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Original Research Paper

Lonar Lake Water: Past and Present

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ABSTRACT

The alkaline Lonar crater, located in the Buldhana district of Maharashtra, India, is the only hypervelocity meteoritic impact crater in basalt rock, ranking third in the world and best preserved impact structures on the earth. The uniqueness of this crater is that it has been formed in strata of hard igneous, basalt rocks. Due to uniqueness and its large size, it has become one of the important craters in the world. The Lonar lake is natural for the accumulation and concentration of saline constituent in the lake water. An attempt has been made to study and compare the information of physicochemical qualities of Lonar lake water. A total of 36 water samples were analysed in 2008 for physicochemical qualities of Lonar lake water. These findings revealed that the Lonar lake water was alkaline (pH 10.3) 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). The Lonar lake is unique in the world for its alkalinity and salinity of the water but it is seen that chlorides and salinity of the lake water is decreasing day by day. Hence, it should be protected and preserved for its uniqueness and a scientific phenomenon as a national treasure.

INTRODUCTION

The alkaline Lonar crater, located in the Buldhana district of Maharashtra is the only hypervelocity meteoritic impact crater in basalt rock, ranking third in the world. The impact occurred about fifty thousand years ago and the resulting crater is a very impressive sight. This large impact crater has a mean diameter of 2 km (6600 feet) and a depth from the rim of 137 m (450 feet). In addition, the crater has unique flora and fauna and is filled with saline water (Thakker & Ranade 2002). The uniqueness of the lake water is its salinity and high alkalinity. A review of literature revealed that its salinity was 40.78, 31.52 and 30.87 g/L in 1910, 1958 and 1960, respectively. The salinity of lake is now lowered down to 7.9% (Malu et al. 2000). The presence of brackish water inside the crater having pH~10 is a distinctive feature of the ecosystem along with high concentration of chlorides, carbonates and sodium ions with SiO_3, SO_4, Ca, Mg and K in minor amounts, besides traces of boron (Joshi et al. 2007). The observed alkalinity is ascribed to an interaction between sodium chloride, calcium carbonate and water over a long period of time. Some geological and chemical reports are available on Lonar lake (Jhingram & Rao 1954, Nandy & Deo 1961).

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 value 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 physico-chemical parameters of lake water becomes important. The physicochemical analysis of water

prevailing in this lake has not been studied in detail so far. The aim of the present study was comparative analysis of past and present physicochemical quality of Lonar lake water and causes behind the changes taking places. Therefore, it was thought to undertake studies on physicochemical analysis of water in Lonar lake.

MATERIALS AND METHODS

Thirty six water samples were collected from 8 sampling sites as shown in Fig. 1. From each site about 1 litre of water sample was collected in bottles and carried to the laboratory for analysis of physicochemical quality. Sampling was done in July to October, 2008. The parameters analysed were temperature, pH, total dissolved solids, total alkalinity, total hardness, calcium hardness, magnesium hardness, chloride, dissolved oxygen, sulphate, nitrate and phosphate. The pH, temperature, DO, salinity and TDS were determined on the spot by water analysis kit and rest of the parameters were analysed in the blaboratory by standard methods (APHA 1998).

RESULTS AND DISCUSSION

The colour of lake water was pale green to dark green because of the dense algal population with predominance of *Spirulina*. The odour was somewhat offensive, particularly in July which is also observed by Muley & Baber (1998). Taiwade (1994) and others observed pH of the lake water around 10. The present study showed the pH varying form 10.2 to 10.5. This increase in pH is mainly due to the lake controlled biological processes rather than equilibrium with CO_2 in atmosphere. In July pH of the lake water is 10.5, which is slightly more than that of August, September and October (Table 1).

According to Surakashi et al. (2007), temperature of lake water was 28°C, and in the present study it was also observed at 28°C. In July temperature was 27°C and in August, September and October it was 28°C. This change occur due to the sun warm top layer of the lake, the epilimnion, during summer which make it less dense than the bottom layer, the hypolimnion. The lower surface temperature fall causes epilimnion to cool to temperature below the hypolimnion which lead overturning of lake. The lake has its localized temperature system and has retained high level of humidity, therefore, the water temperature is quite low as compared to ambient temperature.

