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Geochemical Evaluation of Metal Content and Fluorescent Characterization of Dissolved Organic Matter in Lake Sediments

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Abstract : Purpose of this paper is to evaluate the environmental status of a coastal Mediterranean lake, named Koumoundourou, located in the northeastern coast of Elefsis Bay, in the western region of Attiki in Greece, 15 km far from Athens. It is preserved from ancient times having an important archaeological interest. Koumoundourou lake is also considered as a valuable wetland accommodating an abundant flora and fauna, with a variety of bird species including a few world's threatened ones. Furthermore, it is a heavily modified lake, affected by various anthropogenic pollutant sources which provide industrial, urban and agricultural contaminants. The adjacent oil refineries and the military depot are the major pollution providers furnishing with crude oil spills and leaks. Moreover, the lake accepts a quantity of groundwater leachates from the major landfill of Athens. The environmental status of the lake results from the intensive land uses combined with the permeable lithology of the surrounding area and the existence of karstic springs which discharge calcareous mountains. Sediment samples were collected along the shoreline of the lake using a Van Veen grab stainless steel sampler. They were studied for the determination of the total metal content and the metal fractionation in geochemical phases as well as the characterization of the dissolved organic matter (DOM). These constituents have a significant role in the ecological consideration of the lake. Metals may be responsible for harmful environmental impacts. The metal partitioning offers comprehensive information for the origin, mode of occurrence, biological and physicochemical availability, mobilization and transport of metals. Moreover, DOM has a multifunctional importance interacting with inorganic and organic contaminants leading to biogeochemical and ecological effects. The samples were digested using microwave heating with a suitable laboratory microwave unit. For the total metal content, the samples were treated with a mixture of strong acids. Then, a sequential extraction procedure was applied for the removal of exchangeable, carbonate hosted, reducible, organic/sulphides and residual fractions. Metal content was determined by an ICP-MS (Perkin Elmer, ICP MASS Spectrophotometer NexION 350D). Furthermore, the DOM was removed via a gentle extraction procedure and then it was characterized by fluorescence spectroscopy using a Perkin-Elmer LS 55 luminescence spectrophotometer equipped with the WinLab 4.00.02 software for data processing (Agilent, Cary Eclipse Fluorescence). Mono dimensional emission, excitation, synchronous-scan excitation and total luminescence spectra were recorded for the classification of chromophoric units present in the aqueous extracts. Total metal concentrations were determined and compared with those of the Elefsis gulf sediments. Element partitioning showed the anthropogenic sources and the contaminant bioavailability. All fluorescence spectra, as well as humification indices, were evaluated in detail to find out the nature and origin of DOM. All the results were compared and interpreted to evaluate the environmental quality of Koumoundourou lake and the need for environmental management and protection.

Keywords : anthropogenic contaminant, dissolved organic matter, lake, metal, pollution
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