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Seasonal Variation in Physicochemical quality of Lonar Lake Water

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ABSTRACT

The Lonar crater situated in Buldana District, Maharashtra is natural hyper saline lake formed by hypervelocity meteoritic impact in basaltic rock. An attempt has been made to evaluate physicochemical qualities of Lonar Lake water. A total of 36 water samples were analyzed in 2008 for seasonal variation in physicochemical qualities of Lonar lake water and revealed that, the water is alkaline (pH 10.3) and characterized by high concentration of Salts (9060mg/L), Chloride (3492 mg/L), Salinity (6391 mg/L), Alkalinity (3751 mg/L), Total hardness (480 mg/L), Calcium hardness (118 mg/L), Magnesium hardness (361 mg/L), Sulphate (21 mg/L), Phosphate (0.44 mg/L) and Nitrate (3.7 mg/L), and Dissolved Oxygen (0.0034 mg/L). The data indicated that the alkalinity is increased in monsoon and post-monsoon season while decrease in pre-monsoon season. Likewise the chloride and salinity is increased in pre monsoon season while decreased in monsoon and post-monsoon season. As the Lonar Lake is unique in the world for its alkalinity and salinity of the water but its alkalinity, pH and salinity goes on decrease day by day. Hence this World heritage should be preserved for its alkalinity and salinity.

(**Key Words:** Lonar Lake, Meteoritic impact, alkalinity, salinity)

INTRODUCTION

The Lonar crater situated on the outskirts of Lonar town in District Buldana, Maharashtra (Lat. 19^0 58^I Long. 76^0 34^I) is the only known crater formed by hypervelocity meteoritic impact in basaltic rock. The impact occurred about fifty thousand year ago and resulting crater is a very impressive sight. This large impact crater has a mean diameter of 2 km (6600 feet) and a depth from rim of 137 m (450 feet). Lake water is very salty [1]. Lonar crater is the third natural salt water lake in the world with diameter of 1800 m and 170 m depth. It comes after Bosmatvi Lake in China with diameter of 10,000m and New Cubec in Canada with a diameter of 3500 m [2,3]. The lake was first brought to be notice in 1823 by British officer CJE Alexander in 1896, and American Geologist G.K. Gilbert conducted studies to prove that the Lonar was created due to meteor strikes [4].

Water is directly related to human beings. Visitors and pilgrims use the water of 'Dhar' (a natural fresh water flow in lake) and 'Sitanahani' for bathing and washing besides drinking and discharge of sewage from hotels, stales released directly into the lake water, which deteriorate the quality of water. Another source of pollution is wastes thrown by visitors and pesticide residues from the crop fields after the rains [5]. A review of literature revealed that it salinity were 40.78, 31.52, 30.87 in 1910, 1958 and 1960 respectively. The salinity of the lake is now lowered down to 7.9% [6].

The aim of the present study was to analyze seasonal variation in physico-chemical quality of Lonar lake water. Lonar Lake is a closed one without any outlet and unique due to its salinity, alkalinity and biodiversity. Due to the uniqueness, the lake has evoked much scientific values among researchers and continues to site of attraction for many. Water is the most vital abiotic component of the lake ecosystem and while studying the biodiversity of any lake ecosystem, the knowledge of the physicochemical quality of lake water becomes important. Seasonal variation in physicochemical character of water prevailing in this lake has not been studied in detail. Therefore it was thought to undertake studies on physicochemical quality of water in Lonar Lake.

EXPERIMENTAL SECTION

Thirty-six water samples were collected from eight sampling site of Lonar crater (Fig. 1) in 1L bottles and carried to the laboratory. Sampling was done monthly in the morning in 2008. The parameter selected for analysis were water temperature, pH, total dissolved solids, total alkalinity, total hardness, calcium hardness, magnesium hardness, chloride, dissolved oxygen, sulphate, nitrate, phosphate. The pHs, temperature, DO, salinity, and TDS were determined on the spot by water

analysis kit and rest of the parameters were analysed in the laboratory by standard methods [7].

RESULTS AND DISCUSSION

In this study total 36 water samples; 4 in pre-monsoon, 16 each in monsoon, and in post-monsoon season from Lonar Lake. These 36 water samples were analyzed for the seasonal variations in physicochemical quality of Lonar Lake water. The number of physicochemical parameters like pH, temperature, total dissolved solids, alkalinity, dissolved oxygen, chloride, salinity, total hardness, calcium hardness, magnesium hardness, sulphate, phosphate and nitrate were performed.

