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Crisis intensification of geoecological situation of the Caucasus Black Sea coast and the strategy of risk reduction

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Abstract

The segment of Caucasus Black Sea coast, which is geographically considered as a united geosystem placed in the areal of the segments of Greater and Lesser Caucasus, is one of the densely populated and utilized regions of our Planet, herewith, it is extremely complicated geoecologically and in very crisis situation. In this regard particularly special situation is created in view of development of elemental geological processes of large scale and frequency of its recurrence, which obtained particular character since the end of 20th century. Damaged area makes about 60% and the high risk zone – about 45%.

Special geoecological situation created in the Caucasus Black Sea coast needs particular nature use regime, complex approach of its target utilization and integrated management of geological environment, which foresees the identification of risks of geoecological hazards stipulated by natural and anthropogenic impact, elaboration of criteria of gaudiness of geological environment and working out of regional scheme of minimization of risk of natural hazards. Solution of these key problems will be able by statement of several conceptual issues, such as: identification of background situation of present geological environment, degree of damage of the area by elemental-hazard events and their risk; Regarding interrelation of homogenous geological environment and modification regulations: revealing of the character, scales and distribution areals of modification of geological environment destroyed by anthropogenic stresses, statement of criteria of possibility of human stress proceeding from sensitivity of geological environment and ranging the area according to the possible geological complications from "normal" up to "crisis" situation; working out of regional scheme of integrated management of area and recovery of geological situation.

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1. Introduction

Before dealing with the specific subject of the problem, we consider it necessary to identify, which geomorphological area we allocate in the "coastal areal" in this case. As the Caucasus Black Sea coast segment is situated within the areal of Greater and Lesser Caucasus Mountain Systems and in the formation of their edges solid deposits are important that are brought by the rivers flowed down these mountains, many consider it as a compound part of entire system [1, 2, 3]. We place the geomorphological space within the

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coastal area that is formed as a result of marine and terrain inter-influence in the period of Pliocene – Quaternary [4] the width of which varies from several hundreds of meters to 20-40 km.

Caucasus Black Sea coast, formed during the last stage of orogenic cycle, subjected to considerable transformation in the conditions of regime of active tectonic movements of different characters of Pliocene – Quaternary period, on the background of which, on the one hand, the Netherlands type coasts were formed finally along 500 km, sunken by about 1000 m with large deltas (of Chorokhi, Rioni, Enguri, Kodori, Bzipi, Mzimta-Psou, Kubani), built by strong marine and rive deposits and on the other hand, coasts of Mediterranean Sea, distributed within 2,5 – 6 m and 300-400 m as the terrace stages from the New Black Sea (Holocene) to Eopleistocene (Kuial'nitsky) ages. It is notable, that one and the same terrace surface absolute elevations of the Caucasus coastal zone formed in the different morphostructure, increases gradually from North-West to the South-East. For example, if Upper Pliocene – Lower Pleistocene marine terrace stages are located at absolute height of 70-100 m in Tuapse – Novorossiysk, in the territory of Apkhazeti it is described at a height of 120-140 km and ascended at a height of 190-270 m in the foothills zone of Guria-Achara; reminders of old coastal levels have been observed by us at a relatively higher hypsometric heights (within 400-500m) in Pontides Black Sea coastal zone (Turkey, Trabzon area), where the reminders of marine sands that were maintained in the abrasion sign of wave-beats of the cliffy volcanic rocks indicate the reliable signs of marine activity except of absolute surfaces [5].

Thus, the morphology of marine terraces of the Black Sea coast, their altitudinal allocation or sunken levels, facial composition and thickness of deposits clearly indicate that the Caucasus coast had experienced sharp feature-changing tectonic movements of block character. Such a vast diapason of tectonic movements resulted in high energetic potential of the relief, important deepening of the gorges of main rivers flowed down the Caucasus and Achara-Trialeti mountain systems, due to which are opened all structural stages sharply distinguished from each other litho-stratigraphically and by resistance, and in the large river estuaries there are formed typical underwater canyons of tectonic, erosive (subareal) and combined genesis, characterized for Caucasus shelf, which were important for movement –distribution of along coastal solid streams forming the coastal zone and morphodynamics of the coasts.

