UNIVERSITY "GOCE DELCEV"-STIP
Faculty of Natural and Technical Sciences and
National UNESCO-IGCP Committee

FINAL REPORT

ANTHROPOGENIC EFFECTS ON THE HUMAN ENVIRONMENT IN THE NEOGENE BASINS IN THE SE EUROPE

February, 2012
Stip, Macedonia

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R e c t o r

Prof. d-r Saša Mitrev

February, 2012
Stip, Macedonia

Project title:

Anthropogenic effects on the human environment in the Neogene basins in the SE Europe

Institutions involved in realization:

University “Goce Delcev”-Stip, Faculty of Natural and Technical Sciences and National UNESCO-IGCP Committee, Republic of Macedonia

Leader of the project:

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Participants to the project:

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PREFACE

The National UNESCO-IGCP Committee exists for few decades and successfully executed numerous research-scientific projects, both, through the UNESCO progammes as well as through the scientific cooperation with similar institutions working on the geological scientific problems in the Europe and World wide. The most of the projects have been related to the correlations in geology where prevailed those studying stratigraphy, paleontology, petrology and metallogeny issues. During the last two decades the emphasis of scientific activities of the National UNESCO-IGCP Committee was given to the national geology where this Committee successfully participated in few international projects studying the Carpatho-Balkan region and region of SE-Europe. Numerous publications by the members of the Macedonian UNESCO-IGCP Committee contributed to a wider affirmation of the Macedonian geology and especially interesting raw mineral deposits. Such an affirmation was followed by investments of large foreign companies in explorations of deposits and occurrences of copper, gold and other polymetals at the territory of the Republic of Macedonia.

However, during th last decade the Macedonian UNESCO-IGCP Committee, beside the activities in the area of correlations in geology successfully executed and participated in projects related with environmental issues. In that direction during 2004 and 2005 successfully was realized the project Anthropogenic effects on the human environment in Tertiary basins in the Mediterranean. That project was a fine reason to continue with studies regarding pollution issues, especially those of anthropogene origin in Macedonia and in adjacent areas. Financial support of environmental projects were supported on national and regional level, with an emphasized international support. The UNESCOS's programme for participation was our main destination, which allowed us during last two years (2010-2011) to conduct the project titled "Anthropogenic effects on the human environment in the Neogene basins in the SE Europe" in which beside the National UNESCO-IGCP Committee large support was given by the Faculty of Natural and Technical Sciences and University "Goce Delčev" in Štip. This was a fine opportunity for numerous younger researchers to be involved in the realization of the project and give its contribution in solving issues related to the anthropogenic effects to the human environment.

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INTRODUCTION

The issues related to the anthropogenic effects in the Republic of Macedonia and adjacent regions have been in continuous focus of the European directives agenda and are usually prioritized in regards of study and research. In that direction was also the UNESCO's programme for participation in which actively was involved Macedonian National UNESCO Committee and in accordance to its recommendations directly was involved Macedonian UNESCO-IGCP Committee too. That served as a basic idea for making a concept for participation and realization of one important environmental project targeting environmental issues in the Republic of Macedonia and adjacent areas.

Following the deadlines and official recommendations of the UNESCO's programme for participation for 2010 and 2011, Macedonian UNESCO-IGCP Committee prepared an application with a project-proposal titled: "Anthropogenic effects on the human environment in the Neogene basins in the SE Europe" where as a leader of activities acted the University "Goce Delcev" in Stip as an official legal entity. This was an excellent opportunity for the members of the Macedonian National UNESCO-IGCP Committee once again to be involved in realization of an another important project which is studying anthropogenic effects. This time the major tasks were anthropogenic effects related to the Neogene basins in the SE-Europe.

