MINERALOGICAL SOCIETY
OF GEORGIA

GEORGIAN TECHNICAL
UNIVERSITY

POWER OF GEOLOGY IS THE PRECONDITION FOR REGENERATION OF ECONOMICS

BOOK OF ABSTRACTS

International Scientific-practical Conference on
up-to-date problems of Geology

19-20 May, 2016

„Technical University“

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Tbilisi

2016

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ISBN 978-9941-20-649-8

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SH. ADAMIA, V. ALANIA, N. TSERETELI, O. VARAZA-NASHVILI, N. SADRADZE, * N. LURSMANASHVILI, A. GVENTSADZE
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Active tectonics of Georgia and the adjacent area is determined by its position in the zone of the Late Cenozoic continental collision. The Oligocene is considered as the beginning of syn-collisional stage of development when marine basins of the Tethys were replaced by basins of euxinic type. The collision between the Africa-Arabian and Eurasian plates in the Miocene -Pleistocene caused inversion of the relief - at the place of intra-arc and back-arc basins were formed fold-and-thrust belts of the Great and Lesser Caucasus with the intermontane depression in between [1, 2].

Starting from the Late Miocene, in the central part of the region, simultaneously with formation of molasse there have occurred volcanic eruptions mainly in subaerial conditions represented by intensively fractionated magmatic formation of supra-subduction-type calc-alkaline series from basalts to rhyolites.

Complex network of faults determines the divisibility of the region into a number of separate blocks. The boundary zones between these terrains represent the belts of maximum geodynamic activity.Three principal directions of active faults compatible with the dominant, near N-S, compressional stress produced by northward displacement of the Arabian plate can be distinguished in the region – longitudinal WNW-ESE or W-E and two transversal NE-SW and NW-SE. The first group of structures (WNW-ESE) having the, so-called, “Caucasian” strike is represented by compressional structures: reverse faults, thrusts, thrust slices, and strongly deformed fault-propagation folds. The transversal faults are also mainly compressional structures having considerable strike-slip component. The tensional nature of submeridional faults is evidenced by associated intensive Neogene-Quaternary volcanism in the Transcaucasus. NE-SW left-lateral strike-slip faults are the main seismoactive structures in the western Transcaucasus, while right-lateral strike-slip faults and fault zones are developed in the South-Eastern Transcaucasus. Considerable shortening of the Earth's crust has been realized through different ways: crustal deformation with wide development of compressional structures and lateral escaping. The geometry of tectonic structures is largely determined by the wedge-shaped rigid Arabian block (indentor) and by the configuration of the oceanic-suboceanic lithosphere of the Eastern Black Sea and South Caspian Sea (resistant domains), which cause bending of the main morphological and tectonic structures of the region (Fig. 1).

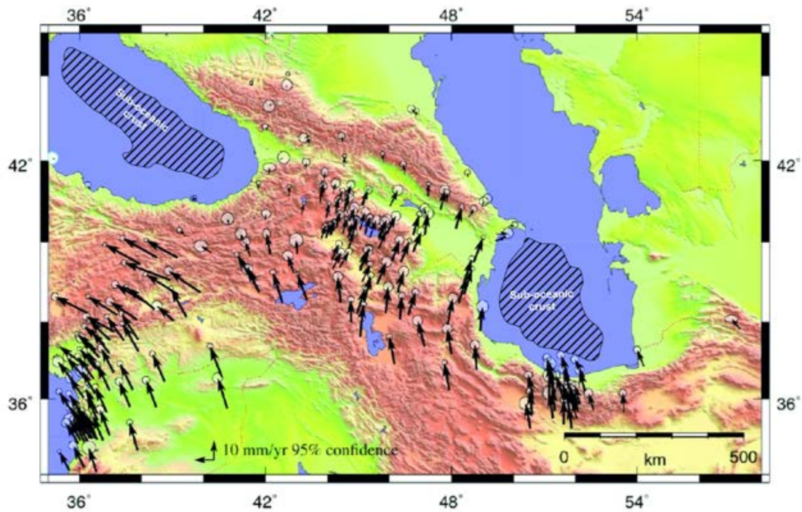

Fig. 1. Map showing GPS velocities with respect to Eurasia and 95% confidence ellipses for the Eastern Black Sea - Caucasus - Caspian region [3, 4].

Variations of P- and S-waves in the crust reveal clear correlation between anomalous high velocities of P- and S-waves with the pre-Caucasian foredeeps and Transcaucasian forelands. Clear spatial correlation of the areas with lowest P- and S-velocities with the areas of Neogene-Quaternary volcanism is traced as deep as 150-200km. Tomographic data unambiguously confirm spatial unity of the main structures of the Caucasus and its basement, the location of the structures in situ and connection of the volcanic constructions with their roots - magmatic chambers.

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THE RESULTS OF COMPIUTER MODELLED DIFFERENT POWERED FIRES

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In recent years there have been several high-powered fires in the world is motorway tunnels. These fires were developing rapidly to catastrophic size. Emitted smoke caused by burning and toxic gases also very dangerous for tunnel users and a lot of people became victims of harmful gases during the fire incidents. According to above-mentioned it is essential to prognosis tic ate burning material products for different version of underground fires. It is clear that fire developing depends on the sorts of burning materials and in the process ventilation is given great importance. In this case ventilation has double meaning it gives the fire basis necessary oxygen for burning and it also neutralize harmful mixtures in the air by reducing their concentration.

We have studied 5, 10, 20 and 30 MW powered fires developing processes by computer modeling to solve the issues is actual for tunnel personnel and for emergency management service for the adequate planning and fulfilling to rescue human lives and material values.

The above-mentioned researched were carried out to make two items exact.

1. What does it look-smoke spreading characteristic in tunnels in natural and mechanic ventilation and whether the speed of air flowing is in accordance the analogical data of happened fares?
2. How to assist tunnel personal to fulfill fast actions and what instruments can we offer them for appreciation and meaning in case of incidents?

In mathematical models the pressure difference between portals was 0.15 Pa by which was shown the imitation of ventilation.

The research subject of numeral modeling was to determine the speed of smoke spreading. As long as it is directly connected with spreading of toxic gases and the issues of their zoning. We reckon that practically at the same speed will happen spreading toxic gases caused by fire. Received results are in good accordance to in situ happened and naturally modeling fire results.

For example, when the difference of pressure between portals was 0 Pa the speed of smoke spreading was 2.8 m/ second and the power of modeling fire was 15 MW.

In the work on the basis by computer modeling is given in tunnels brought about fires to estimate and managing such criteria that on one hand will characterize during the files in limited areas of tunnels human life environment transformation in space and time, on the other hand will make effective the management of emergency situations.

For analysis motor-way tunnel is represented in space with limited expending to one direction complicated engineering structure where there is concentrated traffic flowing. This case stipulates the specific nature of emergency situation management-in limited area of management.

To the fire, that depends on determine its spreading by the tunnel length in above-mentioned work it takes place by virtual division of the tunnel in area zones. The determination will take place taking notice to harmful factors affecting humans health to think of their importance and intensity. During the fire in tunnels in emergency such factors are heat field and toxic materials spreading the area the dynamic of which are stipulated by burning process spreading in certain time.

The news is the possibility of adequate prognostication of rapidly changing situation during fires that is on its parts is the result of analysis received from mathematical modeling.

Thus, in the work we discuss the issue to rescue human life and health that is solved by qualifying fire dangerousness, by the area zones of its spreading taking notice of high dynamic and accompanied by turbulent processes. High temperature, carbon monoxides and dangerous smoke zone determination that happens by talking notice of above-mentioned factors.

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INVESTIGATION OF MESOZOIC-CENOZOIC GEODYNAMICS OF GEORGIA USING PALEO-MAGNETIC DATA

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The goal of the research was to carry out paleomagnetic investigation of the Meso-Cenozoic rocks within the tectonic units, study the direction of the natural remnant magnetization vectors of the rock, stable part and its initial nature; develop the quantitative geodynamic evolution model of Georgia based on the paleomagnetic data.

For this reason, sample stuffs of Jurassic, Cretaceous, Palaeogenic and Neogenic rocks of these tectonic units were collected. Paleomagnetic method was used along the study of existing Mesozoic-Cenozoic rocks within the major tectonic units of Georgia along the selected three transversal main section. The pieces of ore, suitable for the paleomagnetic investigations were selected on site using the field magnetic susceptometer. The work made spatial orientation of the stuffs and measured their location elements as well as determined the distance between the sampling points. Later on, at the desktop processing stage, the collected samples were cut in the cube shape and laboratory testing was carried out to study their lithological composition, ferro-magnetic minerals and structure. Curie temperature and secondary magnetization cleaning regime was assessed, as well. Special instruments were applied to measure the paleomagnetic vector of each samples and the Natural Remanent Magnetization (NRM). Ancient character of the stable component of NRM was examined. Prove of its trustworthiness was verified with paleomagnetic tests; the reliability of the mean direction was tested by statistical methods.

Average paleomagnetic directions for each site of sample and its statistical indexes (angle of direction, scattering coefficient) were calculated. Existing paleomagnetic evidence with obtained from the investigations of the neighboring territories and big plates, allowed to evaluate quantitative migration of tectonic blocks and study the tectonic relationship in geological past, according to Meso-Cenozoic stages.

The investigations gave complete quantitative and aged paleomagnetic data for the territory of Georgia and allowed to study the Meso-Cenozoic geodynamics of the crust of Georgia (Caucasus region) with more reliability.

The conducted investigations have both scientific and practical use. From the scintific point of view, geological scientists solved both regional and local issues for the Caucasus and the whole Alpine Folding belt of neighboring areas by quantitatively characterized Meso-Cenozoic compliant geo tectonic reconstructions. Particularly, the distance between the specific tectonic elements, composing Caucasus and Trans-Caucasus intermountains of lower Jurassic, Lower Cretaceous and Lower and Upper Palaeogene epoch, in which significant tectonic movements took place in the time period and the geostructural pictures of the modern Caucasus was established. From the practical perspective, quantitative characteristics of the geodynamics may be utilized as regional metallogenic and paleogeographic map basis, and the data can be used to study spatial and aged positions of the various mineral composite systems.

The works have been unique in Georgia due to their complexity and the scale which contributed to settling main issues of geodynamics, developing paleogeographic and metallogenic maps and investigating reasonable distribution of the mineral resources.

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FAULT KINEMATICS AND SEISMOTECTONICS OF GEORGIA

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A detailed cartographic network of active faults on a 1:500 000 scale was drawn up and their geometric and kinematic characteristics were specified for the four stages of compiling a new seismic intensity zonation map of the territory of Georgia. Totally, there have been identified and studied in detail 27 long-developing deep faults and fault zones some of which extend far beyond Georgia, into the neighboring countries. A catalogue of active faults attached to the map specifies about dozen of various parameters essential for determining seismic potential of individual faults and the region on the hole. These parameters include fault kinematics, geometry of fault plane, depth of penetration, width of the fault zone, vertical and horizontal displacement, average slip rate along faults, etc. Most of this information has been obtained through detailed field observations, regional and detailed structural analysis, interpretation of aerial and space images. Generally, the obtained results are in accordance with earthquake focal mechanisms for some well-studied Caucasian earthquakes and data on repeated geodetic measurements (including GPS).

The geometric pattern of active faults and their kinematics are compatible with the overall submeridional compression of the region resulted from the Arabian and Eurasian palates. Three main directions of active faults are recognized: WNW-ESE (or- W-E) coinciding with the strike of the belt (so-called ”Caucasian” strike) and two diagonal- NE-SW and NW-SE. Kinematically, the first group is represented by trust- and reverse faults whereas the last two are mainly shear fractures of left-lateral and right–lateral displacement, respectively.

Spatial distribution of seismicity indicates that during the historical time practically all identified faults produced strong earthquakes of magnitude 5 and more. Correlation between geological and seismological data evidences that major events tend to be associated with the largest faults delimiting main tectonic domains of the region and characterized by maximum displacement and slip rates. Those are, in the first place, the main Thrust (M6.3 Chkhalta 1963 earthquake) and the frontal flysch fault (M 7.Rcha 1991 earthquake) along which rejuvenation and displacement of rocks over few tens of m took place during the neotectonic time. Most of the Caucasian earthquakes are shallow (3-20 km deep) related to the sedimentary cover and upper part of “granitic” layer. Few intermediate earthquakes are recorded only in NE Caucasus and North Caspian region.

MODELING OF ECHELON-LIKE FOLDS FORMED BY THE ADVANCE OF ARC-LIKE COVERING PLATE

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To attest the validity of inference on the mechanism of fold appearance in piedmont trough of the Ajara-Trialeti fold zone involved with the thrusting of the “Sakraula” tectonic nappe, we carried out an experiment on equivalent materials. The test was performed on a device allowing one-sided horizontal compression of a laminated model.

The source model represented alternation of layers (2-3 m) of petrolatum and petrolatum and kaolin alloy. Barite powder worked as a lithostatic load.

During the experiment, the initial model underwent gradual unidirectional compression through the arciform pressing body imitating the “Sakraula” tectonic nappe.

At horizontal movement of the pressing body lithostatic load gradually reduced, value of lateral compression did not exceed 20-30%. At the initial stage of compression of the primary model the frontal, linear folds were formed, which under gradual indentation of the pressing tool into the layered model gained an arc-like form parallel to the frontal part of the pressing body. At the second stage of compression, the load was gradually relieved causing thrusting of the slab (of the pressing body) on the laminated model; in the laminated model, additional folds echelon-likely positioned toward the margins of the overthrust stamp were formed. Axial planes of the folds incline in the direction of the main thrust.

Thus, the data of the carried out experiment confirmed our assumption about the formation of additional echelon-like folds in the piedmont trough of the Ajara-Trialeti fold zone.

INFRASTRUCTURAL ASPECTS OF ORE BEARING MEGASYSTEMS OF LOWER-MIDDLE JURASSIC SHALE TERRIGENOUS COPPER-POLYMETALLIC PROFILE OF THE CAUCASUS RIDGE

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The Georgia section of the Lower-Middle Jurassic shale terrigenous belt of the Caucasus ridge is presented by its central and partly eastern segments, which include Kazbegi-Lagodekhi and Chkhalta-Laila tectonic zones and a subzone of the eastern settling of the main ridge. Their constructing terrigene rock masses (enclosing rocks of mineralization) with abundance of clay shales and subordinate amount of sandstones belong to a low-carbon bearing formation [1]. They consist of early alpine volcanism products – effusion formations and sub-volcanic bodies.

A megasystem joins ore bearing systems of different generation, which formed and functioned at different time in pre-collision (spreading) and syn-collision (collisional) periods of evolution of the Jurassic marginal sea of the Caucasus ridge. Correspondingly, spreading (syn-sedimentation) and collision (post-sedimentation) ore bearing systems are distinguished.

The formation of spreading zones (axis subsidence zones) in the basin of marginal sea of the Caucasus ridge at the early alpine cycle of the development was realized in three-step regime: Sinemurian-Early Pliensbachian, Upper Pliensbachian-Lower Toarcian and Aalenian-Early Bajoscian stages. Spreading ore bearing systems corresponding to these stages are revealed in three ore bearing series of rocks of the respective ages characterized by their synchronic magmatic formations: antidromic rhyolite-dacite-andesite-basaltic, sodium basalts and contrast basalt-rhyolitic formations [2]. At the same time, stratiform pyrite ore formation is connected with basaltic components of the mentioned formations.

To form spreading ore bearing systems and associated pyrite deposits existence of the following are necessary: sublatitudinal axis subsidence (spreading) zones and crossing magma- and ore regenerating submeridional deep breaks; local depressions conjugated with spreading zones by deep-sea facies sedimentation and submarine volcanic eruption, specifically, impulses of basaltic lava. (Although, in most cases, in spite of the existence of preconditions, an ore bearing system – stratiform pyrite mineralization is not revealed.)

Spreading ore bearing systems are more fully presented in the eastern segment of the Caucasus ridge where Jurassic marginal sea has been enlarged in due time because of subsidence of a crystalline core of the main ridge. Enlarged belt of the Inherited Lower-Middle Jurassic terrigenous sediments extends also to the East, on the territories of Azerbaijan and Dagestan. A shale terrigenous belt of the central segment is, on the contrary, narrowed, because its northern periphery is covered with the main overthrust of the Caucasus ridge. Correspondingly, a part of the ore bearing systems is buried.

Spreading ore bearing systems of the all three generations are presented in the eastern segment of the shale terrigeneous belt:

- Ore bearing system of Sinemurian-early Pliensbachian generation is revealed in the central part of the sedimentation basin. Here, at gradual deepening of the axis subsidence zone lavas erupted in antidromic succession – at the begining crustal rhyolites and dacites, and finally - pallial basalts. Following the latter, at the activity of postvolcanic metal bearing fluids relatively small scale stratiform pyrite deposits were formed. An example of the mentioned model is the Katsdagi deposit on the neighbouring Azerbajan territory.

Spreading zones of a new generation were replaced symmetrically towards the old (Sinemurian-Early Pliensbachian) spreading zone southward and northward.

- Ore bearing system of the South Late Pliensbachian-Early Toarcian generation is the most productive according to intensity of stratiform pyrite deposits in the area of Matsimi-Kekhnamedan sublatitudinal deep break. It contains the Pilizchay gigantic pyrite-polymetallic deposit. Sulphur-pyrite veins of the Sagatori deposit are associated with the northern ore bearing system of the same generation.
- Ore bearing systems of the following Aalenian-early Bajocian generation are detected in the Katekhi (in the South) and Kyzyldere (in the North) deposits placed in sandstone clay shale beddings of Aalenian-Lower Bajocian, in constructing of which stratiform sulphur-pyrite veins participate as transformed bodies or primary ore relicts.

