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A REWIEV ON ANTHROPOGENIC IMPACT TO THE MICRO PRESPA LAKE AND ITS DAMAGES

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Abstract

Paper presents the results of the integrated and multidisciplinary studies for investigation of the anthropogenic damages to Albanian part of the transborder Micro Prespa Lake. Micro Prespa Lake is lake with international status, as Ramsar Convection, International Park and Special Protection Area-79/409/EEC. According to the studies, investigations and analyses, the following were concluded:

Devolli River- Micro Prespa Lake irrigation system was not scientifically supported by environmental engineering, hydroeconomy and International Rights principles. It does work according to the projected parameters, and also, doesn't supply the agricultural needs. About of 10 % of the water volume, discharges by Devolli River in Micro Prespa Lake during the winter, is taken from this lake for the irrigation in summer.

Great surface of Albanian part of Micro Prespa Lake is destroyed. The other part of the lake is atrophied and the habitat and biodiversity are damaged. Important and unique species of fish, birds and plants of national and international values are risked. The underground karstic connection ways for water circulation are blocked. There are ruining the historic values of the area, such the encient Treni cave from the Bronze Age. The Albanian part of the Micro Prespa Lake has been damaged by the human activities.

A huge amount of 1,2 million cubic meters alluvium has been deposited on the lake bottom and lakeshore, which was transported by the Devolli River waters, since 1974. This river waters, rich in alluvium and organic coal material from outcropped geological formations, also absorbed free chemical toxic remains by the drainage of Devolli farm ground, which have changed the chemical features of the lake water and degrading it. Micro Prespa Lake communicates with Macro Prespa Lake, and together with Ohrid Lake. Blockage of underground karstic connection ways has diminished not only the components of the lake water balance, but also the decreasing yield of the underground springs, that supply the Ohrid lake and drinkable water springs. The Albanian part of the Micro Prespa Lake plays the role of a gigantic decanter. This is an unprecedented case, not only in Albanian but also in Balkan and World hydrography.

Devolli river alluvium deposited in Micro Prespa Lake caused the otherwise of territory of Republic of Albania in this area. Albania will not have any part in this lake after some years. The social and public opinion in Albania, must be conscious for the otherwise of

Albanian territory, which in the case of Micro Prespa Lake has a national and international negative effect on destructions of a transborder lake, defendey by Europian Convents.

Key words: Macro - Micro Prespa and Ohrid Lakes System, anthropogenic impact

1. Introduction

The paper presents the environmental problems of Prespa Lake system, which is the pearl of Western Balkan region. This system is composed of Micro and Macro Prespa Lakes, and is the largest and important limnological object. Prespa Lakes have great and special ecological values. Its environment is characterized by a picturesque nature, particular climate, rich biodiversity, extremely complicated karstic hydrography, high transparency of dark blue waters and uncommonly diversified, beautiful coastline. In particular, the biodiversity of Micro Prespa Lake is very rich. Micro Prespa has high ecological values. Prespa Lakes have a very important influence in the general water balance of the Ohrid Lake. Prespa's hydrographic network is located in the three-state border area, i.e. between Albania, FYROM and Greece, which have the common interest for maintaining and recuperating the special natural hydro-ecological values of European dimensions in this area.

Micro Prespa Lake is lake with international status, as Ramsar Convection, International Park and Special Protection Area-79/409/EEC.The human activity impact on Prespa Lakes system and great damaged of the ecological values are analyzed in this paper.

2. General setting of the area

The study area is located in the Western Balkans, and it is part of three Lakes System: Micro Prespa, Macro Prespa, and Ohrid. These lakes are located at the foot of the rocky Dry Mountain (Mali Thatë), which has a maximal altitude of 2287 m (Fig. 1).

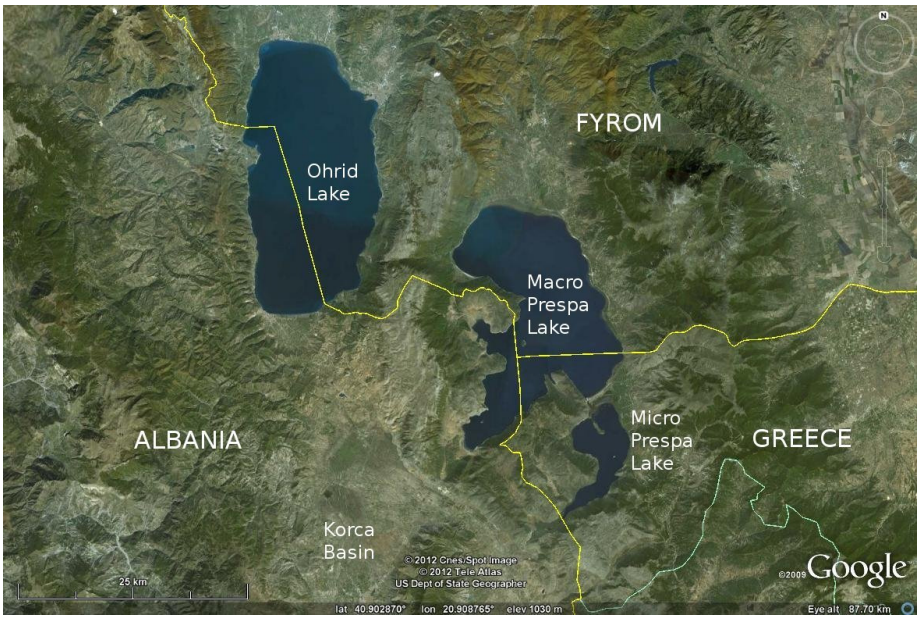


Fig. 1. Satellite image of Prespa-Ohrid lakes system.

