliastomi Lake, the modeling and prevention of prevention measures, is a very important and ambitious problem.

REFERENCES

1. Factors of influence of chemical composition on water. Copyright © 2009-2010 all-about –water.ru; c.1-21(in Russian).
2. G.Abramia, L. Gverdsiteli, D. Eristavi, Description of ecosystem of Lake Paliastomi. Georgian Technical University, Proceedings of Georgian National Academy of Sciences, ISSN -0132-6074, 2017 (in Georgian).
3. G.D. Supatashvili Hydrochemistry in Georgia (fresh water). Tbilisi, Tbilisi University Edition, 2003. pg. 399 (in Georgian).
4. Drinking-water fact sheet updated July 2017 (in English) http://www.who.int/mediacentre/factsheets/fs391/en/
5. Abramia G., Golijashvili A., Rigvava S., Natidze M., Japarashvili N., et al. "Bacteriophages against Antibiotic Resistant Salmonella Bacteria for the Possible Prevention and Treatment of Birds and Clean Up of their Water Habitats. J Vet Sci Technol" 7: 395. doi: 10.4172/2157-7579.1000395, 2016 (in English).

THE LITHOSPHERE OF THE CAUCASUS: TECTONIC ZONALITY AND EVOLUTION

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Tectonic setting and Phanerozoic evolution of Georgia and the Caucasus are determined by its position between the still-converging Eurasian and Africa-Arabian plates at the junction of the European and Asian branches of the Alpine-Himalayan belt. During the Late Proterozoic – Early Cenozoic, the region belonged to the Tethys Ocean and its Eurasian and Africa-Arabian margins where there existed a system of island arcs, intra-arc and back-arc basins characteristic of the pre-collision stage of the evolution of the region.

The tectonic heterogeneity of the Alpine-Himalayan orogenic belt, including the Caucasian region, is caused by anisotropism of its lithosphere, i.e. by the presence of "stable" and "unstable" (mobile) zones (E. Suess). Based on the heterogeneity of the lithosphere, French researcher Fournier identified within the territory of Georgia the following units: 1. mobile zones of the Cavcasioni and Lesser Cavcasioni (Anticavcasioni) separated by Transcaucasian stable area. At the beginning of the last century, the mentioned approach was realized for tectonic zoning of the Caucasus [4; 2] and the followers of Janelidze (Kakhadze; Rubinshtein; P. Gamkrelidze), although, later on, because of total obsession with tectonic specification, these principles were messed up.

According to the theory of lithospheric plates, the Caucasus represents a collage of Eurasiatic, Tethyan, Africa-Arabian plates and microplates of this region [3; 1]. Existing data allow to divide the Caucasian region into two large-scale geological provinces: southern Tethyan and northern Tethyan located to the south and north of the Sevan-Akera ophiolite suture, respectively. The Caucasus is divided into several main tectonic units (MTU). Several platform (sub-platform, quazi-platform) and fold-thrust (from north to south) units are distinguished here. They represent: the Scythian (pre-Caucasus) young platform; fold-thrust mountain belt of the Cavcasioni including the Fore Range, Main Range and Southern Slope zones; the Transcaucasian intermontane lowland (Rioni and Kura forelands) superimposed mainly on the rigid platform zones (Georgian and Artvin-Bolnisi blocks); the Achara-Trialeti and Talysh fold-thrust mountain belts; the Loki (Somkhit)-Garabagh-Kaphan mountain belt; the Sevan-Akeraophiolitic suture; the Lesser Caucasian part of the Taurus-Anatolia-Central Iranian platform and the Aras intermontane lowland. The youngest structural unit of the region is composed of Neogene-Quaternary continental volcanic formations of the Armenian and Javakheti plateaus (highlands) and extinct volcanoes of the Cavcasioni. Only some of MTU are present in Georgia: the Cavcasioni and Achara-Trialeti fold-thrust mountain belts; the Rioni and Kura intermontane depressions-forelands; the northern Transcaucasian (Georgian) Block; the southern Transcaucasian Artvin-Bolnisi Block and the Loki-Garabagh mountain belt; the Javakheti and Keli-Kazbegui volcanic highlands with extinct volcanoes.

The Georgian part of the regional lithosphere is mainly north - Tethyan, partly – Gondwanian, particularly the oldest tectono-stratigraphic unit-MTU (structural stage) of the granite-gneiss basement. Neoproterozoic-Paleozoic basement, represented by regional deep metamorphic complexes, outcrops within the Main Range Zone in the form of basement salients (Sofia, Teberda-Digori, and Shkhara-Adaikhokhi salients separated from each other by Jurassic sediments of the Arkhiz-Klichi and Shtulu-Kharesk depressions); the basement of the Transcaucasian intermontane depression (the Dzirula, Khrami and Loki salientswithin the Georgian and Artvin-Bolnisi Blocks) includes rock complexes characteristic of both continental and oceanic lithospheres: the Makera and Gondarai complexes of the Main Range Zone of the Cavcasioniare continental and the Laba-Buulgen complexes are oceanic; within the Dzirula salient: the Dzirula complex- continental and Chorchana-Utslevi tectonic mélange – oceanic; within the Khrami salient: the Khrami complex is continental;within the Loki salient: the Loki complex – continental and Lokjandari – oceanic. Both zones include Hercynian and even older (Caledonian) rock complexes (Tectono-Stratigraphic Units -TSU). Geochronological dating has shown Neoproterozoic-Paleozoic age for the part of the basement. The basement salientswere folded together with Paleozoic and Mesozoic sedimentary cover (thick-skinned deformations).

Facial and formational characteristics of pre-collision sedimentary cover arealso stipulated by alternation of lithospheric stable and unstable units in space and time. Hercynian and pre-Hercynian basement within the Main Range Zone of the Cavcasioni back-arc basin is covered by Upper Paleozoic marine molassa (for example, Kvishi suite in Georgia), and thick sediments of black slates and terrigenous turbidites with Pliensbachian and Toarcian basalts of Middle Oceanic Ridge-type (Southern Slope Zone). Within the Southern Slope Zone, the oldest stage of the sedimentary cover is Devonian-Triassic strata (Dizi series and its analogues). The uppermost TSU of pre-collision stage is composed of Jurassic-Eocene carbonate and terrigenous turbidites developed within en echelon-arranged eastern and western flysch synclinoriums. The basement salients and pre-collision sediments are strongly folded together (thick-skinned folding). Pre-collision TSU is moderately folded within the Achara-Trialeti belt, in which the sediments according to their formational features form the Guria-Imereti, Achara-Kartli and Trialeti subzones.

Paleozoic, Mesozoic and Early Cenozoic strata of the Georgian and Artvin-Bolnisi Blocks are weakly folded, they include shallow marine and subaerialfacies. Postcollisional TSU (Oligocene-Neogene-Pleistocene) represented within the Transcaucasian intermontane depression as result of topographic inversion of the Cavcasioni and Lesser Cavcasioni is widespread within the Rioni and Kura forelands, and in partly separated basins (Guria, Racha-Lechkhumi, Alazani), characteristic features of this unit are thin-skinned tectonic deformations of shallow marine and subaerialmolasses.

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REFERENCES

1. Adamia, Sh. Plate tectonics and evolution of the Alpine system: Discussion: Geological Society of America Bulletin, v. 86, 1975, p. 719-720,
   doi:10.1130/0016-663 7606(1975)86<719:PTATEO>2.0.CO;2.
2. Janelidze, A. The Problem of Georgian Block. Proceedings of Academy of Sciences of GSSR, v, 3, №1-2, 1942, pp. 49-58 (in Russian).
3. Khain, V. Structure and main stages in the tectono-magmatic development of the Caucasus: An attempt at geodynamic interpretation: American Journal of Science, no. 275-A, 1975, pp. 131-156.
4. Rentgarten V. General overview of the Tectonics of the Caucasus. International Geological Congress, Proceedings of XVII session in the USSR, 1937, v, II (in Russian).

NOMENCLATURE, CLASSIFICATION SCHEMES AND METAMORPHIC GRADE OF SANDSTONES AND FINE-GRAINED SEDIMENTARY ROCKS OF THE KAZBEGI-OMALO REGION JURASSIC TERRIGENOUS COMPLEX

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Between the tectonic setting of the sediment source area, the characteristics of the depositional basin, and the kinds of sedimentary rocks that accumulate in the basins exists a close relationship. Therefore, understanding of the relationship between sedimentary rock characteristics and depositional processes is essential for interpretation of sediment source areas (province), paleogeography and paleoenvironments. The example of the Kazbegi-Omalo region shows the possibility of interpreting the sedimentary environment based on the schemes of the sandstone classification and the results of chemical analysis.

In the literature, there is a plethora of names for fine-grained sedimentary rocks – argillaceous, argillite, clay, claystone, dust, hydrolysate, loam, lutite, ooze, marl, micrite, micstone, mud, mudrock, mudstone, pelite, phyllite, physilite, silt, siltite, siltstone, slate, wacke, and of course, the ubiquitous term, shale.

Various terms are in common use and have been adopted by geologists, but due to the lack of standardization, the terms often mean different things to different people. The problem become complicated when somebody tries to compare the widely used English terms with the traditional meaning established in the other linguistic world, but it is necessary to overcome these difficulties. Even something as seemingly simple as defining the upper size limit of clay is fraught with difficulty due to its duplicitous nature. Somebody defined the clay/silt boundary at 1 micron, a value, which is commonly used today by colloid chemists as determining clay-sized materials. The upper size limit for clay should be 2 microns, a value that is widely accepted today in Europe [1]. The generally accepted value most commonly used, most particularly of North America, place the division between silt and clay grade at 1/256mm or 3.9 microns.

Any undertaking of a study on fine grained sedimentary rocks will ultimately involve the classification and naming of the materials in question. The difficulty in classifying fine grained sedimentary materials in part due to the confusion surrounding the used, or more simply due to the fact that they are geological materials formed from a complex mixture of many different properties that could be used for classification purposes [2].

Currently only one, two or three fine-grained sedimentary rock properties are ever chosen for classification. Historically, classifications of fine-grained sediments and sedimentary rocks have been based on the limited combinations of several main, perhaps considered by some to be fundamental, properties, which include:1) Texture (particle size); 2) Degree of induration; 3) Stratification; 4) Fissility; 5) Chemical composition; 6) Clay mineralogy; 7) Mineral composition; 8) Tectonic association; 9) Environment of deposition.The first seven criteria have commonly been used in descriptive classifications, whereas the final two criteria are of use in genetic classification systems.

The brief summaries of the various classification schemes are used to illustrate the highly vacillating, and sometimes recondite, nature of fine grained rock classification.

Ideally any classification should be comprehensive, scientifically sound, unambiguous, practically oriented, easy to use and avoids unclear, undefined terminology. The advantages of such a classification are the standardization in the reporting of results and their effective communication between users. That particle size is the most important parameter to be used for describing and classifying argillaceous rocks. Therefore, the classification scheme proposed here subdivides argillaceous rocks into subclasses of siltstone, mudstone or claystone, based upon the following particle size definitions and proportions.

Key to successful exploration of shale reservoirs is targeting intervals with superior reservoir and completion quality. However, these so-called shales are more than just fine-grained sedimentary rocks with a high content of organic matter. More precisely these organic mudstones are typically a complex mineralogical assemblage that is heterogeneous at fine vertical scales. In addition to identifying optimal intervals in terms of reservoir and completion quality, operators need a mineralogy-based classification to understand better depositional conditions and correlate reservoirs across different fields and basins. Shale facies are readily and automatically identified using the sCore lithofacies classification scheme. The sCore classification is based on mineralogical relationships within a ternary diagram customized for organic mudstone lithology to determine both lithofacies and reservoir and completion quality indicators [3].

In many common rocks, such as 'normal' marine pelites, no diagnostic minerals and mineral assemblages form in the very low-grade field. In these rocks, the transitions from non-metamorphic to very low-grade and from very low-grade to low-grade metamorphic domains take place through the diagenetic zone, the anchizone and the epizone, each zone being characterized by specific values of the illite Kübler index (KI), which is measured on the <2 μm fraction of clay-rich clastic rocks following the recommendations on sample preparation [4].

Diagenesis, catagenesis, metagenesis terms used to indicate maturation stage of organic material and based on vitrinite reflectance index R_o% are discussed, also the terms for very low-grade and low-grade metamorphic rocks recommended and not recommended for international use.

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REFERENCES

1. ISO (International Organization for Standardization). *EN ISO 14689-1:2003, Geotechnical investigation and testing. Identification and classification of rock - Part 1: Identification and Description.* ISO, Geneva, Switzerland. vol.25, no.4, 2003.
2. Wilkins A.D. Terminology and the Classification of Fine Grained Sedimentary Rocks, 2013.
3. K.S. Glaser C.K. Miller G.M. Johnson W.D. Pennington. Seeking the Sweet Spot: Reservoir and Completion Quality in Organic Shales. Oilfield Review Winter 2013/2014: vol.25, no.4
4. Árkai1 Péter, Sassi, Francesco P., Jacqueline Desmons.Very Low-grade to Low-grade Metamorphic Rocks. Recommendations by the IUGS Sub-commission on the Systematics of Metamorphic Rocks, 2003.

THE NEWEST DATA ABOUT THE MUSHURISTSKALI GOLD OCCURRENCE (UPPER SVANETI)

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Distribution regularities of Upper Svaneti gold mineralization are conditioned by the combination of metalorganic, structural and magmatic factors. Gold occurrences are distinguished by mineral composition diversity, grade of metamorphism and deformation of mineralization hosting environment, types of mineralization hosting fold and fractures structures, the morphology of ore bodies, composition of ore bodies and adjacent metasomatites and etc [1].

Resulted of the field works, there were taken more than 50 samples, from ore bearing rocks and from quartz veins, which of them only 18 sample were analyzed. The analysis were carried out in Izmir (Turkey) at the laboratory ALS Chemexusing ICP methods.

The study area is characterized with difficult geological constriction. Jurassic formations and various types of rupture dislocations are exposes within its properties. Geological occurrences characteristics were made great impact by their activity. Short geological description of the rocks is given bellow.

Lower Jurassic sediments are presented by Muashi stage, which is built with aspide and clayey shales, quartz sandstones. Toarsian stage is presented by lower Sori substage, which is constructed with sandstones and clayey shales. In building of Bayosian and Bathonian stages are participates clay-sandy shales and arkose sandstones. Upper Jurassic sediments is presented by Callovian and Oxfordian stages, shales, marls, marlish shales and limestones are participates in their constraction. It should be noted, that Jurassic sediments are crossed by albitophire veins of the Northern-Western direction.

As mentioned above, Jurassic thin-layered sandstones and aspide shales rows participates in the working district construction. “Black shales” thick series of thin-layered structure and saturated with organic substances is stated between sediments [2]. In the mentioned district, conducted searching works of gold deposits on the left banks basin of the Enguri river is determined, that gold mineralization is related to intense developed zones of small disjunctives, which are accompanying of general Caucasian trend deep faults. Stratigraphically the mineralization is controlled with Toarcian carboniferous black shales suite. Gold occurrences and mineralized areas are located at clay-sandstones thick rows, these mica-quartz sandstones are thin-layered, finegrained, dark gray and black and saturated with sulfides.

Quaternary sediments are presented by two age group: Old Quaternary – glacial sediments are survived at the watershed ridges, New Quaternary – alluvial, deluvial-proluvial, deluvial and deluvial-eluvial sediments. All of these sediments, except for glacial, are collectors of placer gold [3, 4].

Studies conducted by us confirms, that general Caucasian trend fault structures have certain rolefor searching gold occurrences. Pre-mineralization fault structures should be noted as well. Subsidence or uplift of some blocks along these structures indicates presence of favorable conditions for mineralization.

As conducted works and available data shows, gold occurrences related to sedimentary rocks, haven’t great scales and are represented commonlyby quartz-gold-sulfide association of vein facies.

REFERENCES

1. Benashvili K. Stuctural-Geological Position and Perspectives of the Upper Svaneti Gold Occurences. PhD. 2017 (in Georgian).
2. Turmanidze O., Dekanoidze V. The Report about searching of Gold Occurrences allocated to the black shales rows strip left bank in basin of the Enguri river. According to conducted works in 1980-1983 years. Tbilisi (in Georgian).
3. Okrostsvaridze, A. Bluashvili; D. Mythical “Gold Sands” of Svaneti (Greater Caucasus, Georgia): Geological Reality and Gold Mining Artifacts. Bull. Georg. Acad. Sci, vol. 4 N 2. 2010.
4. Okrostsvaridze A. Bluashvili D. Gagnidze N. Field investigation of the mythical “Gold Sands” of the ancient Colchis Kingdom and modern discussion on the Argo-nauts’ expedition; Episodes, Published by the International Union of Geological Sciences June Vol.37, No2. 2014. pp. 147-155.

DISTRIBUTION OF RADIOACTIVE ELEMENTS IN THE PRE-ALPINE ROCKS OF THE DZIRULA CRYSTALLINE MASSIF AND THEIR ECOLOGICAL SIGNIFICANCE

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The study of radioactive elements in crystalline rocks is of great importance. Their qualitative and quantitative determination enables us to comprehend petrochemical, metallogenic, geochemical and ecological issues of containing rocks.

The abstract is based on quantitative radiochemical determinations of uranium and thorium accomplished in 60 samples of crystalline rocks from the Dzirula massif.

Average values obtained during the analyses are given below:

1. In the Precambrian crystalline schists and paragneisses is recorded U – 1.6-7.07 g/t and Th – 7.10-19.20 g/t; in quartz-dioritic orthogneisses and plagioaplites U – 1.7-5.26 g/t, Th – 10.58 -12.67 g/t; in microclinized quartz diorites, granodiorites and tonalities U – 1.20-5.92 g/t, Th – 10.15-18.0 g/t, in Late Variscan potassium-bearing granites – in porphyry-like and equigranular granites, aplites and pegmatites of the Rkvia intrusive U – 2.25 - 6.04 g/t, Th – 11.05-13.35 g/t.
2. Among the determined rocks comparatively high content of Uranium and Thorium is characteristic of the Precambrian crystalline schists and paragneisses, microclinized pre-Variscan formations and Late Variscan K-feldspar bearing granites. Content of radioactive elements in these rocks is likely to be connected not only with the high values of potassium but also with the content of accessory minerals - zircon and monazite.