In the present study the data revealed that there were considerable variations in the quality with respect to their physicochemical characteristics. Physicochemical analysis of Lonar Lake water was studied in different season (2008). It is also observed from the present study that, the colour of the lake water is also pale green to dark green because of the dense algal population with predominating *spirullina.* The odour of lake water is somewhat an offensive. Muley and Babar [8] noted the offensive odour of the lake water. The pH of Lonar Lake water varies from 10.2 to 10.5 and temperature 27^0C to 29^0C. The total dissolved solid is in the range of 6.4 mg/L to 15.2 mg/L and alkalinity in the range of 3400 mg/L to 3988 mg/L. The dissolved oxygen content was 1.4 mg/L to 5.2 mg/L, the chloride 1801.98 mg/L to 4098.69 mg/L and salinity from 3308.43mg/L to 7768.43 mg/L was recorded. The total hardness was in the range of 276 mg/L to 696 mg/L; calcium hardness 80 mg/L to 136 mg/L and magnesium hardness between 144 mg/L to 588 mg/L. The sulphate was recorded as 19 mg/L to 23 mg/L, phosphate was 0.1 mg/L to 0.9 mg/L and nitrate was 2 mg/L to7.4 mg/L during present study (Table 1).

The Lonar Lake is always alkaline-and maximum pH 10.5 in the pre-monsoon, minimum 10.2 in post-monsoon and 10.3 in monsoon (Table 1). The lower pH during rainy season may be due to dilution of alkaline substances in rainy season, and resulting in increase in turbidity of the water which in turn reduced photosynthetic activity of algae. Thakker and Ranade[9] observed the pH 9.5 to 10.0 and Dabhade *et al*[5] recorded it from 10 to 10.5.

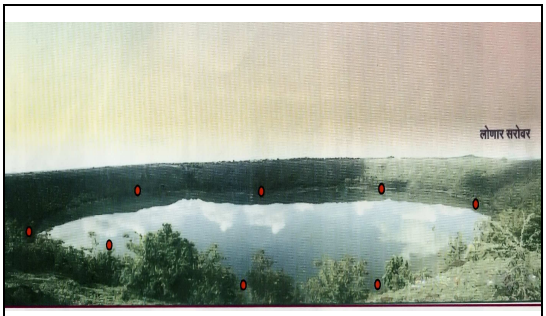

Fig 1: General view of Lonar Lake and sites of water sample collections for analysis

The temperature plays a vital role in the chemicals and biological activities of water body. The temperature of Lake water ranges from 27^0C to 28^0C. Minimum temperature recorded was 27^0C during pre-monsoon season and up to 28^0C during monsoon and post-monsoon season (Table 1). The Lake has its localised temperature system and has retained high level of humidity. The high temperature of water may also higher amount of inorganic salts dissolved responsible for high salinity of the Lake. Dabhade *et al*[5] (2006) recorded that temperature of lake ranges from 18^0C to 32^0C, minimum temperature recorded was 18^0C to 20^0C during November to February, the temperature rises gradually up to 30^0C to 31^0C during March to June and from July to October it ranges from 25^0C to 28^0C. Thakker and Ranade [9] (2002) recorded 35^0C temperature.

The total dissolved solids of a lake ranges 7800 mg/L (post-monsoon) to and highest 10800 mg/L in monsoon and 8600 mg/L in pre-monsoon respectively (Table 1). The high value of suspended solid during monsoon is due to an increase surface run-off. This was also reflecting on the turbidity level. These variations occur due to suspended material and algal bloom in lake water. The total dissolved solids, suspended particulate materials and algal bloom are the main causes determined the transparency of lake water. Thakker and Ranade[9] recorded the total solid was 15500mg/L while Dabhade *et al* [5] observe in the ranges from 9950mg/L to 1200 mg/L.

In the present study, total alkalinity was ranged between 3503 mg/L to 3885mg/L. There was a steep fall in the total alkalinity during pre-monsoon season. Maximum 3885 mg/L was observed during monsoon and minimum 3503 mg/L observed during pre-monsoon. (Table 1) Dabhade *et al*[5] observed the alkalinity of lake water ranges from 1110mg/L to 2051 mg/L and Thakker and Ranade [9], (2002) recorded it 3600 mg/L. Blanford [10] believed that evaporation of water in the absence of any exit was responsible for the alkalinity of lake water. The maximum chloride

content 4126mg/L was recorded in pre-monsoon season while minimum 3054mg/L in monsoon and 3296 mg/L in post-monsoon. Thakker and Ranade, (2002) recorded the chloride as 3000 mg/L while Dabhade *et al* [5] (2006) showed variable ranges from 1440mg/L to 3958mg/L. The salinity of Lake water was 7600 mg/L which is maximum in pre-monsoon season and least content was recorded in monsoon (5606 mg /L) and post-monsoon (5968 mg/L (Table 1)). Thakker and Ranade [9] recorded the salinity of lake water was 5508mg/L. The low temperature of the water may also higher amount of inorganic salts dissolved in it responsible for high salinity of the lake.