For the realization of this important project we have received significant support by the National UNESCO Committee, which have provided to us necessary contacts with the National UNESCO Committees of the Republic of Croatia and the Republic of Slovenia. Since the basic criteria for the realization of the project were fulfilled the process of establishing a scientific network continued through the interconnection of the Faculty of Natural and Technical Sciences with the Faculty of Natural Science and Engineering, Geological Department in Ljubljana, Slovenia and Faculty of Sciences, Institute of Mineralogy and Petrology, University of Zagreb, Croatia. Those contacts helped in formation of three main research teams that furthermore included participants from Bulgaria, Serbia, Kosovo and some other countries in the region of the SE-Europe. The project "Anthropogenic effects on the human environment in the Neogene basins in the SE Europe" initiated large interest at scientific institutions and researchers itself, which has been confirmed by the organization of the three Workshops within relatively short period of time that have been timed by the UNESCO.

The First Workshop has been realized in the Republic of Macedona at the beginning of June 2011 with around 50 participants and presented 15 scientific papers enclosed in the official Proceedings book of this Workshop (*http://frgp.ugd.edu.mk/images/stories/file/pdf/INTERNATIONAL_WORKSHOP/Instead%20of%20Preface%20and%20Papers%201st%20Workshop%202011.pdf*). The next Workshop within this project, at the beginning of October 2011 in Zagreb, was organized by the Faculty of Sciences, Institute of Mineralogy and Petrology, University of Zagreb and Croatian UNESCO-IGCP Committee. Also, at this Workshop took active participation over than 30 participants and were presented 10 scientific papers published in the Proceedings book of the Workshop (*http://frgp.ugd.edu.mk/images/stories/file/pdf/INTERNATIONAL_WORKSHOP/Proceeding%20book%20II%20Workshop2.pdf*). The third Workshop held at the beginning of December, 2011 in Ljubljana was organized by the Faculty of Natural Sciences and Engineering, Geology Department, University of Ljubljana and Slovenian UNESCO-IGCP Committee. There were published 12 scientific papers (enclosed in the Proceedings book) and an active participation of 30 participants (*http://frgp.ugd.edu.mk/images/stories/file/pdf/INTERNATIONAL_WORKSHOP/Workshop%20III%202011%20za%20WEB.pdf*).

All facts mentioned above we may to conclude that the project "Anthropogenic effects on the human environment in the Neogene basins in the SE Europe", with a financial support from the UNESCO, has been realized successfully, while as a permanent scientific documentation remain three proceedings books with more than 50 papers.

1. 0. GENERAL FEATURES OF THE ANTHROPOGENIC EFFECTS ON THE HUMAN ENVIRONMENT

An anthropogenic effect has a major effect on the environment. The ecosystems and the planet as a whole have changed dramatically as a result of efforts to support the growing population. The humanity is more than ever threatened by its own actions because the natural resources are being depleted at an alarming rate, while the human activity is considered the number one cause of the global climate change which is the greatest challenge the human race has ever faced in history. And the scientists fear that the outcome cannot be good without immediate actions to reduce anthropogenic impact on the environment.

Not everyone agrees with the UN definition of sustainable development which foresees development in harmony with the nature because development automatically affects the environment. However, as long as development reduces the negative impact of anthropogenic activities on the environment by reducing carbon dioxide emissions, waste, consumption of natural resources, creating a retreat for wildlife or any other way, it can be defined as sustainable. And the same counts for activity of an individual because industry and building are not the only factors that affect the environment. On the contrary, actions of an individual are just as important. After all, there will be 7.5 billion of individuals by the end of year 2013. And for that reason the transition to a sustainable system requires participation of the wider population although political and economic adjustment are not negligible because the implementation of a full scale sustainability needs a complex and centrally led strategy. A good example is recycling which is an important part of sustainable development. Households and industrial facilities cannot recycle if there is no separated waste collection for instance. On the other hand, the central and local authorities can take all the necessary measures but they will remain without any effect if the people do not actively contribute to the efforts to reduce the human impact on the environment. Transition to sustainability is a process which requires participation of everyone.