3. The above presented average data of distribution of radioactive elements in the studied rocks are almost consistent with average values of uranium and thorium presented in recently published manuals [1, 2].
4. It is noteworthy that in the 80-ies of the last century, during the Soviet period, the military organization had a certain interest in studying a high content of radioactive elements in the Dzirula Massif from view point of opening the Uranium deposit. That's why from this position rather detailed investtigations were carried out. The data obtained during these investigations were never published and are still unavailable.

Radiation measurements of the last years have confirmed presence of high radiation background within the limits of the Dzirula Massif. Due to the fact that the Dzuril massif is located in the central, rather populated part of Georgia, in the future we consider it necessary to conduct a detailed ecological study of this territory from the radiation point of view, in order to determine the effect of radiation on the local population health.

REFERENCES

1. Efremova S.V., Stafeev K.G., Petrochemical methods of Investigation of rocks. Reference Manual. M., "Nedra", 1985, pp. 570-573.
2. Soloviov A.P., Arkhipov A. Ya., Bugrov V.A. et al. A Manual on Geochemical Searches of Useful Minerals. M., "Nedra", 1990, pp. 20-22.

QUARTZ IN MKINVARTSVERI (KAZBEGI) QUATERNARY LAVAS

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The Mkinvartsveri (Kazbegi) volcano is located on the eastern termination of the latitudinally extended Khokhi ridge and is associated with one of the strongest manifestations of post-collisional volcanism in Georgia.

Volcanic activity of Mkinvartsveri (Kazbegi) began in the Middle Pleistocene (450 ka), further continued with long eruptive hiatuses and its last manifestation in the Middle Holocene. Four phases of volcanic activity are distinguished: I – 460-380 ka, II – 310-200 ka, III – 130-90 ka and IV – less than 50 ka. Besides, in the II and III phases, early and late stages have been established [3, 4].

Erupted lavas moved down the slope towards the Tergi river valley and its left tributaries, filling their radially disposed paleo-gorges and forming the lava flows of different length and thickness. The composition of lava flows varies from basaltic andesites and basaltic trachyandesites to dacites with predominance of andesitic and dacitic composition of lavas. The chemistry of lavas shows content of SiO_2 – 53.8-68.0 wt. %, (Na_2O + K_2O) – 5.1-6.0 wt. %, K_2O – 1.4-2.4 wt. %, MgO – 1.5-6.0 wt. %. Almost all lavas belong to calc-alkaline series; they are mildly-potassic according to their K_2O/SiO_2 ratios. The lavas are generally characterized by a low Mg# (0.29-0.48) [4].

In color the volcanic rocks vary from black, dark and light gray, pink-gray to pink and reddish pink, or mixed gray-pink. Sharp or gradual color transitions are common for them. The rocks have a massive structure and a porphyritic texture. The lavas contain 10-15 to 50-60 vol. % phenocrysts on average mainly introduced by large plagioclase laths.

Common phenocrysts association for all types of volcanic rocks are *Pl*, *Opx*, *Amp* and *Qz*. Lavas of basic composition (rarely of medium composition) also comprise *Ol*, whereas dacites contain *Bt*. Plagioclase prevails in volume among other phenocrysts.

Quartz that formed in dacites belongs to equilibrium associations, however in basaltic andesites and andesites it is considered as a xenocryst - an interesting subject for investtigation [1, 2, 5]. Quartz xenocrysts are also observed in the basaltic andesite and andesite lava flows of the Mkinvartsveri. Found in the Chkheri lava flow 2x3 cm quartz xenolith confirms the xenolithic origin of quartz (Fig. 1). Apparently it was incorporated into the magmatic melt during its ascent. Although the source of quartz xenoliths requires further specification.

Fig.1. Quartz xenolith in the Chkheri lava flow.

In lavas quartz xenocrysts are found in small quantities and mostly as fritted grains 0.4-2 mm in size with or without reaction rims. Reaction products (corona) are present at the contact of quartz xenocrysts with the host-rock. The formation of Cpx (augite) corona begins by development of fine microlitic rims around the xenocrysts edges. In some cases quartz grains are directly overgrown by pyroxene and sometimes volcanic glass occurs between them.

Further growth of the corona goes on more or less radially from the surface of the quartz grains. In the studied thin sections all stages reflecting the mentioned process are observed (Fig. 2), including radial-rayed aggregates of Cpx microcrystals already lacking quartz core.

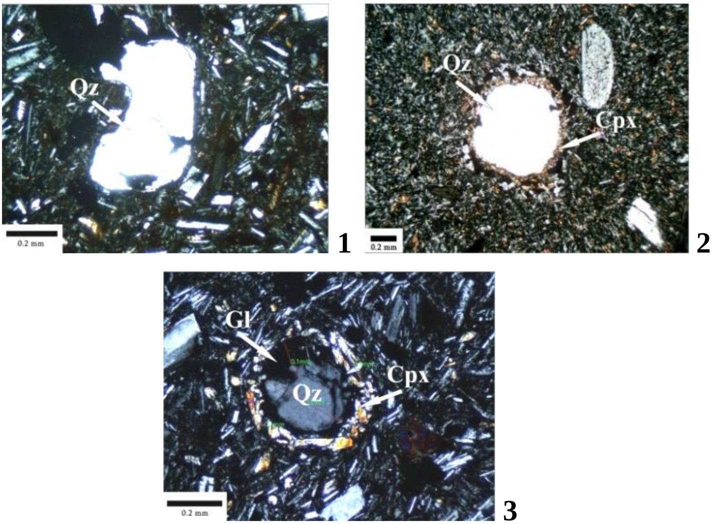

Fig. 2. Quartz xenocrysts photomicrographs: 1 – without a reaction rim, (10×10 μm); 2 – with a thin rim of clinopyroxene, (10×4 μm); 3 – with a reaction corona of Cpx and volcanic glass rim between quartz and Cpx, (10×10μm).

The reaction corona texture reflects both the length of time between incorporation of the quartz xenocrysts and eruption, and the rate of post-eruptive lava cooling. The reaction process between the incorporated quartz and the melt are well-explained by diffusion-controlled corona reaction models.

REFERENCES

1. Bewick S., Deciphering the Tectonics of the Caucasus from Post-Collisional Volcanism. A PhD thesis Department of Environment, Earth and Ecosystems. The Open University, United Kingdom, 2016, 261 p.
2. Har Nicolae, Reaction coronas around quartz xenocrysts in the basaltic andesite from Detunata (Apuseni Mountains, Romania). Geologica Carpatica, 56, 4, 2005, pp. 369-378.
3. Lebedev V.A., Parfenov A.V., Vashakidze G.T., Chernishev I.V., Gabarashvili K.A. „Major Events in Evolution of the Kazbek Neovolcanic Center, Greater Caucasus: Isotope-Geochronological Data“, Doklady Earth Sciences, Vol. 458, Part 1, 2014, pp.1092-1098.
4. Lebedev V.A., Parfenov A.V. Vashakidze G.T., Gabarashvili Q.A., Chernyshev I.V., Togonidze M.G. – Chronology of Magmatic Activity and Petrologic-Mineralogical Characteristics of Lavas of Kazbek Quaternary Volcano, Greater Caucasus. Petrology. Vol. 26, №1, 2018, pp.1-28.
5. Sato H. Diffusion coronas around quartz xenocrysts in andesite and basalt from Tertiary Volcanic Region in Northeastern Shikoku, Japan. Contr. Mineral. Petrology 50, 1975, pp. 49-64.

NEW DATA ON GEOLOGY OF THE GOLD-COPPER DEPOSIT MUSHEVANI 2 (GEORGIA)

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The gold-copper deposit Mushevani 2 is located in the northwestern part of the Lesser Caucasus, in the Bolnisi ore district. It is located 4-5 kilometers north of the Madneuli Mining and Processing Plant and occupies the south-eastern slope of the 1026.6 m high mountain.

The upper part of the deposit is represented by Late Cretaceous vitro-lithoclastic, silicified with various intensity (in places the degree of silicification reaches the so-called secondary quartzites), baritized and oxidized tuffs of rhyodacite composition, yellowish-brown color. The average thickness of the oxidized part of the rocks, consisting mainly of iron hydroxides, is 30 m., its maximum thickness reaches 80 m.

Under the indicated tuffs, the host rocks of the deposit are represented by crystal-lithoclastic, psephitic, less often psammite tuffs, of the same rhyodacite composition, which, in addition to silicification, are largely argillized. Mineral association of argillisites is chlorite-sericite-mixed-layered hydromica-kaolinite-montmorillonite-quartz-pyrite. The rocks are of gray color. The thickness of these tuffs is variable and reaches 150-170 m.

Psephitic tuffs of similar composition, light green in color, are developed at the lower levels of the deposit. These rocks are propylitized that is expressed by the development of chlorite-(epidote)-albite-quartz-pyrite association. In some places they are dissected by veins of gypsum. The thickness of the horizon exceeds 200-250 m.

The rocks are characterized by tuff structure and breccia, ignimbrite-like, spotted texture.

The subvolcanic body of rhyodacite composition is fixed on the northern periphery of the deposit. In it, porphyry discharges are represented by albite and potassium feldspar, which are dispersed in the felsic bulk.

The deposit flanks are covered with loamy deluvial formations, whose thickness reaches 22-24 m, and on the average is 5 m.

The Mushevani 2 deposit is located in a monoclinic structure. The structure of the deposit and the conditions for the localization of ores are largely determined by pre-ore north-eastern, northwestern, sub-latitudinal and near-meridional disjunctive structures. These are the zones of crushing and argillization and associated systems of shearing and tearing cracks. Fracture cavities, interformational spaces are allocating ore. Discontinuous structures in the post-ore period, with subsequent tectonic activation, probably rejuvenated repeatedly, but without significant disturbances and the displacement of rocks and ores.

At the upper hypsometric levels of the Mushevani deposit, poor barite mineralization is developed in the form of metasomatic tabular accumulations, inclusions of their aggregates, veinlets and phenocrysts. Quartz, gold, malachite, azurite, chalcopyrite mineralization replaced the barite mineralization. At a depth, the concentration of barite gradually decreases, and the intensity of mineralization of gold and copper increases. Thus, in the Mushevani 2 deposit, gold-copper low-sulfide non-oxidized and gold-copper low-sulfide partially oxidized (mixed) industrial types of ores are established. At the same time, a significant part of the deposit is composed of gold-copper low-sulfidation non-oxidized ores. The boundary between oxidized and non-oxidized ores is not clear.

The ore-bearing zone consists of the main and several sub-parallel, echelon, relatively small-scale lenticular bodies, with vein-disseminated mineralization. The ore bearing veinlets are of small extent; the thickness of the veinlets rarely exceeds 1 cm. The upper part of the main ore body consists of gold-copper partially oxidized (mixed) ores, and the lower part - a significant (in terms of its parameters) part of it - from gold-copper non-oxidized ores. Small lenticular accumulations of ores, sometimes located in the oxidation zone, in some places - lower, in the non-oxidized zone. The ore-bearing zone dips into southeastern rhumbs (with the dip azimuth from 120^0 to 140^0, the average azimuth of dip is 132^0), at angles from 20^0 to 60^0. The average angle of dip is about 40^0. Ore bodies are characterized by pinching-out both along the strike and down dip.

A deposit according to a set of characteristics, such as: a complex of volcanogenic host rocks, facies (mid-low-temperature) of the circum-ore metasomatites, the nature of mineral zonality, ore mineral association and their structural and texture features, the morphostructure of ore bodies, etc., indicate the epithermal genesis of the Mushevani deposit.

According to the complexity of the geological structure, the deposit belongs to Group III.

U-PB DATING OF ZONAL ZIRCONS FROM THE CRYSTALLINE ROCKS OF THE GONDARAI COMPLEX OF THE GREATER CAUCASIAN MAIN RANGE ZONE (GREATER CAUCASIAN TERRANE)

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The Greater Caucasian terrane in present-day structure corresponds to the Main Range zone of the Greater Caucasus. It is divided into two sub-zones: the Pass sub-zone and the Elbrus sub-zone that by their constituent rocks composition, character of metamorphism and genetic types of magmatites quite differ from each other.

The Elbrus sub-zone can be divided into two units: infrastructure (autochthone Gondarai complex) and suprastructure (allochthone Macera nappe) [1].Unstratified infrastructure (Gondarai complex) is represented by the rocks of a high degree of metamorphism. Here, Pre-Variscan ortho- and paragneisses and migmatites and porphyroblastic and varigrained granitoids occur. Considerable role in the structure of the infrastructure play massifs of biotite granodiorite gneisses (in the interpretation of some researchers - orthogneisses). Host rocks of granodiorite gneisses are crystal schists, amphibolites, gneisses and migmatites, regionally metamorphosed in high temperature amphibolites and subgranulite facies conditions [1]. It should be specially emphasized that the granodiorite gneisses contain xenoliths, most likely of deformed plagiomigmatites, biotitized amphibolites and crystal schists of Cadomian age. Orthogneisses belong to I type granites. In their formation besides the upper crustal formations, the rocks of the simatic crust also partially participated [1]. The latest stage of development reflects formation of Late Variscan porphyroblastic and equigranular potassium granites and connected with them regional metamorphism. The regional metamorphism has retrograde character. On the basis of geological data two stages of regional metamorphism - the Pre-Variscan high grade amphibolite and subgranulite facies (T-650-750 °C, P-3 kbar) and the Variscan – epidote-amphibolite and greenschistfacies (T <430 C, P <1.5 kbar) are established [1].

U-Pb zircon ages determination at the National Chung-Cheng University of Taiwan were conducted. In the Gondarai metamorphic complex bothxenocrysts of detrital zircons, introduced from outside, and zircons formed within the Greater Caucasus are established. Judging from the fact that south of the Greater Caucasus in Neoproterozoic and Paleozoic time large oceanic of the Prototethys was located, detrital zircon could have come only from the north – from the Eurasian continent. All zircons older than 650Ma (beginning of the Cadomian orogeny) we referred to detrital zircons as according to geological data traces of endogenic processes older than those associated with the Cadomian orogeny within the Greater Caucasus are not found. The age of detrital zircons varies in the range of 2981- 724 Ma. It is noteworthy that rather often detrital zircons evidently being already located in the Greater Caucasus, with younger rims, including rims of Cadomian age are overgrown. Among in situ zircons in different zones of zonal crystals three age groups are recorded. Their generation by endogenic processes (regional metamorphism and granitoid magmatism) is conditioned. The first age group (653-513 Ma) indicates a manifestation of presumable high temperature Cadomian regional metamorphism, indicator of which is probably the paragenesises established in the Gondarai complex [3, 4] and granitoid magmatism. In the group 22 figures were obtainned from metamorphic and 14 from magmatic rocks. Earlier by

D. Shengelia et al. [2] from zircon grains of Dariali granitoid massif by U-Pb LA-ICP-MS dating also Cadomian age group was revealed. The second age group (505-367 Ma) corresponds to the Caledonian prograde regional metamorphism (T=650-700°C, P≈3Kbar) and formation of orthogneisses. Caledonian ages were obtained also in both metamorphic (37 figures) and magmatic (81 figures) rocks. The last - third age group (362-297 Ma) reflects the formation of Variscan equigranular and porphiroblastic potassium granites and connected with them retrograde regional metamorphism (T<430°C, P<1,5Kbar). From metamorphic rocks 4 figures and from magmatic rocks 64 figures were obtained. As noted above the existence of several stages of regional metamorphism in the Elbrus subzone is corroborated by geological data as well. The manifestation of Cadomian metamorphism processes within the Gondarai complex of the Greater Caucasus confirms the opinion about Neoproterozoic age of parent rocks of the complex as a whole. Cadomian metamorphic zircons in magmatic rocks are evidently incorporated by granitoid magma during the Caledonian and Variscan orogenies.

REFERENCES

1. Gamkrelidze I., Shengelia D. Precambrian-Paleozoic Regional Metamorphism, Granitoid Magmatism and Geodynamics of the Caucasus. “Nauchni Mir”, Moscow, 2005, 479 p. (in Russian).
2. Shengelia D., Tsutsunava T., Chichinadze G., Beridze G. Some Questions on Structure, Variscan Regional Metamorphism and Granitoid Magmatism of the Caucasian Terrane crystallinecum. Bull. of Georgian Nat. Acad. of Sci. V.8, №3. 2014. pp. 56-63.
3. Baeanov G.I., Kropachev S.M. Stratigraphy, Magmatism and Tectonics of the Greater Caucasus at the Precambriam amd Paleozoic Stages of Development. In: Geology of the Greater Caucasus. M.: Nedra, 1976, pp.45-154.
4. Shengelia D. M. Granulitic Facies of the Greater Caucasus. Bull. Acad. Sci. SSSR, series geology 7, 1968, pp. 23-33.

PROBLEMS OF PREDICTION OF GOLD MINERALIZATION

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Georgia is a gold-mining and processing country. Since 1976 up to date the Madneuli Ore-Dressing and Processing Enterprise has been actively working in the Bolnisi ore-bearing region. At present two gold ore deposits – Madneuli and Sakdrisi – are being exploited; two more deposits are getting prepared for development – Bneli Khevi and Beqtakari; about ten more units are at various stages of research.

Besides the Bolnisi ore-bearing region gold ore manifestations are known in all the ore-bearing regions of Georgia: Svaneti, Achara-Guria, Dzama-Gujareti and Kakheti. The types of their gold-bearing ores significantly differ and make problems when predicting them. Creation of trustworthy methods of quantitative assessment of gold mineralization of certain ore-bearing units, in spite of the available mathematical statistics and electronic data processing in recent years, is still far from the final solving of the problem for the complex processes of ore-forming, the role and mechanism of the impact of lithologic, structural and magmatic factors are insufficiently studied.

