# CREATION OF THE END PRODUCT OF OCEANOGRAPHIC DATA OF THE GEORGIAN BLACK SEA AREA

**Assoc. Prof. Dr. Kakhaber Bilashvili, Prof. Dr. Vakhtang Gvakharia, Dr. Nino Machitadze, MS Zurab Savaneli, Assoc. Prof. Dr. Vazha Trapaidze**

All Iv. Javakhishvili Tbilisi State University

1, Il.Chavchavadze Av., 0179 Tbilisi, **Georgia**

wocean@telenet.ge

## ABSTRACT

The Black Sea coastal zone of Georgia is especially valuable for its natural conditions and economic function. Concerning to the implementation of requirements of EU-Georgia Association Agreement the main guiding document regarding the marine environment is The Marine Strategy Framework Directive – MSFD which came into force on July 15, 2008. The goal of the Marine Strategy Framework Directive (MSFD) is to achieve or maintain Good Environmental Status – GES in marine waters of Europe (including Black Sea) not later than 2020 year.

The paper deals with the realization of the requirements and approaches of MSFD in the part which refers to making inventory, classification and visualization of the current oceanographic databases.

**Keywords: MSFD, marine cruise data, visualization, sediment chemistry, Black Sea**

## INTRODUCTION

The Directive (conceptually linking with EU Water Frame work Directive - WFD) envisages elaboration of such approach which provides protection of the marine biota and minimization of pollution, and at the same time, the marine resources should be used by the society in the stable manner. To solve such controversy tasks, the integrated analyze of system is required which is provided by Ecosystem Approach - EcAp. Such approach is the cornerstone of the European marine strategy, shows the importance of relationship between society and ecosystem and creates the precondition of Ecosystem-based marine environment management.

One from the priorities of the new European strategy is dissemination of the activities set in the Directive on regional and sub-regional level (including the Black Sea region).

The main goal of investigation is realization of the requirements and approaches of the Marine Strategy Framework Directive (MSFD) in the part, which refers to making inventory and classification of the current oceanographic databases aiming to reveal trends of ecological condition of the marine environment.

In the last years, in Iv. Javakhishvili Tbilisi State University within the framework of the programme “International Oceanographic Data and Information Exchange" of Intergovernmental Oceanographic Commission of UNESCO (UNESCO/IOC/IODE) and supported by Pan-European projects (SeaDataNet, EMODNet, EMBLAS etc), the marine data of Georgia (including the

historical ones) have been quested, survived, metadata electronic cataloging has been exercised and after the proper formatting, they was placed in the corresponding European bases which provides their availability, which is the most important problem. Namely, in this research the following data was used for assessment of the chemical condition trends in the Georgian Black Sea coastal zone*[1, 2],*:

- Marine data collected during the expedition in the south-eastern part of the Black Sea by S/R Firm GAMMA on the board of R/V K. PIRI REIS (Docuz University, Turkay) in October of 2000 (Figures 1, 2, 3, 4, 5, 6, 7, 8).

- Data derived within the EU/UNDP funded international project EMBLAS 2 during the marine cruise on the board of R/V "Mare Nigrum" (GeoEcoMar, Romania) in the same area on May 15 – June 15, 2016.(Figure 9).

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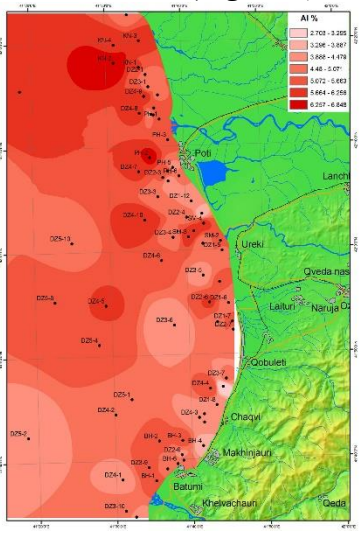
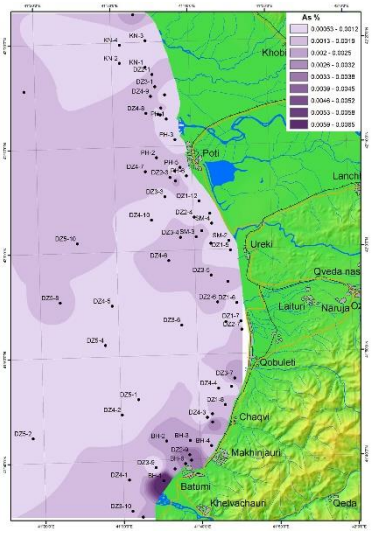