Caucasus Black Sea coast, which is situated among three different units, such as 1) Caucasus folded-sheet system, 2) South Caucasus western Molasic zone, 3) Achara Trialeti zone of Lesser Caucasus folded-thrust system, is so complicated by the young feature-changing tectonic movements and is partitioned by numerous and frequently intersection live tectonical breaks, that according to their movement signs, speeds and the character of development of geological processes there can be distinguished 15 structural blocks [6]. These blocks are as follows:

1. Novorossiysk structural block – by relative sink speed of about 1 mm per year;
2. Lazarevsky structural block – by relative sink speed of about 1 mm per year;
3. Sochi-Psou structural block – by relative sink speed of about 2 mm per year;
4. Gagra structural block – by relative ascending sink speed of about 2 mm per year;
5. Bichvinta structural block, main compound of which is a Gudauta flexure, it comprises the water surface, as well as the part of the shelf zone and annually sinks in average by speed of 2 mm per year;
6. Gudauta structural block – which is related with the flexure of the same name, experiences ascending along the deep break since the Late Orogenic Age until present by amplitude of 3 km. Here the Mesozoic complex of southern slope of Caucasus is thrust to the South on the much squeezed Tertiary deposits of the coastal zone of the Black Sea depression. In addition, this area represents the vastest zone (40 km distance from the shore within the 200 m isobaths) of the shelf of the area of water of the eastern part of the Black Sea. It is significant that in the areal of Bichvinta depression the Pont-Meotis conglomerates are cut in the depth of 28, 5 m, in Gudauta structural block the deposits of the same age and lithology are observed at a depth of 150 m in 5 km distance from it to the East [7];
7. Sokhumi structural block – located among the rivers of Gumista and Kodori experiences the relative sinking by speed of 1-2 mm per year, which is characterized by narrow (up to 2 km wide) shelf at the boundary of 100 m isobaths;
8. Ochamchire structural block – which had being experienced sustainable ascending during the entire Quaternary period by the speed of 1-3 mm per year in average, its indices increase from the seashore to the foothills. In this areal of the structure the Kodori River which early had flowed to the South, gradually moved to the North due to lithological impact of tectonics and solid deposits;
9. Enguri structural block is thoroughly related to the Enguri tectonic depression, which experiences differential sinking from 1 mm from the boundary of foothills to 4 mm in Kolkheti depression. In spite of the fact that its shelf is thoroughly composed by 100-400 mm thick alluvial-marine deposits, it is narrowed

considerably (less than 4 km);

10. Kolkheti structural block experiencing an intensive absolute sinking by the speed of 5-7 mm per year includes Rioni depression of Kolkheti Lowland among the Enguri and Supsa Rivers. Structurally it represents the depression among the mountains formed in the intermediate massif of consolidated folded basis complicated by numerous deep breaks, which are embraced by Samegrelo-Apkhazeti Brach anticline slope-folded zone to the North, by Dzirula crystal massif – to the East, and to the South – foothills of Achara-Trialeti folded system stretched to the West to the Black Sea. It is built by thick (up to 1000 m) marine-riverine deposits of Pliocene-Quaternary and morphologically they have produced ideally plain relief, which is occupied mainly by Pliocene Age wetlands, lakes (among the others the lagoon type Paliastomi Lake) and pit hotbeds;

11. Supsa-Natanebi structural block is located among the rivers of the same names along 12 km, which had being experienced relative ascending during the entire Quaternary by the speed of 2 mm per year and the intensive sedimentation had being underwent (especially, in Holocene, up to 50 m) in the shelf zone. As a result, 10 km wide flatland shelf was formed. Layers of pebbles, sand and clay presented in the vertical allocation of the section clearly indicates to the sharp variability of transgressive and regressive regime of the sea;