At present, in the central segment of a shale terrigenous belt, only one spreading ore bearing system of Late Pliensbachian-Yarly Toarcian generation is revealed. With this system sulphur-pyrite ores of Adange (Abkhazia) and Zeskho (Lower Svanetia) deposits are associated.

Generation and functioning of collisional ore bearing systems in the region are conditioned by early orogenic (Middle Jurassic) and late orogenic (Neogene) tectonic-magmatic activation processes. Epigenetic ore mineralization is controlled by sub-latitudinal over- and underthrusting structures, which itself are formed due to transformation of axis subsidence (spreading) zones of the marginal sea and crossing submeridional deep breaks are ore distribution systems. The ores are localized in the second-order depressions bordered with ore control systems. At that, the ore bearing systems of different generations are of various specializations. Ore bearing systems of early orogenic generation are specialized on pyrrotine paragenesis (copper-pyrrotine and pyrite-chalcopyritic) ores, and systems of late orogenic generation are specialized on pyrite paragenesis (pyrite-polymetallic and plumbum-zinc) ores. They are presented as independent (isolated) monochronic revealed ores as well as combined polychronic pyrite-pyrrotine ores or are put on primary stratiform pyrite deposits and condition their transformation to inherited stratiform body. Pyrite-copper-pyrrotine deposits of Sagatori, Zeskho and Kyzyldere are formed in the area of the early orogenic collisional ore bearing system, and Katekhi pyrite-plumbum-zinc deposit – in the area of the late orogenic system. Pyrite-pyrrotine-polymetallic inherited stratiform deposits of Katsdagi and Adange are the result of the effect of ore bearing systems of both generations.

Ore bearing systems of copper-polymetallic profile, both spreading and collisional, are auriferous systems. Gold mineralization revealing in stratiform pyrite ores (Pilizchay deposit) and deposited-diagenetic pyrite concretions are associated with the functioning of spreading system. However, gold content in shale terrigenous rock masses is mainly conditioned by activity of collisional ore bearing systems. Massive and vein-stockwork bodies of copper-polymetallic ores over their extension are substituted by gold-containing low-sulfidation quartz-vein zones. At that, pyrite-polymetallic ores of late orogenic generation are characterized the highest gold content. Concerning gold content, metamorphogenic quartz-low-sulfidation ptigmatic veins with increased gold content associated with zones of tectonic disturbances of terrigenous rock masses are of certain interest. They are prospective structures for gold industrial deposits, in particular, for revealing a deposit type similar to the Haile deposit (South Carolina, USA).

According to predictive interpretations developed on the basis of the infrastructural analysis of an ore bearing megasystem of copper-polymetallic profile of a shale terrigenous belt of the Caucasus ridge, it is possible copper-, plumbum- and zinc-pyrite deposits of the industrial importance to be revealed on the Georgian territory of the mentioned belt. Within the eastern segment of the belt in trans-Alazanian Kakheti territory the ore bearing structures extend, which contain typomorphic pyrite deposits in ore region of Belokan-Zaqatala (Katsdag, Pilizchay, Sagatori, Katekhi). In case of conducting exploration works, it will be possible to discover analogous deposits in these structures. Also, according to the ore content, the spreading zone Saketseti is more prospective in the area of deep break in the northern part of the eastern segment where powerful basaltic volcanism is revealed. At the eastern side of the zone inherited stratiform pyrite deposit is predicted. An attention is focused on areas covered with main overthrust of the central segment of the shale terrigenous belt where existence of buried stratimorphic and inherited stratiform pyrite deposits is supposed.

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PLACE OF GOLD MINERALIZATION IN ZONAL SERIES OF ROCK HYDROTHERMAL TRANSFORMATIONS AND COPPER-POLYMETALLIC MINERALIZATION IN THE STORI-SATSKHVREKHORKHO SEGMENT OF TRANS-ALAZANIAN KAKHETI

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Stori-Satskhvrekhorkhi segment of trans-Alazanian Kakheti presents a narrow strip of anti-Caucasian direction of the Lower-Mid-Jurasic terrigeneous deposits located in the area of the Stori submeridional deep fault influence within the Stori-Lopota anticlinorium confines. The core of this megastructure is constructed by the Stori series rocks of the Hettangian-early Sinemurian age: rough and coarse-grained plagioclase-quartz sandstones aleurite and pelite shale mid-layers and single bundles. Late Sinamurian-early Pliensbachian phyllitizated clay shales with sandstone mid-layers, Late Pliensbachian-early Toarcian monotonic clay shales and glishoid rock masses and Late Toarcian-Aalenian sandstone-clay shale deposits are seen in limbs of a fold at southern and northern sides. At the Lower-Middle Liasic levels of a section magmatic rocks are abundantly presented as subvolcanic bodies, mainly of gabbro-diabasic content and lava sheets.

Processes of hydrothermal-metasomatic transformations of rocks and ore mineralization are related to the functioning of Stori cross deep faults. Concerning a productive mineralizetion, hydrothermal alteration of rocks, according to the existing data, was realized at pre-mineralization, major mineralization and post-mineralization stages.

According to Korzhinski scheme of alkaline and acidic differentiation of hydrothermal solutions the processes of hydrothermal activity at pre-mineralization period in Stori series had to be revealed at two consistent early alkaline and acidic steps. Albitization of sodic metasomatism-plagioclases in plagioclase-quartz sandstones and generation of quartz-albite veins are associated with the early alkaline step. An acidic step is divided into substeps of leaching and redeposition. Acid leaching processes in Stori series affect terrigenous rocks and associated with them quartz-albitophyre bodies. As a result of their hydrothermal transformations similar metasomatic columns are formed: relatively weakly altered rocks in the outside zone, chlorite-sericite-quartz metasomatites in the middle one and in the inside zone – secondary quartzites (quartz-sericite metasomatites), which often are impregnated with pyrite.

Simultaneously with acid leaching processes, or a bit later, substances were redeposited in upper levels of the geological section. As a result, quartz, quartz-carbonate and quartz-chlorite veins were formed and impregnated, not rarely, with pyrite, importantly, at the time, plumbum, zinc and gold, which were leached from the Stori rock series, were regenerated in the Toarcial-Aalenian-Terrigenous deposits. Regenerated gold is connected with quartz-vein-low sulphide formations.

Productive ore mineralization is associated with the early- Orogen (Mid-Jurrasic) and Late Orogen (Neogen) stages of the tectonic-magmatic activation. At the first stage ores of pyrrotine paragenesis (copper-pyrrotine and pyrite-chalcopyrite), and at the second one – pyrite paragenesis ores (pyrite-polymetallic and plumbum-zinc) are formed. They are superimposed on the metasomically altered rocks of the pre-mineralization stage as well as developed in the relatively hydrothermally unaltered rocks. This circumstance makes it clear that intensive hypogenic transformations of the Stori rock series are not associated with mineralization processes. As for ore-adjacent alterations in productive mineralization, they are feebly marked with silicification and chloritization in pyrrotine paragenesis and with chloritization and calcitization in pyrite paragenesis. Further hydrothermal activity of the mineralizetion is also less intensive. At that time quartz-chlorite and calcite veins without sulphide are developed, which cross vein-stockwork zones of pyrrotine and pyrite paragenises ores.

Distribution of ores of various types is marked by vertical zonality. Pyrrotine ores are mainly connected with the Lower-Middle Liasic stratigraphic levels of terrigenic deposit sections, and pyrite paragenesis ores are mainly localized in the Toarcian -Aalenian deposits, although they are met at lower levels of the section where, as a result of their superimposition on the pyrrotine ores, polychromic pyrrotine-pyrite-polymetallic ores are formed. Tridimensional analysis of different veins of various mineral ores show that vein-formations of pyrrotine paragenesis are placed in the joints of the first-order deformation that occurred at the formation of folds, and pyrite-polymetallic mineralization is connected with joints of the next, second-order deformation, and not rarely with later structures [1].

Mineral-thermometric studies by homogenization and decrepitation methods confirm the staging ore-formation processes. Ores of the first, copper (chalcopyrite)-pyrrotine phase of the pyrrotine stage are formed in the temperature range of 350-280 ^{o}C, ores of the second, quartz-calchopyrite stage – in the range of 280-220 ^{o}C. Pyrite-polymetallic and plumbum-zinc ore formation of the pyrite stage occurred in the temperature range of 280-170 ^{o}C.[1].

Both pyrrotine and pyrite paragenesis ores bear gold-mineralization. Besides pyrrotine, calchopyrite, sphalerite and pyrite, there are arsenical pyrite and marcasite in insignificant amounts, sporadically loellingite, cobalt pyrite and valleriite in the Stori copper-pyrrotine ore series. Quartz-chalcopyrite phase and correspondingly pyrrotine stage ends with gold-bismuth-tellurium association formation. According to some data[2] gold-content in single specimens of zones streaked and impregnated with fine veins of chalcopyrite and pyrrotine is rather high. But thickness and length of these zones are of so small that existence of gold accumulations of the industrial importance is hardly probable.

More important and stable concentrations of gold characterize pyrite paragenesis ores, which are revealed with different intensity above Stori series at the upper levels of the section. Gold content reaches 0.6 g/tone in the polychromic pyrrotine-(pyrite)-polymetallic ores connected with upper Pliensbach clay shale terranes (Satskhvrekhorkhi ore manifestation), and the gold content is in the range of 2.6-2.8 g/t in the single spesiments of monochronic pyrite-polymetallic ores localized in toarcian-aalenian-sandstone-clay shale rock masses (ore manifestation in Pitsristsveri's ravine). Isotopic investigations show [1] that sulphides of pyrite paragenesis (pyrite, galenite and sphalerite) are enriched with light sulphur (δS^{34} up to -8.5‰). It appears, that source of sulphur in the process of ore formation were ore-content terrigeneous rocks, in which diagenetic pyrites consist of facilitated sulphur with the sulphide sulphur-like isotopic composition of ores. With great probability, metal-bearing fluid flows together with sulphur were enriched with plumbum, zinc and gold regenerated from the Stori rock series. Besides pyrite-polymetallic ore- manifestation, gold was assimilated in the quartz-vein low-sulphide zones.

Productive in gold mineralization gold-polymetallic and gold-quartz-vein-low sulphide types of ore mineralizations in the Stori-Satskhvrekhorkhi segment are revealed more intensevely in Toarcian-Aalenian terrigenous deposits. It is strongly necessary to study and estimate the distribution areas of those deposits on gold content in the gorges of the upper reaches of Khiso Alazani River and its left tributaries.

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GEOLOGICAL POSITION AND GENESIS OF GOLD OCCURENCES (UPPER SVANETI, NENSKRA AND NAKRA GORGES)

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The Greater Caucasus represents a collisional orogen, which extends for more than 1200 km between the Black and Caspian Seas in a NW-SE direction. In its construction, two major structural stages are distinguished: the Pre-Alpine crystalline basement and Alpine volcanic-sedimentary cover. The basement complex (200 km x 40 km) is mainly comprised of Precambrian and Paleozoic amphibolites, crystalline schist's, gneisses, migmatites, and granitoids. Several terranes are identified, separated by narrow regional tectonic unconformities or Jurassic depressions. The main part of the Greater Caucasus range includes the Elbrus and Pass terranes [1]. The Elbrus terrains contain upper crustal S-type granitoid and the Pass - I-type granitoid, that have mixed mantle and crustal sources [2]. The Alibeg thrust (SW-NW, <50-60^0) is the main structure of the region, along which the granite-migmatite complex of Elbrus terrane is thrust onto the Sakeni intrusive granodiorite of the Pass terrain. Within the structurally deformed zone, with a thickness of as much as 400-600 m, the rocks are brecciaed and mylonitized, and greisen alteration is developed. The Alibeg thrust is cut by relatively short Alpine faults. The granite-migmatite complex is a collisional-ultrametamorfic formation, which was formed during Upper Paleozoic (318±8 Ma; Rb-Sr age), under HT-LP conditions. Granitoids are represented there by conformity as mobilized cross bodies; their thickness ranges from single to hundred meters. Petrochemically these granitoids belong to S type, peraluminious formation. The Sakeni diorite-quartz diorite-adamellite igneous complex, with an outcrop area of 77 km^2, is an elongate body extending NW-SE and thus parallel to the trend of the Greater Caucasus. It is a meta-luminious mantle-crust I-type body, which was emplaced ca. 315±5 Ma (Rb-Sr age). Presently, four gold-bearing occurrences are located in the Sakeni goldfield: Kakrinachkuri, Hokrila and Memuli. They are localized along the northern margin of the Sakeni intrusion and controlled by the Alibeg thrust fault and intersecting Alpine fault systems. The mineralized zones are formed in the deformed and greizenized rocks of granite-migmatites complex and include veins, pods, and stockworks. Gold occurs with quartz-scheelite, quartz-pyrite-arsenopyrite, and quartz-stibnite assemblages. The highest gold concentrations are with the pyrite and arsenopyrite association. [2, 3] Gold and other ore-related element concentrations were determined in different laboratories; during the past three years, data were obtained from ALS Chemex (Vancouver, Canada) , LTD-Turkey Izmir Subesi and SGS Kapan laboratory using ICP methods.

The Hokrila occurrence is the best studied area of the goldfield. It is exposed on the left bank of the Hokrila River, can be traced for 2.3 km along strike, and has a maximum width of ~500 m. The gold content in the quartz-pyrite-arsenopyrite assemblage locally reaches 30 g/t, and averages 6.11 g/t. The gold content in the stibnite-rich mineralization is 1.23 g/t to 2.33g/t, but Sb concentration reaches 5-6%. Quartz-scheelite associations are located only in the western part of the goldfield, the most uplifted part of the Hokrila area, where W concentration reaches 2.21%. **The Memuli occurrence** crops out between Hokrila and Achapara. It is traced approximately for 1.8 km along strike and reaches a maximum width of 600-700 m. The Au concentration in the quartz-pyrite-arsenopyrite association ranges from 0.62 g/t to 2.84 g/t; average content is 1.26%. In the quartz-stibnite association, the Au content is approximately 1.0 g/t and Sb reaches 1.8%. **The Kakrinachkuri occurrence** is exposed on the northeastern edge of the

Sakeni intrusion and it follows the margin of the igneous body for 400 m with a width of about 40 m. Gold composition in quartz-pyrite-arsenopyrite associations reaches 2.43 g/t and in quartz-stibnite zones is typically 1.0 g/t. In these latter associations, Sb averages 2.12%. In the quartz-scheelite association, W composition is 1.17% [3, 4, 5]. The major tectonic element of the territory of **Manchkhapi gold occurrence** is the northward trending regional fault of general Caucasian strike. Conducted works exposed that on the Manchkhapi gold occurrence useful mineralization is related to hydrothermally altered crushed zone. Metal concentration is significantly high in the developed in this zone rather thick (15-30m) quartz veins which are characterized by complex structure. Average gold grades vary here within 2g/t limits. **The Lakhvra and Orkari gold occurrences** are localized on the left flank of the river Dolra. The zone is of general Caucasian trend and is traced on about 3 kilometers distance. From the North it is limited by the reversed fault, from the South it is limited by the major over thrust and from the East and West it is localized within the rivers Lakhvra and Orkari gorges. Gold is the major prospectivity determinant mineral of the occurrence. Its grades here vary from 0,8g/t to 5g/t**. The Uturi gold occurrence** is exposed on the eastern slope of the mountain Uturi. The zone is the elongation of the Kirari granodiorite intrusion and contact of the Lukhra suite. Maximum width of the zone reaches of 200-300 m. Gold is the major prospectivity determinant mineral of the occurrence. Its grades here vary from 0.7 to 4.18 g/t.

According to the recent classification, gold occurrences of the Nenskra and Nakra gorges are attributed to hydrothermal type of mineralization generated during the regional tectonic and magmatic activity, but away from the magmatic chamber. The classical examples of such type of mineralization are orogenic mineralizations which form in the actively developing orogenic systems. Such type of mineralization takes place under the conditions of high pressure (1.5-5kb.) and temperature (300-450^0 C) at 4-15 km. depth. The mineralization host-rocks are metamorphites, migmatites and magmatites.

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GEOENGINEERING ZONING OF ZEMO SVANETI TERRITORY FOR ITS RATIONAL UTILIZATION AND PROTECTION

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Regarding the detection of dangerous geological processes, ZemoSvaneti is one of the most notorious regions in Georgia. It is due to the hilly, heavily fragmented relief and complex geological composition of the river Enguri catchment basin, climatic and meteorological conditions and increasing scope of anthropogenic impacts on the geological environment.

To prevent the mentioned negative impact on the environment and ensure sustainable development of the territory, the condition of the area should be assessed.

The main goal of the research is to provide engineering and geological analysis of formations spread on the territory, to study the ground waters related to the rocks forming them, modern geological processes and lithological and stratigraphic complexes- ranging from strong rocks to loose rough-grained sediments; forecast of how geological processes and phenomena emerge and develop; taxonomic unit zoning of the area within which engineering and geological conditions are relatively homogeneous.

While further zoning of the research territory districts are separated with regard to the relief, and regions – according to the geological and genetic complexes of rocks.

The rocks within the research territory vary considerably by their genesis, lithological composition, conditions of formation, the age range (starting from the pre-Cambrian age to the top Quaternary layers) and their tectonic stress. Therefore, it has become necessary to group rocks according to those major physical and mechanical features, the distribution patterns of which were materialised in the relevant geotectonic and paleographic conditions. The largest taxonomic unit in such grouping is the so-called ***engineering and geological formation*.** Within the engineering and geological unit taking into consideration physical and mechanical features of rocks across the area, their sustainability and sensitivity to geological processes respective **lithological and genetic complexes** are separated.