Table1: Seasonal Variation in Lonar Lake Water in the year 2008

Parameter	Pre-monsoon (4 Samples)	Monsoon (16 Samples)	Post-monsoon (16 Samples)	Average (36 Samples)
pH	10.5	10.3	10.3	10.3
Temperature	27	28	28	27
Total dissolved solids (mg/L)	8.6	10.74	7.85	9.2
Alkalinity(mg/L)	3503	3884.75	3866	3751.25
Chloride(mg/L)	4125.69	3054.22	3264.74	3481.55
Salinity(mg/L)	7599.81	3606.28	5967.98	6391.35
Dissolved oxygen(mg/L)	4.7	2.9	2.6	3.4
Total Hardness(mg/L)	494	581.5	364.75	480.08
Calcium Hardness(mg/L)	142.8	103.75	115.75	120.76
Magnesium Hardness(mg/L)	351.2	477.75	259	362.65
Sulphate (mg/L)	21.75	21.62	21.18	21.51
Phosphate(mg/L)	0.42	0.43	0.47	0.44
Nitrate(mg/L)	4.2	4.54	2.4	3.7

Dissolved oxygen is important parameter for survival of aquatic life and it is in ranges from 0.0026 mg/L to 0.0047mg/L. Maximum concentration of dissolved oxygen was observed 0.0047mg/L in pre-monsoon season, while minimum during monsoon (0.0029mg/L) and post-monsoon (0.0026mg/L). The depletion in dissolved oxygen values during monsoon and post-monsoon season are due to the tremendous growth of the planktonic community of the lake. Low dissolved oxygen of the lake is indication of the presence of organic matter resulting in higher Biological Oxygen Demand. The “algal bloom” is an adequate to explain the presence of planktonic community of Lonar Lake. It is not only suspended in the

columns of water but has formed scum over the surface of lake water which does not allow the atmospheric oxygen to get dissolve in lake water. Whatever the oxygen produces by phytoplankton through respiration might be utilized by zooplanktons and other macroinvertibrates. Dabhade *et al*, [5] (2006) observed the dissolved oxygen from 1.1 mg/L to 4.87 mg/L (Table 1).

Hardness in water is caused by metallic ions dissolved in water which includes calcium and magnesium ions. Total hardness of lake water was recorded 582mg/L being highest in monsoon as compare to pre monsoon (9494 mg/L) and post monsoon (365mg/L). Dabhade *et al* [5] recorded that the total hardness was slightly fluctuating and in range of 150 mg/L to 350 mg/L while Taiwade [11] recorded it 101 ppm. Calcium is an important element influencing flora of ecosystem, which plays important role in metabolism and growth. The highest calcium hardness was found to be 136 mg/L in pre-monsoon season due to evaporation of lake water during summer while least content was recorded 104 mg/L and 116 mg/L in monsoon and post monsoon season respectively. Normally these ions are not problematic but at higher concentration increases total hardness of water. The magnesium hardness of lake water was found to be 478mg/L in monsoon season and 358mg/L in pre-monsoon. This magnesium hardness was increased in monsoon season due to deterioration of leaf and algae in lake water. Taiwade[11] recorded the calcium hardness as 20.3 ppm where as magnesium hardness as 80.7 ppm.

Sulphate of Lonar Lake water was found to be 22 mg/L in pre-monsoon and monsoon season and 21 mg/L in post-monsoon season. There was slightly fluctuation in sulphate. Dabhade *et al*[5] found that a sulphate variation of lake water has been observed in the range of 0.2 mg/L to 1.90 mg/L. The phosphate of lake water was found to be 0.47 mg/L in post-monsoon season while 0.42 mg/L and 0.43mg/L in pre-monsoon and monsoon season. This decreasing phosphate occurred due to phosphate is readily taken by phytoplankton. Thakker and Ranade[9] recorded phosphate as 0.2 mg/L while Surakashi [12] recorded as 22 mg/L. The nitrate of lake water was found to be 4.5 mg/L and 4.2 mg/L in monsoon and pre-monsoon season respectively. 2.4mg/L nitrate was recorded in post-monsoon season. In monsoon and pre-monsoon season nitrate was increased due to the nitrogenous fertilizers used in agriculture and one of the reason of increasing in nitrate in Lonar Lake water (Table 1).

It can be concluded from the study, that alkalinity was increased in monsoon and post-monsoon season while decrease in pre-monsoon season. Likewise the chloride and salinity was increased in pre monsoon season while decreased in monsoon and post-monsoon season. Lonar crater is coming under threat as result of unchecked sewage flow there has been increased in lake water level in the lake decreasing it's salinity level such change also effect ecosystem.

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