



Study of Physicochemical Characterization of Lonar Lake Effecting Biodiversity Lonar Lake, Maharashtra, India

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Abstract

The lonar crater lake is proved to be caused by a Meteor which is mainly of rocky material and the pH values of the lake water are generally higher than 10 and occasionally reaching 12. The lake is a closed system without any outlet and the lake is unique due to its salinity, alkalinity and biodiversity. 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. Therefore in present article studies on physicochemical quality of water and in Lonar Lake were done and it was seen that chlorides and salinity of the Lake water is decreasing, but the biodiversity of the lonar lake is increasing as we found presence of some microorganisms i.e. Some Bacillus species, Some Lysinibacillus species and Some Pseudomonas species.

Keywords: Meteor, Biodiversity, Physicochemical quality, Bacillus Species, Lysinibacillus species, Pseudomonas species.

Introduction

A meteor entering into Earth's atmosphere can undergo fragmentation¹. Impact of such objects can produce shock waves in solid materials and both impactor and material impacted is rapidly compressed to high density and upon de-pressurization it explodes violently to produce the impact crater². Shock metamorphic effects include a layer of shattered or brecciated rocks under the floor of the crater³. The mark of an impact crater is the presence of some elements like Ni, Pt, Ir, and Co which are not usually found in the Earth's interior¹. The presence of Maskelinite i. e. glassy type material at the impact site is also one of the distinctive features of an impact crater. Meteor impact craters like Barringer Crater also called as aka Meteor Crater in Arizona United States^{4,5} and the Lonar Crater Lake in Buldhana District of Maharashtra India⁶ are rare on Earth's surface. The Lonar crater has water in it and is one of the biggest meteorite craters having Basalt in it; this crater has a large slope with a dense forest in the region. The two slopes within the crater are 15 to 18 degrees and 30 degrees. The slope measuring 15-18 degrees has a notch through which the Meteor came. The opposite side of slope is increased due to the pressure created by the Meteor and by the remains of the notch side blown away. The lonar crater lake is proved to be caused by a Meteor which is mainly of rocky material and the pH values of the lake water are generally higher than 10 and occasionally reaching 12⁹. Negro River basin has a huge amount flooded forest and lakes, which are distinguished by their acidic water (pH \square 4.0) staining wine⁷. Before the impact the meteor has fragmented in three pieces and has led the formation of three lakes known as Lonar Lake, Ganesh Lake and Amber Lake. The Ganesh Lake and Amber Lake are dried up now. This crater has a great importance for studying our probable meteor impact⁸. Concentration of bio-available metals such as Arsenic, Cadmium, Chromium, Copper, Nickel, Manganese,

Titanium and Zinc, Mercury and Lead is toxic to biological systems. Metals such as arsenic, lead, cadmium, mercury, and selenium are highly toxic even in minor quantities. Heavy metal and their salts are considered as very important group of environmental pollutant which in small quantities maybe essential nutrients that protect your health, yet in larger quantity it become toxic and dangerous to human being⁹. High levels of pollutants in lake water causes an increase in biological oxygen demand (BOD), chemical oxygen demand (COD), total dissolved solids (TDS), total suspended solids (TSS), toxic metals such as Cd, Cr, Ni, Pb and fecal coli form and hence make such water unsuitable for drinking. Therefore the metal concentration is to be studied in the lonar lake¹⁰. The alkaline environments are caused by a combination of geological, geographical and climatic conditions. They are characterized by large amounts of sodium carbonate formed by evaporative concentration. In the course of formation of alkalinity, other salts particularly (NaCl) also concentrate, giving rise to an alkaline saline environment⁶. The aim of the present study was to analyze 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. Biodiversity of the lake is an important attraction for studying the physicochemical characters of the lake water. Therefore it was thought to undertake studies on physicochemical quality of water in Lonar Lake.

Methodology

Four sediments samples were collected from selected sites of Lonar Lake with the help of scooper in sterile polythene bag. They were labeled and transported to the laboratory and stored at 40C until further analysis. The soil samples were collected using standard recommended method and the samples were

taken at different depths as depth of the sampling is important because the mobility of nutrients varies with the nutrient content in the different soil zones. The depth of sampling was kept as recommended. For water samples also the standard recommended methods were followed. Sampling was done in March-2011 [Two samples] and May-2012 [One sample]. The parameters selected for analysis for water were temperature, pH, color, odour, total dissolved solids, alkalinity, total hardness, permanent hardness, BOD (biochemical oxygen demand), COD (Chemical oxygen demand), chloride, Nitrates, Nitrites, Turbidity, Salinity, dissolved sulphate, and phosphate. The pH and temperature recorded on the spot by using pH paper and thermometer and rest of the parameters were analyzed in the laboratory by standard methods⁸. The parameters selected for analysis for soil were : soil texture, soil composition [sand; slit; clay], moisture, partial density, apparent density, porosity, volume expansion, water holding capacity, conductivity, soil color, pH, salinity, organic carbon, available nitrogen, available phosphorus, available potassium, total calcium, total magnesium, total sodium, free calcium, copper, iron, manganese, zinc, sulphur, boron.

Results and Discussion

The alkaline Lonar Lake, in Central India, situated in the village at Lonar, Buldhana district, Maharashtra ranks third in the world based on diameter and its high (pH 10.5) alkalinity¹¹. It is a closed system without outlets and regular influents are responsible for its existence. Based on the geological studies, it is postulated that the Lake originated as a meteorite impact crater around 50-53 thousand years ago^{12,13}.