Based on the conducted research, it will be possible to describe engineering and geological conditions of the Zemo Svaneti region, aiming at sustainable exploitation of the territory with environmental protection goals.

GOLD OCCURENCES OF GEORGIA

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The territory of Georgia includes part of the Alpine-Himalayan mountain-fold belt, which as a result of interaction of the Scythian and South Caucasus microplates geologically developed in the marginal area of the Eurasian continent.

Lithogeodynamic complexes, formed in different geodynamic regimes, are observed in the Caucasus, and minerals of different age, composition and type are related to them.

Gold manifestations within the limits of Georgia take different geotectonic positions. Gold manifestations are established in the southern slope of the Greater Caucasus (northern part of the South Caucasus microplate). In Svaneti, in the southern slope of the Greater Caucasus, gold mineralization is localized in areas of middle Jurassic tectono-magmatic activetion of early Jurassic and Palaeozoic terrigenous (in some areas volcanogenic) formations. Paleozoic sediments with graphitized zones are altered to greenstone facies and overlie granite-gneisses and amphibole shales. Gold-quartz (containing minor sulfides) occurrences are found in the Early Jurassic silicified carbonaceous shales, the Devonian-Carboniferous (Dizi series) volcanogenic sedimentary rocks altered to greenstone shales and the Middle Jurassic granodiorites. In some mineralized zones high concentration of tungsten, bismuth and tellurium is established. Scheelite-quartz veinlets are observed at gold-quartz veins.

Middle Jurassic quartz diorite bodies are defined in Dizi series. The Lukhra gold occurrence is located in one of them, where 10-12m thick gold-quartz zones are distinguished (average gold content of 8-10 g/t). Based on current assessment Lukhra occurrence gold potential is about 30 t of metal.

The northernmost occurrences, belonging to quartz-arsenic-sulfide type gold mineralization, are related to tectono-magmatic activation areas and are localized within Early Jurassic flyschoid sediments (Racha). The latter had been accumulating in axial zones of marginal sea. Orebearing shale-sandstones are carbonaceous, slightly carbonate. The zones by thickness of 2-3 meters and with gold content of 4.5-7 g/t (Zopkhito occurrence) are represented by carbonaceous shales, saturated with pyrite and arsenopyrite. They are largely spread (hundreds of meters along strike, 200-300 m down the dip), and contain small discontinuous quartz-antimony veins, some of them are tungsten containing. Sampling results of gold mineralization zones in mines showed that orebearing shales are enriched by cobalt, lithium, vanadium, arsenic and zinc; diagenetic pyrites are often gold containing.

In South Caucasus (within Georgia) Adjara-Trialeti Paleogene volcanics and intrusive, and in the east – Cretaceous volcanogenic-plutonic rocks are goldbearing (deposits: Madneuli, Tsiteli Sopeli, Poladauri).

There is the resemblance between the Madneuli and some Miocene Japanese deposits (the presence of isolated barite bodies and barite-polymetallic accumulations, including gypsum in lower horizons). The main difference, however, is that in Madneuli ore-accumulation process was realized within the closed volcanostructure (whose final formation took place in subaerial conditions), and in most Kuroko type deposits of Japan − on the sea floor.

A few words on goldbearing quartzites in the Madneuli polymetallic deposit. In our opinion, quartz veinlets in gold bearing brecciaed quartzites were formed almost simultaneously with explosive breccias. Gold mineralization areas are known also in Guria and Adjara region, within the Adjara-Trialeti fold system. Several gold anomalies are shown in Guria-Adjara region on the 1:200 000 scale map. One of them is Merisi ore district, which represents copper-gold porphyry paleosystem, outcropping by erosion. Vakijvari and Zoti mineralized areas are known in Guria, and Vaio and Namosastrevi - in Merisi district. The gold potential of Guria and Ajara region is about 80 t.

And now briefly on gold discovery perspectives in Georgia.

There have started exploration works in Sakdrisi deposit. In Madneuli deposit copper reserves expire, but following circumstances are of interest: in deep zones of quartzites copper content reduces and at the same time gold content increases (according to open pit data), it is possible that there is a "hybrid" type deposit in which epigenetic Kuroko type ores are changed by gold-copper porphyry ores in depth. But this is only judgment. At a depth of 1000 m granodiorite porphyry intrusive is established by drilling, the apical part of which contains molybdenum. It is possible, that Tsiteli Sopeli and Poladauri gold-containing structures are of economic importance.

In the Lesser Caucasus, within the limits of Adjara region is an interesting gold mineralization of Vaio. Some foreign investors were interested by this occurence. Vein zones (gold content ranges between 0.2-80 g/t), are located mainly in syenite-porphyries, which form a dome structure together with volcanics. It can be assumed that the volcanic structure is an outcome of syenite intrusion. Only its eroded apical part could be seen.

There are twelve gold placers in the southern slope of the Greater Caucasus, and more than ten gold occurrences, potential deposit of Luxra in the Kirari-Abakuri ore-knot; Arshira and Lasili in the Svaneti range; Tsana and Zopkhito deposits in Racha. Everywhere works should be carried out with study the ore technology. The estimated gold reserves of Zopkhito deposit are 40 t. Similar deposits attribute to economic type gold deposits in carbonaceous formations.

TESTING OF FELDSPAR CONCENTRATE OBTAINED FROM SAZANO PEGMATITES FOR PRODUCING CERAMICS

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Feldspar is a multi-purpose raw material, which is used as one of the batch components in fine ceramic, electroceramic, glaze, abrasive, welding electrode and other industries.

Granites, pegmatites, syenites, etc. are a raw material base for feldspar.

There have been discovered a large number of pegmatite bodies in Georgia, which are mainly concentrated in the surrounding areas of Shrosha and Sazano villages (Zestafoni and Terjola regions).

By mineral composition Sazano pegmatites are undifferentiated quartz-feldspar type, which essential minerals are microcline, albite, quartz and muscovite. The accessories are presented by biotite, garnet, tourmaline, zirconium and mineral ores. Among secondary minerals hydromica, kaolinite, iron hydroxides and manganese are found.

Sazano pegmatites in natural form do not meet the standard requirements in terms of alkali metal oxide amount and potassium modulus, and need beneficiation. The processing circuit provides desludging, electromagnetic separation and flotation, as a result of which I quality high potassium concentrate ($K_2O + Na_2O = 16.0\%$, $K_2O/Na_2O = 3.1$) is obtained, which can be used in the production of fine ceramic and electrodes, and II quality potassium concentrate ($K_2O + Na_2O = 11.4\%$, $K_2O/Na_2O = 1.9$) -for pottery and electrical engineering production.

For testing feldspar concentrates obtained from Sazano pegmatites in ceramics manufacture there were prepared different batch compositions, in which amount of concentrate ranged between 20 and 40%, and remaining part was comprised of different kinds of clay and Bajiti quartz sand.

Drying of ceramic plates made by plastic method was carried out in the air and then at 105^0 C. Afterwards plates were fired in kiln at different temperatures; ceramic properties of fired plates: air and fire shrinkage, water absorption, were studied and optimal temperature of firing was set.

Based on the data of experiments conducted, it can be concluded that the obtained by beneficiation of Sazano pegmatite I-quality concentrate is high quality component of porcelain batch and is suited for fine ceramic production, and II quality concentrate - for faience production. It has been established the optimum batch composition.

GOLD-METALLOGENY REFERENCE POINTS FOR THE AJARA-THRIALETIAN ZONE OF THE LESSER CAUCASUS FOLDING SYSTEM

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The principal reference points of gold-metallogenic specialization for the Ajara-Thrialetian zone is conditioned by functioning of regional (unified) ore-bearing system. This system comprises the Ajara ore complex and ore bearing areas of the Guria region, northern streak of Samtskhe Javakheti, south Iimeret and Shida Kartli north-western part. It is fitted on the Middle-Upper Eocene volcanic-plutonic association that, together with volcanogenic-sedimentary beddings (suits), contained in it, represents mineralization sites.

Ore-bearing system is of gold-copper-polymetallic specialization and porphyry style. In its infrastructure there are distinguished 5 metallogenic stages [1]: 1. Lower-intrusive – gold-copper-porphyry; 2. Lower-transitional - low-sulfide gold-quartz-veined in exocontact parts of intrusives; 3. Intermediate – quartz-veined-copper-polymetallic and interveined - gold-quartz-metasomatic; 4. Upper-transitional – of copper-polymetallic veined mineralization extinction and 5. Upper – argillized (epithermal).

The abovementioned metallogenic stages are represented by various completenesses and mineral associations in various segments of the Ajara-Thrialetian ore-bearing systems [2].

<u>In the Ajara segment</u> there are distinguished four metallogenic stages:

- Feebly expressed low-grade copper-porphyry stockwork and veinlet-mottled mineralization in the late-Eocene intrusive bodies (some ore-manifestations of the Merisi ore bearing accumulation and certain parts of the Uchanba ore-bearing field);

- Low-sulfide gold-quartz-veined formations of the lower transitional stage located in the exocontact zones of the intrusive bodies (the Charnali, Kirnati, Khalastavi, Chakvistavi, Maradidi, Khino , Chkhutuneti, Cocolety, Intskirveti and other ore manifeststions);

- Veined copper-polymetallic ore formation with auriferous metasomatites located in the intervein spaces of the intermediate stage (objects of the Merisi opre-bearing accumulations: Varaza, Obolo-kanli-kaia, Tskalbokela, Verkhnala, Veliburi, Vaio);

- Acidic metasomatites (argillitized)horizons of the upper metallogenic stage with alunite and pyrite layered and vein-shtockwork bodies, zones of alunitization and pyritization and secondary quartzites (the Ghoma-Tsinaveli ore bearing field) located within their borders. They represent epithermal level of the porphyry-copper ore-bearing system, back parts of that can contain large-scale accumulations of gold.

In the Gurian segment the lower-copper-porphyry metallogenic stage is expressed most weakly. It is associated with diorite-granodiorites and syenite-diorites; it is represented by peg-matite mineralization fixing root levels of fluidal flows (certain areas of the Zoti and Vakijvari ore bearing fields). Intermediate low-sulfur gold-quartz-veined stage is grown on the copper-porphyry level and it is manifested on quite large area (the Zoti and Charkhi ore manifestations of the Zoti ore-bearing field, the area of the ancient settlements of the Vakijvari ore- bearing fields). In this zone gold mineralization is associated with metasomatites in the contact areas of diorite stockworks and Middle Eocene volcanogenic sedimentary rocks. The the upper-epithermal stage is distinguished by intensity of gold-ore-bearing; it is represented by acidic argillizated metasomatites and gold mineralizations located in the back parts of them (the Gonebiskari and Pampaleti ore manifes-tations of the Vakijvari ore-bearing field). Small gold-bearing streams, running against the background of argillizated covering within the ore-bearing area, fix fluid flows originated at depths and presumably they denote the existence of large-tonnage gold-bearing environment under the covering.

In the Samtskhe-Javakxeti segment there has been mainly revealed the upper metallogenic stage. Auriferous ore manifestations are incorporated into western-Gagvi-Nageba and eastern-Gujareti ore-bearing accumulations. The mineralized areas, with the unity of contrast metasomatic facies and non-equilibrium relations of ore-mineral aggregates, represent frontal zone of fluid flows functioning. At depth there had to be a stable regimen of ore formation. According to new ideology of prognostication and prospecting, based on this interpretation, there is expected large-tonnage gold-bearing mineralization in the back part of the non-equilibrium ore-metasomatic formations.

On the background of common genetic nature the auriferous ore-bearing objects are characterized by a number of autonomous peculiarities:

-the Gagvi ore manifestation is represented by greisen quartz-muscovite-tourmaline association. Greisens are substituted by beresites and the latter – by quartz-sericitic metasomatites on the background of that there developed postquartz –sericitic gold-sulphidic mineralization. Its formation corresponds with the argillizated (epithermal) metallogenic stage.

- the Nageba ore-bearing area is built by Middle-Eocene thick-bedded tuff breccias. The mineralization is controlled by the powerful fracture zone; in some districts of the zone there can be observed thin and quartz-multimetallic lense-shape formations of weak tension. They represent not the environment of standard veins localization but the “SiO_2 –injections” absorbing structure. These “injections” fix the ore forming extinction level, under which large-scale accumulation of gold is prognosticated.

-The ore manifestations of the Gujareti ore bearing unit (Gujareti, Vardevani, Qcia, Zukiani, Tone and etc.,) fix the gold-quartz-vein-sulfide stage of the copper-porphyry system and the epithermal (argillitized)level covering it.

The Imereti segment comprises the Zekari ore-bearing area that includes the Chochebi, Sairme and other ore-manifestations. According to the existing data their forming is supposedly associated with the ore forming extinction level that corresponds to that of copper-porphyry system pinching out. Under this level there is prognosticated mineralization of gold-quartz-low-sulfide type.

The Sida Kartli segment of the ore-bearing system is represented by the Garta-Dzami ore field. In its infrastructure there are clearly distinguished positions of the Garta gold-copper-molibden-porphyry and Dzama gold-skarn-magnetite deposits. As a whole, they are subjected to porphyry style of mineralization and make ore-magma unite. The fluidal activity stage of the Dzama postmagnetite-gold-sulfide deposit is synchronous with that of the Garta post-copper-porphyry gold-sulfide deposit. The impact of the aforementioned activity in the Garta ore-bearing Paleocene-Lower-Eocene carbonaceous carbonate-terrigenous formation could promote accumulations of commercial gold (of Carlin-type).

As a whole, the Garta-Dzami ore field represents a significant polygon for the development of prospecting-assessment works. The suggested prognostic-prospecting geological works, based on the reference points of the gold-metallogenic model of the Ajara-Thrialetian zone of the the Lesser Caucasus Fol-ded System, will make it possible to get qualified estimation of the gold-bearing ore in the above-mentioned region that most likely will result in reveling of a gold-bearing deposit (deposits)of commercial significance.

COMPARATIVE ASSESSMENT OF ROCK MASS RAITING AND FILTRATION PROPERTIES OF NAMAKHVANI HPP IN GEORGIA

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Hydro Power Plants of different capacities are being developed intensively in Georgia and this fact attracts strongly both local and foreign potential investors to such projects. Construction and operation of Hydro Power Plants is a guarantee for solution of energy problems encountered by the country. In practice, hydro power plants (sometimes even with small capacity) can be built at almost all regions of Georgia. With this point of view, it becomes important to study them and to evaluate in geotechnical point of view. It shall be mentioned that, with cooperation of foreign partners, some large capacity power plants like Mtkvari HPP and Dariali HEP were geotechnicaly studied and construction of these plants is at the final stages now. The following power plants are being geotechnicaly investigated in Georgia: NENSKRA, ONI and TSKHENISTSKALI power plants (cascades), as well as NAMAKHVANI Cascade in Tsageri region. Namakhvani Cascade Project includes construction of hydro power plants at the surrounding areas of the village Zhoneti and Tvishi in Georgia.

Engineering-geological maps at scale 1:2000 were prepared within Namakhvani Cascade geotechnical investigation. Lithology units, obtained during the drilling works, were studied in detail. The rocks observed at vil. Zhoneti, power plant building and substation area, as well as at dam sites, can be described as follows: clastic lava-breccias augite- labradorite and porphyrites, tuff-breccias and tuffs (Bajocian - J_2b_2); whereas at the vil. Tvishi site the rocks are represented by the Jurassic and Cretaceous varieties, in particular: Jurassic tuffs of andesite composition, tuff-breccias and porphyritic lavas (Bajocian - J_2b_3) and multicolored clays, alternation of bedded clay sandstones and calcareous sandstones (Kimmeridgian and Tithonian - J_3km-t); also thickly bedded crystallized sandy limestones of the Cretaceous age, dolomites and dolomitized limestones (Berriasian-Hauterivian - K_1b-h); and very thickly bedded, dense and crystalline limestones (Barremian - K_1b_r).

The rock mass was classified according to the below listed three systems, as well as as per the following data obtained during geotechnical and engineering-geological mapping works: geological structure of rock mass, characteristics of discontinuity (number of joint systems, roughness, joint fillers, type of water inflow), uniaxial compression testing results, rock quality designation (RQD), orientation of main structures towards tunnel axis and other data:

1. RSR (Rock Structure Raiting);
2. RMR (Rock Mass Raiting);
3. Q (Rock mass quality index for tunnelling).

In addition to the aboe, Lugeon tests were carried out in the boreholes in order to determine filtration properties of rocks .

It should be mentioned that during these investigations, rock mass raiting and quality index were assessed in accordance to the international standards, and filtration characteristics, defined during the field testing (Lugeon tests), were checked for compliance with the above mentioned rock mass raiting and quality index data.

These types of rock mass assessments are very important for engineering facilities and especially for hydro power plants, in order to ensure safety during construction and operation process.

ENSURING SUSTAINABLE DEVELOPMENT OF THE SOUTH PART OF THE GEORGIAN SECTOR OF THE BLACK SEA

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International experience shows that financial means spent on protection of the sea and the ocean coastlines are substantially less than the cost of damages and the loss observed in case of no action. Development of the coastline is considered as important for economic advancement of Georgia. A range of miscellaneous projects is planned or in progress in the area. That is why, safeguarding stability and preservation of the coast, in condition close the naturally established one,is rather topical issue.

