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*Editorial*

# Water Environment Pollution and Control in the Dual-Carbon Background

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## 1. Introduction to the Special Issue

Water pollution and control are becoming increasingly important in the global context of carbon peaking and carbon neutrality. Water environment safety is important to keep humans healthy. In this wide "Water Environment Pollution and Control" framework, this Special Issue aimed to provide important knowledge and lay a sound scientific foundation for the control and management of water environment pollution by studying the environmental behaviors and bioavailabilities of various pollutants. The thirteen articles in this Special Issue focusing on water environmental pollution and control are mainly divided into four categories: (1) the composition characteristics and environmental behaviors of the pollutants in the surface water (i.e., the Chinese lakes Ulansuhai [1], Hulun Lake [2], Tai Lake [3], Shahu Lake [4], and Russian Ancient lakes [5]); (2) the assessment of groundwater and aquifer interaction [6] and the sources, risks, and management of groundwater pollution [7]; (3) the impact of polluted water on human health [8–10]; and (4) the removal of pollutants in water [11–13].

Since the call for papers was announced in 2022, and after a rigorous peer-review process, thirteen papers have been accepted for publication in the Special Issue [1–13], which include eleven research papers [1–4,6,8–13] and two reviews [5,7]. We offer brief highlights of the published papers below.

## 2. Overview of the Contribution of the Special Issue

The paper "Differences of Nitrogen Transformation Pathways and Their Functional Microorganisms in Water and Sediment of Seasonally Frozen Lake, China" [1] improves the understanding of the nitrogen cycle in seasonally frozen lakes. Shotgun metagenomic sequencing of subglacial water and sediment from Lake Ulansuhai was performed to identify and compare nitrogen metabolism pathways and microbes involved in these pathways. The study found that ammonia assimilation was the most prominent nitrogen transformation pathway, and bacteria and proteobacteria were the most abundant portion of microorganisms in nitrogen metabolism. Gene sequences devoted to nitrogen fixation, nitrification, denitrification, dissimilatory nitrate reduction to ammonium, and ammonia assimilation were significantly higher in sediment than in surface and subsurface water.

The paper "The Sources of Sedimentary Organic Matter Traced by Carbon and Nitrogen Isotopes and Environmental Effects during the Past 60 Years in a Shallow Steppe Lake in Northern China" [2] quantified the contribution of organic matter sources in the lake sediment via multiple mixing models based on the stoichiometric ratios and stable isotopic compositions. The results showed that the organic matter in the sediments from Hulun Lake mainly came from terrestrial organic matter: the proportion of terrestrial organic matter was more than 80%. The results of the SIAR mixing model further revealed that



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the proportions of terrestrial C3 plant-derived organic matter, soil organic matter, and lake plankton-derived organic matter were 76.0%, 13.9%, and 10.1%, respectively.

The paper "Analysis of the Driving Mechanism of Water Environment Evolution and Algal Bloom Warning Signals in Tai Lake" [3] collected the long-term water quality indicators, ecological indexes, natural meteorological factors, and socio-economic indexes in Tai Lake and studied the environmental evolution of the lake ecosystem. The key time nodes and early warning signals of the steady-state transformation of Tai Lake were also identified, which could provide a theoretical basis for early indication of the transformation of lake ecosystems. Furthermore, the characteristics and driving mechanisms of the lake's ecosystem evolution were analyzed based on the physical and chemical indexes of its sediments and its long-term water quality indexes. These results have important theoretical and practical significance for pollution control and the management of eutrophic lakes.

The paper "Variation in Spectral Characteristics of Dissolved Organic Matter and Its Relationship with Phytoplankton of Eutrophic Shallow Lakes in Spring and Summer" [4] characterized the seasonal changes of dissolved organic matter as well as phytoplankton abundance and composition in Shahu Lake via three-dimensional fluorescence spectroscopy combined with parallel factor analysis. The relationship between the response of DOM and phytoplankton abundance was explored via Pearson correlation and redundancy analysis in the overlying water. Seasonal phytoplankton growth had an important influence on the composition of the DOM.

The paper "Geochemical Indicators for Paleolimnological Studies of the Anthropogenic Influence on the Environment of the Russian Federation: A Review" [5] reviewed the most significant studies of sequential accumulation of pollutants, including heavy metals in the lake sediments in Russia, where there are about 2 million lakes. It was found that sedimentation rates were significantly lower in pristine areas, especially in the Frigid zone, compared to urbanized areas and industrial territories. In addition, the excess concentrations of heavy metals in the sediments of lakes were directly affected by the source of pollution. Further prospects of developing paleolimnological studies in Russia were discussed in the context of the continuing anthropogenic impact on the environment.

The paper "New Green and Sustainable Tool for Assessing Nitrite and Nitrate Amounts in a Variety of Environmental Waters" [6] improved the selectivity and sensitivity of the quantitation of nitrite and nitrate in waters by liquid chromatography with a short analysis time of about 10 min and using low residues. Ion pair formation and ion exchange retention mechanisms were considered. The experimental scheme was optimized and a new research method was established.