Lithologic factors - the mechanism of impact of country rocks on the process of ore formation is various. They appear to be: 1 - a source of full or partial ore load of hydrotherms; 2 - a source of substance for vein minerals of the ore; 3 - environment that can cause ore accumulation and change ore composition due to chemical interaction with the ore-bearing rock; 4 - environment with particular absorptive properties impacting on the ore formation; 5 - favorable (or unfavorable) environment for structural trap provided by a certain combination of physiccal and mechanical properties of rocks composing ore-bearing fields.

Structural factors of gold mineralization – structural researches cover mainly the upper part of ore-bearing-magmatic systems of vertical strike. The structures of middle and lower parts of such systems, the conditions of formation and movement of ore-bearing solutions in the zone of ore accumulation, forms and volumes of collectors of ore-bearing solutions and many other parameters are comparatively less studied.

Magmatic factors are of primary importance in the process of mineralization but, on the other hand, the considerations about the role of magmatism in formation of gold deposits are mutually exclusive.

For today, various considerations on the origin of gold deposits according to the source of substance and assessment of the role of magmatic processes are divided into several groups differing from each other: 1 - magma differentiation; 2 - the subcrustal origin of magma and hydrotherms; 3 - the hypothermal convection or recycling; 4 - origin of gold-containing solutions during granitization of rocks and regional metamorphism.

Consequently, at present the possibility of quantitative prediction is limited due to the insufficient understanding of ore forming mechanism, especially of the processes taking place at deep levels. Their study by the direct method is impossible and thus gold mineralization origin and the role of certain factors of distribution cannot be quantitatively assessed.

To meet the increased needs of the country in scarce raw materials, in accordance with the complex programs of scientific and technical progress, the integrated development of new units must be accelerated. For solution of the problem there have to be conducted profound and integrated scientific researches in order to study formation and distribution regularities of gold ores and gold-bearing deposits and to perfect the principles of prediction of gold mineralization.

The tendency to expansion the prospecting and prediction of ore deposits is caused on the one hand by the increasing demand for this metal in the world market and on the other hand by the necessity of development of scientific and research works of the first stage.

To increase the reliability of prediction of gold ore forming together with the available researches there must be conducted the following works:

1. Develop improved systematics of gold formation based on the principle of their compliance with geological formations
2. Experimental research of gold behavior during the processes of degassing of silicate solutions, crystallization and differrentiation
3. Experimental studies of changes in a wide range of compositions of solutions and rocks during their interaction under conditions of high temperature and pressure
4. Study of molten inclusions and gas components of igneous rocks for reconstruction of thermodynamic parameters of ore-containing magmatic system
5. Carrying out of massive definition of physical and mechanical properties of rocks from ore-bearing fields and deposits together with petro-physical and mineralogical researches.

REFERENCE

1. V. Geleishvili. Gold of Georgia, the thesis for a degree of the doctor of geological and mineralogical sciences, Tbilisi, 1990, 395 p.

FREE GOLD FORMS IN MAJOR DEPOSITS OF GEORGIA

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The geopolitical role in the world community is greatly conditioned by the mineral wealth of the respective territories and the availability of complex science-based means necessary to develop the resources and use them for national interests.

For the purpose of exploring new geological objects and upgrading of enhanced technologies, deep and integrated scientific researches have to be conducted to study formation and distribution regularities of gold ores and gold-bearing deposits and to perfect the principles of prediction of gold mineralization.

In this direction, native gold can solve important theoretical and practical tasks.

In the gold ore manifestations of Georgia native gold is a component part of certain paragenetic associations of ores in deposits of various formations. It bears the traces of endogenic and exogenic transformations. Variations in native gold characteristics are determined by the conditions of miner formation, and therefore they are often used as indicators. In particular, the size of a gold sample reflects changes in the physical-chemical conditions of formation of ores and varies within large limits.

At present gold-bearing mineral associations are of special practical significance; they generally contain gold in sulfides and hydrothermal metasomatites. These associations are especially well studied in gold deposits of the Bolnisi ore-bearing region where productive gold is a component part of “bluish” quartz that was formed at later stages of mineralization, filled up voids in broken down rocks and resulted in mineralization of veined and impregnated forms.

In polished sections, gold grains in open and closed voids of quartzite are observed.

In the oxidation zone dendrite-shaped forms of gold were found.

In polished sections free gold was found in sulfides, in their contact parts and ore adjacent hydromicas as well.

In quartz crystals syngenetic gold is rare; besides, gold occurring in the center of quartz takes forms of quartz crystals.

As a result of diagnostic etching gold grains can be found in the pyrite crystal voids.

By making artificial schlich sections and applying the scheme of deep enrichment it got possible to separate gold grains out of secondary quartzite ores.

Forms of gold grains and their raster drawings are well observed in scanning electron microscope.

REFERENCE

1. V. Geleishvili. Gold of Georgia, the thesis for a degree of the doctor of geological and mineralogical sciences, Tbilisi 1990, 395 p.

GEOLOGICAL-ENGINEERING ZONING OF CENTRAL COLCHIS SEASHORE

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Investigations showed, that by its geological development, the seashore zone is interconnected with the solid geological structures resulting from continental fragmentation.

Using the principle of neotectonic development, the central Colchis area has been identified, which undergoes absolute submergence. Maximal submergence (6 mm/year) has been recorded in Poti [1].

According to the lithodynamic principle, which depends on the coastal zone supply by terrigenous material, abrasion, and solid river sediments, the sub-areas have been identified, where recent geological processes have been intensified as a result of not only natural, but also anthropogenic factors.

According to the recent geologic events, some districts have been identified within the sub-area.

To protect the geological environment of the Colchis seashore zone, definite measures have been elaborated. One of the effective methods is the artificial reconstruction of the coastal zone and beaches natural profile using inert material as filler. It can be applied in the zones of intensive washouts.

Zoning Scheme

Principles of division			
Geological-structural	Neotectonic	Lithodynamic	Recent geological events
Geological-Engineering region	Geological-Engineering area	Sub-area	District
Region of the Caucasian intermountain trough	Central Colchis area undergoing absolute submergence	The Inguri- the Rioni north horn	The Inguri river mouth unstable zone - washouts
			The Khobi-Rioni stable zone
		The Rioni north horn -Poti town	Accumulation
		Poti town – the Supsa right "narionali"	"Narionali" - the Rioni river mouth Intensive washout
			The Rioni- the Supsa Pulsating washouts and accumulation processes

REFERENCES

1. Blagovolin N.S. – Morphostructures and Recent Earth Crust Vertical Motion. Coll. "Earth's Crust and History of Development of Black Sea Through". "Nauka" M. 1975 (in Russian).

ASSESSMENT OF THE LAYERED ROCK SLOPES STABILITY BY THE "SHEAR STRESSREDUCTION METHOD" ONTHEEXAMPLEOFRECONSTRUCTION OF THETSKNETI-SAMADLO ROAD

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Folded massifs built up of stratified clay shales, sandstones and other sedimentary rocks with layers of different thickness and different slope angle are widely spread in Georgia. The stabylity of the surface in such places can be easily broken in a result of the changing of existing profile for urban needs, under the influence of meteorological or seismic impact. Its example is the damaged roads in Tskneti and Akhaldaba during the disaster of 13 June 2015, landslides that occurred at different times and places.

There are many slopes of potential landslides in the city and in the suburbs of Tbilisi, where the unpredictable land works can be endangered. While designing large-scale infrastructural facilities (roads, large buildings, etc.) it is necessary to consider the stability of the surface of the earth after the possible change of its shape and natural balance.

The existing natural and man-made slope stability assessment methods in general provide the performance of the following works:

- Drafting of plan-sections of the existing land surface and design relief;
- Determination of quality of short and long-term stability necessary for object slope with consideration of its purpose, importance and operational conditions;
- Hydrometeorological and seismic characterization of the territory;

- Determination of the estimated coefficient of the seismic activity in the area;
- Establishing the mechanical parameters of the representtative samples of the rocks in dry and wet conditions;
- Determination of the structural weakening of the massif as a result of its decrepitation, atmospheric phenomena and with consideration of the factor of time;
- Calculation of the project objects stability and determining the optimal decision in technical-economical terms by meeting its operational requirements.

As of today, based on the consideration of the completeness, accuracy and practical easiness of estimating of these factors, the reare many methods developed for the stability of slopes. Inter alia, the recent method, which the experts is deemed [1] as“a new era in reporting on the stability of slope”, represents the combination of **Limit Equilibrium (LE), Shear Stress Reduction (SSR) and Finite Elements Methods (FEM).**

The following estimation is done by means of this method using the **“Phase2”** program of the **“Rockscience”** firm and with approach of the so-called removable contact stresses.

The project is drawn up by LEPL G. Tsulukidze Mining Institute based on the appeal of “Caucasus Road Project” LTD, the topographical survey (ACAD-2017-07-03 Topo.dwg), plan-sections of the slope parts of the damaged road, “Geoengineering” [2], U.S. Department of Agriculture [3], engineering and geological conclusions made by “Geological Service LTD” [4], Engineering-Geological Map Tskneti Landslide Disaster Area 2015 Sheet South – Samadlo Road Section [5], and other materials.

The analysis of the mentioned parts of the slope, the results of the conducted engineering and geological study, and the frequency and orientation of general and small size cracks show that this parts represent the combination of the stratified blocks of sandstones and clay-slates, which “escaped” the slip of rocks mass along with the nearby parts and lie so far on the surface of the basic rocks via the thin layer of argillites enriched with existing charcoaled vegetable detritus. The average cohesion and internal friction angle of this layer samples according to [5] could be C= 0.05Mpa and $\varphi=22.5^0$. These indexes could be more reduced to C= 0.01Mpa, $\varphi=22^0$ and even C= 0, $\varphi=20^0$as a result of moisture due to water seeping through the cracks and corners, and this layer can become a slippery surface blocks overlying the main rock mass. In such situation, the long-term stability practically can be reached using artificial supporting structures such as anchors or by removing potentially dangerous rock blocks.

As a result of the calculations, the number and parameters of anchors are determined, which are necessary for long-term stability of breakaway rock blocks over the road in extreme weather and seismic conditions. Forces for removal of the stone block at a dry and wet condition of a sliding surface if such decision is made are defined also.

The results obtained and the original shear stress reduction method of the slope stability calculation can be used for the similar stratigraphical landslide structures.

REFERENCES

1. **Rockscience. A New Era in Slope Stability Analysis: Shear Strength Reduction Finite Element Technique. Strength reduction. 2004.**
2. Engineering-geological investigations carried out under the Tskneti - Solmado Highway and the RoadReconstruction in Tiflis City. Engineering-geological investigations.
3. Engineering Geology Investigation of the June 2015 Jokhonikhevi “Big” Landslide, Tskneti – Akhaldaba Territory, Republic of Georgia. 17 May 2016.

4. U.S. Department of Agriculture Report - “Geological Service LTD“, 20.07.2017. pdf.
5. Engineering-Geological Map of Tskneti Landslide Disaster Area 2015 Sheet South - Samadlo Road Section. Baugeologisches Büro Bauer GmbHDomagkstr. 1a, D-80807 Muenchen – Germany, 08.12.2017.

ECOLOGICAL PROBLEMS OF LUKHUNI ARSENIC DEPOSIT AND THEIR ECONOMIC LOSS ASSESSMENT

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The toxic properties of arsenic and its compounds were known centuries ago. This substance is lethal for the human body. At different times, from the arsenic poisons were produced, which were often used as chemical weapons. Recently, the extraction and processing of arsenic in the world has been restricted due to its toxicity as the storage or utilization of the waste is a problem.

Arsenic ores were found in Georgia in 1929, in Racha – the Lukhuni and Svaneti-Tsana deposits. The production of ores began from 1932. The Urava concentrating complex was constructed, which stopped functioning in 1993.

At present in the vicinity of the plant about 100-110 thousand tons of arsenic containing substances (approximately 4-5 thousand tons of arsenic) occur as mainly burnt waste of sulphide ores and a very poisonous white arsenic precipitated from the air.

Approximately 20 % of the waste was scattered in the environment, and 80 % was kept in the sarcophagus and settlers for temporary storage. Already in 1982 this situation caused a high level of pollution of the region with arsenic, confirmed with complex study of arsenic content in soil and water samples in 2010-2012. Its content in the river Lukhunis-tskali and in bottom sediments reaches 10-12 mg/l, but the value of maximum concentration limit of this element does not exceed 2 mg/l. The high content of arsenic is characteristic also of agricultural soils of Oni, Ambrolauri and Tskaltubo districts, where the content of this element is about 60-70 mg/kg while maximum concentration limit in soils is 2-15 mg/kg.

In 2002-2012, the researchers conducted by us and other scientists showed that the wash-out speed was anomalously low, and in many places the contamination with arsenic is increasing, not decreasing. That's why we consider that improper way of waste storage has led to the creation of secondary sources of pollution. At present, all buildings and constructions in the Racha mining-chemical factory, industrial localities, acid water complex and in the Mephischala sarcophagus are destroyed or damaged. It is natural to consider that these are the objects, where more than 80 thousand tons of arsenic-containing wastes have been concentrated and just they represent the main source of secondary pollution.

Recently, it is very urgent in the world to calculate the economic consequences of environmental impact in monetary value. Many well-known eco-economists work on this issue. For the assessment of the economic damage resulting from soil, vegetable cover and air pollution a certain methodology has been developed.

Taking into account the above mentioned, the experts of the Georgian Technical University and Institute of the Caucasus Mineral Resources conducted an economic assessment of the environmental impact of the Lukhuni arsenic deposit using the results of our research, conducted in 2002-2012 and the methodology accepted and approved in the world.

REFERENCES

1. Kvinikadze M., Kuparadze D., Pataridze D., Tumanishvili G., Khundadze N., Kirakosyan V. "Geo-Environmental Problems of Upstream of the Rioni River". The International Scientific Conference "Problems of Geology of the Caucasus", dedicated to the 85-th anniversary of Alexander Janelidze Institute of Geology. November 25-27, 2010. Georgia, Tbilisi (in English).

2. Kvinikadze. M, Kirakosyan V., Pataridze D., Kuparadze D., Khundadze N. „Geo-Ecological Features of Georgia“. TSU Sciense, 2012, December. Tbilisi. pp. 30-33 (Georgian and English).
3. Kvinikadze. M., Pataridze D., Kuparadze D., Kirakosyan V., Khundadze N. Geo-Ecological problems of the Rioni River basin. Mineralogacal Society of Georgia. Georgian Technical University. Power of geology is the Precondition for Regeneration of Economics. Book of Abstracts. Scientific–Practical Conference. 23-24 April, Tbilisi, 2015. pp 81-85.

ARE THE REDDENED WEATHERING HORIZONS BETWEEN THE KHERTVISI AND TOLOSHI BASALT FLOWS (AKHALKALAKI VOLCANIC PLATEAU, GEORGIA) BOLE BEDS?

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The study and interpretation of reddened weathering horizons (in Georgia historically interpreted as “baked zones”) developed between continental flood basalt flows and now widely known as “bole beds”, is one of the issues of current interest of physical volcanology. These interflow sediments have gained worldwide attention of geoscientists in order to reconstruct palaeoenvironments existed between major eruptive events and understand the impact of continental flood basalts on climates and ecology [4, 3, 1].

Despite these rigorous works, the true identity of the boles in terms of their origin, either as paleosols, sediments, pyroclastics, peperites or weathered lava selvages, remains enigmatic [2]. The matter of interest is to discriminate correctly bole beds, laterites and redearthpaleosols as well. It should be emphasized, that in many cases it is difficult to define a clear differences between them. Various characteristics and interpretations are given by different authors, where key features of such clayey or earthy intrabasaltic layers are in some extent similar. However, one distinct thing that could be noticed in all these characteristics according to various publications is that readearth soils have high humus material content while high Al and Fe^{3+}concentrations are common for laterites. As for the red boles, they comprise relicts of original rocks and exhibit minor variations in their chemistry.

During the study of Akhalkalaki plateau continental flood basalts several “baked” interflow horizons were distinguished within Toloshi and Khertvisi lava successions. The results of field observations, petrographic descriptions and geochemical analyses have been interpreted. On the basis of these data we suggest, that these reddened weathering horizons could be distinguished as red boles (Fig.1 a, b). Further detailed studies and interpretations are intended within the study area.

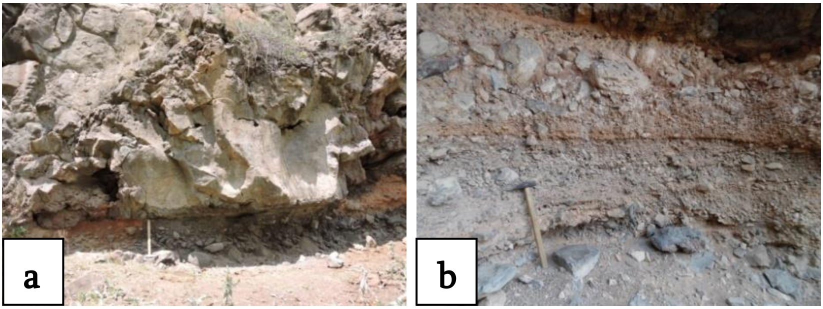

Fig. 1. Field photographs of reddened weathering interflow horizons outcrops: a) Khertvisi; b) Toloshi.

ACKNOWLEDGMENTS:
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REFERENCES:

1. Prosenjit Ghosh, M. R. Sayyed, R. Islam, S.M. Hunderkari. Inter-basaltic clay (bole bed) horizons from Deccan traps of India: Implications for palaeo-weathering and palaeo-climate during Deccan volcanism. Palaeogeography, Palaeoclimatology, palaeo-ecology (PLAEO) 242, 2006, pp. 90-109.

2. Raymond Duraiswami&Purva Gadpallu. Volcanism, Past and Present – The Indian Scenario. *Proc. Indian Nat. Sci. Acad.* **82** No. 3 July Spl Issue, 2016, pp. 549-557.
3. M. R. Sayyed. Flood basalt hosted palaeosols: Potential palaeoclimatic indicators of global climate change. Geoscience Frontiers 5, Elsevier, 2014, pp. 791-799.
4. M. Widdowson, J.N. Walsh & K.V. Subbarao. The geochemistry of Indian bole horizons: palaeoenvironmental implications of Deccan intravolcanic palaeosurfaces. From Widdowson, M. (ed.). *Palaeosurfaces: Recognition, Recomnstruction and Palaeoenvironmental Interpreation*, Geological Society Special Publication No. 120, 1997, pp. 269-281.