Figure1

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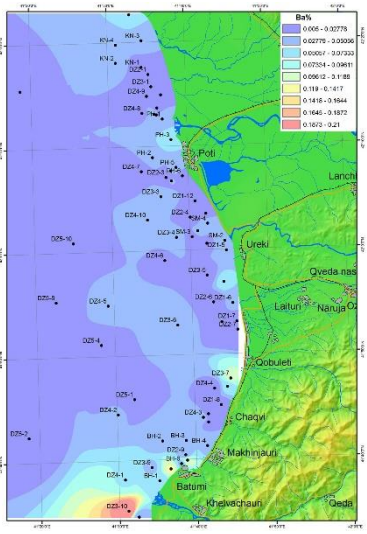


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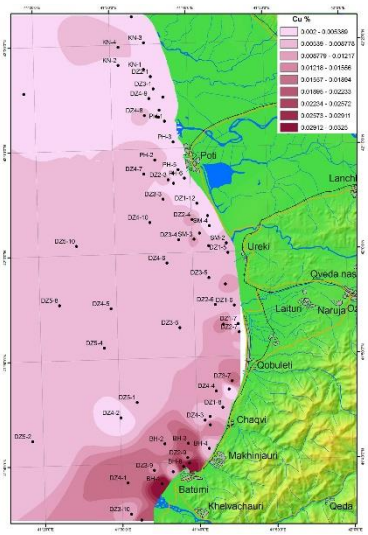


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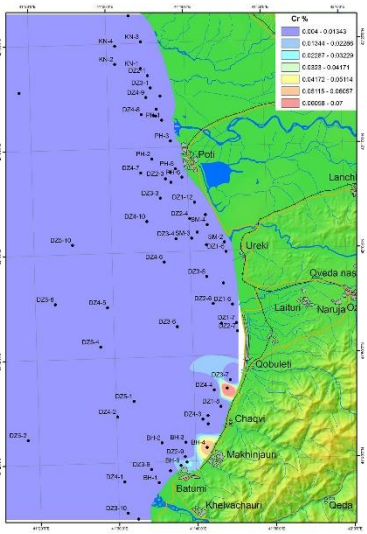


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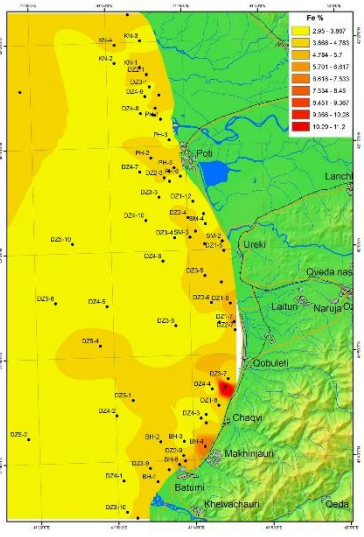


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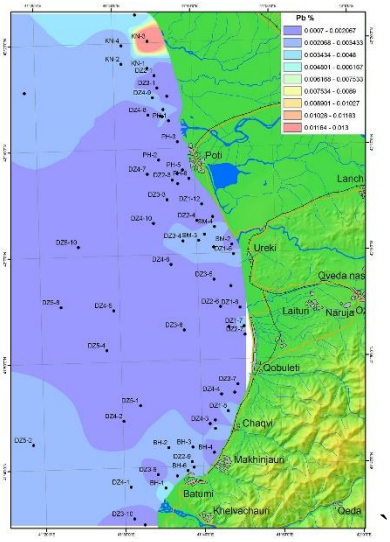


