Anticipated Impact of the Construction of Anaklia Port on the Adjacent Coastal Landscapes

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Abstract: The future development of the marine transport system of Georgia, the necessity of which is undoubted, largely depends on the harboring potential of the Kolkheti seacoast. Among them should be noted the district in front of the River Enguri estuary, which has the most favorable natural conditions for port construction due to the great depths of the Enguri submarine canyon, and it is one of the best in the whole coast for projecting of the future port (Anaklia) here.

Selection of a place for ports in the seashore zone and then designing and building them is a highly responsible task, where a mistake should be excluded. Otherwise, the rebuilding of the already constructed port facilities will be either impossible or too expensive. In this case, are expected irreversible processes, which can be expressed in catastrophic changes of seaside landscapes and complete environment. This is particularly about the coasts of accumulation type where migrations of the beach alluvium during of the sea storms can reach quite large volumes. Fig. 1-2 Therefore, for designing on a high level and proper operating of the future port in Anaklia additional researches and some changes in the port project are needed.

Key words: Submarine Canyon, river sediments, sediment transport

Introductin: 80% of the coast of the Black Sea coastal zone of Georgia belongs to accumulative type. These banks have been formed during long time as a result of the development of complex litho- and morpho-dynamic processes. Under the modern conditions in the coastal zone, there are in progress also powerful lithodynamic processes, resulting in changes in the shore and underwater slope. Nowadays there is a complex geo-ecologic situation on the sea bank near the estuary of the River Enguri. However, in undisturbed natural conditions that were 150-200 years ago, when the human impact on the nature was relatively insignificant, Georgia's accumulated coastline, including Enguri sea estuary were evolving in stable natural conditions. On the beaches of the Black Sea coast of Georgia, according to their composition – pebbly or sandy, depends the amount of displaced material. As it is known, during the sea confusions and storms, there is a massive alongshore sediment transport [1]. During a year, their volume for the sandy beaches reaches 500-600 thousand m^3 and for the pebbly coasts varies within the limits of 30-80 thousand m^3. After the petrographic and mineralogical studies of sediment alongshore streams [2], [3] divided the Black Sea coast of Georgia into eight lithiodynamic systems. [3] Fig. 3 These systems before rough man-caused interference were developing continuously, and then were divided into separate autonomous systems and underwent degradation.

Materials and methods: The survey area is located in the central part of the Kolkheti lowland seacoast. There is a complex interaction between natural and anthropogenic systems. In order to analyze the natural conditions and the EIA in connection with the construction of the Anaklia port, were used morphodynamic, lithodynamic, statistical, hydrometeorological, cartographic, comparative geographical and also general scientific methods.

Results and discussions: The construction of marine ports on the accumulative sea shores requires a highly cautious and accurately calculated approach, as a violation of there existing lithodynamic processes can

result in irreversible negative processes. Incorrectly constructed harbor moles and very long entrance channels, constructed on the submarine slope are often violating the background natural processes course. For example, the Ochamchire, Kulevi, Poti and Batumi ports and terminals constructed at different times have greatly damaged the existing shores, maintaining the stable morphological state of which is still important today.

The part of the estuary of the River Enguri, located near the village Anaklia is the accumulative body, the modern face of which is formed in the second half of the Holocene, before last 4-5 thousands years .[4] The vale relief, adjacent to Anaklia, is distinguished by the low altitudes towards the sea level and wetlands. The vale, located near Anaklia itself, is formed by long lasting accumulation of the River Enguri terrigenic materials. From the site of the port construction to the north, in about 1.0-1.5 km, is located the present day sea estuary of the River Enguri, and in the south there are the Churia National Park wetlands. Along the coastal zone, there is uninterrupted 40-80 meters wide beach line. Along this line is located the old sand-hill (dune), the height of which ranges within 1-2.5 meters limits from sea level. The mentioned old sand-hill separates the sea and the terrestrial lowland areas, which is one of the conditions for geoecological sustainability of the Kolkheti National Park.