Georgia's coastal area, by its origin, is mainly accumulative. It has formed of river sediments carried in by the rivers of the Black Sea Basin over a long geological period. The current coastline established 5-6 thousand years ago, when, after arise of the Black Sea, the level reached its current value. Within this period of time, alternation of water level coupled with tectonic uplifting of the land and the underwater slope result in formation of several ranges of along-shore dunes [1]. The closest to the coastline frontal dune predetermines stability of established natural-geographic landscape and ecology. Beach provides full dissipation of wave energy by redistribution of the beach forming material. If the beach strip is damaged because of one or other reason, or deficit of nourishing sediments is the case, the risk of dune erosion occurs. In case the dune is washed off water ingress in the lower elevated areas can be ranked as ecological catastrophe [2].

Total length of the south section (Ganmukhuri-Sarphi) of the Black Sea coast in the limits of Georgia is about 113 km. Accumulative beaches bordering with the dune account for 96 km (85% of the total length); 4.5 km are used by Batumi and Poti ports; the rest 17 km (15%) are represented by abrasive sections, where the beaches are either non existent or border with stable intusive rock cliffs.

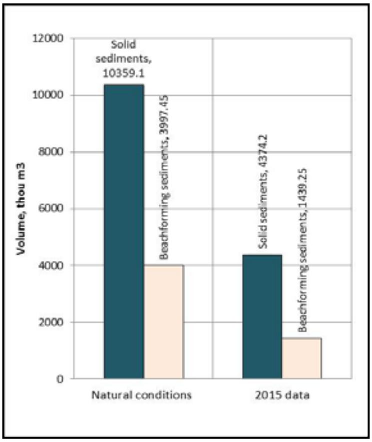

Fig. 1. Beach forming material balance

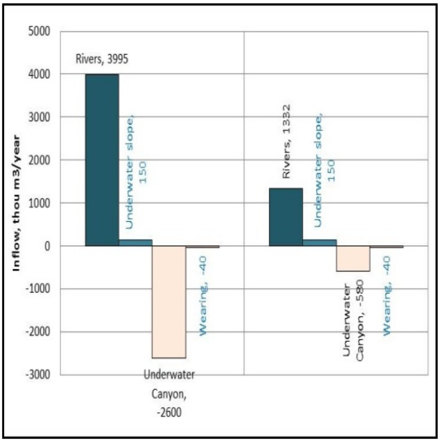

Fig. 2. Beach forming material balance by the rivers

In natural conditions nourishment of the beaches is ensured by sediments carried in by the rivers. Part of the total material introduced by the rivers, particularly the sediments with grain size ranging from 0.05 mm to 40 mm are forming a body of the beach. The beaches of Kolkheti lowland are sandy with grain size from 0.05 mm to 2.0 mm; whereas the beaches of Adjara are formed by shingles carried in by the Chorokhi River. The fact is based on petrographic surveys of the beach material carried out in 70 es of the last century [3].

Possible increase of the sea level caused by the global climate change is to be taken into consideration. According to the current forecast, by the end of the 21st century the global ocean level will increase by 0.4m to 2m. In this conditions accumulative shores, which do not experience beach forming material deficit preserve their stability. Otherwise, ingress of the sea and impact on protected areas located behing the dune may occur.

Preservation of the long-term stability of the coastline requires system approach, which, in its turn, calls forth development of strategic plan for sustainable development of the coastal zone. Main task of the strategy is preservation of the alongshore ancient dune by increase of the volume of the beaches. Volume and width of the beach must ensure full dissipation of wave energy.

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ON TECHNICAL WATER SUPPLY OF TBILISI

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Landscaping is one of the serious problems of the land planning in Tbilisi. In recent years significant decline of the green cover and withering of the plants is observed. To some extent, this phenomenon is due to the frequent droughts. The process is exacerbated by the fact that the plants are not watered, since technical water supply system is lacking. For urban sanitation services, irrigation and other technical purposes expensive, high-quality drinking water is used [1]. Obviously, this practice is unacceptable and alternative water resources to meet technical water demand are required.

The issue has been raised repeatedly; surveys aimed at identification of relevant resource had been carried out. Unfortunately, all attempts failed. Water obtained by drilling turned to be of poor quality [2].

This thesis describes results of preliminary studies carried out by the team and conclusions of the survey.

For provision of the city with technical water, underground and surface waters (small rivers within the boundaries of Tbilisi) have been studied.

Chemical and microbiological analyses of water from the boreholes drilled in various locations in Tbilisi and water from natural sources have been tested in the lab of the scientific research firm Gamma (certified under ISO 17025).

The regime of the groundwater contained in the Quaternary sediments of fossilized deep gullies and ravines in the limits of Tbilisi (the left and the right banks of the River Mtkvari) is drastically variable. This variability is conditioned by tight connection between the groundwater circulation, the surface streams/run off and atmospheric water [3].

Waters are mainly sulphate-calcium-magnesium type, with mineralization 3-4g/l and highly aggressive (SO_4, PH, H_2S).

Because of their chemical composition and sporadic distribution (spatial and temporal) these waters are not suitable for use (irrigation, watering, etc.).

For technical water supply use of Tbilisi Sea is deemed perspective. The filtrates are spread south and west to the reservoir (Tbilisi Sea) comprising Varketili, Avlabari and Gldani-Avchala areas [4]. Chemical composition and regime of the filtrates differ from that of the groundwaters mentioned above. The filtrates are bicarbonate-calcium type, with mineralization below 0.4 g/l and can be used for irrigation.

Currently the filtrates discharge into the Mtkvari and are "wasted".

To abstract technical water for irrigation arrangement (drilling) of a network of boreholes in Vakhetili, Avlabari, Gldani and Avchala districts is advisable. As mentioned above, in these areas probability of tapping low mineralized water is high.

However, it should be mentioned that abstraction of the filtrates must be done carefully with strict monitored applied, since intensive pumping may trigger increase of filtration from reservoir, posing aboveground environment and infrastructure in the area under the risk of damage.

Small rivers (the Mtkvari tributaries) within administrative boundaries of Tbilisi can be used for technical water provision as well. The studies showed that their chemical composition (mineralization <1.0 g/l)is in the limits set for irrigation water. First of all, cleaning up the areas, arranging headworks and protection zones is required. It should be noted that such hydro-technical structures allow regulation of the yield and enable avoiding flash floods and other catastrophic events during the high water seasons. In small gullies recreation and cultural zones can be arranged [5].

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DESTRUQCION OF CYANIDES BY BIOTECHNO-LOGICAL METHOD

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The problem of utilization of cyanide residues persists in scince for quite a log time. It obtains particular acuteness in the recent period, which is linked with the trend of intensification of mining and processing activities.

For example, operation of gold mining enterprise on the basis of Madneuli copper polymetal mine is a significant factor, causing ecological problems in Georgia. In the mentioned case, pile dealkalization method is used. The process is performed in the open air using cyanide compounds. As a result of technological process the problems of destruction (utilization) of cyanide compounds occurs to be utilization of cyanide compounds dispersed in the environment (atmosphere, wastewaters) in the period of performance of technological process, which is not paid due attention and aggravates ecological conditions.

Cyanide ions represent strong inhibitors of growth and cell metabolism (breathing, metabolism of nitrogen and phosphor) of living organism. They supperss cytochrome oxidase of mitochondria and cellular catalase, peroxidase, toryzinaze oxidase of ascorbic acid and phosphates. Cyanides suppress enzymatic activity through linkage in metalloenzymes of metal-bearing co-factor, thus hampering redox reaction, leading to the death of the organism.

Three directions of destruction of cyanides are considered: firs- chemical, second- biological and third-complex, which implies joint use of biological and chemical.Chemical methods are more actively used in practice so far, e.g. alkaline chlorination and oxidation with sulphur dioxide with the support of copper catalyzer. These methods have significant disadvantage, in particular, in the first case high concentration of chlorine and chlorineorganic compounds occur, causing environmental contamination, and in the second case the method can't ensure complete disintegration of cyanide.

Recently use of biological methods in complex with chemical has become actual. Laboratory researches proved that heterotrophic as well as autotrophic organisms like T. thioparus, T. thiocyanooxidanans da Nitrosomonas sp [1] are actively involved in disintegration of cyanides. Number of researches also established that species of microorganisms like Pseudomonas, Esoherichia, Alcaligenes, Althrobacter, Acinetobacter, Klebsiella, Bacellus have the ability of cyanide destruction [2].

Besides, some varieties of fungi (Aspergillus, Gleoeocercospora, Neurospora, Leptosphaeria) also can transform certain type of cyanides into enzymicly lower-toxic form [3]. Besieds, in case of existence of cyanides in complex (cyanides and thiocyanates) certain difficulties occur in the process of their destruction, which is related to the circumstance that association of different varieties of microorganisms and their complex involvement in the process becomes necessary.

In spite of difficulties, use of biotechnology allows development of technological schemes of full-value destruction of cyanides. Besides, biological method doesn't cause formation of other harmful substances and ecological safety is guaranteed.

The novelty of the research is that for the first time in Georgia, association of microorganisms will be studies, which function in natural as well as in industrial conditions and have the ability of destruction of cyanide compounds.

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OPINIONS ABOUT CASSIFICATION OF TRAVERTINE

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For the current stage of industrial development of Georgia, in parallel to mining of manganese, a great importance is paid to the research of non-manganese minerals' fields. Including search of building stones and construction materials. From that point of view, it is important to research such precious and widely used construction stone as travertine.

As a result of 10 years research on the territory of Georgia the author defined some important issues.

Namely:

1. Research of historical-architectural monuments of Georgia revealed that despite that travertine fields are discovered and described only in several places on the territory of Georgia (Truso, Aragvi gorge, Chiatura region), in archeologycal-architectural objects we find large amounts of travertine, usage of which does not correspond to the fields, and there is no indication of authentic casts.

2. In sources of Georgian history of art and archeological sources travertine is mentioned as „shirimi", which is the old Georgian name of the given rock. Also, this term is not used in Georgian geologic terminology, which according to author is not correct and impairs national scientific language as „travertine" is a local term as well, descending from a local toponym. Toponym „shirimi" is used on Mtiuleti range (mountain Shirimi, river Shirimiskhevi), where travertine is met. That's why we think it is reasonable to use this name in Georgian geological terminology.

3. The article includes definitions of calc-tuff, found at different authors and vocabularies. By considering these definitions it is revealed hat there is no common opinion about origin

of the given rocks. This also preconditions the fact of existence of valid classification of calc-tuff, which at its own turn causes inferiority of criteria of classification. The article also includes opinions about classification criteria of calc-tuff, which was enabled by results of corresponding researches and received figures.

4. The article includes petrographic X-ray data of typical samples of different fields of calc-tuffin Georgia.

Author assumes that studying travertine, the so-called „shirimi” has a great theoretical and practical importance, and it requires continuation and deepening of the research.

ANALYSIS OF DEVELOPMENT OF HYDROGEOLOGY SECTOR IN GEORGIA

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An important fact for young Georgian geological specialists is that Hydrogeology has been considered for a non-prestigious occupation for many years. What has caused in reducing of the interest for this branch, while the Hydro resources of our country are still in the process of being mastered, potable water supply problems have not still been resolved for a great number of populated areas and the issue of irrigation water supply is still actual for a lot of peasants. The question is if our country, is as rich in quantitatively abundant and flawless recourses of groundwater, as the old generation of hydrogeologists have left to us.

Our country must be one of those which haven't cared about the issue of conservation and saving of water resources. Numerous citizens are sure that water resources are unexhausted and easily extracted in our country and this has been taking place while saving of drinking water and the effective measures related to it, are getting more and more relevant around the world. Whereas the demand for the underground water resources as an environmentally friendly product is increasing worldwide and the practical meaning of Hydrogeology is getting even more remarkable, the number of hydrogeologists in Georgia is decreasing. Therefore, the inevitable process of generational change in this sector is a quite sensitive issue.

Unfortunately, for obvious reasons, centralized hydrogeological and exploration work hasn't been conducted since the 80's of the XX century (if not considering certain, non-systematic drilling works provided by individual entrepreneurs or limited liability organizations). Besides, the complex water jet research directed to control the quality of fresh ground waters is not carried out any more. Thereafter, groundwater inventory production has been shut, without which maintaining the quantitative and qualitative stability of underground water resources is impossible [1].

The long-term suspension of the complex hydrogeologic works around the country has resulted in a gradual loss of interest (not the need) toward the hydrogeology as a branch itself. In April 2015, the Georgian Technical University hold a practical-scientific conference dedicated to the problems in the field of modern geology. It was revealed at the conference that in the years of 2013-2014 there was a restart of ALAZANI Artesian Basin area and some fresh ground water's monitoring by the “NEA” and the Czech Development Agency. Moreover, the jetting network expansion is also planned in future [2]. After these successful and important steps in the Hydrogeology area we find urgent and necessary on the state entities' level, for such actions to be carried out, that will give a chance for interested young hydrogeologists (noting once again that their number isn't that great) to participate directly in the restarted hydrogeological works.

In this case they will be given a real opportunity to get acquainted with the modern methods of research, to analyze the survey results and future tasks with senior colleagues, expand their knowledge and practical experience in professional terms. This will be a guarantee that the industry will maintain staff in this field and gradually increase the motivation of many young people to serve to our country's really important scope.

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THE CRETACEOUS VOLCANISM OF THE RIVER TEDZAMI VALLEY AND RELATED AGATE CHALCEDONY ORE MANIFESTATION ISSUE

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The river Tedzamiflows at 80 km to the north-west of Tbilisi.

According to the tectonic zoning of the territory of Georgia, it is located in the East part of the central subzone of the Adjara - Trialeti fold zone [1].

The areaunder study, as all the Adjara - Trialeti fold zone is characterized by longitudinal zoningin; its northern zone volcanism develops from Aptian to lower Turonianincluding; in the central zone the volcanism's upper age limit rises up and includes upper Turonian, as of, the lower, southern zone, therein like theKhrami block of the Artvin- Bolnisibelt volcanism age includes Turonian-low Maastrichtian time, thus from north to south there takes place the rejuvenation of volcanism.

Structurally the object for study, Tedzamiis represented by the brachy-anticline, which is mainly built by the Cretaceous and Tertiary sediments.

The Aptian-Upper Cretaceous volcanogenic-sedimentary series is facially represented by volcanic breccias, tuffs, tuff-conglomerates, tuff-sandstones and alternately interbanded lava sheets, sometimes with spherical structure. Their mineralogy-cal-petrographic composition responds toandesitebazalts, andesites, sometimes bazalts; hornblende, biotite-hornblende and Biotite varieties are abundant. The total thickness of the series varies from several hundred meters to 2000 meters [2].

A thick lava complex is located on the middleAlbian stratigraphic level of the volcanogenic series;the thickness of the north wing is 200-250 meters, while the south wing grows to 500 meters. Under the lava complex, volcanic series is spatially connected with parallel dikes complex of submeridional direction, the quantity of dikes is about 100, the tcickness of this dike zone is 1-1.5 km. As for their composition these formations an over laying lava sheets are analogous responds to andesitebazalts, andesites, sometimes andesitedacits; mainly they are represented by hornblende and rarely bybiotite varieties. Agate and chalcedony mineralization genetically and spacially connected with them.

Dikes, as a rule, never occurover the lava complex, that indicates, that they are outthrowchannels of these lava sheets and simultaneously ways of hydrothermal movements. Among the volcanic rocks with dike content there are generally developed spherical, glassy black volcanic rocks, that are of similar composition as the aforementioned ones.The latter ones are mostlyargillazed, carbonatized, silicificated. In these rocks are found agate-chalcedony, amethyst, jasper lenses, geodes, pockests and veins.

This latters generation is related to decay of the afore mentioned spherical formations of volcanic glass, significantly alters as affected by hydrothermal solution. Due to this process released SiO_2 in favorable physical-chemical conditions will precipitate the quartz varieties.

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PROSPECTS FOR THE DEVELOPMENT OF MINING INDUSTRY IN AUTONOMOUS REPUBLIC OF ADJARA

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Restoration of state independence in Georgia brought up a series of economic problems to the country that can be solved, by reconstruction and modernization of the existing branches of industry, as well as by creating new industrial fields based on the country's mineral resources.

In the context of creating economic independence in Georgia currently the primary importance is attached to supplying by precious (gold) and rare metal sources.

In the last decades Georgia entered into a list of gold and rare metal carrier regions, from among geological industrial types of which secondary quartzite and hydrothermal metasomatite are considered as promising.

Continuous increase of demand for rare metals in various fields of industries worldwide caused the necessity in creating mineral raw material base for their production. Increase of gold industrial reserves and study and exploration of promising ore occurrences of rare metal-bearing have been put on the agenda.

Hydrothermal metasomatites of Tsabla-Ghoma-Lashe ore field of Adjara ore district we can consider one of the promising ore occurrences in Georgia for solution of the issue. For many years one part of geologist scientists of the institute has been involved in comprehensive study of Adjara ore district. Development of the project “Prospects for the development of mining industry in Autonomous Republic of Adjara” is based on that particular experience.

Scientific research provides preparation of the ground for transfer of ore occurrences within the pyritic ore field from raw material base for producing sulfuric acids to raw material base for gold and rare elements.

It is the first attempt of comprehensive study of volcanic formations (alunitized tuff, basalt-andesite-basalt-containing lava layers, trachytes) within Tsabla-Ghoma-Did-Ghele ore-field for preparation raw material base for different branches of native industry.

For preparation potassium from trachytes the power-consuming sintering and hydrochemical methods are used. Biotechnological method for preparation potassium salts from alumosilicates will be developed as environmentally sound and economic. The mentioned salts are not produced in Georgia, and demand for this product is very high, in agriculture and chemical industry as well.