According to Thakker & Ranade (2002) TDS (total dissolved solids) of the lake water was 15500 mg/L, but in present study it was observed to be 9060 mg/L. According to Mahajan (2005) dissolved oxygen was found to be 5.75 mg/L and in present study it was 3.4 mg/L. The decrease in dissolved oxygen is due to the respiration and decomposition of organic component. Alkalinity values of lake water recorded by Thakker & Rande (2002), Joshi et al. (2007) and Surakashi et al. (2007) were 3600 mg/L, 2750 mg/L, 3200 mg/L respectively. In the present study it was found to be 3751 mg/L. It can

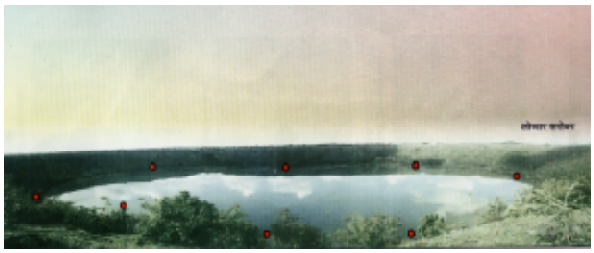

Fig. 1: general view of Lonar lake and sites of water sample collection for analysis.

be concluded that alkalinity of the lake water increases due to the meteoritic water feeding the lake. Various theories have summarized that alkalinity is accounted for the occurrence of sodium carbonate as a result of an interaction between sodium chloride and calcium carbonate in water. Blanford (1870) believed that the evaporation of water in the absence of any exit was responsible for alkalinity of the lake water. One of the reasons of increasing alkalinity is the conversion of sulphate to carbonate through the intermediate sulphide formation and the concentration of lake water (Nandi & Deo 1961). The groundwater of meteorite origin saturate with CO_2 and the concentrate of CO_3/HCO_3^- greatly exceed that of Ca^{++}/Mg^{++} and they precipitate as carbonate. This leaves Na^+, CO_3^- and $HCO3^-$ as major ions in solution.

The algae are ubiquitous and cosmopolitan in habitat. It thrives in lake water on bicarbonates even though there is no free CO_2. The blue green algae can fix dinitrogen of the atmosphere and are capable of using it for their growth and development (Car & Whitton 1982). Chloride concentration

Table 1: Monthly analysis of physicochemical parameters of Lonar lake water in the year 2008.

Parameter	July (4 Samples)	August (8 Samples)	September (8 Samples)	October (16 Samples)	Average (36 Samples)
pH	10.5	10.5	10.2	10.2	10.3
Temperature (°C)	27	28	28	28	28
TDS (mg/L)	8600	12300	9300	7800	9060
Alkalinity (mg/L)	3503	3888.5	3881	3866	3751.25
Chloride (mg/L)	4126	3404.37	2704.12	3296	3492.08
Salinity (mg/L)	7599.81	6247.62	4964.95	5968.01	6391.36
DO (mg/L)	0.0047	0.0037	0.0022	0.0026	0.0034
Total hardness (mg/L)	494	571	592	364.75	480.08
Ca hardness (mg/L)	136	104.5	103	115.75	118.5
Mg hardness (mg/L)	358	466.5	489	249	361.58
Sulphate (mg/L)	21.75	22.12	21.37	21.18	21.55
Phosphate (mg/L)	0.42	0.41	0.46	0.47	0.44
Nitrate (mg/L)	4.2	6.3	2.7	2.4	3.7

Table 2: Comparative physicochemical analysis of Lonar lake water from year 1910 to 2008 by various workers.

Parameter	Christie (1910)	Jhingran and Rao (1958)	TISCO (1960)	Thakker & Ranade (2002)	Joshi et al. (2007)	Surakashi et al. (2007)	Present study (2008)
pH	-	-	-	10	9.8	10	10.3
Temperature (°C)	-	-	-	35	28	28	28
TDS (mg/L)	-	-	-	15500	ND	ND	9060
Alkalinity (mg/L)	-	-	-	3600	2750	3200	3751.25
Chloride (mg/L)	40780	31520	30870	3000	2468.4	5600	3492.08
Salinity (mg/L)	74872.08	57870.72	56677.35	5508	4532	10281.6	6391.36
DO (mg/L)	-	-	-	ND	ND	ND	0.0034
Total hardness (mg/L)	-	-	-	ND	ND	ND	480.08
Ca hardness (mg/L)	-	-	-	ND	ND	ND	118.5
Mg hardness (mg/L)	-	-	-	ND	ND	ND	361.58
Sulphate (mg/L)	1480	300	670	ND	ND	ND	21.55
Phosphate (mg/L)	ND	ND	ND	0.2	ND	22	0.44
Nitrate (mg/L)	ND	ND	ND	ND	ND	ND	3.7