Both the wider population and governments seem to be aware that prompt action is required to reduce an anthropogenic impact on the environment which is the key to reversal of the global climate change as well as reduction of the pressure on natural resources. Things seem to be improving and concrete measures have been undertaken in order to reduce the human impact on the environment by both the governments and people themselves. However, a lot more needs to be done to further decrease consumption of resources and improve environmental management if we want to reverse the global climate change and leave some resources to the future generations. Everything that contributes to sustainability counts, however, the rate of resource depletion and the effects of the human activity on the environment clearly show that we cannot afford small steps and slow transition to better sustainability. The humanity is running out of natural resources and the global climate change is not only something that awaits us in the future but it is already happening.

An Anthropogenic Effects On Environment

Understanding the human impact on environment is a crucial understanding that people need to have. Yet, for many people, this is a topic that does not interest them and even is not likely to grab their attention. The problems from the human impact on

the environment continue to grow, though. Over time, it becomes increasingly important for people to take the time to carefully consider what they can do to lessen this impact. When and if nothing is done to make those improvements, the results will be catastrophic for virtually anyone involved. Yet, there is help and hope for rewards out there.

An Anthropogenic Impact And World Environment

What is an anthropogenic impact on environment? To understand this, consider how people use the world around them for everyday life.

- We use the world as a resource for food to keep us alive and well.
- We use the world as a way to produce energy so that tasks can be accomplished.
- The world is used as a source of medications that help to keep people healthy and heal many ailments.
- The world is used for a source of enjoyment, recreation and simple fun
- The world is used as a natural resource for the production of products including industrial products and supplies.

Daily Impact On Environment

In every way, an anthropogenic impact on environment happens every day. The world has also changed because of these needs and impacts. For example, human pressure, as scientists call it, is greater than every which means more potential problems in the long term. This includes more intensive agriculture that has taken the place of traditional farming methods. This has strained the western rural landscape so badly it threatens it. Look closer to find other examples of an anthropogenic impact on the environment. Tourism, on a massive scale has taken a toll on the planet as well. The natural landscapes have changed considerably, especially coastal areas, mountains and larger lakes. This not only affects the look of these areas but also their ability to sustain wildlife.

An Anthropogenic Effects On Environment

What other ways does the human affect on the environment happen?

- There is a decreased diversity of species since so many habitats have been destroyed
- There is a reduction in the genetic resources for many species, which in turn makes I more difficult for these animals to evolve and continue to prosper
- Energy resources have been drained in many areas

An anthropogenic impact on the environment is significant and in some situations, it cannot be reversed. For this reason, it becomes important and even essential for people to make changes now so tomorrow becomes much easier to live with.

2.0. HEAVY METALS POLLUTION AROUND ACTIVE MINES IN THE TERTIARY BASINS IN THE SE-EUROPE

Beside the other major goals within this regional project the major accent was given to the active mines pollution, since such an objects are existing in the Republic of Macedonia, Bulgaria, Serbia, Croatia etc. Within this review we would like to point out few characteristic moments considering the polluted soils, waters and air by the acid mine drainage, erosion, winds etc. within the Neogene basins. The pollution in general came as a result of an activities of Cu, Pb-Zn, Fe-Ni, As-Sb, coal and other mines and facilities associated to mining activities (milling and smelting plants).

The most important Neogene basins from the anthropogenic input point of view within the Republic of Macedonia were: Skopje, Slaviski, Kocani, Lakavica, Veles and Tikves basin. Within all the aforementioned basins were determined significantly increased concentrations of particular heavy metals such as: Cu, Pb, Zn, Ni, Cd, Mn, Mo etc., as a direct consequence of processes introduced by human activities (mining, milling and/or smelting). We have to point out that in all basins that were subjected to this study was determined significant environmental pollution that in general could be attributed to the anthropogenically induced processes and activities. Especially increased were concentrations of Pb, Zn, Cu, Cd, Mn, Mo and other associated heavy metals. Their concentrations, all together with enrichment factors pointed to medium to strong anthropogenicaly introduced pollution.