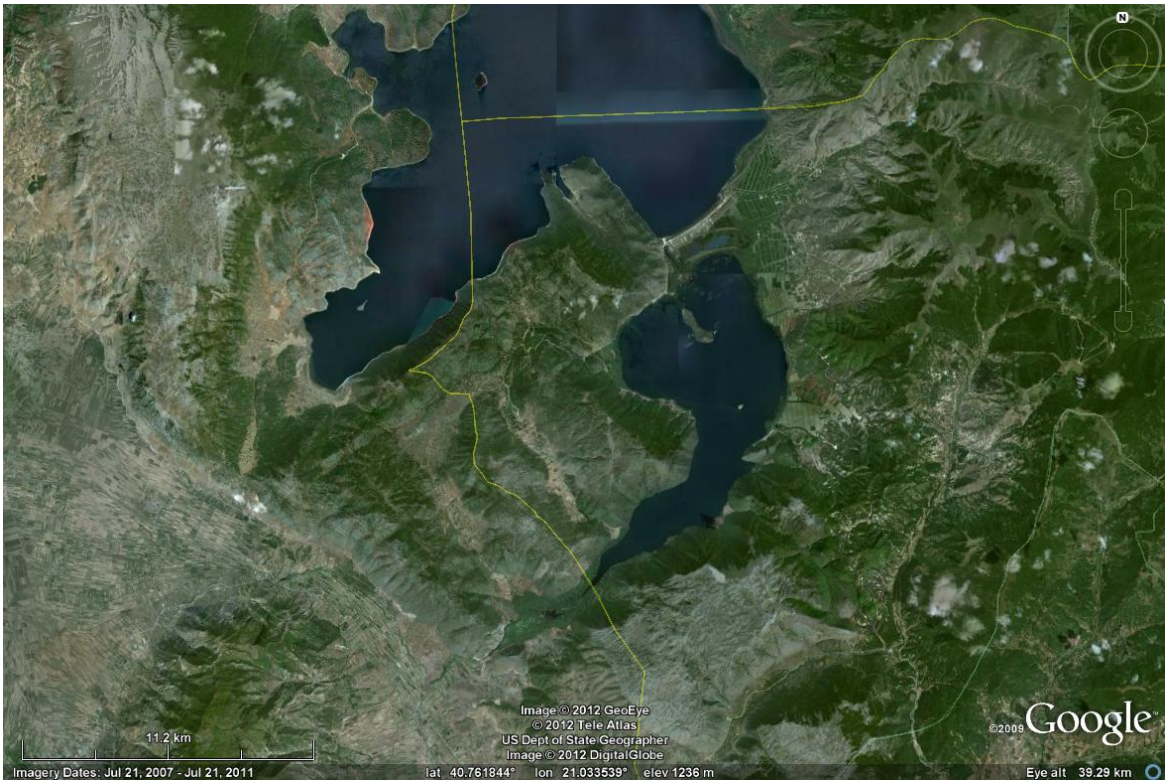
Prespa Lake system is composed by Micro Prespa (surface 43 km2) and Macro Prespa (surface 276 km2) (Bornovas, J. and Rondoyanis, Th. 1985, Gligorevich, L.J. 1988, Hydrogeological Map of Albania, 1984, Pano, N. et al, 1989) This system has a catchment area of 1 363 km2. It is located on 850 meters above the sea level. Macro Prespa is a three-national lake, lying in the territories of FYROM (68%), Greece (14%) and Albania (18%). Its maximal depth is 55 m. Micro Prespa is a two-national lake, lying in the territories of Albania

(12.1%) and Greece (87.9%) (Fig. 2, Photo 1). Its maximal depth is 8 m.

In Albanian Prespa territory some villages are located on the lakeshores. Among these villages is Treni, well known of its prehistoric age origin, in the southwestern lakeshore of Micro Prespa. The population was 6755 inhabitants, in 1997.

Prespa present hilly-mountainous area. Start from the 850 m hypsometric level at Devolli plant, toward the Prespa Lakes, hilly area has a maximal hypsometric level up to 962 meters. At easterdirection are located the mountains. The mountains around Micro Prespa have an altitude up to 1456.7 m. and those of Macro Prespa have a hypsometric level up to 2035.4 m. Macro and Micro Prespa Lake catchments, lie on a mountains territory. Great changes of the mountain highs in a short horizontal distance are area feature. Dominant values of vertical cutting is on average level 100-300 m/km, while in the mountain areas this parameter has the values up to 800 m/km (Meçaj, N 1997).

Limestone landscape is typically karstic, rugged microrelief, karstic channels, fosses, and caves. Prespa Lake system represents a fascinating originality of its nature in Europe. The surrounding environment is characterized by a picturesque nature, particulat climate high biodiversity and, not accidentally, the lake is called the Balkan Pearl.



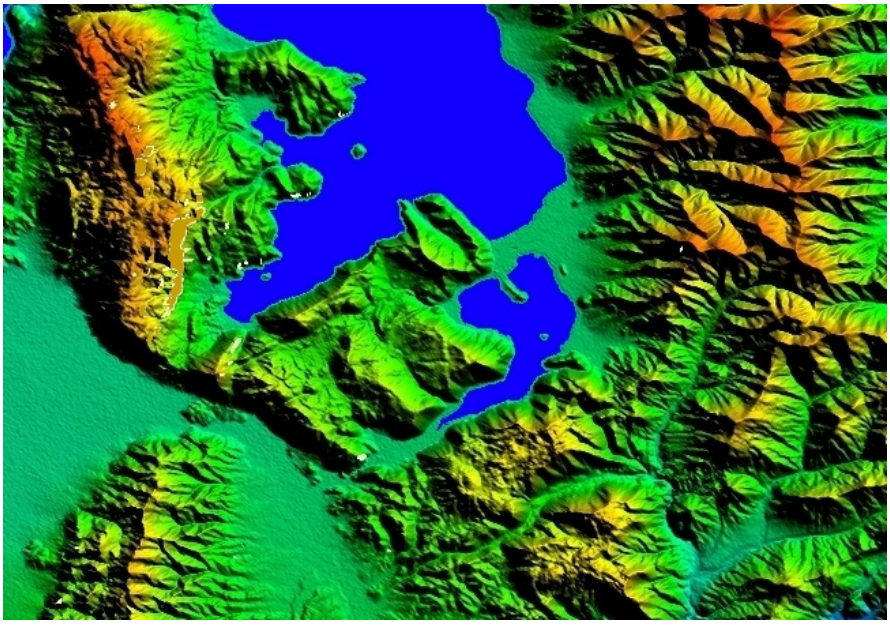


Fig. 2. Top – Satellite image of Micro Prespa Lake. Bottom – its Digital Terrain Model based in SRTM

3. Integrated study methodology

Environmental impact and ecosystem destructions of Micro Prespa Lake have been studying by a multidisciplinary complex methods: remote sensing analysis, hydrographical and limniological studies, hydrogeological, geological, and in particular neotectonics surveys, biological, and environmental investigations. Special attention was being paid for the analysis of the uncontrolled human activity in Prespa ecosystems.

Particular attention was given to estimation of the multi annual hydrological parameters of lakes and atmospheric conditions, solid sediment transport from Devolli river at Micro Prespa Lake, as well as chemical contamination of river and lake water by chemicals used in agriculture. Have been carry out the investigation of karstic phenomenon and circulation of groundwater through karstic space.

4. Limniology and hydrography of Micro Prespa Lake

Korça and Pogradeci basins are characterized by minimal annual precipitation 722 mm and 765 mm respectively and maximal 1200 and 1000 mm. The annual average precipitation in the Dry Mountain (Mali Thate) is 900 mm (Chavkalovski, J 1996, Pano, N. et al 1997, Pano, N. and Frashëri, A. 1999, 2000) (Fig. 3a). Efficacious infiltration in this mountain is 455 mm, while evotranspiration is 426 mm. Water karstic volume of Dry Mountain is 5.2 m3/sec or 165.2x106 m3/year.

In this region, the Micro Prespa-Macro Prespa system represents the largest and the most important limnological object, not only for its great water capacity, but also for its great and special ecological values.