The underwater slope, located along the coast, is characterized by a complex structure. In a shelf line with small inclination is incised a deep-water submarine canyon, whose sources are very close to the shoreline. In particular, the nearest effluent of the underwater canyon in reality starts from 5 meter depths and is 180-200 meters away from the shoreline. Enguri submarine canyon played a significant role from the lithodinamic point of view for development of the coast. An important part of the river sediment was flowing into it, but the remaining sediment was sufficient for the stable development of the shore. After the launch of the Enguri hydroelectric power plant in 1978, started the beach creating sediment deficit, which resulted in the erosion of the banks. According to cartographic materials at our disposal, in the Anaklia future port's section was observed the maximum width - approximately 100-120 m of the terrestrial strip washout. Until 1978, the coast of Anaklia was developing in stable mode. After the construction of the Enguri water power plant entering of the River Enguri beach creating sediment into the sea sharply diminished, causing erosion processes. Fig. 4

After constructing of the entrance channel for ships of the Kulevi terminal (16 km from the Enguri River estuary in the south), in the north of the River Khobi estuary started intensive washouts. In fact, the River Khobi cannot bring the sediments into the sea any more. Also from the north, the beach-creating sediments, displaced along the shore are completely lost in the entrance channel of the Kulevi marine terminal. After the reduction of the beach size, degradation processes of the ancient coastline sand-hill (dune) began. According to the existing paleogeographical data, the old sand-hill (dune) was not experiencing washouts during the past 4-5 thousand years. In case of non-performing of coast reconstruction works, the process of the sand-hill washout will continue and supposedly in the coming 3-5 year period will happen a sea invasion in Churia wetlands. Development of processes in such direction will drastically change the ecological sustainability of the mentioned section of the Kolkheti National Park. After the construction of the Anaklia port, the above processes will intensify, as the alongshore sediment flowing from the Enguri estuary, due to the harbor moles (impeding effect), constructed in Anaklia, will not reach the shores of the sea, located in the north from Khobi estuary.

The mole (breakwater) envisaged by the project will well protect the port's inside water area from the waves, coming from the north and west directions, but it stays practically unprotected from the waves, coming from the south-west direction. During the construction of the port, are foreseen deepening works of the existing bottom surface by means of dredger pumps and excavators. In total, 16.2 million m^3 bottom grounds are to be removed including construction of the internal water area, making of the access channel and construction of the mole (breakwater) fig.5. It should be noted here that extraction of such a volume of bottom grounds from the accumulating shore will have a negative impact on the coastal zone. Part of the extracted sediment will be used to raise the land of the future harbor. The rest part will be filled in into the submarine canyon. Prior to the start of deepening works, will be necessary to perform projecting and research works, which should include marine drilling and geolocation.

During the construction of the northern mole of the port and after construction, the shade of the wave field will be formed for the shores, located on the south. This will result in sediment migration from about1.5-2 km sector, located under the shade, to the north. In such a case is expected:

1. Sanding processes in the turning basin of the harbor where the depths will by and by significantly decrease;
2. Due to the created deficit of sediment, the washouts will start in south, on the beaches, located outside the wave shade.

Based upon the submitted schemes of the 1 phase of the construction of the port and access channel, it is possible to say that the inside water area of the port stays unprotected from the quite strong waves of the southwest direction. Considering the great -18 m depths of turning basin, -18m depth of access channel and -18m depth of the port wall, it is possible to imagine how strong shock will have a 2-3 meter tall wave while collision with a wall.

In the south, outside of the shade of the wave, will aggravate the shore and the underwater slope washout processes, which will accelerate the degradation of the old sand-hill (dune). It should be noted here that today the construction of coast protective sunk breakwaters is in progress. At this time, two breakwaters are built. Unfortunately, the constructed breakwaters have not yet fulfilled their function.

Conclusions

1. **In the EIA report, submitted in connection with Anaklia port construction, is not duly estimated the coast baseline description and analysis;**

2. As the impact area of construction and exploitation of the port, taking into account the course of the baseline lithodynamic processes, can be considered the coastal zone stretch from the River Enguri estuary until the River Khobi estuary – in total 16 longitudinal km. It is necessary to review it in the report.

