

# Diatoms, Spatial Distribution and Physicochemical Characteristics of the Wular Lake Sediments, Kashmir Valley, Jammu and Kashmir

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## ABSTRACT

Lakes and wetlands are dynamic geomorphic units of a landscape that hold geochemical signatures of sediment provenance and paleo-environmental shifts and are major sinks for organic matter accumulation. The source of organic matter is diverse in lake sediments and varies widely with the type and size of the lake and hence it is important to understand the source of organic carbon (terrestrial or in situ) in lake systems in order to monitor the health of the lake. Wular lake, located in north Kashmir, is one of the largest fresh water lake in India, situated at an average elevation of 1580m ASL. The lake is fed by a number of watersheds that bring a diverse type of sediments and organic matter and thus deposit them into the Wular lake basin. In order to understand sediment distribution pattern, content and source of organic matter, sediment provenance and the persisting environment in the Wular lake, 32 lake floor sediment samples covering the entire lake were collected and analyzed for organic element analysis,  $\text{CaCO}_3$ , organic matter, sediment texture and diatom analysis. The results indicated that sediments in the lake are dominated by silt and silty clay. The organic carbon in the lake ranged from 0.83%-4.52% and nitrogen varied from 0.06%-0.5%. The Carbon to Nitrogen (C/N) ratios (9.04 to 22.03) indicate a mixed source of organic carbon but dominated by in situ lake sources from the vascular and lake biota accumulation. The diatom analysis revealed the occurrence of a diverse type of species along the sampling sites present within the lake. The wide distribution of the diatom species such as *Cymbella*, *Cyclotella* and *Tabularia* etc. in the lake indicate high organic pollution and alkaline fresh water environment prevailing in the lake.

## INTRODUCTION

The terrestrial lake ecosystems are strongly influenced by the natural and anthropogenic factors within their catchments. Hence lake sediments have often been used as a tool for environmental surveys (Wahlberg et al., 2002). These freshwater ecosystems are fed by numerous perennial and ephemeral rivers. However, in the present times, the sediment-water chemistry in these freshwater basins is being severely affected by anthropogenic influence due to continuous growing demand for water for various purposes. This has caused depletion and poor quality of surface and ground waters. Hence, there is a need for strict environmental monitoring of these freshwater terrestrial ecosystems. Moreover, as there are very few fresh water lakes and most of them located along the coasts, these wetlands are becoming saline and thus of very little societal use. Hence the growing concern about the status of pristine freshwater lakes located at higher latitudes has generated a need to establish a baseline for ecosystem disturbance (Boyle et al., 2002).

The valley of Kashmir, situated towards the northern fringe of the Indian subcontinent, holds diverse lakes with varied depth and located at different elevations. These lakes serve the local population, for

drinking, irrigation, fishing, recreation and tourism. The surface sediment and water quality in these lake basins is governed by complex natural and anthropogenic activities including weathering, erosion, hydrological sources, climate, precipitation, industrial activities, agricultural land use, sewage discharge, and the human exploitation (Bhat et al. 2014).

The Wular lake is a mono basin, elliptical in shape and plays a vital role in maintaining the hydrographic system of Kashmir valley by acting as a huge reservoir of fresh water. It has a good capacity to hold large volume of water during the floods (Ganai et al. 2010). However, widespread deterioration in sediment and water quality of these inland aquatic systems has been reported in the last few decades due to rapid development of agricultural practices, horticulture, industries around and the urban sprawl (Rashid et al. 2013; Sheikh et al. 2014; Hassan et al. 2015). This has led to the shrinkage of a large part of the Kashmir Himalayan lakes. In view of the spatial and temporal variations in the lake ecology and water systems, sediment chemistry of lake floor sediments, regular monitoring programs are required. This will help in understanding the reliable estimates of the sediment quality, the sediment source and the impact of various pollutants in the lake ecosystem. Due to the continuous uplift of the Himalayas (Agarwal et al., 2011) and the flow of perennial rivers in the Kashmir Himalayan region; the lake bathymetry has decreased sharply as a result of rapid siltation. The lake water is contaminated with domestic and industrial wastes, posing serious threat to the biological diversity within these lakes. The sedimentation rate and pattern in these lakes vary spatially and temporally. Hence, the changes in sediment geochemistry in response to changes in environmental and climatic factors are presented in this study. The present study is also deemed necessary and important as it provides clues about the present environmental status of such freshwater bodies.

More than 10,000 people are directly or indirectly dependent on the Wular lake for their livelihood. The lake serves as home for many bird species and is the main hub for migratory birds, their breeding and stay during the summer in the Kashmir valley. The lake also serves as an important site for recreational and tourist activities. Thus, recognizing the importance of the Wular Lake for its biodiversity and socioeconomic values, the lake was designated as a wetland of international importance under the Ramsar Convention in 1990 (Sheikh et al. 2013). Hence, it is important to conserve the pristine nature of the lake and its surroundings.

The chemistry of the source rock and lake sediments being similar; indicate that the physical weathering of the surrounding rocks and soils are dominant than the chemical weathering (Rashid et al., 2013). Physico-chemical component analysis of the major inflowing streams into the Wular lake revealed that the nutrient load contribution to the Wular lake is maximum during the spring season followed by the summer period (Bhat et al., 2015) and the phytoplankton diversity at the Watlab Ghat points to the abundance of Bacillariophyceae group of diatoms over the others (Ganai et al., 2010). However, the impact