Within the study of pollution related with active mines in the Eastern Macedonia were determined the basics of the anthropogenic impact of this kind of industrial activities within and around the major Pb-Zn and Cu producers in the Republic of Macedonia. All the studied sites have shown significant anthropogenic input and deterioration of the natural values.

These findings were supported by numerous findings of separate studies at separate sites. Some of them were studies of chalcophile elements in Kalimanci Lake surface sediments (Republic of Macedonia) that helped to preliminary examine geochemical characteristics of the surficial Kalimanci Lake sediments due to assumed pollution from the Sasa Mine tailings where geochemical investigation revealed very high concentrations of chalcophile elements (Co, Ga, Mo, Cu, Pb, Zn, Ni, As, Cd, Sb, Bi, Ag and Au) in lake sediments as well as enrichment factors. However, after this preliminary study many questions remain unanswered, therefore further investigations are required. The anthropogenic input of the Pb-Zn Sasa mine was studied in more details by the study of the mobility of metals in Sasa Mine's tailings dam material where the final results have indicated that the Pb is the most mobile metal in Sasa mine tailing found in acid soluble fraction while by far less mobility showed Ni, Cd and Zn with acid soluble concentration less than 7%. These results shown true concerns that tailings from Sasa mine represent a serious threat to the surrounding environment.

The study regarding the cadmium concentration in the soils of the village Gujnovci, as a direct impact of the Pb-Zn Zletovo Mine confirmed increased anthropogenic impacts. There were determined increased concentrations of Cd probably due to disasters that occurred in the lead and zinc flotation dams.

Study of unique Macedonian copper mine, Buchim Mine near the city of Radovis, became more profound through the monitoring deposition of anthropogenic introduced elements in air (case study: copper mine environ) where the conducted

monitoring with deposited dust samples have proven that anthropogenic introduced elements (Cu and Pb) deposit in higher contents in close vicinity of their hot spots (open ore pit, ore waste and flotation tailings landfill).

The abundance of heavy metals in soil has been increased dramatically by the accelerated rate of extraction of minerals and fossil fuels and by highly technological industrial processes. Rapid increases of trace metal concentrations in the environment are commonly coupled to the development of exploitative technologies related to the coal exploitation and power production from it.

The study of an anthropogenic effects on the human environment in the regions of the Pernik, Bobov Dol and Maritza East coal basins, Bulgaria revealed that the coal industry with their mining, preparation and combustion of coal is a polluter of the environment. Various trace elements with environmental concern could be potential pollutants of surface and subsoil waters, soils and plants in the areas of coal basins, preparation plants and thermo-electric power stations. The waste products from coal industry can impact directly and indirectly on the human health and a monitoring of some heavy metals and stick emissions should be conducted.

The previous statement was confirmed by the study of the heavy metals distribution in soil from Kičevo Basin, Republic of Macedonia where data of the spatial distribution of various elements in surface soil over the basin, known for its coal mine and thermoelectrical power plant activities are reported. Three natural geochemical associations, related to the combustion of the coal, has been defined (Cr-Ni-Li-Co-Fe-As; Al-Ca-Mg-Sr and Ba-K-Cu).

The study of the spatial distribution and enrichment of some heavy metals in topsoils (0-5 cm) around a Pb-Zn smelter in Mitrovica, Kosovo covered a region of 300 km^2 where the data evaluation (parametric and non-parametric statistics) have shown that the content of elements such as Ag, Pb, Sb, Bi, Zn, Cd, As, Cu, Hg, Au, Tl and Mo in soil samples appeared as an anthropogenic association of elements due to the mining and processing activities.