3. The report contains only one alternative for the location of the harbor moles. This alternative does not involve the use of great depths of underwater canyons. Therefore, it is necessary to develop and review a second alternative where great depths of underwater canyons will be used during disposing of moles appropriately. In this case, the length of the port entrance channel will be shortened and accordingly will be reduced the amount of sediments, to be extracted and work volume by about 5 million cubic meters.

4. During the construction of the north moles of the port and after the construction, for the south coasts will be formed the shade of the wave field from the south-west direction. This will cause sediment migration from the sector of about 1.5-2-km, being under this shade, to the north direction. In this case it is expected:

- **Sanding processes in the turnover basin where the depths will by and by significantly decrease;**
- **Due to the created sediment deficit, the washouts will start in south, on coasts, located outside the wave shade;**
- **This process will be realized until the time, the mole, foreseen by the second phase will be built.**

5. Special attention should be paid to the problem of maintenance of the old sand-hill (dune). If the dune undergoes further degradation, the seawaters will likely incise in the Churia National Park wetlands, which will significantly change the ecological conditions there. The water level of existing wetlands is 0.9-1.2 meters above sea level. In consequence of degradation of the sand-hill (dune) and the lowering of the beach in front of it, in the Churia marsh the water level can lower. This process will in turn lead to a noticeable change in the surrounding territories, surface water and hydrogeological conditions.

Recommendations

1. **Develop a second alternative of the disposition of the moles, which envisages arrangement of the harbor gate from the side of the submarine canyon.**

2. **Develop the SWOT-Analysis for two alternatives to the harbor arrangement - from arrangement of the gate from the side of the canyon and arrangement of the gateway from the southwest direction by means of making a long access channel.**