PROSPECTING MODEL FOR GOLD-QUARTZ-LOW SULFIDE OCCURRENCES (SOUTHERN SLOPE OF THE GREATER CAUCASUS, GEORGIA)

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Ore occurrence of gold-quartz-low sulfide type originated at the subduction stage of mountain-fold systems development. It is widely known that in the earth's crust take part processes that support the dissipation (scattering) of ore substance, and in exceptional cases, part of it forms significant concentrations.

The metallogenic zone unites terrigenic suites, dislocated at large-scale areas, comprising of thick carbonaceous sand-silt-shaly horizons. Terrigenes are represented by rocks deposited at continental slope and rise, and also by rocks of sericite-chlorite and epidote-granate subfacies accumulated in marginal sea deep troughs. Carbonaceous rocks and intruded granites, small thickness diorites and granitoides are orebearing, where elevated concentrations of gold, tungsten, arsenic, and stibnite are defined. Carbon dioxide layers and invasive granites, small power diodes and granite contaminants contain oily accumulations where high levels of gold, tungsten, arsenic, and antimony are observed. Within the above mentioned suite placers and schlich oreols are observed.

According to geophysical data, within the suites (zones) "hidden" massiffs of granitoides are detected.

A goldbearing metallogenic zone is located in the central part of the southern slope of the Greater Caucasus. The potential gold ore deposits of the Svaneti region are localized in Lower Jurassic flyschoids covering the Paleozoic sediments (Dizi series), in Middle Jurassic granites - quartz diorites, quartz monzotonies and quartz monzodiorites. Ore bodies are mainly located in apical parts of granitoides. While evaluating prognostic gold in the region, it is necessary to pay attention to carbonaceous of terrigenic rocks; amount of pelitic fraction and content of organic substance. These factors determine essential concentrations of gold and its accompanying elements in terrigenic suites. Gold-arsenic-sulfide occurences enriched with gold under the influence of hydrothermmal processes, and in case of gold-quartz-low sulfide occurence - ore formation was preceded by formation of gold anomalies during sedimentation and metamorphism processes.

Ores mainly concentrate in rocks, which experienced metamorphism of green shisct facies, where pyrite and arsenopyrite prevail of all sulfidic minerals; at biotite-chlorite level pyrite and pyrhotite are represented by equal amount, at high levels are met berezites (quartz-albite-pyrite-sericite); at lower levels - quartz-feldspar and biotite-chlorite metasomatites.

The potential of the goldbearing districts should be assessed by taking into consideration the following geological features: the image of tense dislocation of rocks, gold high content in feldspars, presence of small gabbro-plagiogranitic bodies. One of the most important regional feature for goldbearing districts is the presence of ultrabasites. They "complicate" base composition volcanic rocks in the old green-shcist areas or are met in the alochtons that cover granite -gneiss; Gold content (0.02 g / t) in plates, basalts and ultrabasalts five times exceeds the amount of gold in carbonaceous suites. Because of this they are considered as initial sources of gold. In the Caucasus, the areas of ore districts range from 1500 to 2500 km^2.

In dislocation zones organic substance experiences movement and differentiation; its content is elevated in ore bearing tectonites (for example, in Palaeozoic Dizi series, in Svaneti). The content of organic substance in schists of Racha deposits and occurrences, which didn't experience hydrothermal alteration, is up to 2%, and in mineralized zones it decreases till 0.56%.

Svaneti ore district includes the part of the southern slope of the main ridge where the Lower Jurassic flysch clay-sand-stone schists lay directly over the Paleozoic Dizi series. The district is bounded by faults. Here, in Paleozoic metamorphic suites, as well as in monzodiorites is high probability of gold deposits discovery. It isn't excluded gold mineralization presen-ce in Lower Jurassic flyshoids that is evidently convinced by existence of gold-quartz vein systems in the r. Arshira sources (left tributary of the r. Enguri). In Paleozoic shales, most inte-resting are the upper parts - graphitized Permian carbonate sediments. It seems that these graphitized zones were sorces for gold placers, which were relatively enriched in gold. For example, Lakhamula and Tskhumari placers in the Enguri river channel and on the left slpe of the river. In particular, the gold potential in Mestia-Racha ore region is estimated as 210 t, and in Svaneti region - as 350 t.

The whole Kirari-Abakuri ore-knot in Svaneti, where gold-quartz veins are met in each small middle Jurassic body, is prospective on gold. In addition, in many places at the exo-contact zones of intrusive, in hydrothermally altered rocks, gold elevated content is determined; there is also a potential ore-field of Tskhumari-Lakhamula, where only placers are defined yet; there, in Tskhumari placer 0.5 kg piece of native gold was found.

CONTACT METAMORPHISM OF THE DIZI SERIES (GREATER CAUCASUS)

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The Dizi series is exposed within the Southern Slope zone of the Greater Caucasus and is formed in the continental slope and piedmont conditions on the southern passive margin of the small oceanic basin [1]. It is built up of faunally dated (from the Devonian to the Triassic inclusive) [2, 3, 4] terrigenous sediments metamorphosed in low-temperature subfacies of greenschist facies conditions, various volcanites and contact metamorphites. Some researchers believe that the rocks of the Dizi series, prior the contact metamorphism, underwent regional metamorphism, while the others consider that they experienced only anchimetamorphism. However, a detailed study of the rocks was not carried out.

It should be noted that in the Dizi series the Variscan tectogenesis and granitoid magmatism were not revealed. An opinion about the overthrust nature of the Dizi series during the manifestation of the Early Cimmerian (Indosinian) orogeny was expressed by a number of authors.

On the basis of petrographic and mineralogical investigations the authors carried out a detailed study of contact metamorphism rocks of the Dizi series. According to analytical data degree of transformation of the rocks of the series before they underwent Bathonian intrusion processes was determined as well.

The Dizi series is represented by metamorphosed sandstones, gravelites, argillites, carbonaceous-argillaceous shales, silicites, tuff sandstones, volcanites and limestones. Some of the rocks are strongly dislocated and characterized by plicative, finely-folded and banded textures showing the primary lithological heterogeneity of the rocks. During the Bathonian orogeny numerous gabbro-diorite, diorite, quartz-diorite, syenite-diorite, and granitoid intrusions, as well as dikes with a thickness of up to several tens of meters, intruded into the Dizi series. The K-Ar ages of the intrusions correspond to 176-165Ma [5]. The aureole of contact metamorphism of the Dizi series reaches ≈ 350m. Contact-metamorphosed rocks are represented by quartzite, quartz-biotite-sericite-graphite, andalusite-biotite-muscovite-quartz-plagioclase-graphite, andalusite-biotite-muscovite-corundum, andalusite-ordierite-biotite-muscovite-plagioclase-quartz, cordierite-andalusite-corundum rocks, marbles and skarns. They are developed in the extreme western part of the Dizi series and farther ahead are traced as a narrow strip in the eastern direction over 550 m. Numerous intrusive bodies of different sizes are distributed unevenly; contact metamorphic zones overlap each other complicating the formation of a uniform pattern of zoning and determining thickness of each zone. In the distortion of the primary pattern of metamorphic zonation an important role is played also by disruptive dislocations.

To study the rocks of the Dizi series more than 200 thin sections were described. The minerals in the selected 20 key samples were determined by the microprobe analysis. The compositions of biotite, cordierite, muscovite, plagioclase, actinolite, cummingtonite, hornblende, clinopyroxene, chlorite, clinozoisite, K-feldspar, garnet, pumpellyite and prehnite were determined. As a result of interpretation of the obtained data, the authors distinguished three exocontact zones with characteristic mineral associations.

I zone - the most high-temperature one is developed in direct contact with intrusions, extending over <10m. The characteristic mineral associations are: And+$Bt_{0.46}$+$Crd_{0.64\text{-}0.65}$ +

Ms±Pl+Qtz, And(→Fi)+$Bt_{0.36}$+$Crd_{0.48}$+Ms±Pl+Qtz, And-$Bt_{0.36-0.40}$+$Crd_{0.48-0.50}$+Ms±Pl+Qtz+Ilm, $Act_{0.72-0.74;0.73>0.75}$ +$Cum_{0.65}$+ $Bt_{0.65}$+$Pl_{0.95-0.93,0.41-0.49}$±Qtz, $(Mg\text{-}Hbl)_{72}$ +Cum_{62}+ $Bt_{0.64}$±Pl and $(Mg\text{-}Hb)_{0.61}$+$Aug_{0.49-0.53}$+$Bt_{0.50}$+Czo (FeO 6.65 масс.%)+ Scp+ $Grt_{Grs\text{-}Adr}$+Kfs+$Pl_{0.36;0.47;0.54}$. These rocks belong to the andalusite-biotite-muscovite subfacies. II zone is the most widespread zone (thickness 40-150m). The characteristic mineral associations are: And+$Bt_{0.51-0.58}$+$Crd_{0.60}$+$Chl_{0.42}$+Ms+$Pl_{0.34-0.35}$+Crn±Qtz, Bt+Ms+Crn, Bt+Ms+Crn+Chl±Qtz, $Cpx_{0.50}$+ Hbl+$Act_{0.50-0.63}$+ Czo+$Pl_{0.41;0.56;0.77;0.69}$+Kfs+$Bt_{0.50}$±Qtz, Act+Hbl+Pl±Qtz and Cpx+Hbl+Bt+Act+Scp+Cal. The mineral assemblages of the zone correspond to the anadalusite-biotite-muscovite-chlorite subfacies. The characteristic mineral associations of the III zone (50-150m thick) are: Bt+Ms+$Pl_{0.46(Anz)}$+Qtz, Mg-$Hbl_{0.56-0.57}$+ $Bt_{0.51-0.54}$+Cal+ $Pl_{0.82;0.83;0.88}$+Qtz, Bt+Ms+And+Grt+ Ab±Qtz, Cal+Act+Czo, Cal+Cpx+Wo+Gr+Qtz and Act–›Mg-$Hbl_{0.60-0.62}$ +$Pmp_{0.53}$+Phr+Ab+Kfs+Qtz). Degree of contact metamorphism corresponds to the albite-epidote-hornfels facies.

The rocks of the Dizi series, which did not experience the process of contact metamorphism, were metamorphosed under low temperature conditions of regional metamorphism. The characteristic mineral associations of the lowest subfacies of the greenschist facies: $Chl_{0.48}$+Ser+Ab±Tur±Qtz and $Chl_{0.45}$+ Ser+Cal+Ab+Qtz, and associations Act–›Mg-$Hbl_{0.60-0.62}$+ $Pmp_{0.53}$+Phr+Ab+Kfs+Qtz andPmp$_{0.53}$+Phr+Ab+Bt+Chl+Cal+ Phn+Qtz, corresponding to the prehnite-pumpellyite facies were established.

Table 1

Composition of minerals (mass %) from regionally metamorphosed rocks of the Dizi series

Samp.#, mineral	4-13 Chl	8-13 Chl	8-13 Mus	8-13 Mus	41-12 Pum	41-12 Phr	41-12 Phr	41-12 Act	41-12 Mg-Hrb	4-13 Ab	4-13 An	41-12 Ab
SiO_2	25.70	26.69	48.39	49.81	37.59	43.64	43.38	50.95	49.85	68.00	45.05	68.54
TiO_2	0.06	0.06	0.19	0.02	0.02	0.02	0.01	0.22	0.26	0.00	0.00	0.00
Al_2O_3	22.57	23.34	32.23	36.60	25.47	24.32	24.54	3.91	5.86	19.77	35.56	21.29
FeO	26.11	23.55	1.75	1.30	4.39	0.41	0.57	14.79	15.29	0.10	0.23	0.04
MnO	0.21	0.11	0.00	0.04	0.15	0.04	0.19	0.54	0.63	0.00	0.00	0.00
MgO	15.78	16.22	1.99	1.00	2.76	0.01	0.00	12.19	12.61	0.00	0.00	0.00
CaO	0.02	0.02	0.06	0.06	23.28	27.34	27.30	12.38	12.40	0.04	19.15	1.36
Na_2O	0.00	0.01	0.21	0.02	0.00	0.00	0.00	0.23	0.32	11.41	0.79	9.53
K_2O	0.09	0.00	9.64	9.51	0.00	0.00	0.00	0.19	0.29	0.07	0.01	0.01
Sum	90.54	90.06	94.46	98.36	93.66	95.78	95.99	95.40	97.51	99.39	100.79	100.77

According to the new data the following results are obtained:

1. The initial terrigenous rocks of the Dizi series underwent regional metamorphism of the lowest stage of the greenschist and prehnite-pumpellyite facies forming strongly dislocated and finely-folded metasandstones, phyllites, quartzites, marbles and metagreywackes;
2. In the regionally- and contact-metamorphosed rocks of the Dizi series, the authors for the first time have established a number of minerals: cordierite, cummingtonite, corundum, scapolite, prehnite and pumpellyite;
3. In contact metamorphosed rocks three exocontact zones with characteristic mineral assemblages corresponding to andalusite-biotite-muscovite and andalusite-biotite-muscovite-chlorite subfacies and albite-epidote-hornfels facies are distinguished.

REFERENCES

1. Gamkrelidze I.P, Shengelia D.M. Precambrian-Paleozoic Regional Metamorphism, Granitoid Magmatism and Geodynamics of the Caucasus. Moscow, "Nauchni Mir", 2005, p. 479 (in Russian).
2. Gamkrelidze P.D., Adamia Sh.A., Chikhradze G.A., Djavakhishvili Sh.I. New data on the Stratigraphy of the Pre-Jurassic Deposits of Svaneti. Doklady of the Acad. Sci. of the USSR, v. 153, No. 2, 1963, p.p. 424-426 (in Russian).
3. Somin M.L. The Pre-Jurassic Basement of the Main Range and the Southern Slope of the Greater Caucasus. Moscow: "Nauka", 1971, p. 245 (in Russian).
4. Kutelia Z.A. New Data on the Stratigraphy of the Dizi Series (Svaneti)//Bulletin of the Academy of Sciences of GSSR, v. 109, No. 3, 1984, p.p. 29-33 (in Russian).
5. Dudauri O.Z., Togonidze M.G. Petrology and the Isotope Age of the Kirar-Abakuri Intrusive Complex. Proceedings of Al. Janelidze Geological Institute of the Georgian Academy of Sciences, 1998, p.p. 150-162 (in Russian).

SOME DATA ON KHALASTAVI GOLD-COPPER POLYMETALLIC ORE MANIFESTATION
Adjarian Autonomous Republic

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The Adjara-Trielti fold system is a sublatitudinally elongated mountain structure, located between two fragments of the Transcaucasian median massif - the Georgian block in the North and the Artvin-Bolnisi in the South [1] .

The territory of Adjara covers the southwestern part of the Ajara-Trieleti fold system, where the Paleogene volcanic products are spread.

The tectonic regime of volcanism evolution has a rift nature. The powerful volcanic eruptions of the basalt profile in the Middle Eocene period are accompanying the rifting [2].

At the Middle Eocene stage of development a volcanogenic-sedimentary formation was formed, which occupies 80% of the total area. It is divided into two parts: the Nagvarevi and Chidili suites.

The object of our study is the Khalastavi ore occurrence; it is a part of the western zone of the Adjara segment. Middle Eocene volcanogenic stratum represented by alternation of lava sheets of the andesite-basaltic composition and their pyroclasts are widespread here [3].

Young eruptive rocks are spatially confined to the Middle Eocene volcanogenic formations and are represented by numerous dykes, rodlike bodies and individual massif of syenites, syenite-diorites, gabbro diorites. They break through the Middle Eocene stratum that encloses them.

The metallogeny of the site is mainly confined to intrusions and crushed, altered, pyritized zones. The mineralization is represented by copper-gold-polymetallic and gold-sulfur-pyrite mineralization.

The Khalastavi pyritized zones are confined to the Khalastavi anticlinal uplift.

The mineralization is located in the exocontact zone, in close proximity to the intrusion aureoles and their marginal parts. Here, on the area of 1 km^2, several hydrothermally altered zones with gold and copper mineralization are recorded. As to the other useful components, in the zone an increased content of lead, zinc, molybdenum, cobalt, gallium, etc is observed.

According to the results of schlich testing, there are chances for discovery of a number of other similar mineralized zones [4].

The Khalastavi ore-bearing deserves attention for maintaining detailed search operations with the use of underground, mining and drilling operations, with the aim of studying the lower horizons of mineralization.

REFERENCES

1. Kvatashidze R.I. Postgraduate Thesis:"Paleovolcanic analysis and reconstruction of ore-hosting structures on Tibetan volcano-tectonic depression", Tbilisi, Caucasian Institute of Mineral Raw Materials, 1990, 11 p. (in Russian);
2. Adamia Sh. A.; Gamkrelidze I.P. and others Adjara-Trialeti down fold and the problem of formation of the deep-sea depression of the Black Sea //. "Science", 1974, pp. 78-94. (in Russian);
3. Kvatashidze R.I. Information Geological Report #2on the project included in the State Target program "Establishing of geological and prognostic maps for Merisi ore knot (370 km^2) 1: 25 000 scale ". Geological funds. Tbilisi, 2001, pp. 58-59. (in Georgian).
4. Kvatashidze R.I. Establishment of distribution regularities of rare elements within the frames of sulphide ores and crust of weathering of Autonomous Republic of Adjara. Geol. funds. Tbilisi, 2002, 192 p. (in Georgian).

CONSTRUCTION OF HYDRO POWER STATION IN GEORGIA AND ECOLOGY OF RELATED CLIMATIC CONDITIONS

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One of the most essential problems of humanity is issue of climatic changes. Up to outstanding scientists, climatic changes of biosphere caused by unmanaged anthropogenic activities will reach such a critical point in 2030-2040 when environmental disaster is inevitable.

In this respect, territory of Georgia also is not an exception, its unique nature and geographic location can be demonstrated as a model.