Besides, the study of Adjara trachytes for use in ceramic manufacturing (fine ceramics, electroceramics, etc.) is under way.

ECOLOGICAL-GEOCHEMICAL PROBLEMS OF GEORGIAN TERRITORY

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As it is known Republic of Georgia occupies great territory, despite this it is rich in mineral resources. It is vital for economic development of Republic to make extractions and realization of them. Also during the processing of the mentioned resources it is necessary to consider the fact of following ecological normative, for the purpose that unique natural data are not destroyed as a result of technogenic processes.

According to the works carried out by us and the previous researchers, technogenic and natural ecology-geochemical anomalies are distinguished on the territory of Georgia, and it is greatly important to learn them as for maintaining natural environment, as well as for the welfare of local population.

On the ecological-geochemic map of Georgia made by us which is based on dividing landscape-climatic regions the following geochemic anomalies are distinguished:

- Natural and technogene radiation;
- Mining and processing territory pollution;
- Spreading pollution of oil extraction territories;
- Qualitative and quantitative data of geochemical elements in ground and surface waters.

Map shows ecological-hydrologic division of water in Georgia: ecological-protected, defenseless and ecologically less protected waters.

Map also shows industrial objects, variations taking place in the cities of Georgia which represent potentially pollutant areas.

First of all, through our especially conditional signs those territories are denoted according to their ecological-geochemical changeability caused by technogenic processes, expressed environmental ecological worsening, stabilization and improvement.

Finally it may be said that Georgian territory represents ecologically stable region, with comparatively acceptable ecological index. The ecological-geochemical anomalies distinguished on map have limited area for spreading and are characteristic to only mentioned territories. Besides, it is necessary to learn these ecological anomalies for taking measures for the purpose of diminishing or eradicating them completely.

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THE HISTORY OF FORMATION AND THE SOURCES OF ORE MINERALIZATION FOR DEVDORAKI COPPER DEPOSIT (THE GREATER CAUCASUS)

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The Devdoraki copper deposit is situated in the northern part of Georgia on the NE slope of the Late Pleistocene Kazbek (Mkinvartsveri) volcano. It is located in the upper reaches of the Devdoraki River (left tributary of the Terek River) on the right bank of the glacier of the same name. It was discovered in 1903, and geological prospecting work as well as the small-scale mining took place here until the 1930s. The Devdoraki deposit was considered by its recourses of copper as the largest object within the Greater Caucasus. The famous Soviet geologists, namely A.P. Gerasimov, D.S. Belyankin, V.P. Rengarten and others, participated in study of this deposit and published a series of papers about geology, magmatism and ore forming on the territory of the considered region [1, 2]. The results of first stage in the investigations of Devdoraki deposit were summarized in the book of V.S. Bulygo (1930) [3]. He had estimated the resources of the deposit as more than 10 thousands tones and concluded that this object is not perspective for prospecting and exploration due to out-of-the-way place, absence of communications and necessary resources. Subsequently, no scientific investigations were conducted on the Devdoraki deposit. Only in the terminal 1990s the geochemical investigations were carried out within this territory by private mining companies for determination of the perspective of the Devdoraki deposit for gold extraction from ores.

The Devdoraki deposit is localized in the Early Jurassic black schists and siltstones of the Tsiklauri formation south of Main Caucasus fault zone. The host rocks are tectonized intensively, often carbonatized and silicificated. The schists are cut by numerous dikes and veins of Jurassic diabases and gabbroides. In the central part of the Devdoraki deposit there are two necks of dacites and series of andesitic dikes. Their formation is related to youngest activity of the Kazbek neovolcanic center. The territory of deposit is limited by caldera ledge of Paleo-Kazbek volcano in the north-west. The Quaternary lava flows related to different-age pulses of activity of Kazbek and Paleo-Kazbek volcanoes overly the crest of Bagni-Arch-kort ridge south of the deposit. Ore mineralization (pyrite, chalcopyrite, pyrrhotite, galena, sphalerite, tennantite, arsenopyrite, and cobaltite) is localized in sericite-carbonate-quartz veins gravitated to outer-contacts of young andesitic dikes. The ore veins cut as host Jurassic schists as diabase bodies. The average copper concentration in the ores is about 1.5% [3]. It should be noted, that studied part of the deposit (on the right bank of Devdoraki glacier) most likely presents not all territory with development of ore mineralization. It is confirmed by a great amount of the blocks reached by sulfide mineralization in the surface moraine of the glacier. It allows us to propose the presence of rich ore bodies in the hard-to-reach places near foot of modern Kazbek volcano at the altitudes above 3500 m. Moreover, the part of ore bodies could not be outcropped on the recent day-surface.

We have carried out a comprehensive isotope-geochronological and petrological-geochemical study of the igneous rocks and ores spread within the Devdoraki deposit for reconstruction of its formation history and determination of sources of ore mineralization.

The study of mineralogical compositions and character of ore mineralization on the Devdoraki deposit shows, that formation of sulfides took place here over two different-age stages. The first stage was marked by creation of ingrained and dispersed pyrite mineralization with regular cube forms of pyrite crystals (up to 1-2 cm). It occurs as in ore veins as in host black schists and diabase bodies. Complex lead-zinc-copper ore mineralization has been formed later. Its occurrences are known as independent veinlets in ore veins as dispersed impregnation and micro-inclusions in earlier pyrite. The sulfides are usually observed as irregular impregnation and inclusions in the matrix of ore-bearing veins.

The results of K-Ar dating show that the Devdoraki deposit is polychronous and has a long history of its development. The beginning of deposit formation likely was linked with intrusion of diabase bodies in the host Jurassic clay schists about 180-170my ago. In the Early Cretaceous the Jurassic volcanogenic-sedimentary sequences of the Southern slope of the Greater Caucasus were metamorphized (120-100 my ago) up to green-schist facies. As result of heating and migration of hydrothermal fluids the formation of poor quartz-calcite veins with pyrite mineralization took place. Subsequently, in epi-platform period of the Greater Caucasus development, when back-arc basin existed within the considered territory, the earlier formed pyrite occurrences was conserved over two hundreds millions years until the Neogene.

In Quaternary the ore-forming processes were renewed on the Devdoraki deposit. In time of 1st phase of Kazbek volcano activity (460-420ka) the pre-cursor of Kazbek was created in the tectonic zone of Main Caucasus fault. It produced basic and intermediate lavas composing nowadays a series of remnants of Devdoraki and Gveleti lava flows in the crest parts of Bart-kort and Bagni-Arch-kort ridges to north and south of deposit area, correspondingly. In the terminal time of this magmatic pulse (405-365ka) two small volcanic vents were active within the territory of the Devdoraki deposit. It had produced dacitic lavas mainly. A series of andesitic dikes intruded Jurassic sequences as well. The hydrothermal activity associated with youngest volcanism resulted in remobilization of ore components and their deposition as sulfide mineralization in outer-contact zones of andesitic dikes together with sericite, chlorite and quartz. Possibly, the most part of ores explored in the beginning of XX century was produced this time. K-Ar dating of sericite from ore-bearing veins confirms their Quaternary age.

The magmatic activity of Kazbek volcano reached its maximum around 250-200ka when the cone of Paleo-Kazbek was formed. Subsequently, caldera collapse took place after exhaustion of shallow magmatic chamber. On the caldera edge (upper reaches of Devdoraki glacier) an intensive crushing of Jurassic schists and volcanics took places with subsequent cementation of breccias by chlorite-epidote-quartz matrix. The hydrothermal activity over this time resulted in formation of reach ore mineralization within the caldera edge. Recently hydrothermal activity near Kazbek volcano continues in Karmadon gorge and near Abano glacier. It may be the evidence that formation of Devdoraki deposit continues recently on its deeper horizons.

Thus, the results of isotope-geochronological study indicate that Devdoraki deposit presents polychronous ore-magmatic system. It has been formed during two development stages of the Greater Caucasus, in Jurassic – Early Cretaceous and Quaternary time. The commercial copper - base metal mineralization was formed during youngest magmatic activity of the Kazbek volcanic center (450-200ka).

Pb-Pb isotope data indicate that the source of ores at the earlier (Mesozoic) stage of the Devdoraki deposit development was represented by metamorphized Jurassic sedimentary rocks, containing superposed pyrite mineralization. On the later stage the source of base-metal ore mineralization was represented by as metamorphic pyrite as hydrothermal fluids associated with youngest magmatic activity of Kazbek volcano.

This work was supported by RFBR (project # 14-05-00071).

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PERSPECTIVES DEVELOPMENT OF MINING INDUSTRY ENTERPRISES OF GEORGIA IN MARKET ECONOMY CONDITIONS

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1. Georgia's diverse and valuable mineral resources, historical traditions and experience, qualified mining science and engineering and economic staff is a huge potential, which is a sound basis in this field of business for effective functioning and that will significantly improve the country's socio-economic situation.

Mining in the implementation of economic reform in the field of business and market conditions, the insufficient development of the sector can not meet the requirements properly. The study will be improved in the field of economic reforms theoretical and methodological and legal basis the aim of achieving real ways and mechanisms to improve the organization of the market, small, medium and large enterprises and coordinated action to ensure optimal matching with environment generating conditions.

2. Recently, the mining production capacity around the world observed the growing trend of small deposits of successful operation of high-performance parallel introduction of mechanization, to equip them with new machinery, enrichment facilities, and to improve methods of processing systems. As is known, small fields directly associated with the small mining enterprises, - in the form of small mines, which have been carried out a small mining process.

Small deposits reserves exploration potential and economic feasibility of the product market and technical conditions for mining development with a special emphasis on the region's infrastructure development. Naturally, the limited investment in small enterprise profitability is largely determined by the access roads, power, costs, necessary for workers' living conditions, when deposit is situated and populated developed areas. In this case, mine design in preference to mineral extraction and refining small operation, well-tested, environmentally safe technologies by which is removed many varieties of mineral resources with significant quantities and in selecting of the means of mechanization it is used the modular mini relaying metallurgical systems in the form of mining and technical equipment for processing concentrates to dismantle and move of which on the new object as a result of the exhaustion of reserves is not associated with significant costs [1, 2].

3. In 2013, the nominal gross domestic product (GDP) of Georgia increased by 2.5% compared with that of 2012, to $16.2 billion. The country's real GDP increased by 3.2% in 2013 compared with that of 2012. The share of industrial production in the GDP in 2013 was 17.2%. Mining and quarrying accounted for 4.4% of the value of industrial production. In 2013, the real value of production in mining and quarrying decreased by 0.1%, whereas the real value of manufacturing production increased by 8.4%, indicating that Georgia's economy was growing after the economic reforms of the previous decade, but that the mining sector was lagging behind other sectors of the economy (National Statistics Office of Georgia, 2014c; U.S. Central Intelligence Agency, 2014) [3].

By 2014, the mining industry's total production ,,lion's share" (145.1 million GEL) associated with metal ore mining.

Mining licenses issued to registered increased growth (2013 year 1222 Enterprise) and active enterprises in 2013 − 478) as well. In addition, in 2014 the industrial production was 402.2 million GEL, which compared to last year has increased by 123.64%, and with respect to 2010 − 157.79%; The number of employees in 2014 amounted to 7 006 people, that is growth by 653 men, with compared to previous year, while in 2010 to the − 1 914 men; That same year 2014, the mining industry sector salaries amounted to 902.8 GEL, or the previous year increased by 10.2% in 2010 compared to the − 11.2%; According to labor productivity in 2014 amounted to 57.41 thousand GEL, while the previous year, and in 2010 was 51.2 and 50.1 thousand GEL; In addition, the mining industry has increased foreign direct investment in 2010 amounted to 53 435 900 million &, in 2011 − 40 219 600 million &, in 2012 − 4 862 200 million &, while in 2013 − 43 704 900 million & [4,5].

4. In the modern world the network form of coordination among large and small enterprises is considered as system efficieing factor. Large structures and small businesses in the integration process is crucial to the state's economic role objectively determined. The economic function of the support of large and small businesses to strengthen Integra-tion. This is reflected in the enterprise development environment. The state is obliged to make proper economic and organizational support to the integration process of the participants in both large as well as small businesses. In our opinion, should form the state and public institutions, which provide incentives for integration processes. Recently released a new form of so-called small business ,,incubators“. Small firms have occurred to some difficulties in the initial stages of financing, production, management and other fields.

This area must take into account the experience of the US in relation to the organization of business incubators. Because in Georgia there is an informal business incubators work experience, it is necessary to generalize this experience and the support of organizations that have business incubators [2, 7, 8, 9, 10].

5. One of important area of state's economic policy is the management of state property, which is even more important feature of the transition economies, where must be draw the line between property development and facilities management

functions. These considerations, as the mineral-raw material, as well as the mining industry enterprises management approach requires very careful attitude towards economic issues. In this regard, it is appropriate to mineral resources in the form of state property and the mining enterprises in the management of the structure to determine who will be in charge of this property and prudent management of economic relations and the establishment of factories in fiscal efficiency, which is considered an effective management mechanism, which is in charge of the mining industry in particular the industrial sub-economic policy, the implementation of the restructuring of enterprises, strategic and real investor, information and analysis of business plans, perspective plans of enterprises, dividends and profit distribution and other legal mechanisms and etc. In addition, this system of ,,bureau of mining" form, to be submitted in the name of State, including the Government; And, the management of mineral resources will carry out being under submission of Government the Department of Geology in the form of ,,Agency of Mineral Resources", thereby significantly strengthened its activities [2]. So, it is important to separate the from, the strategic direction from the issues of management of the economic mechanism, which, in turn, should be regulated by appropriate legislation.

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RESULTS OF COMPLEX RESEARCH OF THE PROPOSED „BORJOMI-KAZBEGI FAULT”

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The need for using multidisciplinary methods for study of the important seismic structures is emphasized. The research practices employed should include geomorphology, seismology, geodesy, geology, map analysis, seismic tomography and interpretation of stationary GPS data. As an example, such methods have been applied for investigation of the proposed Borjomi-Kazbegi Fault considered as the active west boundary of the Arabian wedge encroached from the south (Fig. 1).

Fig. 1. BKF – Left-lateral strike-slip fault. LLSSF regards as of strike from NE to SW, which crosses the whole Caucasus [1,2,3]

The analysis of geomorphologic maps has shown that the boundaries of Georgia’s main geomorphological units (Great Caucasus Range, Intermontane Depression of the Trans-Caucasus and South Georgia’s mountains) are not displaced under the impact of the proposed Borjomi-Kazbegi Fault.

No displacement was revealed along the proposed BKF as a result of analysis of the topographic maps. The hydrographic network is not disturbed. All topographic features continuously cross the proposed fault zone.

The data obtained from GPS stations point that directions and rates of the dislocations at both sides of the proposed BKF line are the same, i.e. no opposite displacement occurs due to strike-slip effect.

Structural stresses and slickenside alignments observed in the study area (e.g. in the Borjomi valley) should be explained by compressional impacts, but not the influence of the left-lateral movement.

Tectonic zones and sub-zones, as well as their boundaries are not displaced or disturbed under the proposed strike-slip effect. No structure shows any sign supporting their opposite displacement due to the strike-slip impact.

The foregoing conclusions have been justified by geological mapping, geological maps and profiles. In the case of the BKF occurrence, displacements of the mapped geological units should be obvious, especially if the strike-slip of such a considerable lateral displacement existed.

Locations of extinct volcanoes of the Great Caucasus do not match with the proposed Borjomi-Kazbegi Fault. The Neogene-Quaternary volcanoes of Mkinvartsveri (Kazbegi) and Quabarjina’s centers of Keli Plateau are not discontinued from each other or displaced horizontally in the opposite directions.

The map of earthquake epicenters does not confirm seismic activity of the proposed BKF. The seismic activity in the entire area is even.

The data of gravimetric and magnetometric surveys does not point to any displacement of the field contour lines across the proposed fault.

The special multidisciplinary study using the geomorphological, topographic, geodetic, geological, seismological, anomaly gravity and magnetic field methods have not resulted in any evidences supporting the occurrence of the proposed fault (Fig. 2) [1,2,3].

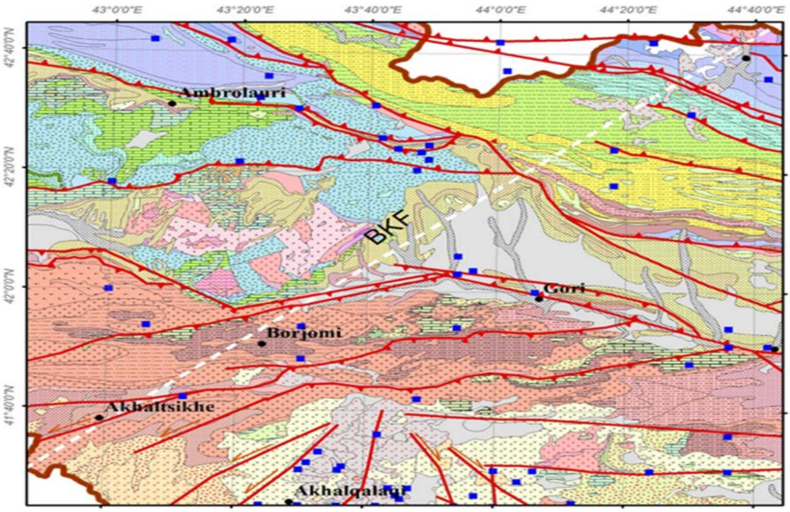

Fig. 2. Geological map of central Georgia, active faults and earthquake epicenters (Mw≥5) and so called Borjomi-Kazbegi fault - BKF

The seismic activity of Georgia, Caucasus and entire basin located between the Black and Caspian Seas, is mainly explained by about 25-30 mm/year rated north convergence of the Arabian microplate, regional crust deformation and disposition of the tectonic and geomorphological (topographic) units matching with the wedge shape of the Arabian microplate, as well as with the layout of the Black Sea and south Caspian Sea areas with oceanic and sub-oceanic crust patterns.