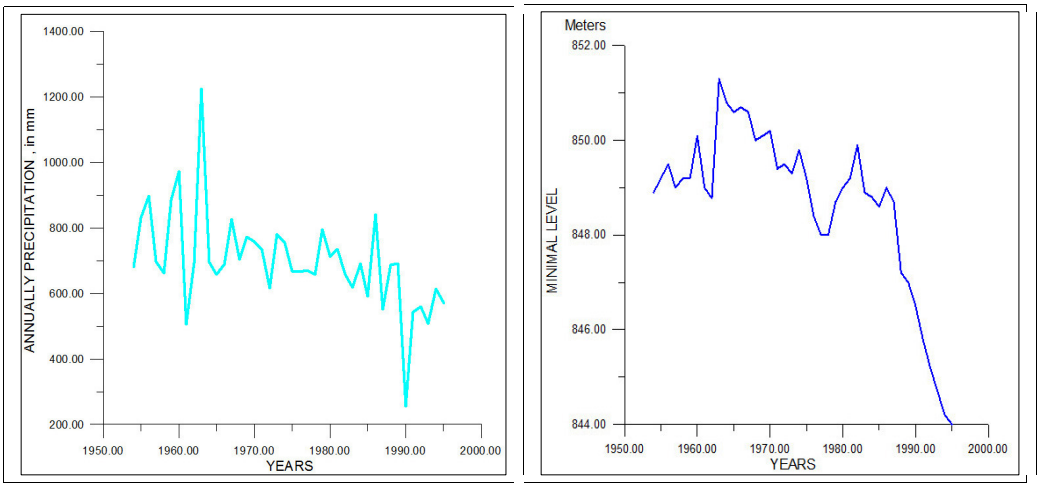
Prespa Lakes are among the most important ones in the Albanian hydrography. They lie in a NW-SE direction and have distinct characteristic. They are mountainous and relatively deep lakes (Fig. 2, Photo 1a, b, c). Micro Prespa length in Albanian territory is 5.75 km. Its minimal width is 125 m in Gryka Ujkut, in SW edge, its maximal width is up to 1500 m, between Shuec and Buzë Liqeni villages.

a) b)

c)

Photo 1. Prespa Lakes views: a) Macro Prespa; b) and c) Micro Prespa views, 2006

There was only one lake in Prespa at the very beginning. It was divided in two parts by thousand years sediment of Saint German (St. German) river, that flows from Vabies mountain in Greece. Actually these two lakes are divided by a narrow piece of land of 3 km long by 1.2 km wide. The Micro Prespa and Macro Prespa lakes had the same water level in the past and were connected by a channel and subterranean karstic aquifers. Micro Prespa water flows in to Macro Prespa Lake through this channel (Fig. 2, Photo 2). A dramatic lowering of the water level occurred in Macro Prespa recently (Pano, N. et al 1989, Pano, N. and Frashëri, A. 2000, Chavkalovski, J. 1996) (Fig. 3b).



a) b)

Fig. 3. Average annual precipitation in Pretori village, and average annual minimal water level (b), Makedonia (After data of Chavkalovski, I., 1997).

The lake was losing about 150x103 m3 each year. Today the two lakes have marked different water level. Micro Prespa Lake has a level at +850 m, while the Macro Prespa Lake

actually has a level at +846 m. There was a lowering of the water level of 7 meters in Macro Prespa Lake between 1987-1990. This means a water reduction of 900 million cubic meters of the water level .

Photo 2. The discharge of Micro Prespa Lake water in to Macro Prespa Lake, through the channel in Greek side, 2000 y.

Photo 3. Karstic activity, Macro Prespa Lake, 2006 y.

Macro Prespa water is very clear up to 20 m depth and it is light blue. During the summer the water temperature is up to 24oC and during the winter it goes up to 0.4oC. Some torrent flows in the eastern part of Macro Prespa and there have not any surface emissary. Intensive water discharges through subterranean ways mainly in Ohrid Lake, that is 145 m lower and in some karstic springs is Devolli plain. Macro Prespa water discharge into karstic limestone of Dry Mountain is very obvious near Gollomboç village (Photo 3, 4). Micro Prespa water was very clear too. Stones in its lake floor looked like beautiful mosaic. At the end of 20 century, water is completely turbid (Photo 5).

Photo 4. Point of the disappearing Macro Prespa water, which migrated to Ohrid Lake (from Google Earth).

Photo 5. Troubles waters in Micro Prespa Lake, 2000 y.

Ohrid is a two national lake lying in the territories of FYROM (70 %) and Albania (30%). It is a tectonic lake, formed during the Upper Miocene. It belongs to the oldest lakes group in the world, having the epithet " Natural Monument of Europe". UNESCO has registered the Ohrid Lake as "Natural and Cultural Inheritance of the World" since 1979. It water level is 695 m and the average depth 145 m. The maximal depth is 295 m, making it one of the deepest lakes in the Europe. Water temperature profil is presented in Fig. 4.

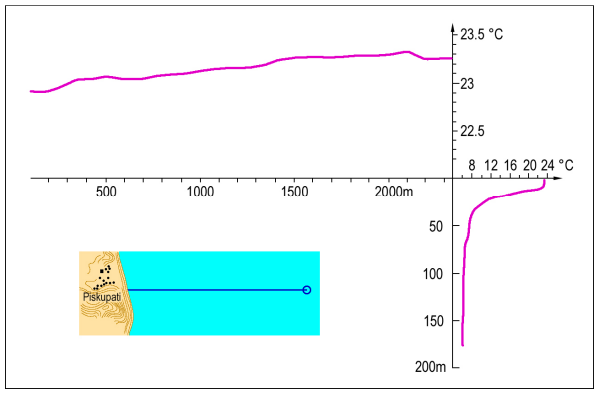


Fig. 4. Water temperature of Ohrid lake.

The Dry Mountain (Mali Thate) in Albanian territory and Galicica Mountain in Macedonian territory separate the Prespa Lake System and the Ohrid Lake. According to the isotopic hydrogeological studies it results that it is the same content of the 18O isotope of the oxygen and deuterium in the Ohrid and Prespa Lakes, and Tushemishti and Saint Naum springs (Eftimi, R. and Zoto, J 1997). It is assumed that all Ohrid Lake springs have a initiate from the Macro Prespa Lake, through the subterranean connected ways, which has a higher water level about 151 m. The springs which emerge in the Saint Naum lakeshore, in the Ohrid City in Macedonia, and in Drilon, Tushemisht etc. in Albanian territory, or those at the bottom of the Ohrid Lake, have a general yield of 12-15 m3/sek (Pano, N. et al 1989). This underground hydraulic connection makes it possible that Micro Prespa-Macro Prespa-Ohrid Lake system stands out in Europe for the fascinating originality of its nature.

5.Underground waters resources

Prespa district is rich in subterranean water resources which are linked with the existence of the two Prespa lakes, masive karstified limestone of Dry Mountain and the precipitation water infiltration in to karstified limestone (Hydrogeological Map of Albania 1984, Pano, N. et al. 1989). According to isotopic □18O (in %o) hydrogeological studies it is concludet that the average height of the precipitation infiltrating into Dry Mountain, is 1130 m (Efthimi, R. and Zoto, J. 1997).

In the western slope of Dry Mountain, from Progri village area to Tushemishti, there is a series of carstic springs. Their yield are determined by very developed underground karstic conections of the water circulation. Three springs, Gollobordë-Mançurishtë-Progër have bigger yield, about 500-600 l/sec. Springs or springs groups of a yield of about 1 to 100 l/sec lie at a distance of 2 km from each other. Strong springs of Tushemishti with a yield about 2 500 l/sec are northward, it Ohrid lakeshore.

But, alluvium which have sedimented in Micro Prespa lase floor has closed the underground water flow conections of some springs that are situated under the lake level (Pano,N. and Frashëri, A. 1999,2000). Recent studies have shown that the yield of some springs is reduced very much.

There are artesian water basins in Devolli and Korça plains. The Quaternary gravel depozits of old river terraces, covered by clay's layers, represented their water horizon.