12. Kobuleti structural block is located among the Tsikhisdziri cliff built by Middle Eocene volcanic rocks to the South and the river of Natanebi, which experiences relative sinking process by the speed of 0 – 1 mm per year during entire Quaternary period. It was followed by the marine transgression and huge (140 m) sedimentation process. In the marine pebble-detritus material presence of Artvin Massif's magmatic rock in great amount indicates that the deposit of the Chorokhistskali River was flowing down to the North of the estuary of the Natanebi River. It is characterized with 1, 5 km long shelf, which is complicated by two underwater canyons. Wetlands of vast distribution formed in Holocene are important ecological units of the coastal nature of Kolkheti in the section of which three horizons of pit can be clearly distinguished in the depths of 8 – 9m, 1,5 – 2,0 m and 0,7 – 0,9 m, which is dated by C14 within the diapason of 2400-6000 years;

13. Sarphi – Kalganderi structural block, which experiences modern ascending by the speed of 2 mm per year, is related to the Acharistskali syncline sinking zone; it is complicated by the latitudinal oriented tectonic break and the flexure-shaped bend is formed, along which the differential movement is under way – it experiences the ascending to the terrain direction by the speed of 2 mm per year, as well as to the sea, where the flexure bend forms the narrow shelf with steep abrasive edge, it is characterized with the weak tendency of sinking;

14. Tsikhisdziri structural block, which is bordered by Makhinjauri break to the South and to the North – by the Chakvistskali anticline built by the Middle Eocene volcanogenic deposits, experiences ascending by the speed of about 2 mm per year. Its narrow (2,5 km wide) shelf is built by about 4 m thick pebble- detritus and boulders destructed from the high abrasive edges and in the lower part, up to 28 m, by the send of different granulometric composition;

15. Chorokhi-Batumi structural block includes the Chorokhi tectonic depression, which had being experienced the sinking during the entire Quaternary by the speed of 0, 8 – 1, 3 mm per year. As a result, vast Kakheti plain was formed built with about 300 thick alluvial-marine sediments and wide sloped shelf. To the North the Chorokhi tectonic depression is embraced by Makhinjauri break, which is expressed by the gravitation stages along the Turkey seashore and to the East – by the Kvariati-Mtsvane Kontskhi break.

According to the above mentioned, Caucasus Black Sea coast and especially, its shelf zone, adjacent to young tectonic movements and live breaks, is considerably complicated by the underwater canyons, formed in the estuary of the main river gorges, which are very important in modeling of alignment of seashore, they constraint to movement and distribution of alongside shore-forming material and litho-dynamical processes. Doubtfully, the main source (90 %) of forming of Caucasus seashore is a solid runoff of the rivers of embracing mountain systems, where the total amount of water flows exceeds to 650 and total deposit of 18 main rivers (Tuapse, Ashe, Psezuapse, Shakhe, Sochi, Mzimta, Psou, Bzipi, Gumista, Kodori, Ghalidzga, Enguri, Khobi, Rioni, Supsa, Natanebi) makes 29950,2 thousand tones [8]. More than 40 % of the solid deposits (about 90 % in the Chorokhi River) irreversibly disappear in the underwater canyons, which are mainly characterized with group allocation (Bzipi, Kodori, Enguri, Supsa, Rioni, Chorokhi), their depths vary within tenth and several hundreds of meters and the heights of the edges make 70-200 m. We have to deal with young canyons, which are related to young tectonic breaks and erosive processes, which should have been related to the New Euxine regression of the Black Sea. In this period the sea level should have been lowered by within 100 m. It is being proved by the drillings made in many areals of Caucasus seashore

and shelf [9, 10].