Alongside various environmental problems should be emphasized construction of hydro power stations on Georgian rivers. As is already known water reservoirs built on the rivers Enguri and Aragvi caused undesirable climatic changes in local regions, which had negative impact on the health of population and changes in the environment. Considering aforesaid it follows that construction of large hydro power stations will unavoidably cause worsening of climatic conditions causing reduction of snow mantle on Caucasus. These changes will cause reduction of rivers' water flow, which affects soil fertility resulting in harvest reduction.

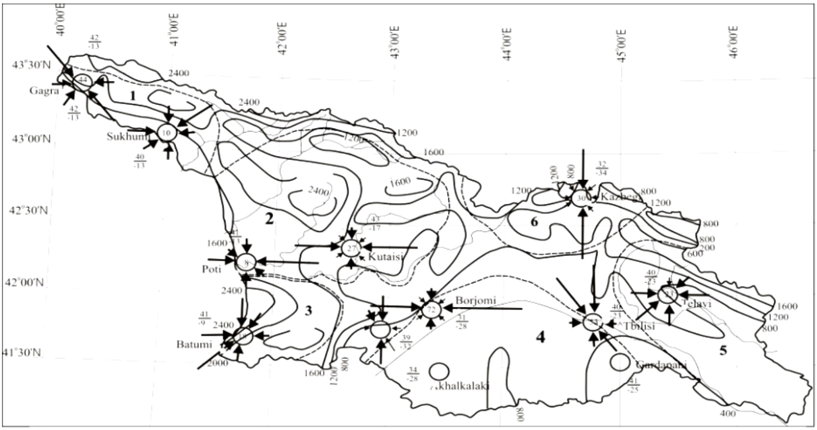
To ensure environmental safety of Georgia following measures are expedient:

- Rehabilitation of meteorological monitoring system, which includes data reflecting ecosystem;
- The monitoring, that defines impact of the existing reservoirs on the climate conditions, must be carried out;

- Rehabilitation of windshield zones management program, which have an essential role in establishing microclimate, hydrological regime and biodiversity of agro landscapes;

- It is necessary to determine the timing of the global warming-induced climate changes in Georgia in order to reduce timely the expected ecological catastrophes;

- Al. Tvalchrelidze Caucasian Institute of Mineral Resources is performing to address the above issues, which, in our opinion, are minimal for solving the current problems.



LEGEND

1. Climate

Annual-average amount of downfall (mm)

1.1 Wind flow during a year

Indicator length from compass coincides with frequency of this direction of wind в in % from total number of observations (without calm). Figures in circle — calm frequency in % from total number of observations

1.2. Air temperature

Figures on the left from town character: in numeratore (°C)—absolute maximum of air temperature (annual); in denominator (°C) — absolute minimum of air temperature (annual).

Fig.1. Map of Ecological – hydrometeorological Conditions of Georgia

THE EXPLORATION CRYTERIA OF GOLD MINERALIZATION IN THE UPPER CRETACEOUS VOLCANOGENIC-SEDIMENTARYROCKS ON THE EXAMPLE OF SOUTH-EAST GEORGIA

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For exploration of gold mineralization localized in the Upper Cretaceous volcanogenic-sedimentary series according to the peculiarities of its geological structure the following criteria and signsmay be used:

1. Quartz-sericite, quartz-sericite-alunite, quartz-sericite-adular, quartz-sericit-hydromica bearing quartzites with cavernous monoquartzite core;
2. Intensely brecciated quartzites (hydrothermal breccias) cemented by more late grey or dark- blackish quartz;
3. Quartzites enrichedwith pre-mineralization jarosite;
4. Psephitic polymict tuff horizon (pre ore) brecciated and silicifieddue to hydrothermal volcanic explosion;
5. Screen of pelitic, thin-layered, plastic and rhyolitic lava flows;
6. Pre-mineralization nontronite argillisites saturated with potassium-bearing minerals;
7. Abundance of diabasic, andesitic, rhyodacitic, rhyolitic and dioritic subvolcanic and intrusive bodies;
8. Intensive brecciation and fracturing;
9. Thick zones of oxidation;
10. Ore-bearing quartz-sericite, quartz-sericite-adular, quartz-sericite-hydromica, quartz-sericite alunite enriched eluvium**;**
11. Barite and barite-base metal mineralization at the objects' upper levels;
12. Hydrothermal propylitesof zonal structure;
13. Pyritized zones saturated with dodecahedral and xenomorphic forms of pyrite crystals.

CURRENT ASPECTS OF SUSTAINABLE DEVELOPMENT OF MINING INDUSTRY

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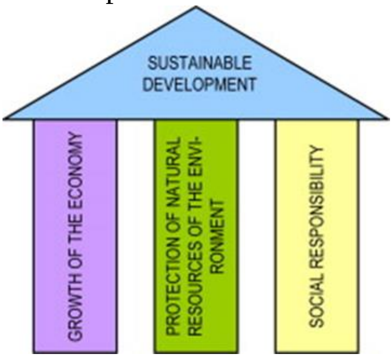
Sustainability focuses on meeting the needs of the present without compromising the ability of future generations to meet their needs. The concept of sustainability is comprised of three pillars: economic, environmental and social - also known informally as profits, planet and people. Sustainability emerged as part of corporate ethics in response to perceived public discontent over the long term damage that a focus short term profits can cause. For example, a factory pouring its waste into a nearby body of water to avoid the short term costs of proper disposal can cause environmental damage that is much more expensive in the long term. Sustainability encourages business to frame decisions in terms of years and decades rather than on the next quarter's earnings report, and to consider more factors than simply the profit or loss involved.

Sustainable development is the organizing principle for meeting human development goals while at the same time sustaining the ability of natural systems to provide the natural resources and ecosystem services upon which the economy and society depend. The desired result is a state of society where living conditions and resource use continue to meet human needs without undermining the integrity and stability of the natural system and sustainable development can be classified as development that meet the needs of the present without compromising the ability of the future generation.

Mining industries provide most of the materials we rely on to build infrastructures and instruments of daily use, to obtain large amounts of energy, and to supply agriculture with fertilizers that enable most of foods produced. At the same time, mining is the human activity that has been more disturbing to environment and is linked to large social impacts and inequalities. The mining legacy and environmental remediation, the present mining and challenges, and the future mining and society are discussed in relationship with environmental health and sustainable development. It is concluded that current mining practices need to change and contribute to community development with more equity, and to protect better natural resources and ecosystems in order to be environmentally acceptable and compliant with sustainable development objectives.



ICMM requires a commitment to our ICMM 10 Principles. These serve as a best-practice frameworkfor sustainable development in the mining and metals industry.

Established in May 2003 the principles respond to the key challenges identified by the Mining, Minerals and Sustainable Development Project's agenda for change.

To ensure the robustness of the principles they have been benchmarked against leading international standards. These include: the Rio Declaration, the Global Reporting Initiative, the Global Compact, OECD Guidelines on Multinational Enterprises, World Bank Operational Guidelines, OECD Convention on Combating Bribery, ILO Conventions 98, 169, 176, and the Voluntary Principles on Security and Human Rights.

The principles were refined in 2015.

1. Apply ethical business practices and sound systems of corporate governance and transparency tosupport sustainable development;

2. Integrate sustainable development in corporate strategy and decision-making processes;
3. Respect human rights and the interests, cultures, customs and values of employees and communities affected by our activities;
4. Implement effective risk-management strategies and systems based on sound science and whichaccount for stakeholder perceptions of risks;
5. Pursue continual improvement in health and safety performance with the ultimate goal of zero harm;
6. Pursue continual improvement in environmental performance issues, such as water stewardship, energy use and climate change.
7. Contribute to the conservation of biodiversity and integrated approaches to landuse planning;
8. Facilitate and support the knowledge-base and systems for responsible design, use, re-use, recycling and disposal of products containing metals and minerals;
9. Pursue continual improvement in social performance and contribute to the social, economic and institutional development of host countries and communities;
10. Proactively engage key stakeholders on sustainable development challenges and opportunities inan open and transparent manner.

The assessment of the mineral-raw material base in Georgia is first of all the geological study of the territory of the country where the materials obtained during the various geological works enable us to determine the scale and quality of minerals in the mineral deposits.

Utilization of mineral deposits is important for the principle of geological-economic approach, which allows for the utilization of some of the deposits is the most rational option for processing systems which should provide the basic and complementary components of minerals and the use of the bay rocks in the light of the protection of nature.

Complex, lossless and rational use of the economic potential of the country's mineral-raw material base will bring great profits in terms of filling the regional and local budget as well as the employment of the population and ultimately the improvement of socio-economic conditions.In order to effecttively exploit Georgia's mineral-raw complex we consider receiving a mining code that will ensure that the legislative obstructions in the field are regulated by market mechanisms to the use of fossil and licensing, small deposits and stimulation of small mining enterprises, fiscal policy, perfection of state institutional policies, improvement of geological infrastructure, etc.

The mining industry contributes to the development of the economy. It promotes infrastructure development, employment of the population and increases the diversification of state revenues. The positive impact of the mining industry is reflected in the good opportunities for employment and community development, but it can not balance the negative impact of this kind of industry on environmental and human health.

The mining industry can be more sustainable if the approaches are intended to reduce negative impacts on environmental impacts or eliminate them completely. In order to make the industry more modern and more sustainable, stakeholder engagement and cooperation are needed.

REFERENCES

1. Dubiński J.Sustainable Development of Mining Mineral Resources. Journal of Sustainable MiningVolume 12, Issue 1, 2013. Pages 1-6.
2. Tvalchrelidze A. G. Mineral Resource Base of the Southern Caucasus and Systems for its Management in the XXI Century: Proceedings of the NATO Advanced Research Workshop ... Held in Tbilisi, Georgia, 3-6 April 2001 Paperback – 31 May 2003. 204 p.

3. Tvalchrelidze A.G. Economics of Commodities & Commodity Markets (Economic Issues, Problems and Perspectives). Publisher: Nova Science Publishers Inc; UK ed. edition (1 Mar. 2011).906 p.
4. Bolshakov B.E. The science of sustainable development. Book I. Moscow, Russian Academy of Natural Sciences, 2011. 272 p.
5. Burtontzel A., Bervar M., Meshko M. Sustainable development: Economic, social and environmental aspects. All-Russian State Library for Foreign Literature. M. I. Rudomino. 2014. 320 p.

POSITION OF OLISTOSTROMES AND WILD FLYSH IN THE CLASSIFICATION OF SEDIMENTARY FORMATIONS

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In sedimentary basins, a uniform process of sedimentation during which, as is known, deposition of normally-sedimentary formations takes place rather seldom but with considerable consequences, disturbs different geological events further reflected in the lithological character of these rocks.

As is known, in the formation of sedimentary deposits, along with many factors (climatic changes, activity of organisms, fluxes and refluxes, facies realm, etc.), tectonic movements play quite an important and often defining role. The sedimentary chaotically built formations under consideration are not an exception.

As a result, among the variety of sedimentary deposits there is a definite group of rocks which by their textural, structural and genetic features sharply differ from norm-sedimentary formations which led to their identification as an independent unit in the form of "event deposits". It has been found out, that one of the main determining factors of their formation are consedimentary catastrophic phenomena occurring impulsevely and covering short time spans. As shown by investigations, such deposits can exist in genetically different formations.

Transgressive and regressive deposits, mostly composed of conglomerates and breccias, are formed as a result of the lowering and rise of sedimentary basins. During these processes, the tectonic movements proceed rather evenly without any cataclysms; thus, as the normal process of sedimentation is uninterrupted, the conglomerates and breccias are norm-sedimentary formations. However, in cases when tectonic movements were activated, catastrophic events were occurring. These events together with appropriate paleogeographic and facies conditions provoke deposition of olistostromes and wild flysch, representing event deposits.

Thus, proceeding from the genetic principles, the chaotic formations under consideration, can be subdivided into two groups: normally-sedimentary (conglomerates, breccias) and event (oilstostromes, wild flysch) deposits.

As is known, geological catastrophic events (unlike the cosmic and technological ones) in the nature are manifested in the form of earthquakes, volcanic eruptions, mudflows and turbidity currents, flood, landslide processes, etc. The sediments formed due to these processes are event deposits characterized by specific structural-textural and lithological features.

One of vivid examples of chaotically built event deposits are the Upper Eocene olistostromes and wild flysch of the Alpine folded area, a subject of interest of many researchers. They contain valuable information for paleogeographic reconstructions and about the tectonic movements at the Eocene-Oligocene boundary, being one of the important periods in the history of the given region.

In the greater part of the Alpine foldsystem olistostromes are part of flysch formation that allow to distinguish them as wild flysh. Accumulation of the flysch formation was complated in the Late Eocene.

In the South Caucasus the Upper Eocene event deposits in the form of olistostromes are developed on the Southern Slope of the Greater Caucasus. Their greatest part is located within Georgia and only their separate outcrops are observed in the Azerbaijan part of the Southern Slope of the Greater Caucasus (Dashbulag, Talistan outcrops, Talistan and Shabian "cliffs ").

The olistostromes under consideration - despite their strong tectonic processing and displacement over great distances (20-50 km) - give valuable information about the paleogeography and tectonic events, including catastrophic ones, going on in the second half of Late Eocene.

The main part of Upper Eocene olistostromes is developed in the eastern segment of the Southern Slope of the Greater Caucasus. Here, from the river Rioni they stretch as a narrow strip to the east, along the frontal line of the thrust of allochthonous flysch deposits of the Mestia-Tianeti zone. Due to this thrust, the deposits under consideration partially, and at places, probably entirely, are tectonically overlapped by the Cretaceous-Paleogene flysch deposits. In their turn, from the north, the olistostromes thrust over the autochthonous norm-sedimentary rocks of the Gagra-Java zone, including the Upper Eocene ones.

Olistostromes are built up mainly of olistoliths of the Mesozoic and, partially, Paleogene deposits of the Gagra-Java zone. Among them the Upper Jurassic reef limestones and Bajocian volcanites are widesprea. Moreover, these olistoliths are characterized by huge size. Especially it concerns to limestones, which in separate exposures correspond to olistoplacs; in volume they reach several hundreds and thousand cubic meters (mountains Orbodzala and Alevis-klde, the Georgian Military road, etc.). Because of huge sizes of these rocks, some of them had earlier been considered as the Upper Jurassic bedrocks.

The presence in olistostromes of exotic inclusions of the Upper Jurassic limestones (the Georgian Military road, Kakheti) and crystalline rocks of the basement (to the east of the river Aragvi) gave rise to the question of the location and structure of the land that supplied the Late Eocene basin with clastic material. Such a hypothetical land was most likely the Racha-Vandam land; it was a chain of separate cordilleras, located in the northern peripheral part of the Gagra-Java zone, extending from the Utsera meridian in the west along the southern boundary of the flysch.

The composition of the clastic material of olistostromes shows that this cordillera zone had been built up mainly of Mesozoic and partially of Lower Paleogene rocks of the Gagra-Java zone; beginning from the river Aragvi and more easterly, it consists of the rocks of the pre-Jurassic crystalline basement It was the main source of terrigene material not only in Paleogene, but most likely in the Cretaceous period as well. In the second half of Late Eocene, during the Pyrenean orogeny, along the thrust front of flysch formations, due to nappe formation there took place an intensive destruction of Racha-Vandam cordillera zone and dislocation of the disintegrated material in the southward direction, towards the epicontinental basin; here there began deposition of olistostromes around the cordilleras.

The considered event deposits of the Alpine fold system, being synchronous formations, clearly pointing to their timing to the same geological event. In particular, such could have been a collision leading to the formation of the fold-nappe structure of the Greater Caucasus. It began at the end of Late Eocene, reaching its maximum in Late Miocene, when the Arabian plate separated from the African plate and began movement to the north.

In conclusion, it should be noted that, in my opinion, classification of event sediments, should be done with account of the extent of force and scale of manifestation of those catastrophic events, which form these sediments. From this point of view, event-induced chaotic sediments (olistostromes, wild flysch) are formations of higher order compared to analogous sediments of the rhythmically built formations (tempestites, turbidites).

ARCHITECTURE OF THE UPPER MIOCENE-LOWER PLIOCENE GODERDZI SUITE (GODERDZI PASS AREA, SOUTH GEORGIA): IMPLICATIONS FOR PALEOENVIRONMENTAL RECONSTRUCTIONS

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The geological studies of post-collision volcanic formations of Southern Georgia go back to the very beginning of the last century and have been highlighted in numerous publications so far. Nevertheless, some issues still remain questionable and need further detailed investigations and up to date interpretations.

The main goal of the performed research is to assess the impact of the volcanic processes on the biotic and abiotic components of Paleoecosystems on the example of Upper Miocene-Lower Pliocene Goderdzi suite. For this purpose, the representtative cross-section was studied in the Goderdzi Pass area, in the rivers Dzindze and Adjaristskali headwaters. In this locality, the Goderdzi suite overlies Middle Eocene and younger volcanic formations with unconformity. According to available data [1, 2] two distinct parts - lower pyroclastic and upper lava flow units could be distinguished in the Goderdzi suite here (Fig.1).

Accurate specification of facies is the key to understandding of eruption style and emplacement environment of volcanic products. Based on available data interpretations and our field observations and laboratory studies, several lithofacies have been identified within the pyroclastic flow unit, which was considered to have a uniform character until now: massive lithic breccia and conglomerates, crystal-rich tuffs, lithic-rich tuffs, crystal-lithic rich tuffs and vitroclastic tuffs [3, 4, 5].

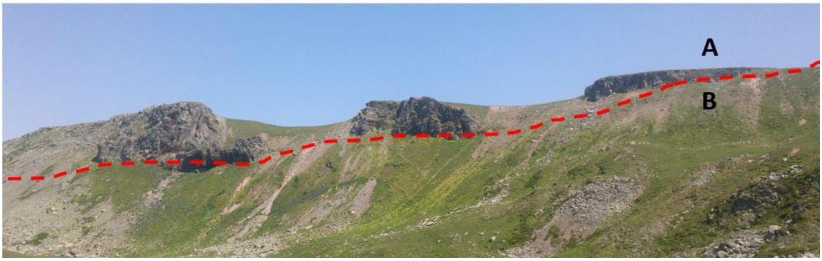

Fig.1. The studied cross-section of the Goderdzi suite. The dashed line indicates the boundary between the two parts of the suite: upper lava (A) and lower pyroclastic (B) flow units.