6. Review on area geology

Prespa Lakes are located in the piedmont carbonate structure of Dry Mountain (Geological Map of Albania, 2002, Tectonic Map of Albania 1986, Pano, N. and Frashëri, A.

1999,2000). This carbonate structure presents a horst of Upper Triassic and Lower Jurassic age limestone (Fig. 5). Tectonic development during the geological periods was intensive on Triassic-Jurassic limestone. Upper Cretaceous limestone and middle Eocene flysch are lied in some sectors of the region. In the northwest of Macro Prespa Lake Pliocene clay and sandstone deposits are settled. Placers deposits, clay, argillite, clayed sand, sand, gravel, cobbles, broken stone of recent Quaternary are located over the Pliocene clay-sandstone and Eocene flysh lakeshores. Proluvial deposits are observed in some sectors. Ultrabasic rock individualization interrupts the Albanian side of Micro Prespa Lake. Ultrabasic rocks have a tectonic contact with limestone.

A Pliocene terrigene continental deposit shown that was deposited in the inter-mountain lakes and in the deltas of the rivers, which was flowed in these lakes. This fact demonstrated that under the neotectonics development, following contrast relations of the uplifts and plunges has been created the depression where are sediments the deposits (Fig. 5) (Aliaj, Sh. et al 1995, Pano, N and Frashëri, A. 2000, Hyseni, A. et al 1999. These lakes started to form during the Pliocene about 5.5 million years ago and were completely formed in Holocen period. Karstic activity was developed at the same time (Photo 3). So both, tectonic and karst development have been created the conditions in formation of the Macro and Micro Prespa lakes.

There was intensive erosion in all Prespa area rocks so a great quantity of alluvial sediments is carried and deposited to the bottom of these lakes.

Area geological settings is the main factor that conditioned lakeshore stability of the Prespa lakes. High and abrupt lakeshores are located at limestone's sectors (Fig. 5, 6). Abrupt lakeshores are located generally in the southwestern edge of Micro Prespa Lake. These shores are from 10 to 50 m high. Spilea rocks stands in the north side of the Wolf's Gorge (Gryka e Ujkut). They begin at the lakeshores and go up to 1150 meters. There some precipices are found, with a height from 10 up to 50 meters. Relatively un-stable are lakeshores in the Quaternary, Pliocene clay-sand's deposits or Eocene flysch sectors, in the particularly in the slope breccias sectors. In other shores sectors, the slopes are some meters away from the lakeshores. There is a gravel belt between them. In the lakeshores of both Prespa lakes have flow's cones of the mountain's streams, which are dry during the summer.

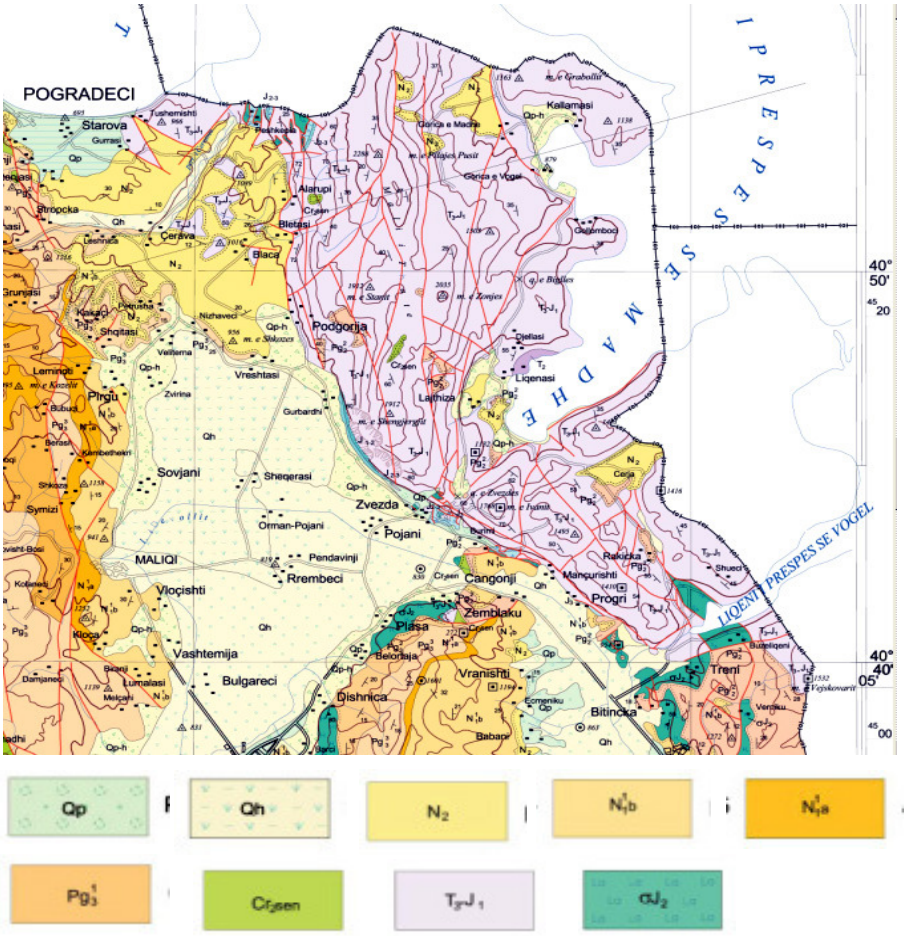


Fig.. 5. Geological Map, Prespa lakes-Ohrid Lake area. (Geological Map of Albania, at scale 1:200.000, 2002). 1. Holocen- alluvion, proluvion, lacustrine, aleurolite, sand, gravel; 2- Holocen- swap deposits, clay, sand peat; 3- Pliocene- clay, sanstone, gravelite, conglomerate; 4- Burdigalian- clay marl, siltstone, limestone, limestone; 5- Aquitanian- sandstone, siltstone, conglomerate; 6- Lower Olygocene- muddy and siltstone flysch, limestone; 7- Upper Cretaceous, Senomian- limestone, conglomeratic limestone; 8- Upper Triassic-Lower Jurasic- Limestone, dolomite; 9- Amphobolitic peridotite.

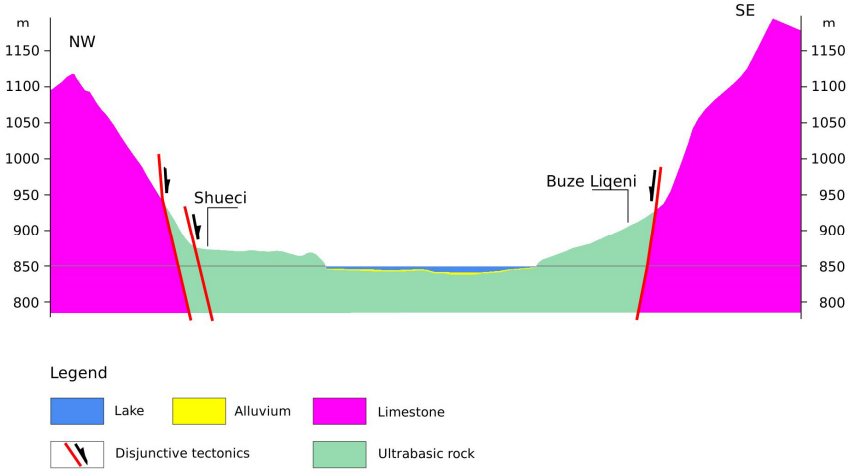


Fig. 6. Geological Profile through Micro Prespa Lake

The geological settings of the region has created the condition to find some minerals in Prespa area, in particularly industrial materials (construction's materials). There are quartzose sand and clay. Limestone and ultrabasic rocks represented very high quality constructive materials.