3. **Develop mitigation measures for maintaining of the old sand-hill (dune).**

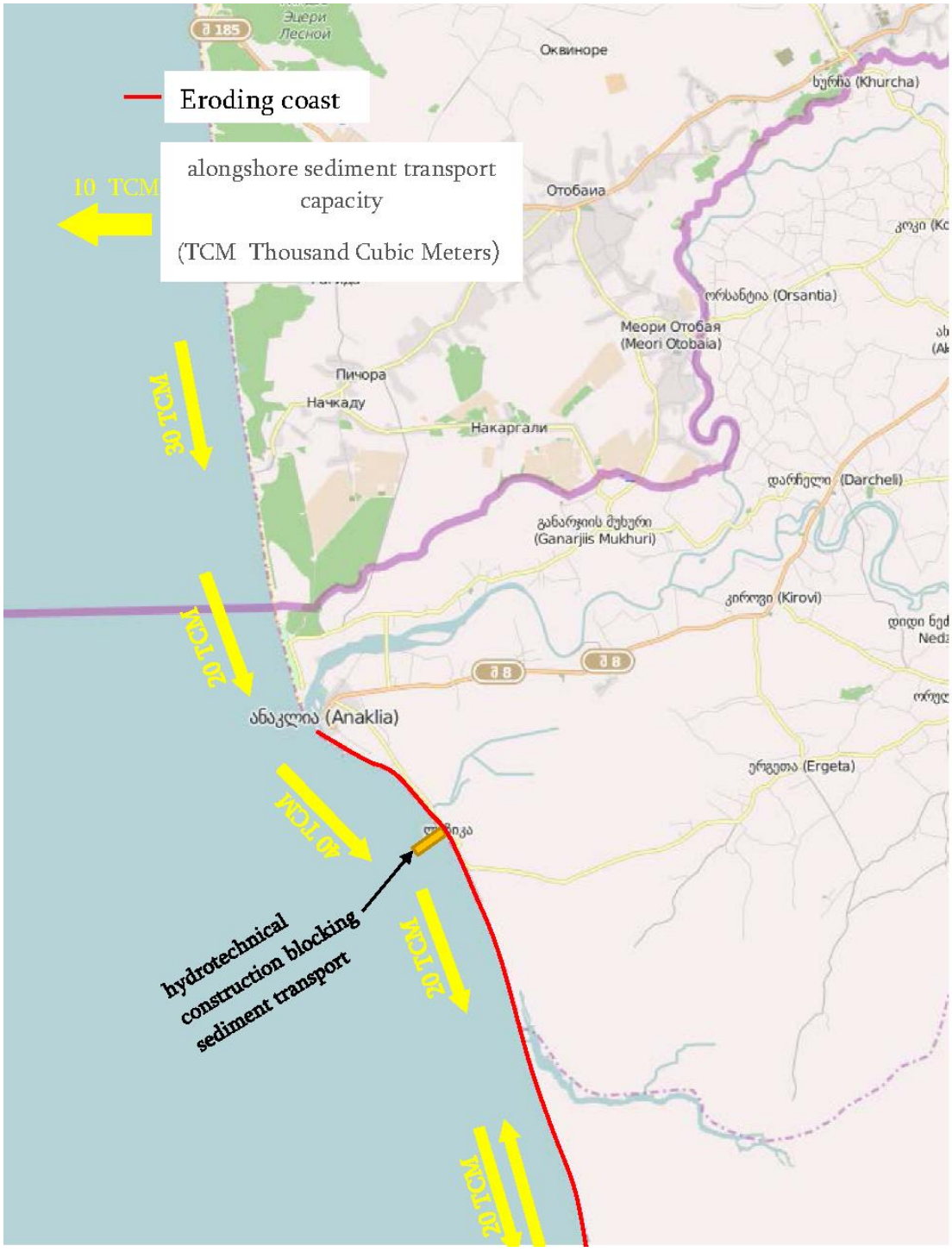