It is well-known that the Goderdzi suite hosts numerous remnants of fossil plants, which are of great ecological significance suggesting that paleoenvironment could be deduced through their precise identification. Two horizons of rich in fossil plants tuffs (mainly leaves) were distinguished during the field works. 12 taxons were identified and described from the lower horizons. It should be noted that only one plant species of the *Lauraceae* family were known within the suite but the rest 11 fossil plant species have been found and described here for the first time. Recently found new flora species, confirm the previous researchers' opinion about the subtropical character of the Goderdzi suite fossil flora.

Paleoenvironmental reconstructions through further detailed study of volcanic, volcanogenic-sedimentary and sedimentary facies, post-volcanic alterations, and permineralized flora will enable us to determine the combination of biotic and abiotic factors affecting ecosystems in the process of formation of the Upper Miocene Lower Pliocene Goderdzi suite.

ACKNOWLIDGEMENTS:

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REFERENCES

1. N. Skhirtladze. On the Lithology of the Goderdzi Suite. Proceedings of the Institute of Geology and Mineralogy of the Academy of Sciences of the GSSR, 1951. pp. 143-169. (in Georgian).
2. B. Tutberidze, Geology and Petrology of the Alpine Late Orogenic Magmatism of the Central Part of the Caucasian. Monograph. Tbilisi State University Publ. House, Tbilisi, 2004, pp. 13-80 (in Russian).
3. J. Branney, M. & Kokelaar, P. Pyroclastic Density Currents and the Sedimentation of Ignimbrites. Geological Society Memoir No. 27, 2002, p. 57.
4. Mc. Phie, J., Doyle, M., & Allen, R. Volcanic Textures. A guide to the Interpretation of Textures in Volcanic Rocks. Centre for Ore Deposit and Exploration Studies. University of Tasmania. (1993), pp. 124-180.
5. Cas, R.A., & Wright, J.V. Subaqueous Pyroclastic Flows and Ignimbrites: an Assessment. Bulletin of Volcanology, 53 (5), 1991, pp. 357-380.

ENGINEERING-HYDROGEOLOGICAL FACTORS OF ENVIRONMENTAL IMPACT OF THE CONSTRUCTION OF THE KHUDONI POWER PLANT

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Construction of Khudoni Hydro Power Plant has a rather long history. As it is known the construction activities began in 70ies of the last century and then during the long period it was stopped due to acute protests of local community and to the on-going unfavorable social and political processes. From the beginning of the XXI century the construction of the Khudoni HPP has become a topical issue. According to new project data, there building of a dam with height 200.5 m, 3 km remote from the village Khaishi down the stream is foreseen. As a result the water artificial reservoir will be created with total volume of water 350 mln.m^3. The square of flooding will be 500 ha [1]. In this case, within the flooding zone 14 settlement of Upper Svaneti including the second significant settlement of this region – village Khaishi will be under water. The main purpose of presented work is to characterize negative environmental impact of hydro technique complex components (dam, derivation tunnel, reservoir) building and exploitation on basis of critical analysis of fund and literature materials, also on the basis of interpretation of collected during the filled works actual data, from point of view of Engineering Geology and Hydro Geology [2]. The main idea of this work is that the very difficult, intersected reliefs, geological structure, engineering geological and hydro geological peculiarities of the region dictate us that it is unallowable to construct on the river Enguri, near the village Khaishi, the dam with height 200.5 m [3]. This opinion is proved on the basis of detail description and analysis of engineering geological and hydro geological conditions of the construction area [4]. Namely, there is underlined that due to existence of instable, steep, easy disintegrating slopes on the considered section of the Enguri river-gorge accumulation of disintegrated material in water reservoir will reach the catastrophic scale and permanent cleansing of reservoir is technically unfeasible task. Pursuant to the above mentioned we consider that from engineering-geological viewpoint height of the dam should not exceed 100 m. and in this case, it will be possible to avoid flooding of many hazardous sections that will ensure normal functioning of hydro technical complex.

REFERENCES

1. Khudoni Hydropower Project. Trans Electric Limited. Technical Summary. Tbilisi, 2008;
2. Ministry of Energy of Georgia. Environmental and Social Impact Assessment of Khudoni HPP (Final Report), Tbilisi, 2008;
3. Republic of Georgia, Ministry of Energy. Khudoni Hydropower Project. Report on Geological Evaluation by LEPL Alexander Janelidze Institute of Geology, Tbilisi, 2008;
4. Republic of Georgia, Ministry of Energy. Khudoni Hydropower Project. Phase III Feasibility Study. Geological and Geotechnical Report. Tbilisi, 2010.

ESTIMATION OF NOISE POLLUTION OF SHALVA NUTSUBIDZE AND SIMON KANDELAKI STREETS OF TBILISI BY MOTOR TRANSPORT

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Noise pollution is defined as a form of physical pollution, i.e. the level of existing noise exceeds the natural noise level. Under a short-term exposure it causes anxiety and in the case of prolonged action – damage to the sensory organs or death of organisms. From the physiological point of view, noise is defined as an unfavorably perceived sound and represents one of the typical environmental contaminations.

The main input to transport noise (up to 90%) generation in modern cities is the auto transport. Normative parameters for unstable noise are equivalent to sound levels L_{Aeqv} (dBA), which depends on a traffic intensity, part of trucks and public transport into the transport flow, average velocity of traffic flow, geometric characteristics of the road, parameters of the dividing line and etc. [1-3].

Present research refers to state of noise pollution on Shalva Nutsubidze and Simon Kandelaki streets of Tbilisi by motor transport. Studies were accomplished on working days. The main part of transport flow was passenger cars. Their number was above 90 % of all the passed automobiles. The number of passed motor transport in the investigated regions changed depending on time of the day and night.

The results of calculations for definition of noise level L_{Aeqv} of high intensity traffic intersections of Shalva Nutsubidze streets are shown on fig. 1.

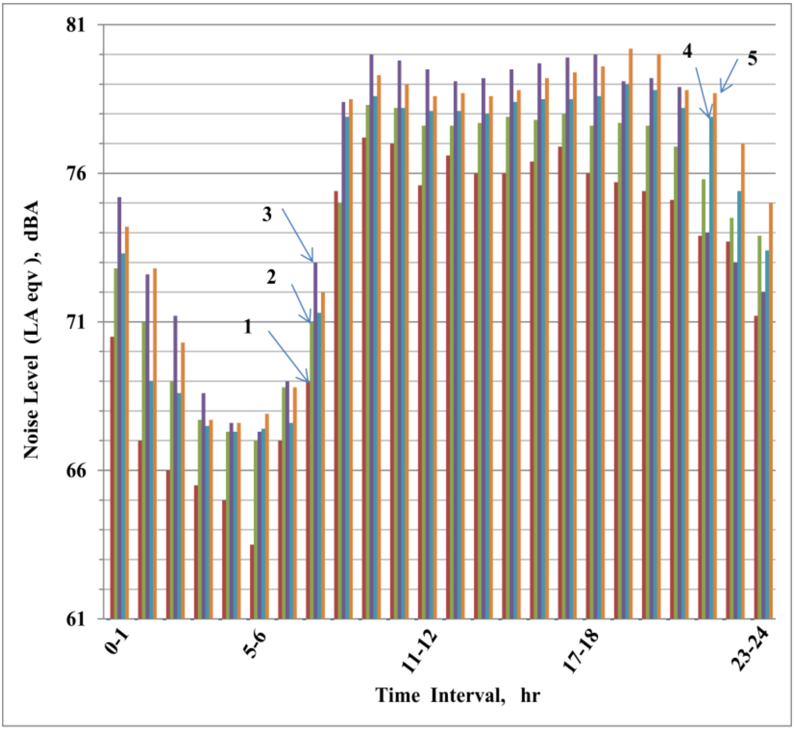

Fig. 1. Variation in noise level L_{Aeqv} (dBA) during twenty four hours with one hour time intervals in high intensity traffic intersections of Shalva Nutsubidze street. 1 – The section of Shalva Nutsubidze street from Sandro Euli street to Besarion Zhgenti street; 2 – The section of Shalva Nutsubidze street from Besarion Zhgenti street to Giorgi Dzotsenidze street; 3 – The section of Shalva Nutsubidze street from Giorgi Dzotsenidze street to Ferdinand Tavadze street; 4 – The section of Shalva Nutsubidze street from Ferdinand Tavadze street to Mikheil Asatiani street; 5 – The section of Shalva Nutsubidze street from Mikheil Asatiani street to Budapest street.

On fig. 2 is shown the map of Shalva Nutsubidze street with indicated maximum values of L_{Aeqv} (dBA).

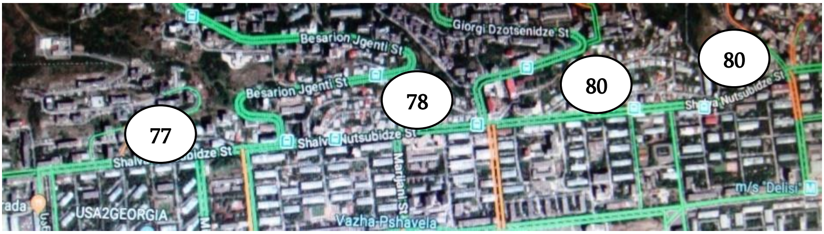

Fig.2. The map of Shalva Nutsubidze street with indicated maximum values of L_{Aeqv} (dBA).

On fig. 3 is shown the map of Shalva Nutsubidze and Simon Kandelaki streets with indicated L_{Aeq} maximum values.

Fig. 3.The map of Shalva Nutsubidze and Simon Kandelaki streets (one-way traffic) with indicated L_{Aeq} maximum values.

According to the research results, it can be inferred that a motor transport has an important effect on eco-system of Shalva Nutsubidze and Simon Kandelaki streets. It is necessary to optimize noise pollution sources by restriction of transport flow velocity, decreasing of part of trucks into the transport flow at a defined time of day and night.

REFERENCES

1. Guidelines on protection from traffic noise areas adjacent to the road. ODM 218.2.013-2011. M.:ROSAVTODOR 2011 (in Rus.).

2. Methodical recommendations for the registration of noise pollution in the composition of territorial integrated schemes for protecting the urban environment. L., 1989 (in Russian);
3. Methodical recommendations for estimating the necessary sound reduction in populated areas and determining the required acoustic efficiency of the screens, taking into account sound absorption. Ministry of Transport of the Russian Federation. State Road Service. (ROSAVTODOR). Moscow, 2003 (in Russian).

STRUCTURAL FEATURES AND GENESIS OF KHACHKOVI GOLD-ORE OCCURRENCE

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Khachkovi gold-ore occurrence is located in Tsalka region, on the southern slope of Mount Arjevani, in 4-km north of Khachkovi. From the north, it is bounded by Arjevan-Bakuriani sublatitudinal regional overthrust, from the south with Neogene-Quaternary lava flow. From the west and the east, propagation of the ore field is determined by transverse near meridional fault structures and sub-intrusive bodies concentration area. The endogenic structural control of the ore field is determined by the Arjevan-Bakuriani regional fault. In our opinion, it should represent ore distributing structure and as in most cases of other mineral fields, it does not contain mineralization.

Khachkovi gold ore occurrence is represented by hydrothermal gold-sulfide and pyrite type mineralization. It is located in the roofing blocks of the mentioned regional fault and is localized in its parallel steeply dipping fissured zones.

In the Middle Eocene tuffaceous rocks 0.5km wide ore-bearing zone of sub-latitudinal orientation is distinguished. It forms the zone of intensive mineralization along the river Khachkovi, which is represented by altered rocks saturated with quartz-calcite-barite veins. They contain sulphide veins and impregnations. The quartz-baritization zone №1 is located in the upper valley of the river Khachkovi on its right slope). 70 samples were obtained from this zone, 58 of them were analyzed on gold, in 29 samples gold composition exceeds 1g/t.

The Pyritization Zone №1 is located in headwaters of the first left tributary of the river Khachkovi. It is represented by a 50-70m thick mineralized and hydrothermally altered ferruginous zone. From 90 samples 55 samples were analyzed on gold. Gold content varies from 11g/t to 3,2 g/t.

The pyritization zone №2 is located in headwaters of second left tributary of the river Khachkovi. It is presented by irregularly pyritized and hydrothermally altered andesit rocks (mainly silicified and kaolinized). From 50 samples of this zone, 30 were analyzed on gold. Gold content varies from 0.8g/t to 1,7g/t.

Analysis of the available material and data of our studies provide the basis for expressing the opinion on the origin of Khachkov ore-occurrence. It represents an apical part of magma system, where developed propilitic and gold-bearing barite-polymetallic seam and impregnated mineralization, which is related to action of convectional system.

REFERENCES

1. M. Tskhelishvili et al. Results of general exploration activities in the region of Rekha-Gujareti and Khachkov gold and polimetallic occurrence. Tbilisi, Georgia, 1985.
2. R. Beradze et al. Geological works conducted in central part of Adjara-Trialeti geological-economical region. Tbilisi, Georgia, 1982.

PROSPECTS OF APPLICATION OF MINERAL WATERS FOR A MATTER OF DEVELOPMENT OF MOUNTAIN RESORTS IN THE ADJARA-TRIALETI REGION

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As is well known, Georgia is rich in natural resources of mineral waters. With this in view, the Adjara-Trialeti region is most distinguished, where waters of various composition and medicinal properties spread. Among these waters genetically sharply differing two groups of mineral waters prevail. These are: 1. Average and low mineralization carbonic acid waters; 2. weak and low mineralization nitrogenous and nitrogen-hydrogen sulfide thermae [1, 2].

With the theoretical and applied point of view interesting is the fact that these various type waters often expose in immediate proximity to each other.

The presented report will consider only the waters located in medium and high mountain zone of the Adjara-Trialeti region. Such approach to the problem is justified by the goal to connect application of mineral waters with mountain resorts already existing and those to be built in future in the region.

Only in this region of Georgia we meet hot carbonic acid mineral waters together with cold ones. Cold waters are mainly spread in western part of the region (Nabeghlavi, Sairme, Danisparauli, Namonastrevi, Kokotauri) and central and southern parts (Mitarbi, Machartskali, Tsinubani, Vardevani, Gujareti, Ramniskhevi, Flate). Hot carbonic acid mineral waters are concentrated in the central part of the region (Borjomi gorge) and within the limits of Akhaltsikhe depression (Akhaltsikhe, Nakalakevi, and others).

Part of mineral waters of the region is more or less assimilated but there are such outcrops, resources of which are used only partially or are untouched yet (Zekari, Abastumani, Tviri, Sadgeri therma carbonic acid waters of the Gujaretistskali and Adjaristskali river-gorges).

Deposits of Abastumani and Zekari mineral waters are most noteworthy among thermal waters by their great potential. Abastumani deposit is distinguished by its favorable location and perfect natural conditions; temperature of its chloride-sulfate sodium-calcium water of low mineralization (up to 0.6 g/l) reaches 48^0C. In terms of assimilation/extraction Zekari thermal big-debit springs are of not less interest. These sources give low mineralization (0.15-0.20 mg/l) 37^0C water with increased content of silicium acid (50 mg/l).

Factually, geological-prospecting works have not touched yet sub-thermal waters of the river Adjaristskali (Bogauri, Tomasheti, Shubani, Kldis abano, Chanchkhalo et al). Though these sources are characterized by very small debits, we can acquire significant resources of thermal waters due to adequately performed prospecting-boring works. Interest towards mineral waters of this gorge is conditioned by their perfect location and closeness to the Black Sea.

With the view of prospects, to receive ample resources of carbonic acid waters outcrops in the Gujaretistskali river gorge are rather attractive. Here, starting from Mitarbi mineral water hole and upwards along the gorge, there are several outcrops. Most significant among those outcrops are soda mineral waters of average mineralization: Machartskali, Tsinubani, as well as low mineralization waters of "Narzan" type: Vardevani, Ramniskhevi. Mineral waters of the above stated gorge are distinguished in high concentration of diluted free carbon dioxide gas.

Geological-prospecting works have not touched yet the outcrops of carbon acid waters of the Adjaristskali river gorge either. Soda water of average mineralization (6.0 g/l) of Danispireuli is remarkable for its interesting chemical composition. Source debit is insignificant, but after prospecting and tapping works we can obtain mineral water resource of high therapeutic-health-improving properties. In this gorge we observe small debit outcrops of low mineralization carbonic acid waters of Namonastrevi.

Today, in the process of the development of mountain resorts the rational assimilation of various types of mineral water resources existing in this region can greatly contribute to this process. In this case, we can transform the resorts of climatic profile into climatic-spa resorts. To achieve it, it will be necessary to build bath premises and mineral water pump rooms on the sections of mineral waters located near the resorts; it will attract additional contingent of holidaymakers, guests and tourists and will provide functioning of mountain resorts at their full capacity all year round.

REFERENCES

1. B. Mkheidze, Z. Kakulia, A. Songhulashvili, I. Nanadze, M. Kopadze, L. Glonti. “Prospects of increase and assimilation of mineral and thermal waters resources of Adjaristskali river gorge”. J. “Science and Technologies”, 1(721), 2016, p.p.54-60 (in Georgian);
2. B.S. Mkheidze. Hydrogeology of perspective deposits of mineral waters of Adjara-Trialeti folded system. Transactions of Acad. Sci. Georgian SSR (Sector of hydrogeology and engineering geology)// Hydrogeology and engineering geology in national-economic assimilation of territory of Georgia; number 10. Tbilisi, “Metsniereba”, 1988, p.p. 39-50 (in Russian).

THE UPPER AND MIDDLE JURASSIC TERRIGENOUS COMPLEX OF THE KAZBEGI-OMALO REGION: CRITERIA TO DEFINE A SUCCESSFUL SHALE GAS PLAY AND SHALE RESERVOIR QUALITY

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In conventional oil and gas accumulations shales comprise the source rock, from which hydrocarbons generated following the subsidence. Through geological time, these hydrocarbons migrate from the source rock, through carrier beds and ultimately accumulate in porous reservoirs (typically sandstone or carbonate) in discrete traps. These traps are typically located in structural highs on the margins of the basin centers.