7. Biodiversity and present legal protection status

The biodiversity of Micro Prespa Lake is very rich (Bega F. 2000, Bimo T. 2000, Pano, N. et al 1997, Pepo E. 2000, Qoshja, Zh. 1979, Rakaj N. 2000, Shumka S. 2000).

The Prespa area envrironment is aride. The Flora – vegetation and forests with 71 sorts of trees, shrubbu trees, and the aquatic bed plants extend in some sectors:

- The aquatic bed plants: Caratophyllum sp., Myriophyllum sp., Lemna Minor, Trapa Natans, Nymphaea Alban, etc.
- The trees: Salix sp, Querqus Cerris, Querqus Pubescens, Querqus Petrea, Fagus Silvatica, Oatria Caprinifolia, Fraxinus Ornus, Carpinus Betulus, Acer Pseudoplantanus, Pinus Nigra, Abies, Ingland Regia, Castanea Sativa, Corulys, Juniperus, etc. Oak forests in Maja Zonjës, Maja Kallogjerit and Faqes së Osojës in Makro Prespa area and Koria e Trenit in Micro Prespa area make this region very beautiful.
- The Emergents:Carex sp., Trifolium sp., Phragmites australis, Tupha sp., Scirpus sp., etc.

The fauna of the Prespa Lakes distinguished by:

- Rare fish Rutilus prespensis,Chordrostoma prespensis, Barbus prespensis, Albumus belvica, Albumoides binpunctatus orhiadanus, Cobitis meridionalis, Cyprinus carpio, Salmotrutta peristericus, etc.
- Birds: Pelecanus criptus Bruch (Photo 6 a,b), Pelecanus onoctotalus, Pholacrocorax pygmeus, Ardea purpurea, Plegadis falcinellus, Egretta alba, Platalea leucorodian Anser anser are representatives of the birds.
- Mammals are habitants of the Prespa area, as Rhinolophus ferrumequinum, Pipistrellus nathussi, Glis glis, Canis lupus, C. aureus, Lutra lutra, Felix silvestris, Meles meles, Ursus arctos, etc
- The Polygonetum amphibii are very sparseness associacion in the Prespa lakes. In particularly the Potameto-Najadetum H. findet in the Macro Prespa Lake.
- The pelagic zooplankton community of Microprespa Lake consists of 43 species. The main representatives of the zooplankton are composed by: Protozoa-1 specie, Ritatoria-16 species, Cladocera-16 species, Copepoda-9 species and Mollusca-1 specie.

Photo 6 a, b. View of Pelecanus Criptus Bruch.

Prespa's Lake catchment has unique natural values, particularly ecological value. It has great international values. Not accidentally the lake is called the Balkan Pearl. Since 1957 it was

become as National Park, Wetland of International Importance in accordance with Ramsar Convention, Special Protection Area (79/409/EEC), and Important Bird Area (ICBP-IWRB).

8. Historical wealth of Prespa

Baing very beautiful and having favorable natural conditions, Devolli and Pogradeci areas were the living place of Enkeley Ilirian tribes in 1500-1400 BC (History of Albania 1959, Samsuri V. 2000). In Micro Prespa lakeshore, in its south-west edge, there is a prehistorical living place, Treni cave (Photo 7). The first living traces in this cave belong to Neolithic Age (Ancien Neolit). The others cultural layers belong to Bronze Age (ancien and late) and the Iron Age as well. Prehistoric drawings found on Spilies rocks, in the northern lakeshore of Micro Prespa Lake are of a great value (Photo 8). At the same time the eremeticus cherchs built in Prespa area rocks is of a great historical value.

In 851-1018 new towns appeared in this area. The center of it was Devolli town. During the last years of the 10th century Prespa and later Ohrid become important centers of the Bulgarian empire of that time. It is characteristic that all the orthodox churches of the XIII-XIV centuries were built according to the bisant style. One of the fourth cherches that could servire is that of St Mary'' in Grad Mountain Island in Macro Prespa lake. It was build during the 14th century and its famous for its wall pictures of great artistic values.

Photo 7. Prehistoric Treni cave at Micro Prespa lakeshores.

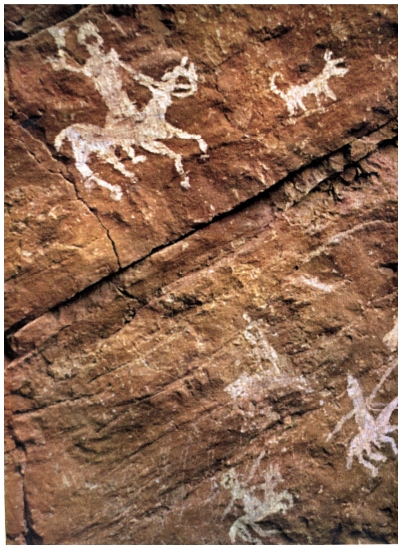


Photo 8. Prehistoric ancient designs at the Spilea rocks, on Micro Prespa lakeshore (after Andon Grazhdani 2000).

9. Anthropogenous impact

Unfortunately, anthropogenous activity has greatly damaged the ecological values of Prespa Lakes system for a long time, in particular in the Albanian part of Micro Prespa Lake, which have caused the lake biological equilibrium and biodiversity destruction (Pano, N. and Frashëri, A: 2000):

- The construction of the hydrotechnical works (Fig. 7):
  - Network channel (1976), for the irrigation of Devolli and Korça plants,
  - Supply of Micro Prespa lake with Devolli River water (Photo 9),
  - Opening of new agricultural land against agrotechnical criteria, and
  - Discharge of polluted urban and industrial water into this system etc.
- Habitat loss and deterioration of over the last five years are the major factors causing

serious threat to plants and animal species.

- Uncontrolled timber harvesting and overgrazing have resulted in degradation deforestration of the forest resources and serious erosion.
- Uncontrolled fishing and hunting have caused great damage to a large number of fish species and games.