Fig. 1 Alongshore sediment transport capacity

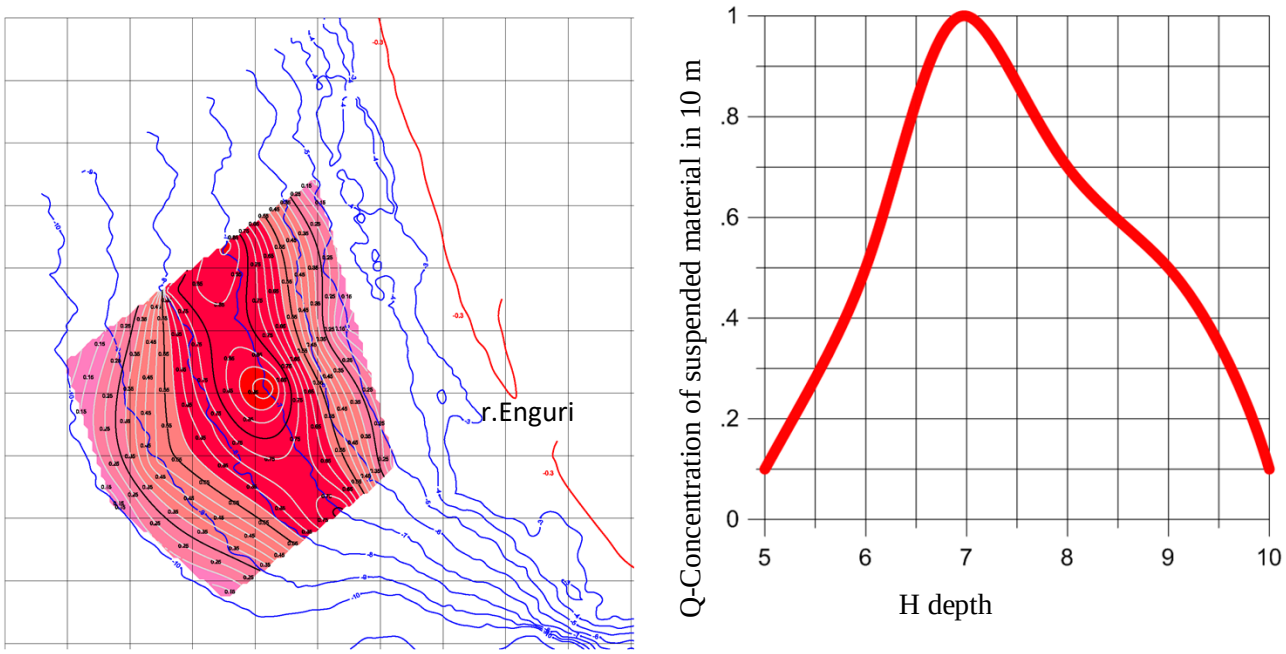
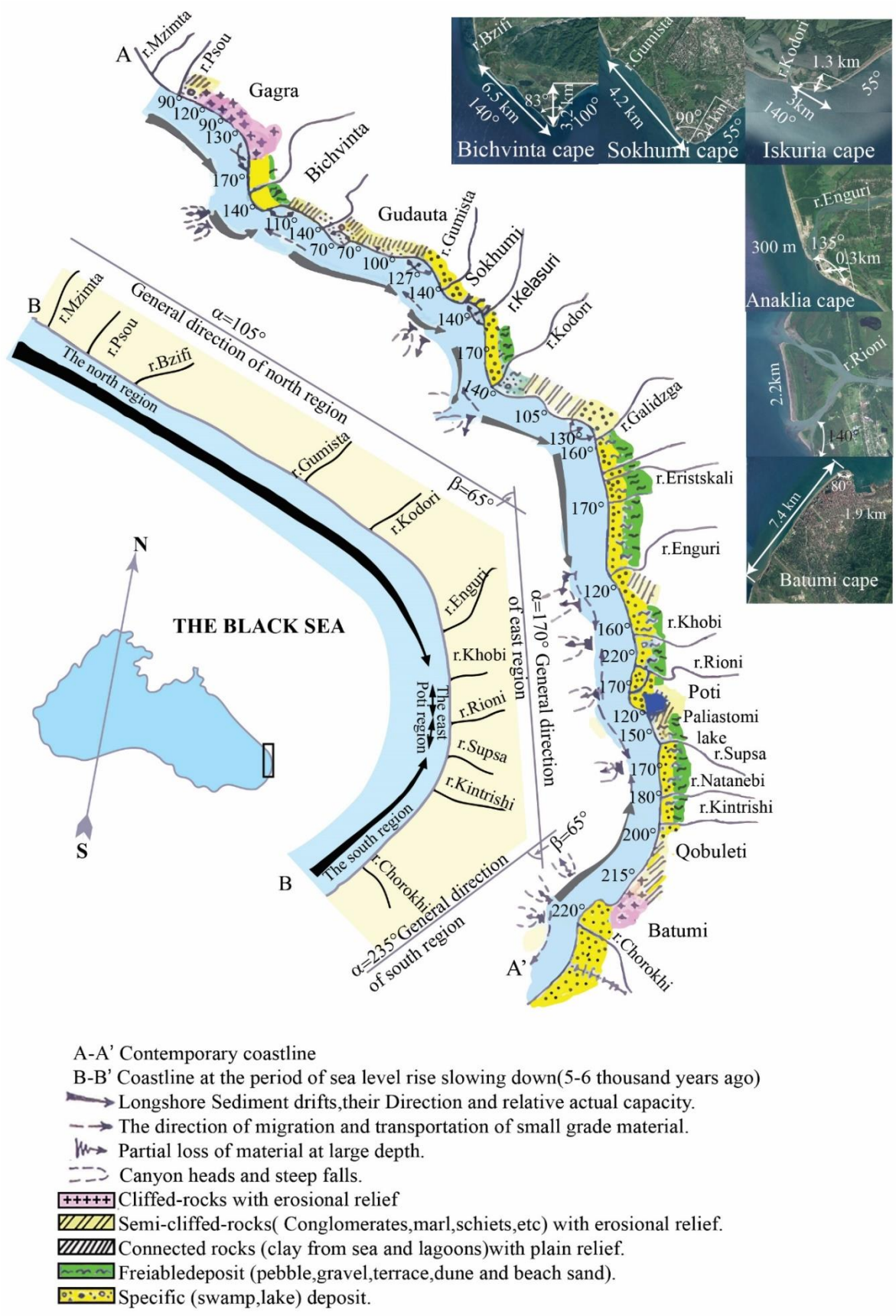