The diameter around the Lake is about 1.75 Km and water enters the Lake through rain, ground water seepage and the springs situated in the cliffs at the edge of the Lake. It does not receive any industrial discharges. Alkalinity of the Lake is attributed to the high content of sodium carbonate and hence was used previously as a source of washing soda¹⁴. The water in the crater is very salty. It is 10 times saltier than drinking water. Salts and minerals like sodium, chloride, carbonates, fluorides and bicarbonates (TDS around are found and as this water do not drain away these substances get collected beneath the surface^{5,15,16}. In such conditions one cannot think of any living organisms, but microorganisms like *Arthrospora*, proteobacteria and algae are found abundant¹⁷. It revealed that Lake water is alkaline (pH 9.5) and characterized by high concentration of salts (9060 mg/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), nitrate (3.7 mg/l) and dissolved oxygen (0.0034 mg/l).

Physical characters of the lonar lake water sample are appearance turbid with algal growth; odour objectionable, turbidity as NTU 4.2.

Chemical characters of Lonar lake water sample are pH 9.5, chlorides 542.20, nitrates 21.30, nitrites traces, total hardness 670, permanent hardness 260, TDS 2041, iron 0.45, fluorides 1.7, alkalinity 420, total suspended solids 1580, total solids 2600, BOD 1864, COD 3168 [table-1].

Table-1
Lonar Lake Water Analysis

Sr. No.	Parameters	Results		
		Sample I	Sample II	Sample III
1	Physical Appearance	Turbid	Turbid	Turbid
2	Odour	Oweful	Oweful	Oweful
3	Turbidity (As NTU)	2.80	3.50	4.20
4	pH	8.40	7.64	6.84
5	Chlorides	542.20	57.82	47.32
6	Nitrate	21.30	30.00	32.00
7	Nitrites	Traces	Traces	Traces
8	Total Hardness	640.00	650.00	670.00
9	Permanent Hardness	220.00	250.00	260.00
10	Total Dissolved Solids	2041.00	1080.00	860.00
11	Iron	Nil	0.40	0.45
12	Fluorides	0.80	1.70	1.60
13	Alkalinity	420.00	410.00	390.00
14	Total Suspended Solids	559.00	40.00	1580.00
15	BOD	1520.00	1380.00	1864.00
16	COD	1860.00	620.00	3168.00
17	Total Solids	2600	1120.00	2440.00

Physical characters of the lonar lake soil sample are soil composition [sand 9.01, slit 45.52, clay 55.03], moisture 7, partial density 3.95, apparent density 2.15, porosity 63.50, volume expansion 34.80, water holding capacity 70.02, conductivity 0.109, color : gray, texture : sandy clay [table-2].

Chemical characters of lonar lake soil sample are pH 9.5, salinity 0.96, organic carbon 0.63, available nitrogen 141.98, available phosphorus 50, available potassium 784, total calcium 36, total magnesium 18, total sodium 0.15, free calcium 5.77, copper 2.49, iron 10.41, manganese 12, zinc 2.48, sulphur 8.7, boron 0.79 [table-3].

Conclusion

From these observations we can say that the alkalinity of the lonar lake is decreasing as the pH is ranging between 8.4 to 9.5 and calcium magnesium and sodium concentrations are minimum; due to which salinity of the soil is not high. But the water sample is having high chlorides, hardness and salinity due to which the alkalinity of the water is in higher range. But these reports are not as high as previous reports of scientists on lonar lake water and showing a continuous decrease in the salinity and chlorides of the lake water¹⁸.

The Lonar Lake is unique in the world for its alkalinity and salinity of the water but it was seen that chlorides and salinity of the Lake water is decreasing day by day¹⁸.

Table-2
Lonar Lake Soil Analysis [Physical Parameters]

Sr. No.	Parameters	Results		
		Sample I	Sample II	Sample III
1	Sand	7.00%	8.05%	9.01%
2	Slit	41.52%	41.02%	45.52%
3	Clay	49.51%	49.03%	55.03%
4	Moisture	6.00%	5.85%	7.00%
5	Water holding capacity	61.24%	61.20%	70.02%
6	Partial Density	3.38%	3.30%	3.95%
7	Apparent density	1.31%	1.50%	2.15%
8	Porosity	63.20%	63.50%	63.04%
9	Volume Expansion	34.65%	34.80%	33.04%

Table-3
Lonar Lake Soil Analysis [Chemical Parameters]

Sr. No.	Parameters	Results		
		Sample I	Sample II	Sample III
1	pH	7.9	7.99	7.8
2	Salinity	0.327	0.331	0.96%
3	Organic Carbon	0.57	0.25	0.63
4	Available Nitrogen	Nil	Nil	141.98
5	Available Phosphorus	30	50	9.8
6	Available Potassium	376	784	500.25
7	Total Calcium	36	Nil	Nil
8	Total Magnesium	18	Nil	Nil
9	Total Sodium	0.15	Nil	Nil
10	Free Calcium	5.77	Nil	2.6
11	Copper	2.49	Nil	2.49
12	Iron	10.41	Nil	0.547
13	Manganese	12	Nil	13.67
14	Zinc	2.48	Nil	1.314
15	Conductivity	Nil	Nil	0.109
16	Sulphur	Nil	Nil	8.7
17	Boron	Nil	Nil	0.79

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