Thus, Caucasus Black Sea coastal segment, the geomorphological peculiarities and diverse-specter landscape-climatic conditions of which have been formed on the common background of geological development of Greater and Lesser Caucasus, facilitated to optimal development of living environment of population and multi branch economy. Due to the above mentioned, historically this region is one of the densely populated and adopted areas of the planet. Here one can meet the landscape characterized to the typical subtropical climate with unique Colchis and Mediterranean relict vegetation phenomena (including Pliocene pine forest of Bichvinta) such as coastal floodplain hygrophilous forests, wetlands vegetation and xeromesophilous Colchis box-tree. Due to the above mentioned, numerous National Reserves are being established in the areas of etalon landscapes of particular scientific and cultural aesthetic value including Bichvinta-Miusera, Mzimta, Kintrishi, Psou-Gumista, Kolkheti, etc. The rest occupies 33710 ha (including Pichora-Paliastomi wetlands and the Paliastomi Lake) and according to the Ramsar Convention it foresees the international cooperation in the sphere of wetlands conservation and their sustainable use. Optimum climate-landscape environment with unique sanitary beaches (including Ureki magnetic beach), thermal and mineral waters (Tsaishi, Menji, Gumista, Matsesta), cultural and historical monuments, natural phenomena and present international resorts (Batumi, Kobuleti, Sokhumi, Bichvinta, Gagra, Sochi, Matsesta) and ports (Batumi, Poti, Sokhumi, Sochi, Tuapse, Novorossiysk), create unique outlook of this region that facilitates to development of recreation and tourism industry and in general, development of its economy. Over here passes the important section of Baku-Supsa oil pipeline and as for Batumi and Supsa oil terminals, they are already put in motion. Anaklia and Kulevi Ports are yet in the stage of construction and projecting. During the forthcoming years the recreation zones of the Black Sea coast should be extended 4 times and the farm production – 1, 5 - 2 times.

As the Caucasus coastal zone was under the great anthropogenic stress historically and recently the conditions became critical and the situation became extremely complicated in natural environment, therefore, extreme ecological situation have been occurred in many places. The situation is complicated due to large-scale development of elemental geodynamical processes (abrasion-washing away of coasts, river erosion, landslides, mudflows), as well as due to frequency of its recurrence in time and made by them negative consequences. Extreme ecological problems have been occurred in the second part of 20th century due to elemental phenomena in this region and this problem became more extreme due to not to conduct timely preventive measures. Its following social-economic and ecological problems have reached their critical limit.

Under the risk of hazard are more than 1500 settlements; during last 40 years more than 50 000 men became eco-migrants, several hundreds of men were perished and economic loss made several milliards of USA dollars. Only in Georgia's coastal zone in 1975-1985 by conduction of special engineering-geological researches of 1:10000 scale at 221.8 thousand hectares it was identified that 26,1 % of total area is in catastrophic conditions due to geological elemental phenomena, where more than 1007 landslide bodies and 64 mudflow-transformable waterways have been mapped and the area under the particularly high risk makes 27%.

It is being stated statistically, that due to sensitivity of natural environment of the territory, the development of surface processes, exceeding the accepted background, occur once per three years and their extreme reactivation – once per 8-10 years. Numbers of researches relate the maximum of development of the processes to the 11-year cycle of sun activation, which is compatible with the intervals offered by us. Though, in the first decade of the 21st century this regulation has been broken and the activation of processes above the accepted background occurs nearly each year. Its reasons are as follows: 1. earthquakes activations in the Caucasus (as an example, in Georgia the earthquakes of 1991-1992 recreated and reactivated more than 20 thousands of landslide-gravitation bodies); 2. frequency of process-provocative negative meteorological elements in time and space on the background of global climate change; 3. high anthropogenic stress and not taking into account the ability of environment regarding its resistance to stress.

At present in the Caucasus Black Sea coastal zone more than 60 % of the territories are under the high risk of element. The area is located in the humid subtropical climate zone, where the annual amount of precipitation within the multi-annual regime fluctuates within 1533-1555 mm (Sochi, Sokhumi) and 1758-1831 mm (Poti, Kobuleti). Due to this circumstance, soils of 150-200 tones per 1 ha of arable lands are washed away annually, and this index increases to 300-500 t during the heavy rains. There can not be found the farm land not eroded by certain degrees, and on approaching to present days the "prompt anthropogenic" erosion processes are being increased more progressively. Due to washing away of the river sides, which fluctuate within 1, 5-2, 0 m and 3, 0-4, 5 per year, hundreds of hectares of farm lands are lost annually.