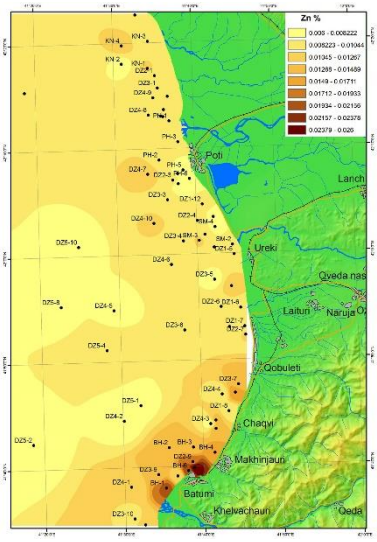




Figure 7 Figure 8

In both expeditions sediment sampling were performed using grab samplers. The pre-treatments of collected sediment samples and determination of metals was carried out in the Scientific Research Firm GAMMA Testing Laboratory (accredited by National Accreditation Center, Certificate of Accreditation GAC-TL-0067). Trace metal measurements (Fe, Al, Cu, Zn, Cr, As, Ba and Pb) were performed and similar standard methods and techniques of probe chemical analysis were used *[3]*.

In the year of 2000, bottom sediment samples from 75 stations of the sea were collected throughout the entire Georgian shelf covering the depth range from 10 to 1500 m. A summary of these measurements is provided in Table 1.

**Table 1. The metals concentration in the bottom sediments of Georgian shelf, 2000**

| | Al, % | Fe, % | Mn, % | Cu, ppm | Zn, ppm | Cr, ppm | Pb, ppm | As, ppm | Ba, % |
|---|---|---|---|---|---|---|---|---|---|
| **Averag** | 4,98 | 4,08 | 0,14 | 81,22 | 102,30 | 81,42 | 21,04 | 13,86 | 0,03 |
| **Min** | 2,70 | 2,95 | 0,06 | 20,00 | 60,00 | 40,00 | 7,00 | 5,30 | 0,01 |
| **Max** | 6,85 | 11,20 | 0,37 | 325,00 | 260,00 | 700,00 | 130,00 | 65,00 | 0,21 |

**Copper and Zink:** High concentrations of Cu (325ppm) and Zn (260ppm) were found in bottom sediments collected from shallower depths near the estuary of Chorokhi River in response to the wastes discharged from mining enterprises in Murgul ( Artvin) region of Turkey *[3, 5]*, in the immediate proximity of the boundary with Georgia and from Merisi (Adjaria) within the Georgian sector. They however decreased to the north. In sediments of the underwater slope of Kolheti lowland, Cu and Zn were distributed evenly at their background levels ranging from 20 to 45 (theaverage:30 ppm ) for Cu and from 62 to170 (the average:110 ppm) for Zn.

**Arsenic:**The distribution of arsenic in the shallow bottom sediments within Adjara section of underwater slope was analogous with distribution of Cu and Zn. High concentration of As (65 ppm) is found in bottom sediments collected from shallower depths near the estuary of Chorokhi

River mouth. Arsenopyrite is included as a part of the sulphide minerals discharged into the sea together with other chalcophilic minerals from the mining regions of Georgia and Turkey.

**Chromium:** This metal was distributed unevenly in bottom sediments. It mainly accumulated in sediments of the Chakvistskali – Supsa inter-mouth region with maximum concentrations 700 ppm in the estuarine regions of the Chakvistskali and Natanebi Rivers. The main sources of chromium are dark minerals (magnetite, biotite, pyroxene), the rock-forming minerals of the volcanic ores of basic composition (basalts, andesites, porphyrites, tuffs, tuffbreccias, etc.) by the small rivers of the region (Korolistskali, Chakvistskali, Choloki, Natanebi, Supsa). In contrast to the copper and zinc, accumulation of chromium is natural, since it is not connected with any anthropogenic impacts.

**Lead:** The average concentration of lead for Georgian shelf was 21 ppm. Lead was distributed evenly throughout the shelf. Except of one station, where maximal concentration 130 ppm is fixed, lead content did not exceed 50 ppm, minimum was 7 ppm , and that corresponded to the local background level.

**Barium:** High content of barium in bottom sediments was mainly confined into coastal zone of the Georgian shelf. The maximum concentration (in the limits of 0.1-0.2%) was found in the region between the Chorokhi River mouths to Batumi. Its distribution was related to the products of weathering of the barites - polymetallic layers of the South Caucasus, transported to the sea by the Chorokhi River. Accumulation of barium was also observed in the estuary sediments of Kintrishi River (0.05-0.1%). In coastal regions of the West Georgia, metamorphic geological formations containing clay minerals (in particular zeolites), rich in barium, were found. Possibly, that terrigenous material was enriched by above mentioned minerals, which explains comparatively high content of barium along the coast.