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CURRENT STATE AND DEVELOPMENT PERSPECTIVES OF THE COAL INDUSTRY OF GEORGIA

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1. Compared to Georgia's small total area, country is rich with natural resources, among which minerals are of the great importance. Nation's mineral resources fund counts 950 deposits of national and international importance (62.8%); the rest of deposits go to resources of local importance and valuables under investigation.

2. According to the historical data coal production in Georgia counts over 150 years, being nation's one of the most important fuel source until 1960-ies. Coal production had a very important role in country's economy serving as industrial fuel to ferrous metal sector, cement production, providing power sector with power coal as well. The highest year of production was recorded in 1958 at the level of 3,001.7 thousand tons of coal, out of which almost 48% fell to the share of Tkibuli-Shaori mines. As Armenia and Azerbaijan have no coal resources, Georgia was the only soviet republic in the Caucasus with own coal production. At that time coal was considered asintegral part of the country's energy balance. Starting from 1960-s of the last century the structure of Georgian energy balance has gradually changed, mostly caused by extensive construction of gas pipelines. Increased demand for natural gas turned to be a substitute to steam coal. In particular, this adversely affected production of lignite coal supplying thermal power plants. Due to poor development of extraction technology and geological conditions management, mines were closed one after another except Tkibuli-Shaori deposits, keeping relatively stable production but low volumes.

With Georgian coal reserves evaluated at 331.1 Mt the industry was stagnant for quite a long period.

Existence of coal deposits near Tkibuli was acknowledged in twenties of 19th century, while first production started in 1846 through open-casts by primitive method. At the end of 19th century coal was produced by deep mining. Based on results of additional field exploration indicating more than 500 MT probable reserves and 331 MT of geological reserves. Tkibuli-Shaori coalfield can be considered as deposit of international importance. ,,Western" mine was commissioned in 1941, followed by ,,Tkibulskaya" in 1942 and mine named after G.Tsulukidze in 1948. After 1951, when Shaori area was discovered, the Tkibuli coalfield was renamed as ,,Tkibuli-Shaori“. Forth mine was put into operation in 1973.3 With the commissioning of enrichment plant in 1952 it became possible to obtain coke concentrate (in the blend with Tkvarcheli coking coal), which was then supplied to Rustavi metallurgical plant. Along with overall tendency in coal industry, mining gradually declined since nineties reaching economically unimportant level, until reaching almost zero volume in 2005. 2006 year became turning point in revival of Georgian coal industry with foundation of ,,Saknakhshiri (GIG Group)“ Ltd. As a result of rehabilitation of the existing infrastructure and introduction of new technologies, coal production entered new stage [1,2,3].

3. Founded in April 2006, ,,Saknakhshiri" (GIG Group) Ltd is wholly owned by GIG holding with the operations focused on coal mining activities, including coal extraction and enrichment A solely owner of economically important coal mining assets, Saknakhshiri is a premier coal mining company in Georgia and only provider of locally mined coal.

Dzidziguri and Mendeli mines, where current operations are taking place, represent the key production assets, located within Tkibuli-Shaori coal basin in approximately 30Km from Tbilisi-Kutaisi Highway connecting east Georgia to the Black

Sea. The company owns a coal reserve amounted to 331 million tons in Tkibuli-Shaori region, while in Vale mineshafts (currently the mine is shut down), Saknakhsiri owns brown coal reserves of 76 million tons.

Quick Facts of 2014:

<u>Reserves:</u>

Hard Coal - 331 MT 40+ years maturity (Tkibuli-Shaori)

Brown Coal (lignite) - 76 MT 40+ years maturity (Vale)

<u>Financial Highlights:</u>

Annual coal production: 350kT.

Sales Revenue: 34.2 million GEL.

EBITDA: 8.2 million GEL.

Employees increased by 11% in 2014 and reached 1,450 people [3,4].

4. Out of two deposits at the disposal of ,,Saknakhshiri", Tkibuli-Shaori is the largest coal deposit in Georgia, while Akhaltsikhe (Vale) is the second large coal basin. At present, company's production takes place at Tkibuli-Shaori coalfield in two mines sharing common administrative and ventilation system. Akhaltsikhe deposit is not exploited, as there is necessity to conduct additional geological survey, according to international standards. In 2014, ,,Saknakhshiri" has produced 350Kt raw coal. For the given moment, our products are primarily used in cement production.

5. Nowadays we are actively involved in the building of ,,Saknakhshiri" into an integral part of the country's prosperity through constant work on maintenance and improvement of its technical and managerial expertise. Company continues re-equipping and re-constructing of the mines, opening new coal areas that altogether will further lead to more annual extraction volumes of coal in the future. For exploration and automation of extraction processes, last year, 3D mine planning system based on Data Mine software was implemented.

Extraction volume increase up to 850 000 Tonnes per year in order to ensure additional coal for the 150MW Thermal Power Plant, planned to be constructed by ,,Georgian International Energy Corporation“ Ltd in Gardabani.

New mineshaft development in Tkibuli-Shaori coalfield in order to ensure additional coal provision necessary for the 300 MW Thermal Power Plant, planned to be constructed by ,,Georgian International Energy Corporation“ Ltd.

100-150 MW Coal-Fired TPP: The new Coal-Fired Power plant project (installed capacity 100-150 MW) will be based on Tkibuli coal resources. Feasibility Study of the project has been conducted and company is in the process of selecting EPC contractor for the project. Projected Investment equals to 120-180 mln. US dollars and the project is expected to be constructed and commissioned within 36 months. After completion of this project, GIG plans to further expand by constructing two 300 MW coal-fired TPPs in Tkibuli.

Development of Coal Mine: Under existing coal mining license in Tkibuli region, the company plans to reconstruct and develop mine, which will increase coal extraction volume up to 2 million tons per annum. Development will require investment of around 240 mln US dollars [2, 7].

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MONITORING OF BEACH LITTER WITHIN GEORGIA'S BLACK SEA COAST

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****Scientific Research Firm GAMMA***

The problem of pollution of the coastal areas with solid waste has essentially become aggravated in Georgia in recent years. In Georgia the investigations concerning marine litter has not been yet carried out. Therefore, there is no methodology, experience or any research material with regard to this category of pollution. With consideration of the relevance of the problem of Georgia's coastal zone, we planned and implemented a pilot research program to eliminate existing gaps. Researches have been carried out within the framework of scientific topics by Al. Janelidze Geological Institute of Iv. Javakhishvili Tbilisi State University, with participation of Scientific Research Firm "Gamma". Preliminarily trained two students were involved in the research activities.

Based on the methodology [1, 2], beaches for pilot study were selected according to the following considerations: Ureki was selected as the first survey site. This is a famous resort, which has its customers. The resort is densely populated during the summer season. Due to its healing and recreational benefits, mainly children are spending their summer holidays there. In addition, nowadays intensity of construction works and infrastructure development is notably increased in Ureki, namely in Shekvetili zone.The northern part of Ureki borders the River Supsa Mouth.The potential source of pollution is the River on the one hand, and densely built-up town on the other hand. The beach between Kobuleti and Shekvetili was selected as the second survey site, namely 2 kilometers north from the extreme northern edge of Kobuleti. The area adjacent to the beach is not populated. The nearest source of pollution with solid waste is not observed (Pict. 1, 2).

50 m long sampling units have been marked on the selected beaches. Marginal spots have been marked with flag-markers. The exact locations on the map were fixed through GPS. Visible landmarks have been also recorded.

The pilot program included research of macro-litter - 2.5 cm large waste. All items in this size category were collected, identified according the "Master List",recorded and filled in proper forms [1].

After completion of works, all litter was removed from sampling units and were disposed in municipal waste bunkers.

Pict. 1. Ureki beach. October, 2015

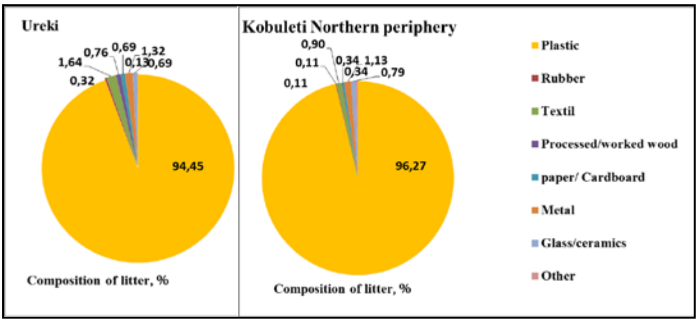
Pict. 2. Kobuleti beach

Obtained Results

Initial visual assessment of study beaches revealed that both study areas are full of unprocessed, natural wood debris. Despite the fact that this category of litter is not noted in "Master List", we still evaluated them. It should be noted that the obtained results in all cases will be approximate, as a relatively large logs of wood are collected and withdrawn from the beach by the local population, using them for heating purposes. Despite the estimated results, assessment of the existing situation on beaches could not be reflected without taking into account this category of litter.In future, this issue should be consulted with waste monitoring experts. Their recommendations will be considered during the preparation of the National Program.

The volume of natural wood litter on Ureki beaches in percentage is up to 90%, on northern periphery of Kobuleti beach – more than 66%. The share of plastic litter on Ureki beach is 9,54%, while on northern periphery of Kobuleti beach –32, 31%. The volume of other types of litter is negligible.

The obtained results show that the percentage distribution of the different categories of litter is similar for both beaches. If we measure the litter categories without natural wood waste, the volume of plastic litter is 95 – 96%, footwear and textile remains are a bit more than 1%(1,64 – 1,13% respectively), the volume of other types of litter is less than 1% (pict. 3).



Pict. 3. Composition of beach litter

Among the constituent elements of the plastic litter, the bottle caps take the major share - 30% and more. The volume of different sizes of plastic bottles is 10%. A large volume of different-sized pieces of plastic litter are also marked - 20%.

It should be noted that the volume of medical litter is quite high within the study section, including medication vials, ampoules, syringes and needles; transfusion system was discovered as well. For 100 m long section their density is 132 units on Ureki beach, while on Kobuleti beach - 114. Based on this, we suppose that hazardous waste is not properly managed within the study region and that they are dumped together with municipal waste.

According to the initial results, we can conclude that the litter on the surveyed sections of beaches is generated from land-based sources. They do not contain elements that could occur in the sea from ships, or could be related to fishing. Solid waste, including wood litter is transported by rivers into the sea. This explains the layout of litter like strips along the entire length of the beach, and the relatively clean and contaminated zones alternation.

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THE USE OF AGRO GEORGIAN MINERAL RESOURCES FOR PRODUCTION OF ORGANIC AND BIOORGANIC FERTILIZER OF NEW GENERATION

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For Georgia, agriculture is one of the priority areas. For its development it must be ensured that it was full and safe fertilizer. To this end, much of the mineral resources of the country were fully used.

The fououng: These resources are. primary and technogenic deposits of peat, coal and brown coal, phosphorite, trachytes, glauconite, zeolites, etc. In addition to improving these fertilizers must be used as waste production fashionable, polymetallic deposit and waste manganese production and other small and substandard field containing molybdenum, manganite, magnesium, cobalt, zinc and others.

Organic and organic-mineral fertilizers compared with less active mineral kinds and doses of use 5-10 times more, ceteris paribus. Now development of new methods and materials towards the activation of which will contribute to the production of new types of fertilizers to be on the level of activity on a par or better than mineral fertilizers. And that will provide a number of advantages both on plant nutrition as well as from an environmental point of view.

One of the main sources of organic raw material is peat. Deposits of peat in the country are located in many regions: Samegrelo, Upper Svaneti, Samtskhe-Javakheti, Abkhazia, Kvemo Kartli Kartli, Guria, Adjara. Total reserves of peat estimated at about 800 mils M 3, but these stocks are poorly understood and require further research.

Coal reserves are confined to the Tkibuli-Shaori, Tkvarchelski fields. In addition to these reserves to produce fertilizer and can attract coal lingnitovye unprofitable deposits. Such as the south of Kakheti deposits of brown coal deposits in Samegrelo Magana, Gelati Grigoleti deposits of coal, fartshanakanebi, Kwibi Gordski-field area forecast total reserves of 800-900 mil tons.

Of particular interest is brown coal embers and coals of other formations that are natural sources of metamorphosed natural humid acids. From this point of view is significant deposits of brown coal, with reserves Akhaltsikhe 75 mil Tony.

In the case of increasing the nutritional value of the fertilizer significant gain presence potash and phosphate components. Resources in this direction is kaliiderzhaschie trachytes, glauconite, phosphorite filifsiti and etc. Are the first three in the area covered by the Georgian Glebe confined to terrigenous-carbonate formations glauconite.

One of the main areas of deployment is trachytes Asskanska group bentonite clay deposits where estimated reserves trachytes in 8 mils Tony. Significant reserves trachytes location is Adjara region.

Glauconites scale representation in Georgia mainly as glauconite sandy limestones in the Cenomanian deposits and timed phosphorite forces.

Location them in western Georgia (godagoniskoe Lechkhumi and field) is of great interest potassium included kind of zeolite-filifsiti. It is a relatively rare species. In Georgia, a place situated in the accumulation filifsitov Guriiskogo ridge area (Lanihutsky poplars).

The field has good geological conditions and high content.

Filifsiti little studied species. Weakly studied as an indication field, hence the need for detailed further research. Based on the above thesis can be concluded that in Georgia there are considerable resources of mineral and organic cheese to develop new technologies and production of modern organic, organic-mineral and fights bio organic-mineral fertilizers and growth promoters plants provide both efficient power plants, as well as supporting environmental security environment among.

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PROSPECTS OF EXPOSURE OF GOLD CONNECTED WITH THE MORFOLOGY OF LINEAMENTS AND INTRUSIONS OF ADJARA-GURIA REGIONS

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Gold mining was developed in Georgia from the ancient times, what is evidenced by Greek myths and mine openings of the Bronze Age. Unique golden articles discovered at Vani excavations, alone, evidence that in our country great amount of gold was available and supposedly, its most part was of local origin. Great number of the golden ore traces in Adjaria and Guria offer that gold mining was practiced in this region as well.

According to our data, geological structural composition of Caucasus is basically determined by orthogonal-diagonal lineament systems [1]. These systems are segments of larger (sometimes even global) structures. Adjaria-Guria region – western part of Adjaria-Trialeti folded system, which is controlled by latitudinal lineament zone. This zone consists of the number of lengthwise elements and is of graben-syncline shape, with depressed middle part. In the western end part the folded system drastically changes its direction to south-west, that, according to our data, is caused by Pontus-Caspian regional lineament. The region is divided into several blocks drowned to the west with meridional furrows. Lineaments of north-western direction are represented in a form of individual ruptures, certain part of which are of covered nature.

The region, similar to the entire Adjaria-Trialeti zone, is built of the Cretaceous and Paleogene-Eocene volcanogenic-deposited rocks, though the configuration of the underwater trench was initiated in Aalen and then it was developing for the entire Jurassic period. Maximum drowning of the trench was achieved in the middle Eocene, when, of volcanic activity resulted in accumulation at calc-alkali volcanogenic and volcanogenic-deposit formations.

In the district there are revealed intrusions of medium and base compositions imbedded Merisi-Uchambosa and Vakijvari magmatogene deposits (syenites, syenite-diorites, trachites, gabro and gabro-diorites). In opinion of the number of researchers, the mentioned bodies are through, rod-batholitic nature and these are genetically related to the basic – sulfur-pyrite and gold containing copper-multimetallic ores and for this reason their investigation, reconnaissance and forecasting was conducted around these intrusions.

Our researches conducted on some of these intrusions revealed that these bodies are not of rod-batholitic shape but rather of steep sheet shape. Their necks are steep and, as a rule, are connected with the lineaments of different directions [2].

According to our data, metallogenic specialization of the region, is determined by the lineaments of north-west direction. We add to these structures in Caucasus the ore regeneration role. In case of Adjaria-guria ore district, mineralization is related to the Elburs-Daralagezi lineament zone, distinguished by us, which is spread over about 1000 km from the territory of Iran to the Black Sea and controls number of gold and multimetallic miners: in Iran – Staneh, Uteh, Zhiroft etc; in Azerbaijan – Gyumeshluk, Danzik, Sadarak etc., small mines in Turkey. Spatially, Adjaria-Guria gold-containing copper-multimetallic mines and deposits (Merisi, Charnali, Gonebiskari, Papaleti, Vakijvari, Nasaxlebi etc.) are related to the same lineament.

Scale of the l.lineament and its metallogenic specialization offers that the degree of potential of the golden ore deposits in the territory of Adjaria-Guria is high and, according to our data, require further investigation.

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RECOMMENDATIONS ON FIXED TAX FOR USE OF MINERAL RESOURCES

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The work is aimed at drawing up recommendations on fixed taxation for use of mineral resources. At present, under the law of Georgia "On Charges for Use of Natural Resources", the charge (tax) is imposed not on the extracted (mined) useful ore-bearing minerals (rock mass- nonmetallic deposits) but on their each component. This causes misunderstanding between the producer and the Tax Service. Taxable metals are extracted after ore is mill processed. However, the law of Georgia does not provide for granting licence for ore processing. Accordingly it is not taxable.