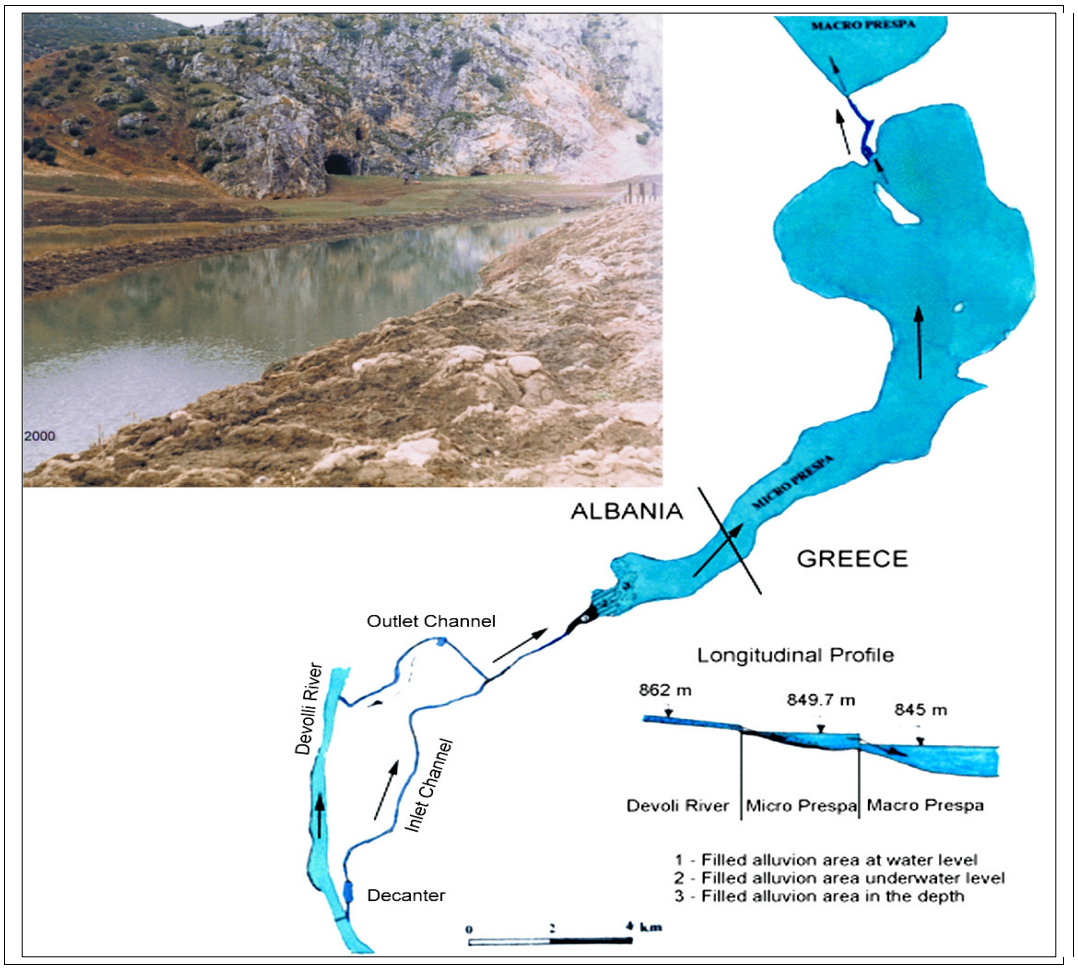


Fig. 7 Water Supply and Irrigation System Sketch from Devolli River to the Micro Prespa Lake and water flow to the Macro Prespa Lake. Top – Left: photo of the channel that supplied Micro Prespa Lake with Devolli River water.

9.1 . The influence of the hydrotechnical constructions on destruction and ecological stress of the Micro Prespa Lake.

A channel of a water capacity Q=10 m3/sec to supply Micro Prespa Lake with Devolli River water during the winter was constructed in 1976 (Fig. 7). 30-70 million cubic meters water a year was discharged into Micro Prespa Lake through this channel. According to the project, the maximal water hyplometric level in the lake was 852.2 m at end of the supply period. During the summer, the lake water has been used for the irigation of Korça and Devilli plains, with a surface of 22 500 ha. The maximal quote of exploitation, by the project has been 850.2 m.and can be used 90 milion cubic meters water.

The waters of Devolli River, which is one of the most turbid rivers of the Balkan Peninsula. Waters of Devolli River have a mean mineralization M = 483 mg/l and a hardness 12 German degree. Granules with a diameter less than 0.02 mm have predominated in this

sediment. Granules with a diameter less than 0.002 mm are up to 14% of this sediment mass. According to the American Classification ASTM, this sediment is classified as Lean Clay CL. According to their plasticity index Ip=13.5, and to the upper and lower limit of the plasticity, respectively Wl= 42.2% and Wp=28.7 %, illite and montmorillonite represents this clay material. Great amount of Devolli River waters flowing in to Micro Prespa Lake during the winter. A considerable amount of solid matter enter in to the Prespa Lake and were decented in the lake. Under existing conditions, Micro Prespa Lake plays the role of an authentic gigantic decanter (Photo 10a, b, c).

To avoid alluvium a decanter, have been constructed, which in reality doesn't work. Studies have shown that Devolli River water flows undecanted into Micro Prespa Lake, depositing about 1.2 million cubic metters of alluvium, which has resulted in lowering of the water volume, lake surface and drastically damaging the lake ecological values. Being free of alluvium, but not by the chemicals, the water flows into Macro Prespa lake, converting into international waters.

In these condition Devolli River-Micro Prespa Lake irrigation system ist'n scientifically based not only on environmental engineering but also but also on hydroeconomial and international rights laws. It also does not work according to the projected parameters and does not correspond to the agricultural needs. Water quantities taken from Micro Prespa in summer, especially during the last years, have been les that 10% of the volume of the water inserted into the lake. So, in 1997, only 2.3 million cubic meters was taken away instead of 90 million cubic meters projected to be taken. In 1998 only 5 million cubic meters and in 1999 also anly 5 million cubic meters or 0.4 m3/sec from 10 m3/sec according to the project. This happened because Micro Prespa Lake communicate with Macro Prespa Lake (Fig. 7, Photo 1c). In these conditions turbid water of Devolli River upon flowing in Micro Prespa Lake decant in it, ruining it and, being free of alluvium, flow in Macro Prespa Lake.

9.2. Damages of the biodiversity

Micro Prespa Lake has great problems of eutrophism (Photo 1c, 11, 12). Eutrophication processes are promoted by enrichment in nutrients. The direct consequence of such addition is represented by a change in biodiversity (Bega F. 2000, Bimo T. 2000, Pano, N. et al 1997, Pano, N. and Frashëri, A 2000, Pepo E. 2000, Qoshja, Zh. 1979, Rakaj N. 2000, Shumka S. 2000).

Another negative aspect is the penetrating of a considerable quantity of toxic remains and absorbed coal organic material by the drainage of Devolli farm grounds and by geological section outcrop. The lake water content nitrite, nitrate, ammoniac, phosphate, carbonate, and organic material. Chemical change of the water has been observed up to a distance of some hundred meters, from the southwester edge of lakeshore to inside of the lake (Kanani K. 2000). This changes the lake water features and degrades their habitats.

Habitat loss and deterioration of over the last five years are the major factors causing serious threat to plants and animal species. In particular, this phenomenon obviously influences a part of the aquatic flora and fauna in the lake.

9.3. Threaten flora

- The aquatic bed plants: Nymphaea Alban in paeticularly, Caratophyllum sp., Myriophyllum sp., Lemna Minor, Trapa Natans, Leucojo-Fraxinetum Angustifobiliae, Potameto-Wallisnerietum, Nymphoidetum Peltatae etj.
- The trees: Carpinus Betulus, Acer Pseudoplantanus, Corulys, etc.

9.4. Threaten fauna

- The fishes: Leuciscus Illyricus; Salmotrutta Peristeris; Barbus Prespensis
- The zooplankton: Eutrophication processes have changed also in zooplancton composition of Micro Prespa Lake.

a)

b)

c)

Photo 10. General view of the damages of ecosystem at Prespa Lake shore,

(a) 2000 y., (b)(c) 2006 y.