Since there are no active metal mines in the Republic of Croatia, Croatian team members significantly contributed through the studies of metal pollution of historical mining sites. In that direction the study of the influence of historic mining and urbanization on geochemical features of the Gradna Stream, Samoborska Gora Mts., Croatia have proven that the environmental impact of the siderite-polysulfide-barite-hematite Rude historical mining site as well as urbanization caused sudden increase of metal concentration in water and decrease of adsorbed metals.

Another significant input in regards of historical mining activities in the Republic of Croatia was the study of distribution and behavior of selected elements in the Veliki Potok/Črnomerec Creek, Medvednica Mts., which originates near the historical Pb-Zn-Ag mining site. While the upper course of the creek flows through the Nature Park Medvednica presenting uninhabited and preserved nature area was characterized by moderate pH, high redox potential, low nitrate, ammonia, phosphate and sulfate concentration, as well as with low content of all analyzed metals with exception of Mn, the lower course flowing through the city of Zagreb presents urbanized area have shown high pH value, low redox potential, increased conductivity, increased content of nitrogen and phosphorous species and increased concentration of Hg and Cu. Stream sediments from the lower course were characterized by high content of exchangeable metals, especially Pb, Zn and Cu.

3.0. USE OF DEPLETED URANIUM AMMUNITIONS DURING THE BALKAN CONFLICTS

The North Atlantic Treaty Organization's (NATO) airstrikes in Kosovo (Yugoslavia) seem to have caused considerable environmental damage. A large number of industrial facilities were reportedly attacked and destroyed. As a consequence of this, significant amounts of hazardous chemicals have been released into surface waters, ground waters, air and soil, affecting the wider Balkans region. However, these transboundary pollution events have caused less public concern than subsequent admittance that the alliance had used depleted uranium (DU) ammunition both in Kosovo and during the earlier military operations in Bosnia and Herzegovina. Reports in public media have often echoed anger and dismay regarding the use of DU, suggesting that depleted uranium ordnance contributed to the "Balkan syndrome". Concerns were raised by governments which had peace-keeping troops deployed in the Kosovo region after the airstrikes, since a substantial number of soldiers developed health problems which were allegedly linked to DU. Similarities were established with the "Gulf War Syndrome" – an array of chronic illnesses that have apparently affected tens of thousands of US soldiers. In contrast, government contractors and the army itself have issued a series of reports and studies suggesting that depleted uranium represents no real threat to health and safety.

Clearly, ammunition containing DU components leave behind a long-lasting contamination on the battlefields, which is not compatible with civil radiation protection norms. This argument holds independently whether or not there is an objective immediate or long-term danger to man and the environment.

Transuranium elements and other fission products possibly contaminating DU ordnance cause additional public concerns over risks to the health of humans and the environment, especially in the case of countries producing DU ordnance where manufacturing technologies may not necessarily meet US standards in the purification of uranium coming from spent nuclear fuel.

Ordnance dumped in the Adriatic Sea reportedly contained no DU munitions. An understanding of the biogeochemical uranium cycle in the marine environment provides no apparent reason for concerns regarding radiological hazards of DU. Uranium is present in seawater at an average concentration of 3.3 ug/L, mainly in the form of the highly soluble uranyl-tricarbonate complex. Uranium concentration factors in sediments and marine biota are small, so even if moderate quantities of DU ordnance were dumped in the sea, this would not be the cause of hazardous uranium levels in the marine environment. Nevertheless, we believe that these weapons should be retrieved and disposed of, especially in cases where ordnance was dumped in shallow parts of the Adriatic Sea, since they may pose a distinct and immediate threat to the fishing industry in the region.

Complete reports with full disclosure of the relevant facts regarding DU deployment in the Balkans and in the adriatic region will be welcomed by the scientific community and civilian population living in affected regions.

4.0. RADON POLLUTION IN PART OF THE TERTIARY BASINS IN THE SE-EUROPE

Radioactivity is a part of our everyday's life and as such, it is present in every medium of the living environment. The study of radioactivity in the living environment is a crucial segment of radiation protection, but at the same time, it is a useful tool in the exploration of the transport processes which originate from the nature itself.