ND = Not determined

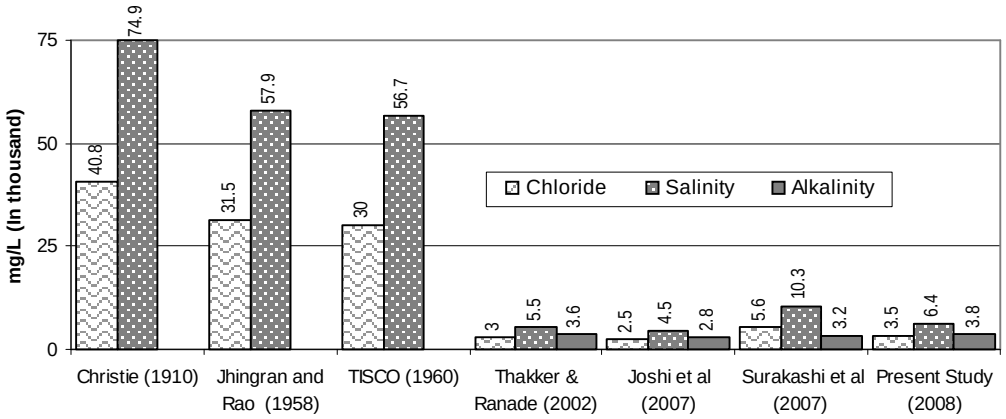

Fig. 2: Comparative analysis of chloride, salinity and alkalinity of Lonar lake water from year 1910 to 2008 by various scientists.

recorded by Christie (1910), Jhingran & Rao (1954), TISCO (1960), Thakker & Ranade (2002), Joshi et al. (2007) and Surakashi et al. (2007) of lake water was 40780 mg/L, 31520 mg/L, 30870 mg/L, 3000 mg/L, 2468 mg/L and 5600 mg/L (Table 2). In the present study chloride in the lake was 3492 mg/L. One of the reasons for decreased chloride in lake water was drying up of water during 1970 to 1985 in summer and the dried salt from the lake was sold. The salinity of lake water recorded by Christie (1910), Jingran & Rao (1954), TISCO (1960), Thakker & Rande (2002), Joshi et al. (2007), Surakashi et al. (2007) was 74872 mg/L, 57870 mg/L, 56677 mg/L, 5508 mg/L, 4532 mg/L and 10281 mg/L. In the present study it was 6391 mg/L showing decreases with time (Fig. 2).

According to Dabhade et al. (2006) total hardness of lake water ranged from 150 mg/L to 350 mg/L, and in present study it was observed to be 480 mg/L. The increasing hardness was due to the farming done in lake area where the fertilizers used come in lake during rainy season with agricultural wastes and soil. In present study it was observed that calcium hardness of the lake is 118 mg/L. It is increases during July due to the evaporation. The magnesium hardness of the lake water is 361 mg/L, and it increases during August reaching 466mg/L to 489mg/L. It is increased due to circular line of trees in the lake area and algae present in the lake. During summer, the leaves fall and in rainy season they reach lake water with runoff. Decomposition of these leaves and algae releases magnesium into the lake water. According to Surkashi et al. (2007) sulphate of the lake water was 22 mg/L, and in the present study it is observed to be 21 mg/L.

Dabhade et al. (2006) observed that phosphate of the lake water was 2.5 mg/L and nitrate was 9.2 mg/L. In the present study phosphate of the lake water was 0.44 mg/L, and nitrate 3.7 mg/L. The phosphate and nitrate decrease due to their uptake by excessive growth of algae.

It can be concluded from the study that the pH of Lonar lake water is more or less constant around 10 but chloride and salinity are decreasing day by day. The world famous saline Lonar lake will be no longer saline, hence the lake should be protected and preserved for its saline uniqueness as a natural treasure.

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Conferences/Symposia/Workshops on Environment

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Contact name: Miss Laksanavadee Jaturapat

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Contact name: Dr.T.Vijaya Lakshmi, Conference Secretary

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