Among the forms of geoecological elements in the Caucasus Black Sea coastal zone the abrasion-wash-

out processes and landslide phenomena are of considerable importance according to their scales and risks of hazard.

Course of intensity of abrasion–wash-out of coasts are conditioned by: 1. morphology of coasts (morphometric alignment, cliff elevation, beach width); 2. lithological peculiarities of coast building rocks and their sensitivity to abrasion-wash-out processes; 3. present tectonic movements; 4. regime of variability of sea level and wave energy; 5. quantitative index of beach-forming solid deposits of the rivers and their distribution along the coastline; 6. wrong human activity (excavation of beach-forming material from the river beds and beaches; wrong planning of coast protective constructions and blocking the solid deposits on the rivers of Chorokhi, Acharistskali, Enguri, Zhoekvara by building the hydrotechnical constructions on them).

It was identified by researchers, which the wash-out process does not occur in case presence of more than 35-40 m wide beaches on the coasts of the Black Sea let alone the granulometric composition of beach-forming deposits and the energy of affecting waves. Energy of 6-8 m points goes down in case 20-40 m wide beaches. In addition, the thicker is a beach-forming materials, the rapid is putting down the wave energy. The most frequent storms observed characteristic for Caucasus coast are of 6-7 point, among them – the waves of 7 m tall in Gagra area, in Poti and Kobuleti areas – maximum height of waves are 9 m and the power of blow – 6, 2-6, 5 m/m2. Due to blowing power of such waves the cliffs of shores built by volcanogenic rocks move back by 0,01m/year, built by conglomerates – by 1-5 m/year and by porous sandstones and clay deposits – up to 5-10 m/year. Shores are thoroughly washed away in case less than 10 m wide beaches.

In addition, if about 20% of entire sea shore is occupied by cliffs built by basic rocks (in the areas of Tuapse, Gelenjik, Gagra, Bzipi, Makhinjauri, Tsikhisdziri, Gonio-Sarpi) and the degree of the intensity of abrasion processes in them depends on the cliffs' morphology and height and rock firmness, the rest of the shores are formed on basis of accumulation of the river deposits, the potential of sustainability of wash-out of which is defined by the beach width and their fraction composition.

It is notable, that during last 40 years the abrasion and wash-out of the Caucasus coasts takes place extremely intensively and irreversibly. During the mentioned period the beaches of Krasnodar Krai had been reduces 2, 0 -2, 5 times. 180 km out of 320 km of total length of Georgia's coast are located in the zone of intensive wash-out and 120 km are in the condition of limited dynamic balance. Winter storms of 1960, 1971 and 1978 made loss of 17 million dollars; numerous accumulation shores intruded in the sea were washed away. During 1960-1980 more than 120 million dollars were spent for reconstruction of coasts, though, this measure did not have much effect, because the total area of washed-out shores exceeded 1400 ha. Coastal wash-out is particularly intensive in the areas of Gagra, Akhali Atoni and Ochamchire. The sea was intruded in the terrain by 500 m in the area of Poti and by 300 m – in the area of Adlia.

Among the cause-effect factors of extreme worsening of coasts the first is the considerable fluctuation of periodical deficiency of coast-forming river deposits and alongside coastal streams, which is related partially to the fluctuation of recurrence of rivers' solid runoff.

Good prove of it is the area of Poti, where at the estuary of the river of Rioni the Pasisi fortress built in the year of 134 at the coastal zone moved from the shore by 5 km for 1831 (it means that the land was increased annually and its index made 3,5 m). The sea shore at Poti fortress was growing by 6 m in average per year during 1578-1856 and by 27 m – during 1838-1925, and as for Poti lighthouse, it was being replaced by speed of 45m/year since 1860 till the beginning of 20th century.