The ^{222}Rn radon isotope (hereafter referred to as radon) originates from α-radioactive transformationof ^{226}Ra in the ^{238}U natural decay chain in the earth crust. Only a fraction (defined by the emanation coefficient) of radon atoms leave the mineral grain and migrate through the medium either by diffusion or advection and eventually enter the buildings or exhale into the outdoor atmosphere.

Up to date at the territory of the SE-Europe the most extensive and intensive studies have been been performed by the national survey in Slovenia, where radon in air was measured in 1000 dwellings, all kindergartens and schools, a number of karst caves (with emphasis on the Postojna Cave), major spas, major water supply plants, major hospitals, major wineries and some others. In more than 50 buildings, radon problem has been successfully mitigated. Recently, radon surveys has been extended also to outdoor air and soil gas. Geogenic radon mapping at sixty points, uniformly distributed all over the county, have shown the rangeof radon activity concentration in soil gas of 3–211 kBq m^{-3} and arithmetic mean 36 kBq m^{-3}. With respect to geology, the highest values have been observed over carbonates in western and southern part of the country, with the arithmetic meanof 50 kBq m^{-3}. Elevated values have been also found at points in close proximity to the tectonic faults. The lowest values were measured over clastic sediments.

An additional study, performed in a regular grid over carbonates at depths of 50 cm and 80 cm, has shown significant fluctuations between the measuring points at both depths, and also an important role of unexpected changes of microclimatic parameters, as mowing grass in our case.

Concerning radon measurements in the Republic of Macedonia we would like to point out that the preliminary measurements of radon and thoron concentrations in the soil gas were done, using short term active method. Field measurements were made at a distance of 1-2 m away from the randomly selected houses in Skopje and Prilep. The arithmetic mean values of radon and thoron concentrations in the soil gas were found to be 15.9 ± 5.6 kBq m^{-3} and 5.3 ± 2.3 kBq m^{-3}, respectively. Activity concentrations of ^{40}K, ^{226}Ra and ^{232}Th in soil were evaluated from gamma spectrometry analysis on the soil samples that were collected from the same locations. Indoor radon concentrations were measured in the houses of the same locations.

A limited number of measurements of radon and thoron soil gas concentrations in the soil gas in Skopje and Prilep led to conclusion that there is a correlation between radon and thoron concentrations in soil gas, as well as a correlation between activity concentrations of ^{40}K, ^{226}Ra and ^{232}Th in soil is confirmed. Possibilities for other correlations are not excluded. However, the number of the data points is too small to allow generalization of the last conclusion. These results can be utilised to set up the methodology for a more systematic investigation to radon concentration in the soil gas.

5.0. ANTHROPOGENIC INPUT AND IMPACT TO THE NORTHERN AND CENTRAL ADRIATIC COASTAL REGIONS

An assesment of the anthropogenic impact to the northern Adriatic coastal marine ecosystem was performed through the study of the Use of stable nitrogen isotopes composition of particulate organic matter in the costal environment (Istra Peninsula, Northern Adriatic) where increased nutrient inputs mainly in coastal ecosystems can be often reflected as eutrophication that consequent influence to the aquatic communities. Coastal environments are exposed to anthropogenic nutrient inputs from untreated domestic and municipal sewages, industrial effluents, traffic, tourism, agriculture as well as aquaculture activities. Such inputs lead to increased primary production and concentration of particulate organic matter (POM) in the water column, increased abundance of nuisance algae, consequent reduced oxygen content of the water and decimated some other marine organisms.

Previous studies of stable isotopes, mainly nitrogen $\delta^{15}N$, have shown several marine organisms and POM are usable as a tracers of anthropogenic pollution. It was proved that the POM derived from sewage effluents has higher $\delta^{15}N$ values relative to POM of unaffected marine environments and can be therefore used as a tracer for detecting anthropogenic inputs into the marine coastal ecosystem.