Therefore, the norms of the taxation do not correspond with reality. In his interview (Georgian Economics #26 2014) David Arevadze, doctor of geologic-mineralogical science, member of the Georgian Engineering Academy, spoke about this problem. The problem can be solved in case the fixed tax is imposed on the extracted ore (broken body of rock) according to the type and geographical location of the deposits. This will ensure waste free production and the rational operation of deposits. Calculation will be made using the following primary documentation:

* Schematic map of geological-economic zoning (Ju.Nozadze et a., Georgian geofund inventory number 19327, 2005);
* Geological reports of the Geological Funds and other documentation which show that the specific proportion of the main ore-bearing components and associated constituents are relative to the whole volume of the ore rock body;

* Price indices for ore-bearing components as of 2016.

Under the current legislation – “Taxable object for use of natural resources in the Georgian territory (including territorial waters, air space, continental shelf, and special economic zone) is the volume (quantity) of the existing natural resources.

In our opinion, there are a lot of inaccuraces , first, mineral resources are not only useful minerals, and second, any interference into nature causes changes in natural environment followed by adequate unwanted processes.

Proceeding from the above mentioned, taxable object should not affect the environment by its activity, particulary:

Use of mineral resources resources in those limits (dimensions) which are provided for by the law of Georgia “On Mineral Resources”.

We think that the term “charges” has not been chosen correctly as charges may be a one-time payment. For example, to cover expenses spent for pleniminary work for licencing the area of natural resourses while the following tax should be imposed for use of mineral resources:

1. For production of useful minerals (the tax should be imposed according to the geological-economic district (zone), and differentiated, in accordance with, the individual sectors and kinds of useful minerals);

2. For processing useful minerals (taxation is differentiated in accordance with different kinds of produced minerals);

3. For use of natural underground voids, such as:

a) caves etc.;

b) use of underground porous rocks for oil and gas storage;

c) laying underground communications;

d) construction of of objects for special purposes (laboratories, airfields, etc.);

e) construction of underground storages, coolers etc.

4. For geological, mineralogical, paleontological collection and musium pieces.

5. Proceeding from the fact that during the investigation of mineral resources the environment is being affected (during transportation of waste from holes and openings), the tax should be imposed also on investigation of mineral resources.

In case the user of mineral resources is imposed a fixed tax on measured ore extraction (rock mass) according to individual deposits and not for its each components, then, under the current legislation, the deposits will not be developed irrationally.

At the same time it should be taken into account the geographic location of the object, the economic character of the region in accordance with our schematic map "Geological-Economic Zoning of Georgia".

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CHARACTERISTIC FEATURES OF UPPER CRETACEOUS VOLCANO-SEDIMENTARY HOST ROCKS AT MADNEULI POLYMETALLIC DEPOSIT, BOLNISI DISTRICT, GEORGIA

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The Bolnisi mining district is located about 50 km south of Tbilisi, close to the Georgian-Armenian border. It is tightly linked to the ore mineralization of the Lesser Caucasus from the western part and also to the Eastern Pontides orogenic belt from the Eastern part, which is one of the important metallogenic provinces in the world, and which hosts various prospects and deposits such as volcanogenic massive sulfide, epithermal gold-silver, porphyry copper-molybdenum, and skarn type deposits [1]. The Bolnisi district is a Cretaceous magmatic region, with complex, laterally and vertically variable regional stratigraphic relationships. This investigation is based on physical volcanology and facies architecture of the host rocks, such detailed investigations was applied for the first time in the Madneuli open pit in this region. The Upper Cretaceous rock formations are subdivided into five separate suites. The host rock succession of the Madneuli deposit belongs to the Mashavera suite, and consists predominantly of lava, pyroclastic, volcano-sedimentary and sedimentary rocks of rhyodacitic composition. A granodiorate porphyry to quartz diorite porphyry intrusion crosscut by drilling at a depth of 800-900m beneath the Madneuli deposit. The host rock from the Madneuli deposit was dated by whole rock K-Ar geochronology at 88-89 Ma [2, 3], and rhyolite domes from the same area yielded whole rock K-Ar ages of 84-85 Ma [4]. Moritz et al. [5] reported U-Pb zircon ages of 86.6 and 87.1 Ma for dikes crosscutting the Mashavera suite in the open pit. Nannoplancton determinations by Migineishvili and Gavtadze [6] of samples from the Mashavera suite suggest a younger Campanian age. Facies-oriented analyses during field work enabled us to identify characteristic sedimentary and volcanic structures and textures in the entire Madneuli open pit, which were useful tools for distinguishing facial units. They allowed us to understand depositional environments and processes. Twelve lithofacies were singled out in our study for the first time at the Madneuli deposit. They are grouped in two facies assemblages: (1) a lower volcano-sedimentary assemblage, including silicified bedded volcano-sedimentary facies, fine-grained accretionary lapilli tuff and tuff with bioturbation, water-settled pyroclastic fall deposit, pumice-rich volcaniclastic facies and peperite; and (2) an upper volcanic assemblage, including rhyodacitic pyroclastic flow with flow foliation, columnar-jointed ignimbrite, rhyodacitic extrusion, non-stratified rhyolitic to dacitic breccia facies, ignimbrite, lithic to pumice-rich facies and hyaloclastite [7]. The lower, bedded volcano-sedimentary assemblage is rather thick and is predominant in the Madneuli open pit. Strongly silicafied, very fine-grained tuff horizons interbedded with turbiditic rock, volcaniclastic mudstone and sandstone. Classical slide slump units, cross-bedding, bioturbations, load casts, wave and current ripples, flame structures are also present in this assemblage. Slide slump units indicate downslope movement of sediments, either along volcano flanks, triggered by volcano – tectonic events or gravitational slumpling within debris apron environments. Structures indicate that they represent typical fine-grained material transported and deposited by a turbiditic current [8]. Fine-grained vesiculated tuff is associated with different types of accretionary lapilli horizons, which is evidence for phreatomagmatic volcanic activity and the distal location of these ashfall deposits [9]. In addition, there is a pumice-bearing pyroclastic unit interfingered in this sequence. Two types of rhyodacitic lobe hyaloclastite flows are described for the first time in the Madneuli deposit: hyaloclastite with glassy-like selvages and hyaloclastite with pillow-like forms, which underscores the evidence of shallow marine depositional environment of the host rocks of the Madneuli deposit with radiolaria-bearing horizons from the Eastern upper part of Madneuli open pit. The absence of different resedimented rock fragments, the gradational contact with coherent lava, their laterally discontinuous character, and the absence of bedding support their in situ hyaloclastitic nature. A paleo-reconstruction of their environment was undertaken, in which hyaloclastite record the interaction of magma emplaced in unconsolidated volcano-sedimentary rocks [10].

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SANDSTONES FROM THE KAZBEGI-OMALO REGION

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The Lower- and Middle-Jurassic deposits from the Yazbegi-Omalo Region of the Folded System of the Caucasus (comprises the Main Range of the Greater Caucasus and Kazbegi-Lagodekhi tectonic zones) comprises well-developed, unequally distributed sandstones that occur in both the transgressive and regressive parts of the section. According to their genesis and composition they are divided into quartz, arkosic, plagioclase-quartz sandstones and quartzites. Sandstones are generally represented by plagioclase-quartz varieties (sometimes mica-plagioclase-quartz). Just the latter ones are considered in the present work.

The Pliensbachian, Toarcian and Aalenian deposits of the schistose terrigenous formation of the Folded System of the Caucasus include plagioclase-quartz sandstones of various thicknesses that are developed in the form of interlayers among clay shales, slates and argillites. The sandstones represent dark grey or grey medium- and fine-grained (0.1–0.3 mm), rarely coarse-grained, thick- and thin-layered (12–5 m) rocks. They are often characterized by macro- and microstreation conditioned by the distribution of mica flakes, carbonized plant remnants and speckled pyrite parallel to bedding planes. Due to very fine dispersivity of the basic mass of the samples under research it became necessary to prove and make more exact their mineral composition and correlation of mineral phases. Thus, to study the sandstones and the country rocks, parallel to the petrographic description there have been used X-ray diffraction and X-Ray fluorescent analyses. The principal minerals, composing the rock are the following: quartz, plagioclase, muscovite (sericite).

Q u a r t z is the main component of the researched sandstones (up to 70%). There are observed isometric grains as well as elongated ones. Sometimes their contours are indistinct, notched or angular, that is almost always the result of the secondary alteration processes - corrosion and regeneration. There rarely occur clastic grains with primary contours. Quartz is characterized by both – wavy and normal extinctions. Grains are usually clear transparent, sometimes with the finest crystals of accessory minerals and gas-liquid inclusions as well.

P l a g i o c l a s e in such type of sandstones are represented by albite and albite-plagioclase. There frequently occur albite polysynthetic twinings. Plagioclases are generally uninjured. There rarely occur weakly sericitized crystals.

M u s c o v i t e occur in the form of elongated colorless flakes. They are deformed bent or split on (001) plane. It is characterized by high colors of interference. Muscovite elongated flakes generally are of subparallel distribution in the rock.

In the researched sandstones there are observed open structures caused by stress pressure. More frequently there are observed point and linear contacts. Some of the quartz grains are surrounded by regenerative rims. These transformations are associated with the catagenesis and metagenesis stages. The peculiarity of the cementing material and the available data on the degree of organic matter maturity makes it possible to attribute the researched psamitoliths to metasandstones.

The cement in plagioclase-quartz sandstones is presented by chlorite-hydromica (or chlorite sericite). The sandstones from the Tusheti area (the river Pirikita Alazani basin) are virtually sterile against the carbonate content. On the territory of Khevsureti, in the Toarchian-Aalenian deposits there occurr brownish-grey sandstones and siltstones with carbonate cement (calcite, calcite, ferruginous dolomite, ankerite). The cementation is of basal or contact type. The chlorite-illite-sericitic cement is of flaky or fibrous structure. Fibrous cement surrounds the fragments and causes corrosion or grows into them and makes brushy excretions. The aforementioned chlorite-illite-sericitic excretions make division among the grains. The carbonate cement is of basal type. In such a case the corrosion of terrigenous grains is well-expressed. As expected the clastic material of sandstones and siltstones is mainly represented by quartz the content of that sometimes increases up to 70%; besides the quartz it contains about 22% of Ca–Na plagioclase (4.04Å). Considering the data on the interstratal space (dα/n 4.02–4.03Å) it has been established that the plagioclase is represented by acid varieties of the albite-oligoclase sequence (the anorthite molecule up to ≈ 5%). The analysis by X-ray diffraction method revealed mica content though it is unreal to distinguish clastogenic muscovite from autigenic sericite basing only on these results.

In common sandstones cement is represented by illite and/or sericite (dα/n is changeable within 10Å limits) and Fe–Mg chlorite (7 and 14Å).

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ALPINE TYPE QUARTZ VEINS

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Almost all the outcrops of the Lower- and Middle Jurassic schistose terrigenous formation of the Greater Caucasus Folded System are cut by hydrothermal quartz veins and veinlets of various thickness and trends.

In the present work, the research has been focused on issue of genesis, mineralogy and geochemistry of quartz veins and veinlets occurring in the Liassic schistose terrigenous formation of the Piriqita Alazani valley.

In the Piriqita Alazani valley, as well as throughout the whole Caucasus, the deposits of Low- and Middle Jurassic schistose terrigenous formation are represented by clay shale, slate, sandstone and siltstone layers of various thicknesses where quartz veins of various thicknesses and length are widespread. In the geological section of the schistose terrigenous formation clay shales are predominant; siltstones and sandstones are relatively few and the contained opaque, dense and coarse grained vein mineral is almost always represented by milky white quartz aggregates; in most cases it completely fills the fractures, in small pockets and holes of that, there sometimes occur certain, well-developed microcrystals and druses represented by almost quite transparent rock crystal and smoky topaz crystal forms.

In natural exposures the network of quartz veins is visually distinct; they are of several generations though they are homogenous and almost monomineral. The veins cross each other in various directions;their strikealso coincides with the direction of schistosity and bedding but generally they are representted by secant bodies along the fractures and cracks.

The aforementioned quartz veins and country rocks were studied by microscopic (AMSCOPE PZ300T-3M), X-ray diffraction (DRON3) and X-ray fluorescent (XRD EDX 3600R) methods of analysis; the results are interesting though there is still much to be researched and specified. From our viewpoint, the quartz veins are genetically close to “Alpine type veins”; they are associated with the bedding and fracturing of sandstones caused by metamorphism and tectonic forces. Their body is more or less straight or of lenticular shape; the vein length varies from centimeters up to ten meters. The vein forms are various and depend upon the fracturing and composition of the country rock. The structure of the vein is mainly homogenous; sometimes there are observed relicts of the country rocks, chemical and mineralogical compositions are almost the same.

One of the most important factors of Alpine-type quartz mineral formation, together with pressure and temperature, is geological environment, particularly the mineralogical and chemical composition of quartz generating geological body, tectonic conditions and temperature of percolated water, geochemical activity and other peculiarities.

Rocks of terrigenous formation have undergone the process of catagenesis and with the increasing depth the intensity of transformation increases too; sometimes the catagenesis level acquires elements of metagenesis and accordingly in the geological section the degree of recrystallization increases from top to bottom. At the initial stage of catagenesis, in the rocks of terrigenous formation there appear hydromica and chlorite; deeper catagenetic changes are revealed by generation of fine flaked sericite that transforms into muscovite, light-colored chlorite and extraction of aggregate quartz. With the increasing temperature there are generated Alpine quartz veins at the expense of sandstone quartz.

Applying polarization microscope there have been studied some samples of the above-mentioned quartz veins and country rocks; these samples are mainly represented by clay shales and metasandstones. Except for a few cases, hydrochloric acid does not react with country rocks and quartz veins.

Microscospically at low magnification quartz veins are represented by sterile monomineral quartz; they are characterized by spear-shaped mosaic structure, striation, though not often they are quartz-feldspar-bearing. In order to specify the coexistence of mineral phases and their quantity in the available samples of the quartz vein and country rocks in parallel with the petrographic descriptions there was carried out X-ray diffraction analyses (number in the box corresponds to the point of X-ray diffraction analysis). In the quartz vein sample there were clearly fixed monomineral quartz(95%) peaks, rarely - Ca-Na feldspars, in the country rocks - quartz, Ca-Na feldspars, Fe-Mg chlorites and traces of micas at trace level.

Aline-type quartz veins are usually generated in low temperature conditions; it is associated with the hydrothermal mineralization formed as a result of low temperature regional metamorphism with participitation of percolated waters. Hydrotherms, for their part, affect the rocks of terrigenous formation in spite of the little impact of low temperature of metamorphism and weak geochemical activity of penetration; consequently, in most cases only quartz is crystallized in cracks, joints along the bedding plane and other holes.

We believe that the temperature of Alpine quartz generation corresponds to that of country rocks catagenesis. It is confirmed by the fact that the data of Alpine vein quartz decrepitation and those of quartz generated during the country rocks catagenesis are usually identical.

Alpine quartz veins contain information concerning the country rocks transformation system. The resemblance of the gas emission temperature parameters during the decrepitation of fluid inclusions can be explained by the common nature of quartz vein generation and origin of regeneration quartz cementation at the expense of quartz grains dissolution during the catagenesis.

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OPPORTUNITIES OF SUPPLYING FARMLANDS OF JANDARA IN MARNEULI SETTLEMENT WITH IRRIGATION WATER

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Jandara settlement is located in the extreme north-west flank of the city of Marneuli. The area of agricultural farmlands is over 300 ha. Since the 90s of the last century due to the deterioration of the irrigation system these farmlands have not been supplied with water for irrigation. At present they are only used as pastures. Because of poor sedimentary climate conditions of the region the above mentioned areas are practically dried up from the middle of the summer.

For the non-irrigated lands we offer consumption of those resources of underground waters, which are unusable for the centralized water supply system [1].

As a result of studying the fund data in Marneuli region there were registered outlets of underground waters (springs and wells), which were characterized by high debits, but could not be used for drinking or farming purposes. In spite of the fact that the data were very old, a part of them was managed to be fixed in situ due to carrying out field works.

On the south-west flank of Jandara on the first terrace of the Algeti River grove there was revealed an abandoned well, in which a static level of water was 2 m abave-ground level (Pic. 1).

Pic. 1. An abandoned well on the first above-groove terrace of the Algeti River

As a result of trial pumping it was stated that the expected debit of this water should not have been less than 40 m^3/hr. The chemical analysis of the water showed its uselessness for drinking-farming and irrigation purposes, because it contained high concentration of sulfate ions.

Water point (point A) on the above-groove terrace of the Algeti River, conditional straight line, is located at a distance of 1.0 km from the south border (point B) of the contour of the non-irrigated farmlands lying in the north to it (Fig.1). The difference of hypsometric levels is no more than 67 m. In case of supply of water from point A to point B there arises on opportunity for Jandara settlement farmlands create autonomous irrigation systems based on the underground water resource.

Fig. 1. The scheme of supplying of Jandara farmlands with underground waters from the above-groove terrace of the Algeti River

To achieve this objective on the existed information level it is necessary to decide some contradictory issues.

a. Stating solid hydro-geological parameters of the water intake point, making more precise the seasonal change of the water level, chemistry variability, exploitation resource and so on. The solution of this task needs obligatory hydro-geological monitoring to be conducted.

b. The water for the irrigation must be brought to quality requirements.

Chemical analysis of the water taken from the well showed rather negative results. Total dissolved solids (1492 mg/l) is by 1.5 times more than the permissible norms, total rigidity (14.13 mg/l) – two times more, than the norm and massive share of sulfate ions (725 mg/l) – three times more. So such water definitely needs to be treated-conditioned. Nowadays maximally effective is reverse osmosis water treatment technology.

c. To define the optimal route for supplying the farmlands with water and choosing its technical equipment.