As you may know, the solid deposits were and are very important in the formation of the Caucasus coastline (in geological past and nowadays), therefore, in spite of the fact that a total amount of solid deposits flowed into the Caucasus sea area are estimated within 30 million tones, the beach-forming mass amount does not exceed 4,7 million tones. At the same time, the researchers prove that recently the quantitative index of the rivers' solid runoff should have been much fewer, than that of Quaternary of the geological past. It is proved by petrographical researches of deposits of terraces and beds of the main rivers. If in the ancient terrace deposits dominate (60-80%) materials of carbonate-terrigenous rocks, in their floodplain–riverbeds exceed (60-70%) the rocks of crystal and volcanogenic formation, which mainly occupy high mountain-nival zone above forest belt within 30-35 %. This is stipulated by the following circumstances: 1. due to heavy karsting the surface runoff module and erosive wash-out of the carbonate rocks, which occupy about 30% of the total area, is gone down nearly to zero; 2. the most part of the river basins are covered by forests and the erosive-gravitation processes are reduced to minimum index; 3. only small amount of bottom sediments of water-unstable terrigenous deposits reach the sea water area.

Proceeding from above mentioned, in order to fill the deficiency of beach-forming solid runoff, one of the considered main directions is to supply the slopes of gorges by accumulated weathered porous material of

the cliffy rocks of considerable amount for the purposes of artificially increase of solid runoff in the main rivers transit beds. Regarding above mentioned the Service of "SAKGEOLOGIA" investigated valid material of 20 million m^3 in the river gorges of Georgia's Black Sea basin, more than 30 % out of which will be got under the distribution zone of the sea morphodynamics by all means due to rivers' hydraulic regime. Though, the amount of this kind of enriching products is much more in the river gorges of the Caucasus Black Sea coastal basin.

As the greatest factor of geoecological imbalance of the Caucasus coastal zone appeared the irreversible anthropogenic pressing on environment since the second part of 20th century and this process acquires broader scales in nowadays reality (Kulevi building and Anaklia perspective sea ports, building hydrotechnical cascades in the Chorokhi River basin, exploitation of inert materials of the river beds of Apkhazeti coastal zone in great amount for building Sochi winter Olympic complex), it will be followed by all means by geoecological cataclysms of the coastal zone in case the proper preventive and adoption measures based on scientific analysis will not be carried out.

Landscape phenomena are more hazardous for population of Caucasus coastal zone, as well as to farm lands and resort-recreation areas, railways and motor roads. In spite of the fact that the research of this region have been carried out for more than fifteen years and for solution of this problem several hundreds of dollars were spent, the landslide risk of hazard is the unsolvable problem today anyway.

In spite of the fact that in the coastal areal more than 5000 landslide bodies are observed, due to sensitivity of geological environment, they vary within the very low (10.01) and very high (0.9) categories according to the degree of vulnerability of the territory and risk of hazards and the coefficient of frequency of their activity varies – within 0.02 – 12.1. The territory built by Oligocene-Miocene clay-sandstones are distinguished by high degree of vulnerability and risk of hazard, such as Sochi-Matsesta section, the zone of hilly terrace morphology of Apkhazeti foothills and Guria, as well as huge laterites formed in the volcanogenic deposits of Middle Eocene in the hilly zone of Achara.

According to the data of 1980, the landslides with total area of 1145 km^2 are observed in the Krasnodar Black Sea coastal zone. Most of them, with high risk of hazard, are observed in the section of Sochi-Matsesta. More than 500 landslide bodies are observed only in the territory of Didi Sochi (Big Sochi).

More than 1000 landslide bodies are observed in the Apkhazeti coastal zone. About 90 % of the territory is under the risk of hazard of those landslide bodies and are injured by the landslides of different age and origin in the areal of spreading of Maikop sediments. 80 settlements are in the zone of high risk of landslides. Only due to the extreme activation of 1987-1989 years' landslides about 1400 houses were destroyed and injured and 4500 ha of farm lands were removed from the turnover of agricultural economy.