9.5. Underground water resoures and springs

Lacustrine alluvium has coated all shallows of Micro Prespa lakeside and has blocked its underground water resources. As a result water balance of Micro Prespa Lake is ruined and drinkable water springs yield is diminished. There are springs such as Ventrok that had a great discharge of 13.8 l/sec before the lake was stuffed with sediment deposition that is drying up.

Environmental Evolution of Micro Prespa Lake Using Landsat Images

The analysis is based on Landsat images from years 1972 (1973 for the NIr band), 1987, 2002 and 2010. Three methods were used for the processing of images:

a) Natural color combination Blue-Green-Red for each year, enhancing the colors in water surfaces in order to make visible water turbulences. Enhancement of colors was done keeping as reference the Ohrid Lake, which water showed no signs of turbulences.

b) Combination in false colors of NIr bands in two ways: 1973~Blue, 1987~Green, 2002~Red and 1987~Blue, 2002~Green, 2010~Red. Such combinations were used to identify variations of lakes shores [Frasheri Cico Fundo, 2010]

c) Combination in false colors of NDVI in two ways: 1973~Blue, 1987~Green, 2002~Red and 1987~Blue, 2002~Green, 2010~Red. Such combinations were used to identify variations of vegetation lakes shores [Frasheri Cico Fundo, 2010]

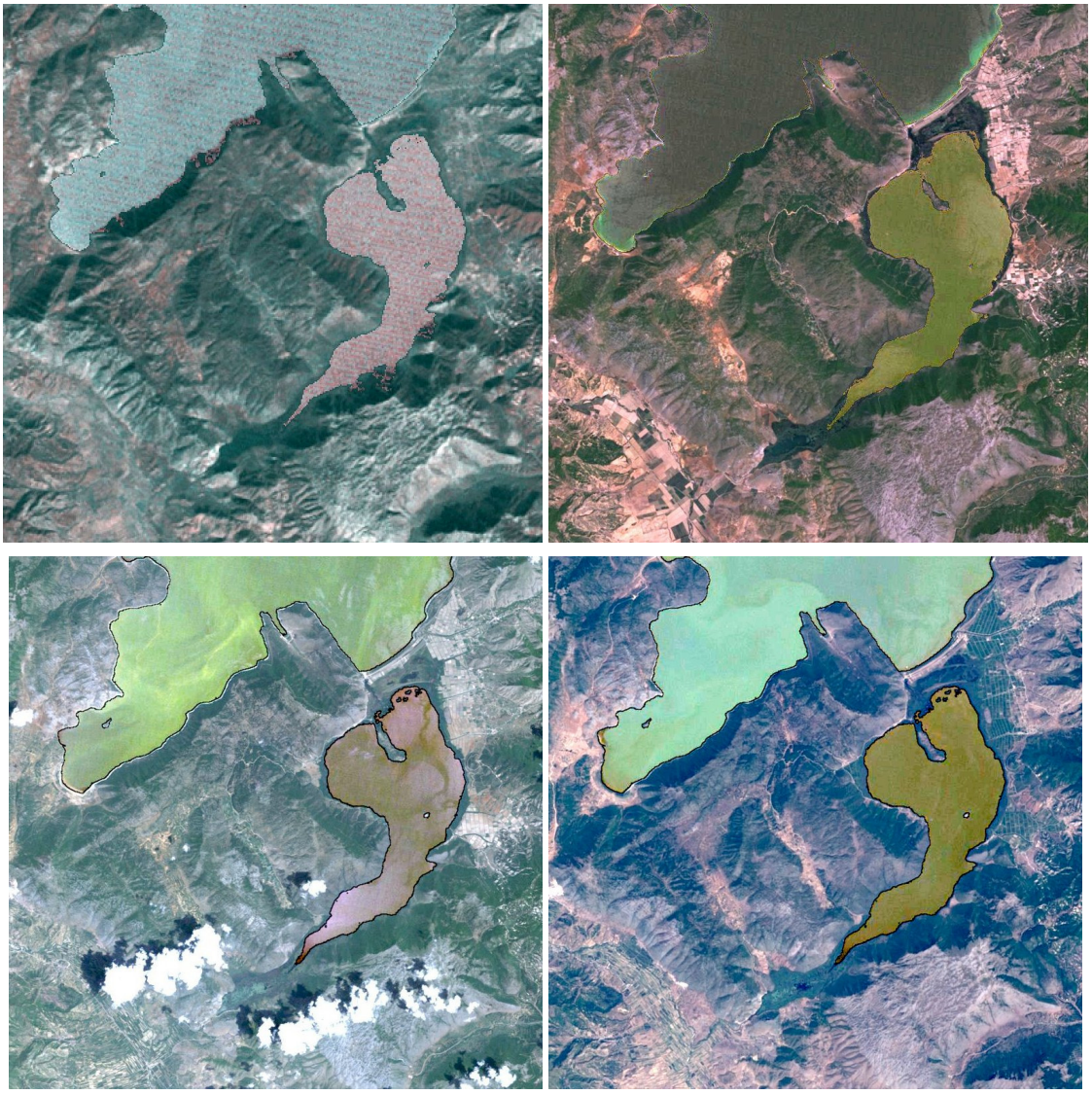


Fig. Aaa – Natural enhanced colors of Macro and Micro Prespa Lakes (top left ~ 1972, top right ~ 1987, bottom left ~ 2002, bottom right ~ 2010)

In 1972 there are no significant turbulences in both Macro Prespa and Micro Prespa. Water of Micro Prespa looked more “reddish” proobably because of being more shallow. Instead, in 1987 there are first signs of turbulences in Micro Prespa, and first signs of turbulences near shores in Macro Prespa. Situation resulted dramatic in 2002, while showed a little improvement in 2010 as result of interruption of water flow from River Devolli in Southwestern corner of Micro Prespa (colors of this corner are not enhanced).

A view of Southwestern corner of Micro Prespa Lake is visible in Google Earth.

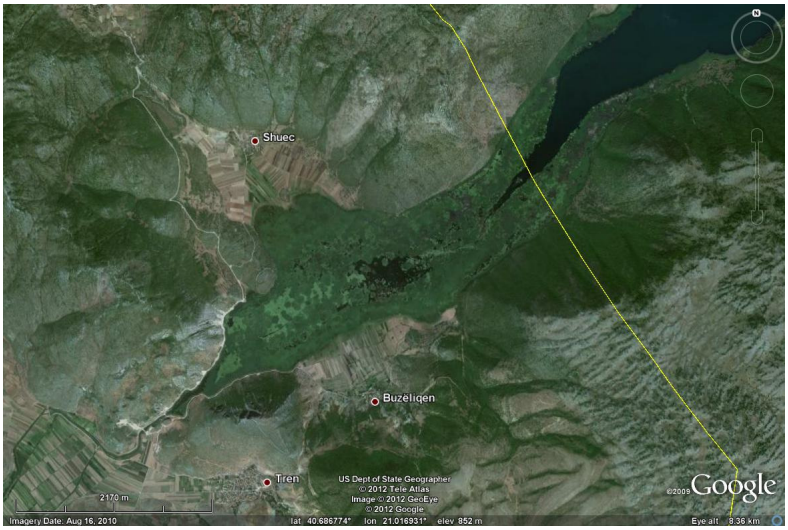


Fig. Bbb – Google Earth image of Southwestern corner of Micro Prespa Lake. Villages of Shueci and Buze Liqeni are shown as repers for the geological profile of the Lake

It is clearly visible that almost the whole corner is filled with vegetation (mostly reeds), except a small area at its center. In the bottom-left corner of the image there is visible the channel used to flow Devolli River waters into the Lake during winter time.