The paper "A Review of Groundwater Contamination in West Bank, Palestine: Quality, Sources, Risks, and Management" [7] reviewed the four levels of domains used to evaluate the groundwater condition in the West Bank for the past 27 years, including (i) assessing the groundwater quality in the West Bank, (ii) identifying the sources of groundwater pollution, (iii) determining the degree of health risks associated with groundwater pollution, and (iv) determining the role of groundwater management in maintaining the quality and sustainability of these groundwater sources. A review matrix was developed based on these four core domains. The results showed that the contamination and shortages of drinking water in the West Bank were among the most important challenges facing the Palestinian National Authority (PA) and the population residing in all sectors.

The paper "Health Risk Assessment of Nitrate and Fluoride in the Groundwater of Central Saudi Arabia" [8] assessed the non-carcinogenic health risks posed by nitrate and fluoride to infants, children, and adults using the daily water intake (CDI), hazard quotient (HQ), and non-carcinogenic hazard index (HI). Groundwater samples were collected from 36 wells and boreholes in three central Saudi Arabian study areas for nitrate and fluoride analysis using ionic chromatography and fluoride selective electrodes, respectively. Fluoride in 30.55% of the samples exceeded the WHO recommendations for acceptable drinking water (1.5 mg/L). The average hazard index (HI) values for adults, children, and infants were 0.99, 2.59, and 2.77, respectively. Accordingly, water samples from Jubailah

and Wadi Nisah may expose infants, children, and adults to non-cancer health concerns. Immediate attention and remedial measures must be implemented to protect residents from the adverse effects of $F^-$ in the study area.

The paper "The Problem of Selenium for Human Health—Removal of Selenium from Water and Wastewater" [9] analyzed the change in the content of selenium (Se) in drinking water, raw water, as well as treated and raw wastewater in an annual cycle in the city of Szczecin. Selenium content in raw water was the highest in the summer. The removal of Se from raw water and wastewater was difficult because Se is often present in many complex forms and can form various compounds with other elements. Treated wastewater could be a source of Se in the environment, and the discharge of treated wastewater can become a secondary source of Se in the surface water. Treating wastewater resulted in lowering the Se content in the wastewater by as much as 47%.

The paper "Distribution, Sources, and Risk of Polychlorinated Biphenyls in the Largest Irrigation Area in the Yellow River Basin" [10] studied samples in the Yellow River irrigation area in Inner Mongolia, China to determine the polychlorinated biphenyl (PCB) content and to investigate the contamination of PCBs in agricultural soils irrigated chronically with polluted water. The distribution and migration of PCBs under long-term irrigation were also studied with 100 farmland soil profile samples. Cluster analysis was used to identify possible sources of PCBs, and the USEPA Health Risk Evaluation Model was used to assess the health risks posed by PCBs to humans.

The paper "Different Adsorption Behaviors and Mechanisms of Anionic Azo Dyes on Polydopamine–Polyethyleneimine Modified Thermoplastic Polyurethane Nanofiber Membranes" [11] successfully developed a method for removal of anionic azo dyes using the polydopamine–polyethyleneimine (PEI)-modified TPU nanofiber membranes (PDA/PEI-TPU NFMs). After six iterations of adsorption–desorption, the adsorption performance of the PDA/PEI-TPU NFMs did not decrease significantly, which indicated that the PDA/PEI-TPU NFMs had a potential application for the removal of Cr molecules by adsorption from wastewater.

The paper "Treatment of Wastewater Effluent with Heavy Metal Pollution Using a Nano Ecological Recycled Concrete" [12] synthesized a new material (Nano ecological recycled concrete, Nano-ERC) for removing heavy metals from wastewater. The results showed that nano-ERC simultaneously reduced the treatment cost of the simulated wastewater effluents and the environmental burden of solid waste. The adsorption capacity of nano-ERC was presumed to be significantly enhanced by adding nano CuO. Nano-ERC can serve as a cost-effective approach for the further treatment of wastewater effluent and may be applied more widely in wastewater treatment to help relieve water stress.

The paper "Simultaneous Removal of $COD_{Mn}$ and Ammonium from Water by Potassium Ferrate-Enhanced Iron-Manganese Co-Oxide Film" [13] developed a stable and efficient method for removing water pollutants. The catalytic oxidation ability of iron–manganese co-oxide film (MeOx) was enhanced by dosage with potassium ferrate ($K_2FeO_4$) to achieve the simultaneous removal of $COD_{Mn}$ and NH4+ from water in a pilot-scale experimental system. By adding $K_2FeO_4$ to enhance the activity of MeOx, the removal efficiencies of $COD_{Mn}$ and $NH_4^+$ were increased to 92% and 61%, respectively, and the pollutants were consistently and efficiently removed for more than 90 days. The mechanism of $K_2FeO_4$-enhanced MeOx for $COD_{Mn}$ removal was proposed by the analysis of the oxidation process.

## 3. Conclusions

The guest editors envision that the papers in this Special Issue will be of interest to researchers and practitioners and help identify further research directions. We also hope that the results and methods presented in these studies will shed light on the efficient removal of pollutants from water bodies, the pollution control of water ecosystems, the risk assessment of water quality to human health, the impact evaluation of climate change on the availability of surface and groundwater resources, and the interpretation of future policies for sustainable water environmental management.

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