In the case of unconventional hydrocarbon accumulations (such as shale gas), everything gets upside down – with shales acting as both source and reservoir rock, and the extensive basin centers becoming the exploration targets. Besides, it is only within the last few decades that technology has enabled shale gas reservoirs to be exploited more economically.

Exploration for shale gas brings a series of new challenges; among them collecting various geological, petro-physical and geotechnical data for insufficiently thought-out and less explored areas of hydrocarbon provinces.

Report summarized some of the most important geological, geochemical and geotechnical criteria that are widely used to define a successful shale gas play; some criteria are necessary and others are desirable. The criteria are based on data from analogous shale gas plays in the USA, which are known to vary considerably from one another. The analytical data of the Kazbegi-Omalo region (availability and shortcomings) are presented below.

Organic matter content (TOC). Shales should be rich in organic matter, with total organic carbon (TOC) values > 2% [1, 2]. >4%. Jarvie [3] uses a cut-off of just 1% present-day TOC, and quotes averages for the 10 top US systems as 0.93-5.34% TOC. ***Kazbegi-Omalo region data:*** some data available from previous sources. In this study TOC in Kazbegi-Omalo region vary from 0.39 to 3.04% [2]. A cut-off of TOC > 1% is used for a potentially viable shale gas resource.

Gamma-ray values. High gamma radiation is typically an indication of high organic carbon content. Gamma log response should preferably be "high" [1]; 20 API above shale baseline; >230 API; >180 API; >150 API, but lower if TOC is demonstrably high (D. Gautier, USGS, pers. comm.). ***Kazbegi-Omalo region data:*** not determined.

Kerogen type. Kerogen should be of Type I, II or IIS [1]. Ideally, II [3]. This indicates a planktonic, marine origin. Information on kerogen type is incomplete. ***Kazbegi-Omalo region data:*** Chichua *et al*. [4] identify Type III kerogen in southeast basins of the Greater Caucasus. This type of kerogen is mainly derived from terrestrial vegetation and has much in common with humus coal organic material.

Original hydrogen index (HIo). HIo preferably >250 mg/g [1]; 250-800 mg/g [3]. Note: it is important to have information on original, rather than present day HI values. This conversion depends mainly on kerogen type. ***Kazbegi-Omalo region data***: not determined.

Mineralogy/clay content. Clay content should be low (< 35%) to facilitate fracking and hence gas extraction. Jarvie [3] stresses the requirement of a significant silica content (>30%) with presence of insignificant amount of carbonate and of non-swelling clays. ***Kazbegi-Omalo region data:*** recent work combines mineralogical and petrological data of previous sources and new analyses.

Net shale thickness. Moderate shale thickness is considered to be ideal; >50 ft (15 m) [1]; >20 m ; >150 ft (45 m) [3]. Conventional wisdom is that the “thicker the better”, but this may not necessarily be the case [2]; >25 m in <200 m gross section. Thick shale sequences (100s of metres) tend to be regarded as “basin-centre gas” plays rather than shale gas plays. ***Kazbegi-Omalo region data:*** net potentially productive shale thickness with the possibility of thin units of higher-than-background TOC in the Kazbegi-Omalo region requires clarification.

Shale oil precursor. A shale oil precursor should ideally be identified. ***Kazbegi-Omalo region data:*** distribution of potential hydrocarbon resources in the Jurassic complex (at a depth of 7 km and upper) - milliard tonne of oil equivalent (toe)/one thousand km^2 = 0.03/4.3.

Thermal maturity. The shale should be mature for gas generation; Ro = 1.1 – 3.5% is widely accepted as the “gas window”. Charpentier & Cook [1] use a cuff-off of Ro >1.1%. Smith *et al*. [5] use 1.1% as it demarcates the prospective area in the Fort Worth Basin; Jarvie [3] quotes a higher cut-off of Ro >1.4%; 1.2 – 3.5%; <3.3% . Conventional wisdom is 1.25 – 2%, but “empirical wisdom” is 1.75 – 3% [2]. ***Kazbegi-Omalo region data:*** In this study Ro = 3.5% and more [4]

Gas content/saturation. Gas should be present as free gas (in matrix and fractures) and adsorbed gas. Gas contents should be 60-200 bcf/section or >100 bcf/section [3]. ***Kazbegi-Omalo region data:*** not known.

Depth minimum. Depth >5000 ft (>1500 m) [1]. Lower pressures generally encountered at shallower depths result in low flow rates. ***Kazbegi-Omalo region data:*** thickness of Jurassic terrigenous sequences is 3000-6000 m.

Shale porosity. Typically 4-7%, but should be less than 15% [3]. ***Kazbegi-Omalo region data:*** preliminary data 7-12%.

Overpressure. Slightly to highly overpressured [1, 3]. The Barnett Shale is slightly overpressured. ***Kazbegi-Omalo***

region data: not known.**Tectonics and burial history:** Preferably in large, stable basins, without complex tectonics [1]. Wells should be drilled away from faults, where possible**.** *Kazbegi-Omalo region data*: The Jurassic terrigenous complex of the Kazbegi-Omalo region formed in the sedimentary basin at the north edge of the Tethys Ocean. During the Toarcian-Aalenian the basin developed in conditions of *passive* continental margin, *cratonic basin* and during the Bajocian-Batonian in *active continental margin* conditions.

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REFERENCES

1. Charpentier R.R. & Cook T.A.USGS Methodology for Assessing Continuous Petroleum Resources. U.S. Geological Survey Open-File Report. 2011, 2011-1167.
2. Gilman, J. & Robinson, C. 2011. Success and failure in shale gas exploration and development: attribu-tes that make the difference. Oral presentation at AAPG International Conference and Exhibition, Calgary, Alberta, September 12-15, 2011. http://www.searchanddiscovery.com/documents/2011/80132gilman/ndx_gilman.pdf
3. Jarvie D.M. Shale resource systems for oil and gas: Part 1 – shale gas resource systems, in J.A. Breyer (ed.). Shale reservoirs – Giant resources for the 21st century. AAPG Memoir 97, 2012, 69-87 .
4. Chichua B. et al. CMRI Report, 1980, 160 p. (in Russian).
5. Smith N. Turner P. & Williams G. UK data and analysis for shale gas prospectivity . In Vining B.A & Pickering S.C. Petroleum Geology: From Mature Basins to new Frontiers – Proceedings of the 7th Petroleum Geology Conference. 2010, 1087-1908.

STUDY OF WINE PITCHERS (QVEVRI) AND THE RAW MATERIAL USED FOR MAKING THEM

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Earthenware and ceramic pottery is one of the most important material monuments of Georgia. Wine pitchers occupy a special place among them. The tradition of making wine pitchers in our country is 8000 years old and is a part of Georgian cultural identity. It is a glorious fact that the leading experts of 7 countries, together with our scientists, considered Georgia to be a homeland of wine. In 2017, a monument of Georgian wine pitcher (qvevri) was erected in front of Bordeaux Museum (La Cite Du Vin) in France and it will remain there forever. Export of wine is of great importance for Georgia as for a sovereign country therefore, the demand for quality wine pitchers (qvevrebi) is increasing.

The production of wine pitchers strongly depends upon the mineral composition of the raw material (quality), treatment procedures and the technological processes of their drying and sintering. The raw material is composed of clay (kaolinite and montmorillonite group) minerals, similar to them (group of halloysite, chlorite and hydromicas) minerals and mechanical admixture minerals (feldspar group, quartz group, carbonates, ferric oxides and hydroxides, etc.). Fractional-granulometric size of minerals composing the raw material used for making wine pitchers, is also of great significance. Most clay minerals, composing the raw material, have to be of smaller sizes (less than 20 microns) in comparison with the mechanical admixture minerals of larger sizes (more than 20 microns).

Communication with winemakers showed us that a definite part of the pitchers in some cases spoil the wine kept in them; therefore we decided to study in detail the raw material used for making wine pitchers, mineral and chemical composition of old and modern wine pitchers, the technology of their making. At the same time, we began to search for the available information. The obtained data obviously show that detailed mineralogical, petographic, X-ray diffraction and chemical researches have not been carried out up to date, excluding fragmental works on certain issues. The fact is that the wine pitcher made of low quality raw material and by wrong technology is often the reason for spoiling wine. Therefore, at present it is very urgent to study the samples from the deposits of raw material used for making wine pitchers and to develop a final standard model of wine pitcher (qvevri).

At this stage, samples of wine pitchers have been investtigated found on the territory of Georgia. In particular in the Armaztsikhe-Bagineti and Armaziskhevi wine-cellars, in Kavtiskhevi (a fragment of the wine pitcher sent to the exhibition in Bordeaux), Dedoplisgora, Samadlo and Gostibe, one made in 1980 and wine pitchers made in recent period in the Imereti, Kakheti and Guria regions. Raw material for making the wine pitchers extracted from pits located in various regions of Georgia (the Tkemlovana village in the Upper Imerety region, the Shrosha village in the Lower Imerety region, the Atsana village in the Guria region, the Vardisubani village in the Kakheti region, in Mtskheta) was studied as well.

As mentioned above the main goal of our research is the integrated study of raw material for making wine pitchers from various deposits of Georgia (chemical and mineral composition, grain sizes) and samples of wine pitchers made of the aforementioned material (chemical and mineral composition, grain sizes, density, porosity, water absorption, drying and sintering conditions). According to the obtained results there can be determined chemical and microbiological processes going on in wine during the winemaking and fermenting in the wine pitchers.

Polarizing microscope (AMSCOP 600T) was used to determine mineral composition (cementing and mechanical admixture material) and fractional-granulometric composition of wine pitchers and raw material used for making them. X-ray diffraction analyzer (DRON-3) was used to determine the essence and quantity of certain mineral phases and X-ray fluorescent analyzer (XRF EDX 3 600B) - to determine the total chemical composition of wine pitchers and raw material.

Data analyses of the carried out integrated studies showed that the samples of old and modern wine pitchers often greatly differ from each other. They are made of raw material of diverse mineral composition applying diverse technologic conditions. Some of them are perfectly sintered and some samples show that the process of sintering is not completed; visual examination of the latter ones show that they consist of three layers – two brown layers with a dark gray interlayer; the layers are not of equal thickness.

The X-ray fluorescent analysis showed that the content of rock composing and admixed chemical elements in the raw material from the Vardisubani, Tkemlovani, Shrosha, Meqatubani, Atsana and other pits differ from each other. It differs even within the limits of each pit due to various mineral composition of certain pits in accordance to the variety of depth and location conditioned by essence and quantity of the weathered at different degree minerals composing the primary rocks that were deposited and settled at different periods of time.

The X-ray diffraction analysis of the raw material used for making wine pitchers and of old and modern pitchers samples enables us to determine the essence and quantity of certain phases of each mineral composing and degree of crystallization of these minerals. According to the X-ray diffraction patterns we can determine the structural changes that took place in minerals after the sintering process - which mineral structure was transformed and to what degree. The mechanical minerals composing the raw material used for making wine pitchers such as: quartz, feldspars (plagioclases, potash feldspars), pyroxenes, amphiboles are resistant against the process of sintering at 950-1000^{0}C; they undergo certain structural changes but preserve the crystalline structure. As wine pitcher constituents, they are stable and they do not suffer from weathering and oxidation-reduction reactions; as for clay minerals, hydromicas, while sintering at 950-1000^{0}C their crystalline structure entirely changes and they transform into stable amorphous glassy phase. The existence of montmorillonite crystal phases in the wine pitcher sample points to the violation of the sintering process of the wine pitcher; in this case, the process of sintering is not finished; presumably, it was sintered at 750-800^{0}C. In the sample, having been sintered at 1200-1250^{0}C, high temperature conditioned the formation of hematite and mullite.

After sintering, the walls of wine pitchers remain partially porous. The essence and sizes of pores depend upon the essence of the minerals composing the raw material, their grain-size and sintering temperature.

The researches of wine pitchers and of the raw material used for making them were carried out by means of polarizing microscope (petrographic analysis). That allowed us to determine the nature of composing rocks and accessory minerals, their grain-size, the forms of mineral crystals, grains or rock fragments, products of transformation and its degree, the degree of cementing between the mechanical minerals and the basic mass.

ON POSSIBILITY OF USE OF WATER ACCUMULATIONS FORMATIONS OF TECHNOGENIC GENESIS, EXISTING IN GEOLOGICAL ENVIRONMENT, AS WATER ABSTRACTION SITES FOR IRRIGATION SYSTEMS (ON THE EXAMPLE OF MARNEULI)

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In the process of watering of agricultural lands, minimum resource consumption is achieved in the case of drip and sprinkler technologies.

In Marneuli region, against the background of increase of irrigation water deficit, modern irrigation technologies are actively introduced, among others, in small owner-operated farms. In the latter, water is supplied from low flow capacity branches of central channels. But in hot summer period, the water in these branches doesn't satisfy minimum water intake requirements. For prevention of such circumstances, preliminary "storage" of water, preparation of reserve by creating artificial water catchment basins (ponds) has been approved. It is related to expensive and labor-consuming processes and hence infeasible for low-budget farms.

On the sixth kilometer of the road, connecting the settlements Tsereteli and Baidari, a pond of inhomogeneous configuration is detected, which was formed on the south periphery of the road, on former paleo-pond of sub-longitudinal directions. Its south bank, through the steep slope, connects to the plain, which represents the first terrace above the riparian forest of the river Khrami. The north bank, with a cracked slope, spreads to the watershed hillock of the rivers Khrami and

Algeti. Former pond is fed by the discharge from the channel, following the north bank on the section, where the end of the paleo-lake depression is contoured by the hillock of sub-meridian direction (Fig.1).

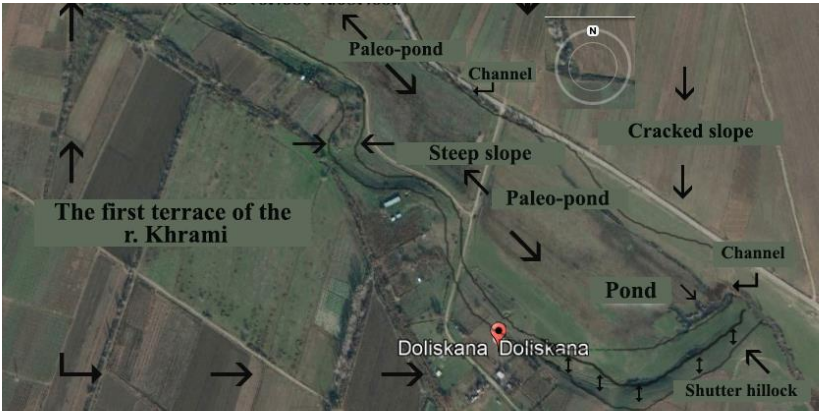

Fig. 1. Geomorphological Position of Pond.

The water in the channel flows, practically permanently, during the spring - summer, with more or less abundance. The pond does not dry in this period. According to primary data, its surface area was 1940 m^2. Average depth is 1.15 m. Water volume is 2231 m^3. Pumping out, performed during 10 h with the capacity of 60 m^3/h lowered the water level in the pond by 0.28 m. Consequently, flow of water from the channel to the pond made minimum 40 m^3/h.

At present, the pond should be regarded as reserve masin, potential water source, for implementation of watering using efficient, but energy consuming technologies. For identification of its real potential, research activities shall be conducted: exact circumference of the water surface shall be identified, depths of the pond shall be studies in the whole aquatorium by means of multi-point measurements; monitoring shall be carried out for recording of seasonal variations of water level, as well as water inflow data. The above-stated is related to financial costs. Irrigation using the selected technologies also requires financial expenses.

We consider the expedience of implementation of the proposed idea, as compared with traditional method, against the background of demonstration of significant advantages of irrigation using technologies and the existing water resource crisis in the world.

If, for watering of 1 ha area in the case of pour surface irrigation watering average norm is 800m^3/ha, for drip irrigation it is 80 m^3/ha. Consequently, in the pond with presently determined water reserve, single-time provision of 111 household plots of 2500 m^2 area is possible, which makes 27.7 ha. In the case of use of pour method, only 2,8 ha will be watered.

The view of US Kansas State irrigation systems from cosmos is considered the example of achievements of human civilization (Fig. 2). Green circles are blooming agricultural lands under desert conditions, watered using center pivot irrigation method [1].

a. View from cosmos **b.** Central pivot irrigation of pot

Fig. 2. USA-Kansas State. View of Agricultural Lands from cosmos.

On may 12, 1934, as a result of catastrophic deflation, caused by hurricane, 25 cm fertile layer of soil was removed from agricultural lands of Kansas. Restoration of vast destroyed areas became possible by filling underground aquifer –

"Ogallala freshwater sea", its utilization through boreholes and further, implementation of efficient – low-flow – central pivot irrigation technology.

During recent decades, deficiency of demand for water resources develop in accelerated pace in the world. Intensification of critical processes is conditioned by poly-component reasons. Mankind confronts these challenges as far as possible. One of key directions is reduction of water consumption in the process of utilization through development of innovative technologies.

Preparation of inactive pond fed by aimlessly flowing surface water, as water extraction site for irrigation based on highly efficient technologies shall be appropriate from the viewpoint of prevention of irrigation water crisis.

REFERENCE

1. http://loveopium.ru/fotografiya-2/chelovecheskaya-civiliza-ciya - iz-kosmosa.html

CORRELATION OF THE MAIN TECTONIC UNITS AND PALEOTECTONIC RECONSTRUCTIONS OF THE EASTERN BLACK SEA – CAUCASIAN – SOUTH CASPIAN REGION

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Eastern Black Sea – Caucasian-South Caspian Region sited at the central part of the collisional zone between Eurasian and Africa-Arabian continents represents a collage of lithosphere fragments of oceanic Tethys and its northern and southern continental margins.

Within the region, there existed systems of island arc, intra-arc and back-arc units. Several events of supra-subduction, MOR and withinplate types magmatic activity and obduction of oceanic crust, lateral displacement of lithosphere fragments took place during the Neo-Proterozoic, Paleozoic, Mesozoic and Early Cenozoic.