The variation of lakes shores was done comparing NIr images by combining them using false colors. Permanent water areas appear in black, permanent ground areas in gray or nuamces having all three RGB base colors, while areas where the shore line has moved appear in specific colors with only one or two components of base colors.

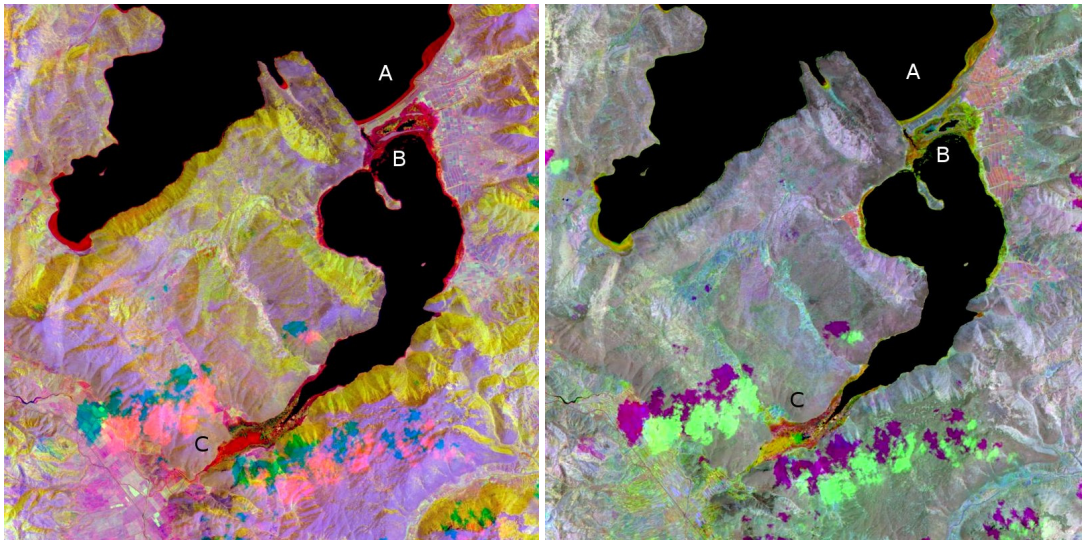


Fig Ccc – Combination of NIr bands (left: 1973-1987-2002, right 1987-2002-2010)

In the combination of 1973(blue) – 1987(green) – 2002(red) part of Macro Prespa Lake shore (“A”), the Northern shore (“B”) and the Southwestern corner of Micro Prespa (“C”) are in clear red color, indicating that during the period 1987–2002 there is a loss of water surface. In Macro Prespa it was result of decrease of water level, while in Micro Prespa it was result of sedimentation and increase of reeds. In the combination of 1987(blue) – 2002(green) – 2010(red) the same areas A and B show lack of red component, indication that during 2002–2010 there was no change in the shore line. Instead in the area A there are reddish spots due to development of reeds while in its center the green spot indicates that the

area filled with reeds in 2002 resulted improved as clear water in 2010.

The variations in time of NDVI are presented with false colors in the figure:

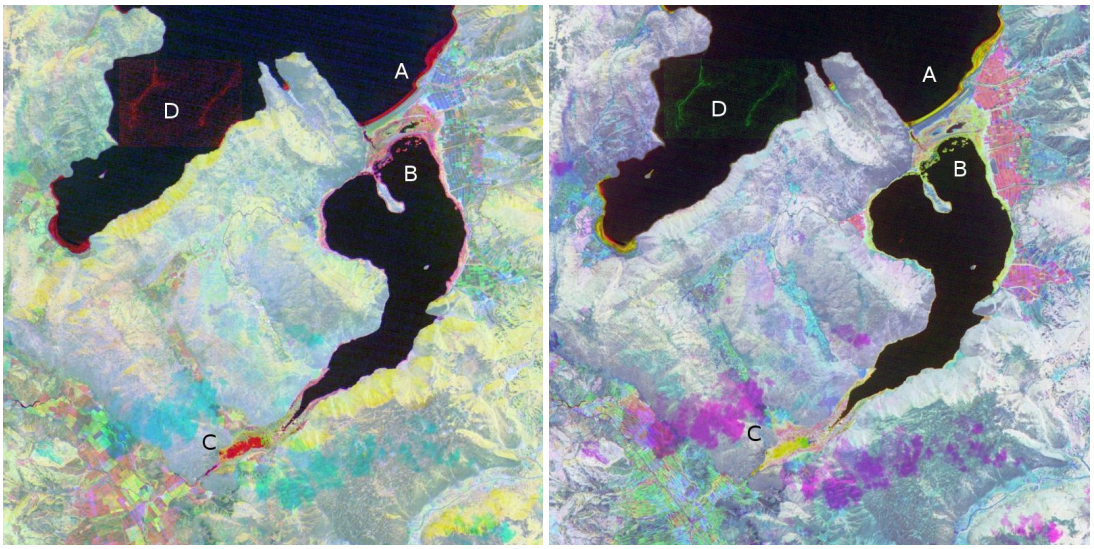


Fig Ddd – Combination of NDVI (left: 1973-1987-2002, right 1987-2002-2010)

The same phenomena are visible in false color combinations of NDVI for the two periods 1972(blue) – 1987(green) – 2002(red) and 1987(blue) – 2002(green) – 2010(red). The environmental situation in both Macro and Micro Prespa Lakes is deteriorated during the period 1987 – 2002 and has a slight improvement during 2002 – 2010, result of interruption of water loss in Macro Prespa and of Devolli River water flow in Micro Prespa. The area indicated by "D" shows strips of algae developed in Macro Prespa waters in 2002.

11. Otherwise of Albanian territory in the Prespa area – as a conclusion

The above factors have helped sediment deposition of about 1.2 million cubic meters into Minor Prespa Lake, diminishing the water volume and the surface of this lake. It is the otherwise of the Albanian territory.

The lack of the respective action plans and platforms for scientific and economic cooperation based on International Legal Acts, has in turn damaged the creation of the necessary space for the complex and integral use of the hydrological resources of this lake system for hydro-economic purposes, conserving ecological values.

It is this pearl that Albania is losing as a result of uncontrolled human activity. Albania will not have any part in Micro Prespa Lake after some years as a results of this great deterioration which is spreading all over the lake. This destruction of the Albanian side of Micro Prespa Lake step by step will extend in all water volume of the lake. Being Transborder Lake, their destruction will bring problems in the relation between both countries.

Being scientists, we made an appeal to local community and government, state government and scientists of different fields to take urgent measures to interrupt the further damage of Micro Prespa lake and the unlawful change to Albanian territory.

Let us save this pearl, regenerating it, improving the life the local inhabitants and transforming the district into a wonderful tourist place.

a)

b)

Photo 11. Eutrophication of the Micro Prespa Lake water, 2000 y.

a)

b)

Photo 12a, b. Eutrophication of the Micro Prespa Lake water, 2006 y.

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List of the captions

List of the pictures