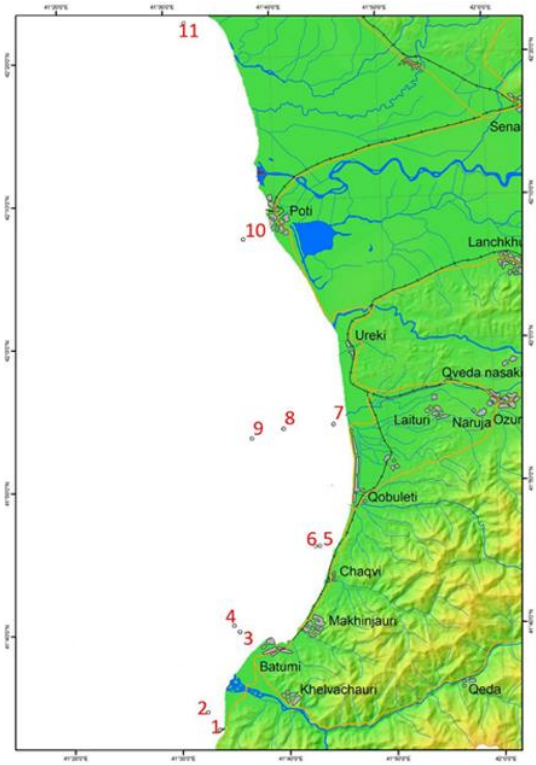
**Aluminum:** Being one of the basic rock-forming elements, aluminum constituted 2% to 7.5% of sediments of the Georgian shelf which are found at higher proportions in the area of Kolkheti lowland. On the average, in the northern part of the Georgian shelf, aluminum content was 3-4% higher than in south because of gradually increase of clay fractions in sediments in the northwards direction *[3]*.

**Iron:** Coastal region of the shelf located in the inter-mouths of Korolistskali, Chakvistskali, Kintrishi, Natanebi and Supsa Rivers was characterized by high content of iron (>11%) *[3, 4]*. These rivers drains the western extremity of Adjara-Trialeti folded system and carry the products of red-soil weathering crust into the sea. High content of iron is related with the dark minerals (magnetite, black mica, etc.) In this region, high content of iron coincided with high content of chromium, which pointed to their common source. Within the limits of Kolkheti lowland, iron content varied from 3 to 5% in sediments of the underwater slope.

**Manganese:** In sediments from Chorokhi River estuary to the town Kolkheti, Mn distribution was practically homogeneous and equal to the natural background level from 0.06 to 0.37% with 0.14% on the average *[4, 5]*. This level corresponds to Mn concentration in the red-colored soils of coastal zone of Adjara and Guria. In the area between Natanebi and Supsa Rivers, thickness of this type of soil is maximal and the discharge into the sea is therefore most intensive. It came in to the sea in a large volume with suspended solid sand particles of the Rioni River waters. The content of Mn in the coastal zone sediments depends up on activity at the Chiatura mining factory.

Below are overviewed the results of study of bottom sediment, sampled in Georgian sector of the Black sea, in frames of EMBLAS II project, during the Joint Open Sea Survey (JOSS) and National Pilot Monitoring Studies (NPMS) Scientific Cruise. Results are given in Table 2. Received data

are discussed with respect to investigations of Black sea sediments, provided by our scientific group.





| Station | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| H | 40 | 80 | 40 | 80 | 40 | 80 | 40 | 80 | 200 | 80 | 40 |
| As, Mg/kg | 11.4 | 22.4 | 22.8 | 15.8 | 11.8 | 14.8 | 11.4 | 13 | 25.8 | 14.4 | 19.2 |
| Cu, Mg/kg | 83.5 | 135 | 129 | 77 | 33.5 | 97 | 107.5 | 69.5 | 63.5 | 42.5 | 46 |
| Zn, Mg/kg | 93.5 | 100.5 | 97 | 82.5 | 78.5 | 91.5 | 95.5 | 84 | 81 | 76.5 | 85.5 |
| Ni, Mg/kg | 51.5 | 67.5 | 73 | 57.5 | 61.5 | 63.5 | 98 | 62 | 61 | 62.5 | 56 |
| Cd, Mg/kg | < 2,5 | < 2,5 | < 2,5 | < 2,5 | < 2,5 | < 2,5 | < 2,5 | < 2,5 | < 2,5 | < 2,5 | < 2,5 |
| Pb, Mg/kg | 28 | 29.5 | 26 | 38.5 | 27.5 | 33.5 | 48 | 49 | 30 | 26.5 | 31 |

