

## Assessment of the quality characteristics of two lakes (Koronia and Volvi) of N. Greece

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**Abstract** Quality parameters from 17 sampling stations from Lake Koronia and 18 from Lake Volvi were determined during sampling period of one year. Physicochemical parameters (pH, conductivity, DO) did not show remarkable differences neither between sampling sites nor between sampling periods. Nutrient concentrations (nitrogen and phosphorus compounds) were higher in lake Koronia than in Volvi showing relatively small temporal and spatial variations. As far as heavy metals in sediments, lake Koronia is considerably more polluted than Volvi lake especially with the metals Fe, Mn, Zn, Pb and Cd. The mean total concentrations of metals in lake Koronia decrease in the order Mn > Zn > Cr > Pb > Cu > Fe > Cd. The mean total concentrations of metals in lake Volvi decrease in the order Mn > Zn > Cr > Cu > Pb > Fe > Cd.

**Keywords** Lake sediments · Water · Heavy metals · Nutrients · Physicochemical parameters

### 1 Introduction

Anthropogenic impact on natural environments and especially on aquatic ecosystems is currently a topic of increasing concern. Deterioration of surface water and especially Lake water quality has recently observed in many aquatories. The potential causes of such a situation are various point source pollution (domestic and industrial effluents) can be localized and well-established, whereas the influence of non-point pollution (runoff from intensively cultivated areas and urban centres) is less obvious because of the inadequately defined direction and frequency of non-point source loading. Most of those activities lead to the pollution of lakes. The quality of lake water may vary depending on the geological morphology, vegetation and activities in the catchment basin, as well as on the location of the sampling site. In Europe, pollutants of domestic, industrial and agricultural origin have seriously degraded the lake quality during the last centuries, especially after the industrial revolution. The introduction of large quantities of nutrients, mainly nitrogen and phosphorus to lake waters can cause eutrophication problems (Michelutti *et al.*, 2002; Kouimtzis *et al.*, 1994; Fytianos *et al.*, 2002). Nitrates devire from agricultural sources and, unlike phosphorus, which is absorbed by soils, it is, in part, washed from the land during storm events.

In Greece, both point and non-point pollution sources contribute to the deterioration of river water quality. Until recently, few domestic waste-water

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phosphorus content of a water body is mainly affected by the natural characteristics of the drainage basin (morphometry and edaphic factors) and the anthropogenic nutrients inputs (Rydin, 2000).

Orthophosphates in Koronia lake were generally found at concentration levels between 0.31 and 3.14 and in Volvi between 0.11 and 0.81. Concerning phosphates, Koronia lake and more polluted than Volvi. The highest values were found at sampling site 15 for Koronia and 11 for Volvi.

Phosphates concentrations were low in Volvi lake showing relatively small temporal and spatial variations, that were attributed to agricultural and municipal activities.

Comparing the total concentrations of heavy metals in sediments between Koronia and Volvi lakes (Table 2), we conclude that metal pollution in sediments of the Koronia Lake is considerably higher. No significant differences in heavy metal concentrations were observed in the sediments from all the stations in Lake Volvi and Koronia, suggesting influence from geological factors rather than from point sources.

The mean total concentrations of metals in Koronia decrease in the order  $Mn > Zn > Cr > Pb > Cu > Fe > Cd$ , while for Lake Volvi the order is  $Mn > Zn > Cr > Cu > Pb > Fe > Cd$ .

The above mentioned order shows an increased Cr and Zn participation in the soil metal content which could possibly be attributed to anthropogenic pollution.

The anthropogenic mean concentration heavy metals in sediments follow the order:

$Cd > Pb > Mn > Zn > Cu > Fe > Cr$  for Koronia Lake and  $Cd \geq Pb \approx Cu > Zn > Fe \approx Cr > Mn$  for Volvi Lake

## Conclusions

Quality parameters were determined in the water of Volvi and Koronia Lake during sampling period of one year. Physicochemical parameters (pH, conductivity, DO) did not show remarkable differences nei-

ther between sampling sites nor between sampling periods. Nutrient concentrations (nitrogen and phosphorus compounds) were higher in Koronia lake than in Volvi showing relatively small temporal and spatial variations, that were attributed to agricultural and municipal activities (EC Council Directive, 1998).

Concerning the total concentrations of heavy metals in sediments, Koronia lake is considerably more polluted than Volvi lake especially with the metals Fe, Mn, Zn, Pb and Cd.

## References

- Andreadakis, A., & Katsara, A. (1995). Quality characteristics of surface waters in Greece in relation to European Union legislation. *Water, Science and Technology*, 32, 183–190.
- Belzile, N., & Dixit, S. (2004). Sediment trace metal profiles in lakes of Canada. *Environmental Pollution*, 130, 239–248.
- Bostrom, B., Jansson, M., & Forsberg, C. (1982). Phosphorus release from lake sediments. *Archiv of Hydrobiology Beiheft Ergebnisse Limnologia*, 18, 5–59.
- Coale, K., & Flegal, A. (1998). Copper, zinc, cadmium and lead in surface waters of lakes Erie and Ontario. *Science of the Total Environment*, 87, 297–300.
- EC Council Directive relating to the quality of water intended for human consumption of *Journal of European Communications*, 1998 L330 (98/83/EU), 32–51.
- Fytianos, K., & Laurantou, A., (2004). Speciation of elements in sediment samples collected at Lakes Volvi and Koronia, N. Greece. *Environment International*, 30, 11–17.
- Fytianos, K., Samanidou, V., & Agelidis, T. (1986). Comparative study of heavy metals pollution in various rivers and lakes of N. Greece. *Ambio*, 15, 42–44.
- Fytianos, K., Siumka, A., Zachariadis, G., & Beltzios, S. (2002). Assessment of the quality characteristics of Pinios River, Greece. *Water, Air and Soil Pollution*, 136, 317–329.
- Kouimtitz, TH., Samara, C., Voutsas, D., & Zachariadis, G. (1994). Evaluation of chemical parameters in Aliakmon river, N. Greece. *Journal of Environmental Science and Health*, A29 (10), 2115–2126.
- Michelutti, N., Doubas, M., & Lean, D. (2002). Physical and chemical limnology of 34 oligotrophic lakes in Canada. *Hydrobiologia*, 482, 1–13.
- Rydin, E. (2000). Potentially mobile phosphorus in lake Erken sediments. *Water Research*, 34(7), 2037–2042.
- Standard Methods for the examination of water and wastewater, 18th ed., APHA, AWWA and WPCF, Washington DC, 1995.