It was observed that anthropogenically derived organic matter from inadequate municipal infrastructure can cause the increase of $\delta^{15}N$ values in POM and consecutive negatively influence on the coastal marine ecosystem. On the other hand, the purification plants can cause the depletion (even negative) of $\delta^{15}N$ values as was observed in POM samples from Pula and Rijeka cities.

Relatively larger $\delta^{15}N$ values at the end of the summer compare to the spring sampling period can be explain as the result of higher amounts of the organic matter due to tourism and also with the rapid and changeable movement of floating POM material in the water column owing to the wind, current circulation and tides.

The ^{15}N enrichment observed in POM from Istra coast were lower than in anthopogenically more affected semi-enclosed Pirovac Bay and significantly higher than unaffected sampling locations of Koranti Islands (both located in the Central Adriatic).

An assesment of the anthropogenic impact to the central Adriatic coastal marine ecosystem was performed through the study of the content of chalcophile elements Cd, Cu, Pb, Zn derived from aquacultural activity near Vrgada Island (fish farm) of marine sediments (Central Adriatic, Croatia). Knowing that among numerous polluting substances, heavy metals present one of the biggest environmental problems due to their toxicity, long time persistence in the contaminated environment and their bioaccumulation in living organisms. The latter has become increasingly significant scientific topic in recent years due to its detrimental effect on the food chain and consecutive for humans.

Sediment elemental concentrations were generally thought to be the result of a variety of processes, including natural factors such as weathering of heterogeneous geology, local seabed morphology and hydrological and chemical status of seawater, as well as anthropogenic input (industrial, mining and urban wastes). It is expected that also intensive aquaculture activity has the potential to modify natural concentrations of metals in local sediments, with the metal output of farms observed to be up to several tons per day. The aquaculture activity can affect the surrounding environment with uneaten feed, faeces, excreted metabolic wastes and medicines.

Among the geochemical elements, particularly chalcophile elements can be extremely toxic to the environment and also human health. Therefore, the present study focuses on the concentration of the chalcophile elements Cd, Cu, Pb, and Zn in sediment around fish farm near Vrgada Island.

According to the results it was concluded that:

- The results indicate low concentrations of presented elements; average values of Cd 0.11 ppm, Cu 4.96 ppm, Pb 8.33 ppm and Zn 16.58 ppm. Suggesting that the effect of observed fish farm activity on the local marine ecosystem is practically negligible as well as that the calculated geoaccumulation index (I_{geo}) values indicated that the sediment below the investigated farm is uncontaminated.
- The concentrations of chalcophile elements (Cd, Cu, Pb and Zn) in sediment around the fish farm near Vrgada were generally below Central Adriatic background values as well as concentrations of upper continental crust.
- The concentrations of Cd, Cu, Pb and Zn were generally below those of other comparable fish-farming areas.
- During the first and second sampling periods, concentrations of chalcophile elements (Cd, Cu, Pb and Zn) in sediment below the cage containing older fish were clearly higher than in sediment sampled below the cage with small fishes. The reason is likely the higher level of production in the former. In August 2009 this trend was reversed, probably associated with the reduction in productivity of the final catch of old fish.

In conclusion, concentrations of heavy metals in sediments near the Vrgada aquaculture farm are generally low, and the influence of such activity on the surrounding marine environment practically negligible.