Fig. 2 Q-Concentration of suspended material in 10 m sea water layer near Enguri river sea mouth



A-A' Contemporary coastline
B-B' Coastline at the period of sea level rise slowing down(5-6 thousand years ago)
Longshore Sediment drifts,their Direction and relative actual capacity.
The direction of migration and transportation of small grade material.
Partial loss of material at large depth.
Canyon heads and steep falls.
Cliffed-rocks with erosional relief
Semi-cliffed-rocks(Conglomerates,marl,schiets,etc) with erosional relief.
Connected rocks (clay from sea and lagoons)with plain relief.
Freiabledeposit (pebble,gravel,terrace,dune and beach sand).
Specific (swamp,lake) deposit.

Fig 3. Morphodynamics and lithodynamics scheme of black sea coast of Georgia. By A.kiknadze

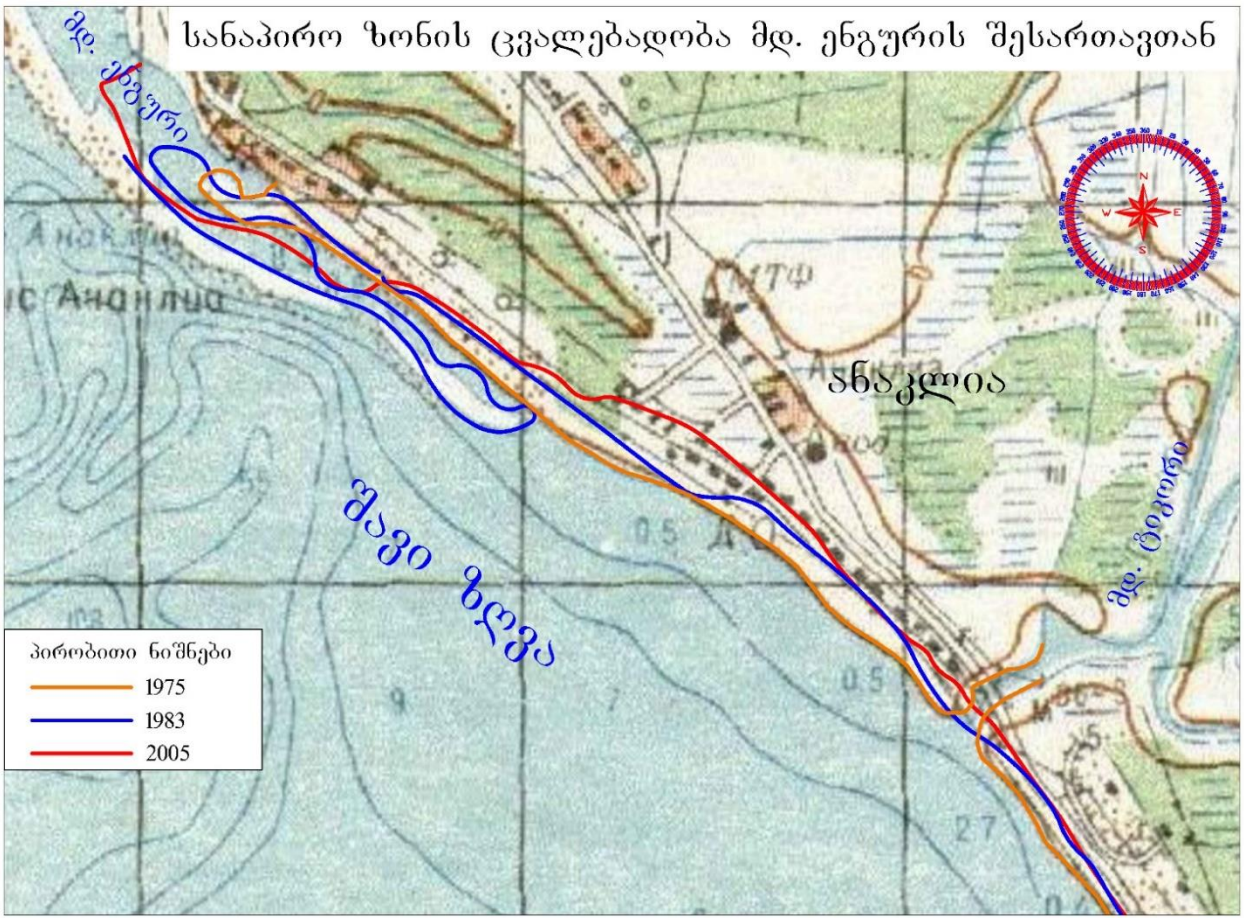


Fig 4. Coastlinee changes near r.Enguri sea mouth

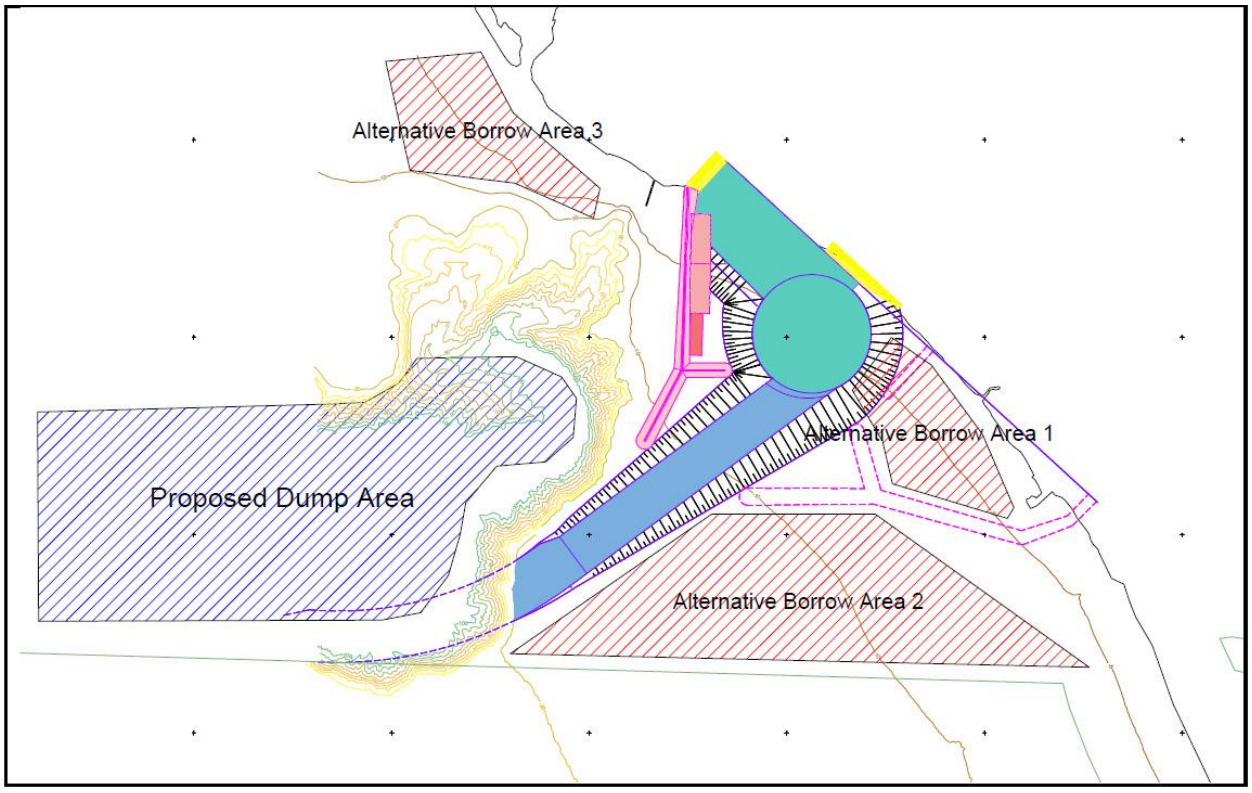


Fig. 5 Anaklia sea port project first stage

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