112 settlements are located in the areal of about 400 landslide bodies in the coastal zone of Achara-Guria.

In the Caucasus coastal zone according to the genesis of origin dominate climatogenic (hydrogenic) landslides (70%), forming of which are directly related to the increasing of humidity in the zone of slope deformation due to impact of atmospheric precipitation and ground waters. Extreme reactivation of such types of landslides in Apkhazeti coastal zone were observed 21 times during the last 100 years, which in average equals to interval of recurrence within the 4-5 years. 4-5 years cycle of recurrence is identified in the coastal zone of Krasnodar. Though, the intervals of activation period do not always coincide to each other in the segments of the coastal zones of Krasnodar, Apkhazeti and Achara.

According to the risk of hazard of landslide processes, the second place can be rendered to so called, coastal (basic) landslides; they occur in the river sides and sea shores and are characterized with greatest linear extension.

These kinds of landslides are characterized by regressive development and they obey to recurrence of slopes forming. As for the landslides of present dynamics, most of them are related to the last stage of generation of slopes.

Recurrence process of development of coastal landslides is stipulated by general changes in basis of erosion in the integral connection with the eustatic condition of sea level. Development –activation of coastal landslides on the long rivers begins in the second phase of the river erosion processes, when the rising of the basis of erosion takes place and the bedding process of the river gets into side-erosion phase. Intense wash-out of coasts and activation of coastal landslides takes place during the process of sea level eustatic rising of terrain sinking. As in the Black Sea basin we have to deal with the sea transgression and level rising, there exist preliminary conditions for continuation of intense reactivation of the coastal landslides in the Caucasus coastal zone in the 21st century. Though, as researches prove, variability of sea level in the area of its parameters takes place inhomogeneously – in Poti in average by 5,6 mm per year, in Batumi – 0, 798 mm and in Tuapse –2,4 mm.

Conclusion: Urgent geoecological situation created in the Caucasus Black Sea coastal zone needs particular regime; complex approach to the targeted adoption and integral management of natural environment, which foresees the identification of risk of geological catastrophes stipulated by natural and anthropogenic affect; elaboration of spatial organization and criteria of "persistency" of natural environment; and working out of regional scheme for minimization of hazards of natural catastrophes.

Solution of these key problems will be available by statement of conceptual issues as follows:

- what kind and of what scale local and regional changes took place early in natural environment, in order to restore the retrospective model of the past;
- to be identified the background conditions of present natural environment and the vulnerability rate of the territory towards elemental-catastrophic phenomena and risk of their hazard in the relationship with the regulations of homogeneousness and variability of natural environment;
- to be revealed the character, scale and extension areals of changes of natural environment destructed by anthropogenic stresses, to be identified criteria of availabilities of natural environment and to be carried out the ranging of the territory;
- to be worked out the long-range prognosis of changes of development-reactivation of natural-catastrophic phenomena;
- to be worked out the regional scheme of improvement of geological situation and integral management of the territory;
- to be prohibited strictly the removing of inert materials from the beds of the beach-forming rivers for their using in the construction near the coastal zone;
- to be investigated the quarry areas optimally processed in the basins of main beach-forming rivers for the purpose of increasing the rivers' solid runoff artificially;
- to be carried out permanently the regional geomonitoring researches for optimization of possibilities of reduction or elimination of hazards of natural elemental processes and to be defined the crisis of multi risk assessment index of catastrophes. First of all, it is necessary to create the polygon for joint geomonitoring researches of Georgia-Turkey – as a transboundary region – as a dynamically active and geoecologically particularly stained region of multispectre landscapes. On basis of obtained research results to be worked out the project of natural resources rational use, environment restoration-improvement and ecological safety of population;
- for creation of the model of optimization of reduction and environmental management of elemental phenomena to be elaborated the methodology of intellectual provision and systematization of obtained information, base which should include the targeted, numerical, management and social aspects of monitoring elemental phenomena of environment.

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