6.0. FINANCIAL REPORT

Within the planned activities for the implementation of the sub-regional project that was funded by the UNESCO, in which participated researchers from Macedonia, Slovenia and Croatia, were performed the following forms of activities that are an integral part of the project:

- Organization of three workshops (Workshop), one workshop in Macedonia, the second one in Croatia and the third one in Slovenia, where have been presented the research results of research teams working on this project in countries on particular issues associated with anthropogenic influence and impact to the Neogene basins in the region of SE Europe. This region, where belong the countries from the former Yugoslavia (Republic of Macedonia, Slovenia, Croatia, Serbia) for a longer period due to many anthropogenic effects (industry, mining, metallurgy, war activities, the interventions of NATO forces in the former Yugoslavia, transboundary pollution, Chernobyl, etc..) have been exposed to severe anthropogenic impacts, which especially were manifested in the Neogene basins where lives the majority of the population in concerned regions. Research teams that were formed for the realization of this project already for longer period were carrying out scientific research, which have provided numerous and priceless data concerning the quantification of these effects in regions where the surveys have been conducted.
- Printing of three separate issues of each workshop in English. The issues themselves had character of international conferenceProceedings.
- Purchase of equipment necessary to support the implementation of the project.

During 2011, there were numerous activities throughout the month of May and June in preparation of the first Workshop which took place in Macedonia. These activities included field activities of the research team from the Republic of Macedonia all together with researchers from the Republic of Slovenia, Croatia and Serbia in Neogenite basins in Macedonia (Skopje, Tikvesh, Pelagoniski, Strumica, etc.).. During these research activities were obtained numerous information used in preparation of papers that were presented in the First Workshop Proceedings.

Within the overall project implementation research group in Macedonia consisted of: Prof. Dr. Todor Serafimovski, Prof. Dr. Blazo Boev, Prof. Dr. Sonja Lepitkova, Prof. Dr. Trajce Stafilov, Prof. Dr. Orce Spasovski; Prof. Dr. Violeta Stefanova, Prof. Dr. Zoran Panov, Assoc Prof. Dr. Goran Tasev and Assoc Prof. Dr. Dejan Mirakovski.

The funds received by the UNESCO program were in the amount of MKD 1,323,700, and these funds were spent for the planned project activities and in accordance to the approved breakdown of expenditures by the UNESCO.

The expenditures were as follows:

1. Travel and daily costs for project participants
   1.1. Travel and daily costs of participants from the Republic of Slovenia and Croatia, as well as experts from other countries in Europe, 100,000 denars
   1.2. Travel and daily costs of participants from Macedonia 100,000 denars

2. Royalties for participants from the Republic of Macedonia carried out research and preparing publications and writing and preparing and publishing the proceedings of conferences in the amount of 668,700 denars.

3. Costs for printing the proceedings of conferences in the amount of 215,000 denars

4. Costs for purchasing equipment in the amount of 215,000 denars

5. Costs for administrative support of the project 25,000 denars

Financial report prepared by

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ANNEX III PARTICIPATION PROGRAMME
2010-2011

FINANCIAL REPORT

Which must be sent to UNESCO, ERC/RSC/PP Section - Fax 33 1 45 68 55 34
on completion of the project

Country (or NGO)

Number and title of the request:

In pursuance of 35 C/Resolution 67 adopted by the General Conference concerning the principles and conditions governing the Participation Programme:

1. I hereby certify that the financial contribution of US $ 31 000 received from UNESCO for the above request has been fully/partially* spent, in accordance with the purposes for which it was granted, as follows:

		US$
(a)	Travel and daily costs of foreign participants	2300
(b)	Travel and daily costs of Macedon. participants	2300
(c)	Ryalities and conferences and meetings	15500
(d)	Proceedings costs	5300
(e)	Purchase of equipment	5000
(etc.)	Administrative support	600
	TOTAL	31 000
	Unspent balance to be returned to UNESCO	/

2. I undertake to keep **all supporting documents (receipts, contracts, invoices, etc.)** in respect of the use made of this financial contribution for a period of five years after the end of the biennium concerned and to provide them to UNESCO when it or its Auditor so requests, failing which unsupported amounts will be reimbursed to UNESCO.

3. For a regional project, the Member State or group of Member States which submitted the request is responsible for filling in this form.

Date	Stamp and signature** (of the financial officer)	Stamp and signature (name of the Secretary-General of the National Commission or of the international non-governmental organization)

* Delete as appropriate.
** Both signatures are required.