For delivering water of the presumable and more capacity (60 - 70 m^3/hr) it will be enough to use polyethylene pipeline with a diameter of 75 – 110 mm. Hypsometric difference can be got over by using "ЭЦВ 8/40/120~ pump.

d. Irrigation must be carried out by modern and economical technologies.

With economical consumption of water two main approaches are distinguished: drip irrigation and overhead irrigation. Economy of drip irrigation is clearly seen from comparing the average norm stated for 1 ha to the traditional irrigation norm. For the region "drip irrigation" indicator is 50 m^3/ha instead of 800 m^3/ha! For large areas in the world there are approbated Center-Pivot irrigation system and Lateral Move irrigation system technologies. The choice of technological components for these systems depends on the extent of the area to be irrigated, as well as on the actual data of the exploitation resource of water and on the desirable automatization level of the course of the processes.

Solution of irrigation problem of Jandara settlement farmlands is connected with labor and material costs. Project economics is closely connected with the socio-economic level of the country. But as a result of its output real prospects of practical implementation of this task are felt.

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SUPRA-SUBDUCTION AND POST-COLLISIONAL MAGMATIC EVOLUTION OF GEORGIA

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Georgia is a part of the Alpine-Hymalayan belt and is a unique region of continental collision zone of pre-, syn- and post-collisional magmatism (Fig. 1).

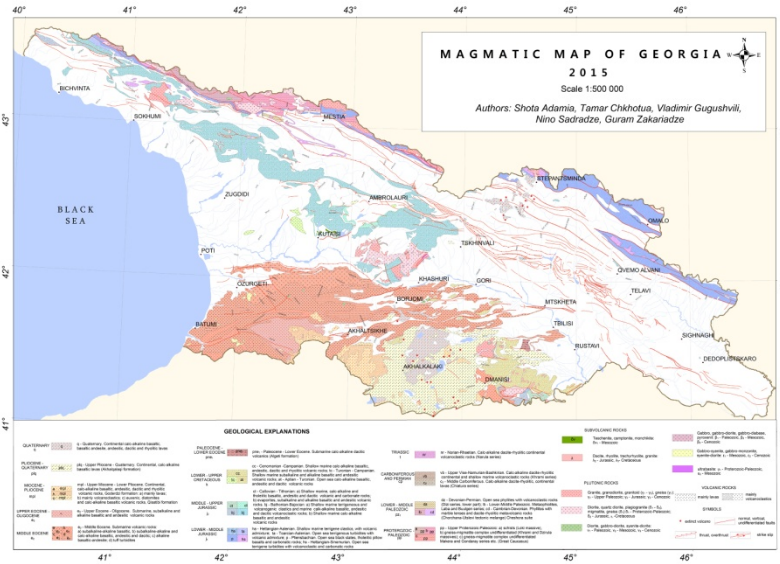

Fig. 1. Magmatic map of Georgia [1]

Magmatic evolution is an important event in the formation and development of the geological structure of Southern Georgia, where several reliably dated volcanogenic and volcanogenic-sedimentary formations are established.The region representsa modern analogueof continental collision zone, where subductionrelatedvolcanic activity lasted from Paleozoic to the end of Paleogene.After the period of dormancy in the Early-Middle Miocene starting from the Late Miocene and as far as the end of the Pleistocene primarily subaerial volcanic eruptions followed by formation of volcanic highlands and plateaus occurred in the reigon.According to Lordkipanidze et al. [2] the Upper Miocene to Holocenevolcanic rocks are related to the transverse Van–Transcaucasian uplift and belong to post-collisional calc- alkalinebasalt–andesite–dacite–rhyolite series.

A system of island arc and intra-arc rift basins (Artvin-Bolnisi and Achara-Trialeti)has been interpreted as character-ristic of the pre-collisional stage of the region development, while sin- post-collisional geodynamic event has been attributed to intracontinental one. Outcrops of the postcollisional magmatic rocks are exposed along the boundaries of the major tectonic units of the region [3].

Late Cenozoic volcanic formations of Southern Georgia cover a wide range of compositions from basalts to rhyolite. Enrichment in large-ion lithophiles, clear negative geochemical anomalies of Nb and Pb and low Ni concentration are indicative of a source enriched in subduction related fluids.

The main reason of similarities in the petrochemical and geochemical features of supra-subduction and post-collisional-magmatic formations of Southern Georgia is the role of the last piece of subducted oceaniclithosphere-slab.

The geodynamic model of the post-collisional volcanism of the region (Fig.2) is proposed on the tomographic model of the lithospherebased on P and S velocity distributions and source [4].

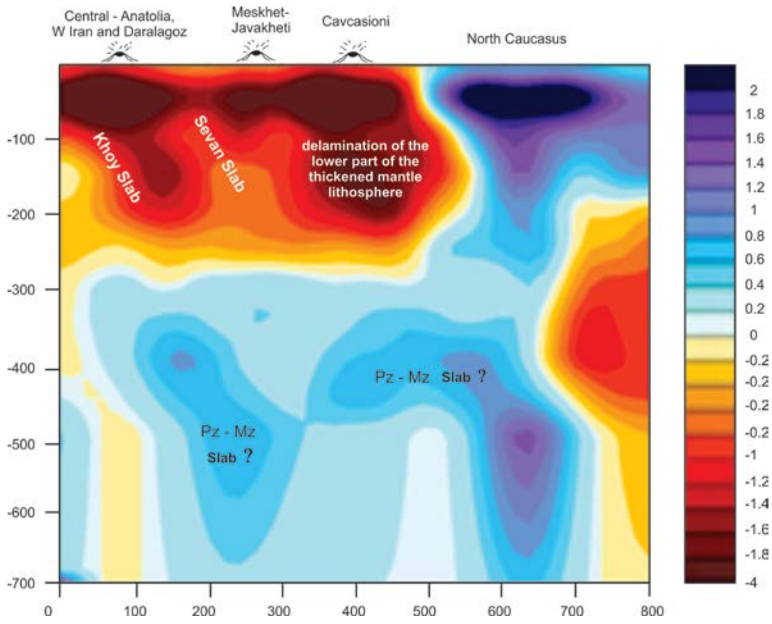

Fig. 2. Geodynamic model of post-collisional volcanism of Southern Georgia [5].

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STUDYING THE IGNIMBRITES OF KVEMO-KARTLI AS A POZZOLANIC ADDITIVE OF PORTLAND CEMENT

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For the last 25 years cement industry of Georgia continuously have been lacking for an active mineral (pozzolanic) additives of high quality. It incites the cement manufacturers to use ill-conditioned materials for this purpose [1, 2]. Eventually it causes worsening the quality of cement or increasing the consumption of a valuable component - clinker that will raise the cost of production considerably.

Elimination of the above mentioned problems is possible through utilization of non-traditional, new cheap local raw materials. In this regard, **fused tuffs - the ignimbrites,** widely spread in Kvemo Kartli (Bolnisi and Dmanisi regions) are interesting.

The purpose of active mineral cement additives is to bind calcium hydrooxide - $Ca(OH)_2$ as a result of which calcium hydrosilicates and hydrogarnets additionally form, initially in the form of gel, which will further crystalize and give additional strength to cement stone. In additives of volcanic origin this role is performed basically by aluminosilicates, especially if they are in glassy state. These are volcanic ash, tuffs, pumice, trass, etc. None of additives currently used in Georgia (tuffs, basalt, pumice, etc.) are characterized by high hydraulic activity, which, probably, could be explained by low content of glassy phase in them. The specificity of mechanism of formation of ignimbrites define the peculiarity of their mineralogic structure, in particular, it is supposed that they were formed in the process of sedimentation and baking of ash and pumice particles, erupted from volcan, as a result of steam impact, and it conditions high content of glassy phase in ignimbites. They are characterized by average mechanical strength and easy grindability.

Application of ignimbrites in cement procudtion is not known up to present.

Chemical composition of ignimbrites of different locations are presented in Table 1.

Table 1

Chemical composition of ignimbrites, mass %

Location	L.O.I	SiO_2	TiO_2	Al_2O_3	Fe_2O_3	P_2O_5	MnO	SO_3	CaO	MgO	Na_2O	K_2O
Kazreti	1.40	73.30	0.37	12.60	2.60	0.09	0.09	-	0.86	1.70	5.00	1.00
Guguti	1.50	63.80	0.72	15.90	4.52	0.17	0.11	-	2.00	1.70	4.90	4.00
Mushevani	3.30	70.60	0.09	12.30	1.52	0.12	0.08	0.47	2.20	0.40	3.40	4.10
David-Gareji	3.70	70.70	0.14	11.90	1.30	0.18	0.08	-	2.20	1.10	2.10	4.00

According to X-ray analysis rocks consist in the core of crystal phases of feldspars, and quartz hydromicas. An amorphous substance quantity - volcanic glass is noted.

For revealing pozzolatic properties of the ignimbrites the testing in accordance with GOST 25094-94 has been held, which has proved their high pozzolatic activity. Students t-criterion is within limits 25 - 30.

Cements with an additive of ignimbrite have been in vitro prepared and tested on European standard En 196-1.

Testing of pozzolanic properties revealed high activity of ignimbrites. Physical-mechanical testing confirmed possibility of application of ignimbrites as an additive to cement in quantity from 6 up to 35 mass.%, therefore portland-pozzolanic cements of the CEM II/A-P and CEM II/B-P type where received, with strength class - 22.5 N, 32.5 N and 42.5 N (EN 197-1). Application of ignimbrites as a pozzolanic additive to cement, in the conditions of an acute shortage of similar standard raw materials in cement production of the republic, is expedient.

The developed technical solution is a novelty and the Georgian Patent for useful model has been granted [3].

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DATA ON U/Pb ZIRCON DATING OF LATE VARISCAN GRANITOIDS OF THE GREATER CAUCASIAN TERRANE

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The Elbrus and Pass subterranes of the Greater Caucasian (fig. 1) terrane distinctly differ from each other by the character of regional metamorphism and granitoid magmatism of Variscan orogeny [1, 2, 3, 4].

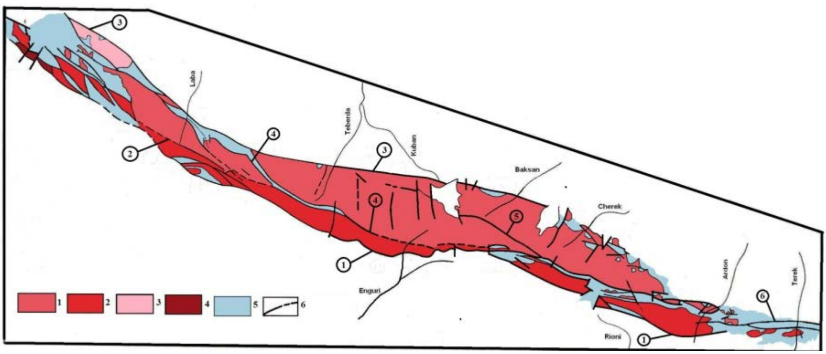

Fig. 1. Simplified scheme of tectonic zoning of the crystalline basement of the Greater Caucasus Main Range zone (after M.L. Somin [1]).
The Main Range zone of Greater Caucasus (1-4). Subzones: 1– the Elbrus, 2 – the Pass, 3 – the Huko and 4 – Bambak; 5 – tectonic depressions built up of Lower-Middle Jurassic sediments; 6 – faults (figures in circles): 1 –the Main Range, 2 – Sanchar-Dzichec, 3 – Pshekish-Tirniauz, 4 – Alibek, 5 – Adil-Su and 6 – Buron-Lars.

In particular, in the Elbrus subterrane the following events took place: Bretonnian granitoid magmatism and Sudetic regional metamorphism and granitoid magmatism. Within the Pass subterrane only Sudetic granitoid magmatismis manifested, but it considerably differs from that of the Elbrus subterrane. Distinctive feature of magmatism of the Pass subterrane is also a significant influence of granitoids over their host rocks.

U-Pb zircon dating of granitoids of the Elbrus and Pass subterranesgave different results as well. The age of granitoids was fully corroborated by the authors with the help of LA ICP MS U-Pb ($^{206}Pb/^{238}U$) zircon dating. Theresults of age determinations of 22 zircon crystals from granitoids of the Elbrus subterrane show mean 309.1±2.5 Ma,butof 21 zircon crystals from granitoids of the Pass subterrane- 325.1±2.5 Ma. Comparing the obtained data of age determinations isstated:

- ✓ the rocks of the Elbrus subterrane are younger than those of the Pass subterrane by 16 Ma;
- ✓ the inherited age of zircons from magmatites of the Elbrus subterrane is determined only in 3 crystals and covers a small interval – 630-690 Ma;
- ✓ the inherited zircon age from the same rocks of the Pass subterrane is determined in 14 crystals, covering the interval of 400-1800 Ma;
- ✓ Th/U ratio in zircons from granitoids of the Elbrus subterraneoccupies also a small interval (0.221-0.794), while the same parameter in the zircons from granitoids of the Pass subterrane falls within a rather wide interval (0.076-1.136);
- ✓ zircons from both subterranes also differ from each other by values of $\varepsilon_{Hf}(T)$ and T_{DM}^{C}, showing that these values are considerably lower in zircons from granitoids of the Elbrus subterrane, than in zircons of same rocks of the Pass subterrane.

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MINERAL PRODUCTS DEMAND AND SUPPLY FEATURES

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1. Mineral resource is a mineral formation, from which can be removed useful components (metals, non-metallic elements, minerals or hydrocarbons), which are used for Industrial, agricultural and in any type of entrepreneurial activity. The history of minerals use by man is as old as Paleolithic era, -long before when people were not yet aware of the use of agriculture.

2. Like others goods, the demand and supply on mineral products in market economics is very important to ensure optimal use, their production and pricing decisions. When discussing the influence of price formation on the demand, we mean the individual demand, as well as over all (market) demand. Usually the demand for goods in most cases linked to a certain period and the price.

3. But price changes and changes in the size of the request will not be the same for many goods (including mineral) and in the case of all economic situations. Size, which responds to changes in the price of demand, economists have called the demand elasticity. Overall individual demand on mineral commodities is more or less inelastic (i.e. for gold products-mainly jewels, oil products- in the short period of time, paving stones, etc.), but there are some minerals, the demands for which are elastic (eg. limestone, diatomite, granite, etc.) However, we must know that is commodity ,,necessities” or ,,luxuries” it does not depend on the real characteristic of commodity, but the buyer's tastes and preferences. Changes in the demand for minerals are determined also by the nonprice factors - changes in income, consumer expectations, the existence of substitutes, and so forth.

4. The overal demand on mineral products has an intermediate nature. Society does not directly use the vast majority of minerals. Then, when the minerals are the basic raw material for industry, they made some of the final product which may be the subject of luxury for customers. (eg. Iron ore is a necessity for production of steel, but a car, produced of steel, may be considered a luxury.)

Most minerals have many applications which make them under the influence of variety of factors. Most minerals like other goods have substitutes as well, However, the possibility of using them gives them a different dimension. For example, if coal prices are increased people will use electricity , and the demand for power, for which the coal is an essential raw material, will increase. In such case if all the uses of coal in the whole country are considered then there is practically no relationship between its overall demand and change in price. For some minerals there is a joint demand. For example. steel production is consumed simultaneously iron ore, limestone, coal, dolomite and other minerals. The changes in prices in one or two of them the production demands model does not change.

5. Mineral products are sensitive to technological innovation with respect to their extraction, processing and the fields of their use, which affects the supply and demand. These factors are affected by the state's policies, regulations, and some of its limitations. Especially vulnerable is oil to state policy, wars, natural disasters and other force majeure situations to such an extent that it can instantly increase the prices, but it does not lead to a reduction in demand adequate.

6. Under the complex influence of all the above mantioned factors is created the supply of mineral goods. Despite the diversity and complexity of these factors impact it is inevitable their timely and correct understanding and evaluation to produce the optimal plan of mineral production. Otherwise,

incorrect calculations will cause damage to producers on the competitive market.

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GEOECOLOGICAL ASPECTS OF GROUND WATERS ARTIFICIAL REFILLING

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Protection of Aquifers from full or partial exhaust by ground waters artificial refilling has great importance. By this method is possible to increase ground water intake productivity ons 30-40% without great reconstruction and investments.

There are two basic methods of artificial refilling: pressure and free-flow. The methods have universal character and we can use them as in arid so in humid zones where water requirement is provide by underground water reserves.

For example let us consider Alazani artezian basin that is situated in intermountain depression. This depression is constructed by Agchagil-Apsheron thick depositions in which waterproof and water permeable strata provide pressure horizons. There are water abundant quaternary deposits on those rocks which supplies water to many human settlements. Take account of established resources we may suppose that water requirement is provide. But take into consider subsidiary investments and big areas for sanitary zones it will be evident preference of artificial refilling, that is more economic and ecological acceptable. Artificial refilling is possible by excess surface flow. We can use artificial refilling without decreases sanitary flow. For this purpose we can use 50% from Alazani low water discharge 97%, that in Birkiani. Shakriani and Chiauri is equal to 1.3s, 3.9, 2.5m^3/s.

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IT’S PUBLISHED AS PRESENTED BY THE CONFERENCE ORGANIZATIONAL COMMITTEE

Given for production 18.02.2016. Signed for printing 13.05.2016. Size of paper 60X84 1/16. Approximately 8 pr.sh. Circulation 130 psc.

Publishing House “Technical University”, Tbilisi, Kostava 77

Verba volant, scripta manent