Figure 9

**Table 2. The metals concentration in the bottom sediments of Georgian shelf, 2016**

| | Fe, % | Al, % | Mn, % | As, ppm | Cu, ppm | Zn, ppm | Ni, ppm | Pb, ppm |
|---|---|---|---|---|---|---|---|---|
| **aver** | 4,44 | 6,31 | 0,092 | 16,62 | 80,36 | 87,81 | 64,91 | 33,41 |
| **min** | 4,05 | 4,51 | 0,074 | 11,4 | 33,5 | 76,5 | 51,5 | 26 |
| **max** | 5,30 | 7,25 | 0,144 | 25,8 | 135 | 100,5 | 98 | 49 |

**Fe**

Terrigeneus material, transported by rivers to the offshore zone, contains about 4-5% of iron. The maximal concentration – nearly 12% - is characteristic for specific red weathering crust and red-colored soils, presented in the Adjara – Trialeti folded system, at 300 – 400m above sea level, in Guria and Adjara regions. The sediments of rivers, drained this geological formation (Natanebi, Supsa, Bartskana, Chakvistskali) are enriched with iron. As a result, in estuarine zones of mentioned rivers the iron concentration is high. In the JOSS/NPMS under study area, the iron content in sediments varies within 4– 5%. This range of concentration is similar to average concentration of iron in 2000.

**Mn**

Concentration of manganese in bottom sediments from JOSS/NPMS studied area, varies with 0.074 – 0.14%. Increase of concentration from south to north is so observed, but the concentration is relatively decreased compared with 2000.

**Cu and Zn**

In the JOSS/NPMS under study area, in bottom sediments, cooper and zinc content varies respectively within 33.5-135ppm, and 76.5 – 100 ppm. It should be noted that maximal concentration of this elements near Batumi sea area with evident accumulation of Cu – 135 – 129 ppm and Zn – 97 – 100 ppm is fixed as usual, but concentration is slightly reduced compared to 2000.

**As**

In bottom sediment from JOSS/NPMS under studied area, content of As varies within 11 – 25 ppm, it is a same range as 2000. High concentration is fixed on two areas: Batumi sea area – 22 ppm, and Poti sea area – 25.8 ppm.

**Ni**

In bottom sediments from JOSS/NPMS studied area, concentration of Ni is 51 – 98ppm, what in conjunction with data received in 2000.

**Pb**

The concentration of Pb from JOSS/NPMS studied area is same of 2000: 26 – 49 mg/kg .

**Al**

The concentration of Al in sediments varies in limits of background level, within 4 – 7 %.

## CONCLUSION

Concerning to the implementation of requirements of EU-Georgia Association Agreement the main guiding document regarding the marine environment is The Marine Strategy Framework Directive – MSFD, the main goal of which is to achieve or maintain Good Environmental Status – GES in marine waters of Europe (including Black Sea) not later than 2020 year. Following the requirements and approaches of MSFD in the part which refers to making inventory, classification and visualization of the current oceanographic databases, research on metal content in sediments were conducted.

Peculiarities of metal content in bottom sediments of Black sea Georgian sector is related with the natural and anthropogenic factors. The main source of terrigenous material in the southeastern sectors of the Black Sea in Georgia, is represented by river alluvium, transported from three different geochemical provinces: 1. Anatolian upland (riv. Chorokhi watershed); 2. Western termination of Ajara-Trialeti folded system (watershed Korolistskali – Supsa interfluve); 3.Southern slope of Great Caucasus and Kolkheti lowland (Rioni, Khobi and Enguri watershed).

Western Georgia mountain region is rich with mineral deposits (30-35 years ego mining industry was an important part of the economy of country).

Contamination of rivers by municipal wastewater, mining proceeding wastes, drained to the Black sea can be considered as anthropogenic impact factors. Waste and sludge from abandoned mining sites and enrichment industries, including arsenic, cooper, manganese extraction and enrichment facilities, is a major environmental hazard.

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