Final closing of the oceanic and back-arc basins, continent-continent collision, topographic inversion and formation of the present-day structure of the Caucasus was accomplished in the Late Cenozoic.

Regional geological, paleobiogeographical, geophysical and paleomagnetic data indicate a position-correlation of the main tectonic unites of the region in relation to Africa-Arabia, and Eurasia (Fig.1).

An interpretation in favor of a Gondwanan origin of Late Proterozoic-Middle Paleozoic Transcaucasian terranes basement rocks was proposed by Zakariadze et al [2]. During the Early–Middle Paleozoic, in the wake of northward migrating Gondwanan fragments the Paleotethyan basin was formed. Northward migration of the Transcaucasian massif throughout the Paleozoic caused narrowing of the Rheic Ocean (Prototethys) and its transformation into an oceanic back-arc basin. The crystalline basement of the fold-and-thrust belt of the Cavcasioni (Great Caucasus) consists of various Paleozoic metamorphic and magmatic rocks.

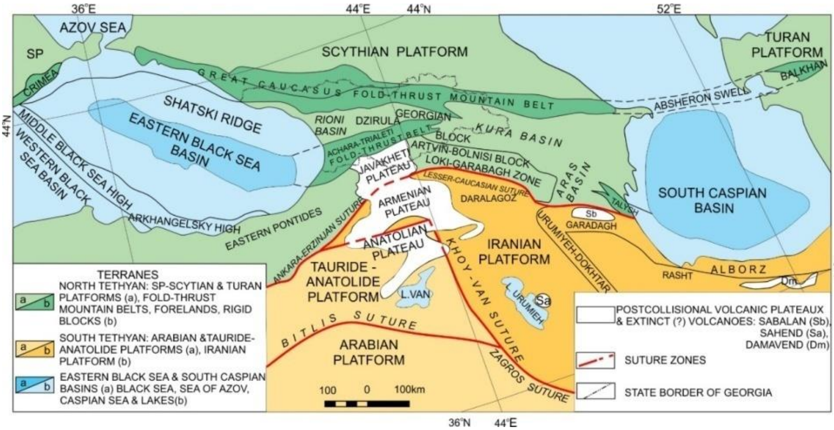

Fig. 1. Schematic map of the main tectonic units of the Caucasus and adjacent areas [1].

The southernmost strip of the crystalline core is represented by thrust slices of metaophiolites – Paleozoic oceanic accretionary complex. In the Late Paleozoic-Early Mesozoic, the oceanic basin separating the Africa-Arabian continent from the Taurus-Anatolian-Iranian platformal domain was gradually extending. However, this time, only the Central Iranian Terrain (CIT) separated from Gondwana. The Taurus-Anatolian Terrains (TAT) separated from Gondwana later, in the Middle Jurassic. The Neotethys was formed in the Middle-Late Mesozoic. Northward displacement of TAT resulted in its gradual approaching with the Pontian-Transcaucasian-Iranian active continental margin, narrowing of the Paleotethys-Tethys, formation of the suture belt between the TAT and CIT. The suture belt, apparently, is presented by fragments of ophiolite mélange of the Lakes Van-Urumiyeh and Khoy region (Fig.2).

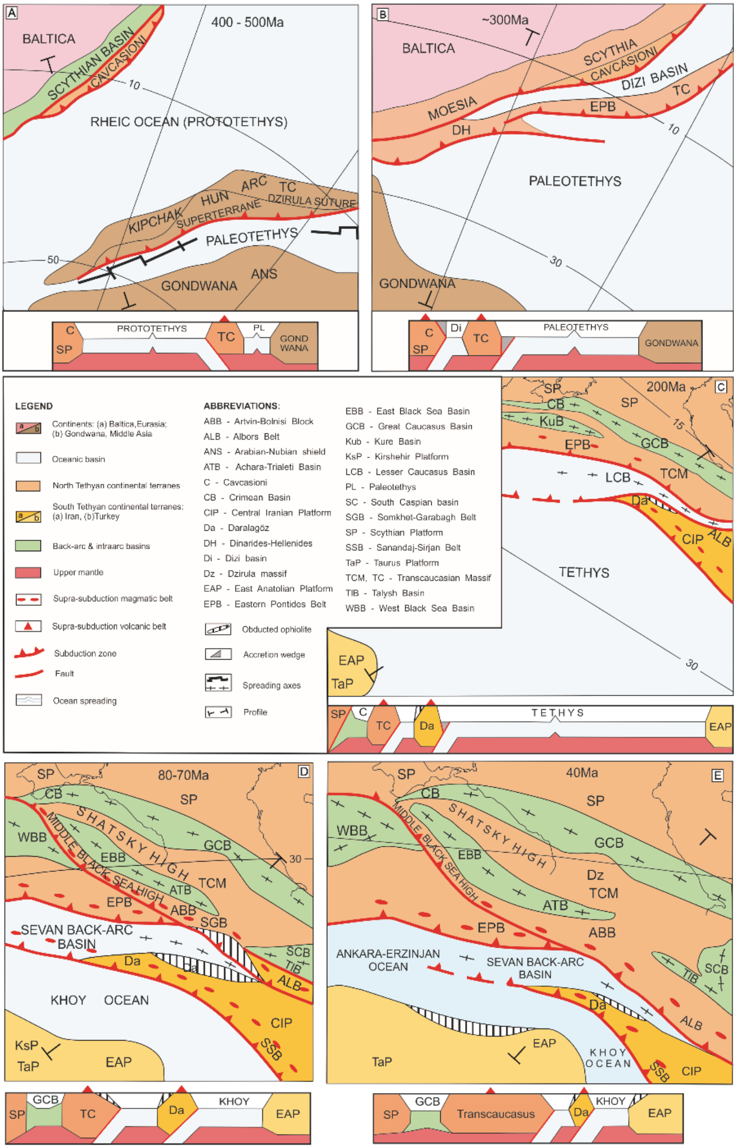

Fig. 2. Paleoteconic reconstructions of the Caucasus and adjacent areas: (A) Early–Middle Paleozoic,(B) Late Paleozoic, (C) Early Mesozoic, (D) Late Mesozoic; (F) Early Cenozoic [3]

REFERENCES

1. Sh. Adamia, T.Chkhotua, T. Gavtadze, Z. Lebanidze, N. Lursmanashvili, N. Sadradze, D. Zakaraia G. Zakariadze. Tectonic setting of Georgia–eastern Black Sea: a review. In: M. Sosson, R. Stephenson, S.Adamia (eds), *Evolution of the Black Sea and Caucasus*,Geological Society of London, Special Publications, 428, 2017, pp. 11-40.
2. Zakariadze G., Karpenko S., Basilev B., Adamia Sh., Oberkhanseli R., Solovieva N. and Ljalikov A. Petrology, geochemistry and Sm-Nd ageof pre–late Hercynian paleooceanic complex of Dzirula salient of Transcaucasianmassif: Petrology, v. 6, no. 4, 1998, pp. 422–444 (in Russian).
3. Adamia, S. Chabukiani A., Chkhotua, T. Enukidze, O. Sadradze, N. and Zakariadze G. Tethyan evolution and continental collision in Georgia, in Sorkhabi R., ed., Special Paper 525: Tectonic Evolution, Collision, and Seismicity of Southwest Asia: In Honor of Manuel Berberian's Forty-Five Years of Research Contributions: Geological Society of America Special Paper 6, 2017.
4. DOI:https://doi.org/10.1130/2017.2525(16)

ZONING OF MOUNTAIN TERRITORIES IN ACCORDANCE WITH THE DANGER OF EXODYNAMIC PROCESSES

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Exogeodynamic processes in the world. At the turn of the 20th century and at the beginning of the 21st century, on a global scale, the activity of exodynamic processes has increased enormously due to global climate changes, seismic activity and anthropogenic factors; these factors are of global character and develop over the whole planet; hence, their manifestation is also intense in Georgia.

Exogeodynamic processes in Georgia. The territory of Georgia, 70% of which belongs to a very complex region of the Alpine-Himalayan type in accordance with the development of exogeodynamic processes and risks of dangers among mountain countries, occupies one of the most important places. From multispectral spontaneous exodynamic processes, dominates landslide hazard (more than 53 000 landslide-gravitation areas (22%), debris/mudflows are recorded up to 3000 is the river basins, the total area of which occupies 29% of the country's territories. River floods and erosion reach 25%. 70% of the country's territory and 62% of the populated areas are in danger of geological disaster; 14.2% of agricultural land are intensively damaged. During the past 21 years, (1995-2016), the direct damage caused by landslide-gravitational and debris/mudflow processes amounted to 1.901 billion GEL, and 144 victims [1].

Early Warning System of exodynamic processes in the world and in Georgia. Activation of exodynamic processes is associated with many factors and it is difficult to determine in advance the exact time and duration of activation; but it is possible to determine the scale and study causes of their development, also as a result of observations, to evaluate the dynamics of processes, to create a database of single data and to rank the territory (zoning) for hazards [2, 3]; awareness of the relevant institutions and the population, also in case of the implementation of protective measures, mitigation of possible outcomes and their avoidance. To achieve the above-mentioned is necessary zoning of the territories by geohazards, development of alert systems and attention to the early warning system that is implemented in Georgia, in particular in the Devdoraki River-basin and which functions successfully.

REFERENCES

1. E.D. Tsereteli; M. Gaprindashvili; I. Chkheidze; Z. Kvaratskhelia; Sh. Lobzhanidze; O. Kurtsikidze; G. Gaprindashvili; O. Gogrichiani: Z. Maisuradze; G. Kunchulia; Z. Dolidze; O. Abutidze; T. Gerkeuli; M.Giorgobiani. Geological report envisaged by the draft law on the Rioni River basin flooding control climate-stable practice project - implemented within the framework of "the UN Development Program". National Environmental Agency of the Ministry of Environment and Natural Resources Protection of Georgia. Tbilisi 2014. 197 p.
2. E.D. Tsereteli, N.E. Tsereteli The danger of natural catastrophic processes in Georgia: the status, the methods of estimating the prognosis and protection. Proceedings of International Conference "Geomorphology of mountains and plains, interrelations and interaction". Krasnodar (Russia) 2001, 138-146.
3. E. Tsereteli, G. Gaprindashvili, Ts. Donadze, T. Nanobashvili, O. Kurtsikidze. Some aspects of the methodology of disaster geological process hazard and rise mapping on the example of Georgia. International conference „Applied Ecology: problems, innovations“ (proceedings) Tbilisi -2015, pp 30-36.

COMMODITY SECTOR OF THE WORLD: OPPORTUNITIES, CHALLENGES, AND LESSONS FOR GEORGIA

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In the recent 30-40 years, economic development of the world was synergistically followed by gradual increase of production and consumption of the main primary commodities. By the beginning of the new Millennium production of metallic and food commodities reached its maximum values, and further expansion of commodity production without worldwide exploration campaigns and dramatic increase of harvested area will lead to exhaustion of commodity resources.

Role of commodities in the modern world could not be overestimated. First, commodities are subject to worldwide inter-country and intercontinental flows, which, in turn, promote development of other businesses. Second, trade of commodities is the basic imperative on which the international commerce is based. Third, commodities provide excellent possibilities for private investments. Four, in a short-term run commodity prices are subject to distinct cycles and correspondingly predicttable. Such environment creates room for speculations, which, in turn, ensure liquidity of commodity markets. Economic modeling has shown that the world, the commodity exporting and the commodity importing countries' GDP in great extent depends on volume of produced, consumed or exported commodities. In other world, periods of economic development are characterized by increasing in commodity production and consumption whereas periods of recession are distinguished by diminishing volumes of produced and consumed commodities.

International commodity flows have huge impact on improvement of the modern world infrastructure. Development of crude oil and natural gas pipelines, tanker and LNG fleet, oil and LNG terminals, oil, gas and coal ports, etc. aim a sole target – efficiently and timely provide commodities to consumers.

Commodities play a significant role in the world geopolitics. President Nixon and State Secretary Henry Kissinger were perhaps the first ones who used the "oil weapon" for achieving political goals. In eighties of the recent century President Reagan persuaded Saudi Arabia to flood the world market with cheap oil at the same time providing inner market with petroleum from strategic reserves. These measures, known as "a new political economy of oil", ultimately lead to collapse of the USSR. Such measures were kept for the last time by President Bush in autumn 2008 to punish Russia for the war with Georgia and, perhaps, also Venezuela for rigid anti-American politics of Hugo Chavez. However, this time such a politics leads to a global economic crisis.

The main lesson of the crisis is very simple: the world has changed, and gambling with commodity prices is extremely dangerous; on the other hand, it became clear that extreme expansion of the finance sector on commodity market is destructive. Thus, a real equilibrium, a golden mean between the commodity chain and the world economic development should be urgently elaborated

Since 1970, natural gas plays gradually increasing role in global geopolitics. Today Russia is the most important gas supplier of the world. At the same time, it meets serious difficulties in pursuing its gas geopolitics, and its first obstacle is Ukraine: 70.15% of gas exported to the Europe passes through Ukrainian gas pipelines, 18.41% – through Belarusian network and only 11.44% are directly exported from Russia to either Finland or Turkey. The Nord Stream has not significantly improved the situation. Of course, Ukraine tried to use this circumstance for its own benefit, and these actions are leading to Russia-Ukraine gas conflicts. Thus, all actions of the Russian

Federation against Ukraine should be considered from this point of view.

Surprisingly, consecutive administrations of Georgia paid no attention to these global tendencies. Moreover, Georgia is a country tending towards the EU but is applying the olden, obsolete Soviet Mining Code. Even the Russian Federation, Kazakhstan and other CIS countries with the developed mining infrastructure have changed mining legislation but Georgia like Uzbekistan and some other typically post-Soviet country had performed no steps in this direction.

Hence, examples of China, South-East Asia, Iran, Qatar, Venezuela, etc. have clearly demonstrated that the basic engine for economic development is extensive exploitation of primary commodities and their related downstream industries.

Mathematical and statistical modeling, which will be presented in course of the oral presentation, clearly outlines that only the usage of local and imported primary commodities may lead to accelerated industrial and economic growth.

The lesson is simple: the Georgian government shall change governmental management of primary commodities dramatically and rapidly, and only in this case the country will be able to overpass finally consequences of the economic crisis of the recent century nineties.

RESULT OF STUDIES OF CAUSES CONTRIBUTING TO DEFORMATION OF ACCIDENT-SENSITIVE BUILDINGS AND CONSTRUCTIONS IN TBILISI

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The present article considers the results of studies of causes leading to deformations of accident-sensitive, hazardous buildings and constructions in Tbilisi.

The following type grounds are used mainly for bases-foundations of deformed buildings-constructions existing is Tbilisi:

1. Anthropogenic, that is filled-up grounds, which are spread almost on the whole territory of the town and cover upper layers of its relief. These rocks are of very non-homogeneous structure and are mainly represented by clayey grounds with various contents of construction and everyday wastes. These rocks are used for foundations of buildings as a result of wrongly performed engineering-geological assessment and this often leads to rather negative outcomes [1, 2];
2. Clay-loamy type rocks of diluvium–proluvium genesis. These rocks in definite regions of the town have no alternative as base-grounds. They are distinguished by good tolerance but in wrong exploitation conditions, such as wetting or other anthropogenic effects, they quickly lose hardness, which often results in deformation of buildings founded on these type rocks [1, 2];
3. In the studies of clayey rocks loess grounds attract our attention. These grounds are spread widely. When dry, they are characterized by properties similar to those of clayey ones, but when wetted they lead to big vertical deformations, that is land subsidence, which is rather dangerous for bases of buildings [3, 4].

4. Pebble rocks of alluvial origin are widely spread within the territory of Tbilisi. These layers are residues and fragments of terraces of the second and third groves of the river Mtkvari. As a rule, their filler, clayey rock contains gypsum. Experiments carried out by the Institute proved that in case of wetting these rocks undergo deformation, which is associated with leaching of gypsum particles from the ground.
5. The main petrean and semi-petrean rocks which form the structure of Tbilisi territory are mostly presented as succession of argillites and sandstones. In good conditions they reveal the best properties for founding (grounding) of buildings, but they are easily weathered and weathered layers created in the upper strata often create problems for foundations, especially in the zones where they are wetted [5].

Analysis of performed researches enabled us to determine the main factors and causes leading to deformations of hazardous building and constructions of Tbilisi, which can be divided into the following main types:

1. Endogenous factors: a) earthquakes and b) oscillations and vibrations of anthropogenic origin;
2. Exogenous factors: a) modern geodynamic phenomena and processes; b) impact of climatic-meteorological factors (wind charges, rain, sharp temperature changes, bad quality building material's prescription-attenuation" etc.);
3. Hydro-geological factors: a)deformations conditioned by alteration of levels of underground waters – suffosion, land subsidence; b) in case of loess or subsidence of base-grounds, their wetting due to damaged water conduits or depreciated communication networks; c) in case of salted bases-grounds the wetting-leaching of grounds and development of suffosion processes at the terms of damaged water conduits or depreciated communication network;

4. Inadequate evaluation of building properties of bases-grounds: building on non-consolidated anthropogenic grounds or other rocks of specific properties;
5. Violation of building rules and norms (wrong construction solutions).

As a conclusion, we can state that the main causes of deformations observed in buildings on the territory of Tbilisi are hydro-geological factors such as alteration of levels of underground waters at the terms of natural or damaged communication networks (or both together) owing to which leaching-suffosion and land subsidence processes are developed. Likewise significant place is occupied by the causes conditioned by incorrect evaluation of building properties of bases-grounds, violation of building rules and norms (incorrect superstructures) earthquakes, climatic-meteorological impact and others.

REFERENCES

1. G. Buachidze, G. Chokhonelidze et al. Analysis of engineering-geological conditions of Tbilisi in connection with deformation of buildings and constructions (in Georgian).
2. Japaridze G.V. Engineering geology of Tbilisi, 1984 (in Russian).
3. Chokhonelidze G.I. et al. Loess–type rocks of Georgia; “Metsnie-reba” 1977 (in Russian).
4. G. Chokhonelidze. Engineering-geological studies of Tbilisi loess –type rocks (in Georgian).
5. Engineering-geological description of petrean rocks of Tbilisi as bases-grounds (in Georgian).

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