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## A SEARCH FOR THE SOURCE AND ORIGIN OF WHITE PEBBLES/SILICA PEBBLES FOUND AT LONAR CRATER, BULDHANA DISTRICT, MAHARASHTRA, INDIA.

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### ABSTRACT

*White pebbles of Silica origin, found in large quantities at Lonar Crater has been reported, though the source and origin of these pebbles as well as big boulders and basaltic rocks appearing white in color is not yet understood still. Research papers on Lonar Crater has not reported the abundance of pebbles and boulders present in Lonar Crater affected area, so far river pebbles and Lonar Crater pebbles exhibits similar in characteristics, physically and in chemical compositions, but boulders of big size are not found in any other water body or wetland water body. It has been reported through this paper of such big boulders and concluding that Lonar pebbles and big size boulders are not Lonar Crater origin. They have been transported by human activity and natural calamity. Boulders and pebbles may not be the evidence of meteorite impacted at Lonar Crater. They are not related to meteorite impact or volcanic eruption. They are not formed from the impacts of meteorites or volcanic eruptions.*

**Keywords:** River Pebbles, Lonar Crater, Lake Periphery, White Pebbles/Silica Pebbles, Big Size Boulders.

### 1. INTRODUCTION

The Latest research so far carried out points that Lonar Crater was formed by a meteorite impact. The Crater was formed some 6,56ka<sup>1</sup>. The Crater is situated in the Buldhana District of Maharashtra, the co ordinates of the Crater is 19°58'N and 76°30'E. The diameter of the Crater is found to be 1.83km and the depth is 150meters. There is a shallow water body existing at the crater, the formation of which is unknown. There is no aquatic life existing in the water body except some microorganisms known as green algae, due to which the water looks somewhat green in color. The nature of the water is found to be highly saline and highly alkaline. Migratory birds are found to come here from November to February. Due to its rich biodiversity existing at Crater Lake, to conserve and sustain this rich biodiversity, it has been considered as a world heritage (i.e., of International importance) and hence from 11<sup>th</sup> November, 2020, LonarCrater Lake has been declared as Ramsar Site.

#### 1.1 Some of the earlier works carried out by different researchers on Lonar Crater.

Maloo et al. studied geology of Lonar Crater and concluded that little Lonar structure (Ambar Lake) is not a second impact crater<sup>2</sup>. Poornachandra et al. studied Lonar Lake with respect to Paleomagnetism and concluded that absence of any trace of recent volcanism in the entire Indian subcontinent, indicates that Lonar Lake has probably been formed due to meteorite impact during Quaternary times<sup>3</sup>. Hagerty and Newsom studied Hydrothermal alteration at Lonar Lake impact structure and stated that the results suggest that Lonar Crater has a great potential as a laboratory to further study geochemical and hydrothermal processes that may be important on the surface of Mars<sup>4</sup>. Stroube et al. carried out a chemical study of the Impact Glasses and Basalt from Lonar Crater, and concluded that no conclusions concerning the composition of the impacting body can be justified by the data obtained to date<sup>5</sup>. During the crater formation, rocks near the surface are not found to be pressurized<sup>6</sup>.

#### 1.2 Scope of work

To search the source and origin of white pebbles/silica pebbles found at Lonar Crater on a large scale through resemblance with white pebbles found in the river Bhima/Chandrabhaga, Pandharpur, Maharashtra, To report the observation of boulders found near the lake periphery and also the white appearance on the temple stones found at Lonar Crater Lake.

## **2. METHODOLOGY**

The representative samples of white pebbles were collected from the river Bhima/Chandrabhaga, Pandharpur, Maharashtra and were transported in a polythene bag for further analysis work. The Lonar pebbles/silica pebbles detailed description is given in the paper "Polymorphs of silica in the form of white pebbles, detected at Lonar Crater, Maharashtra, India"<sup>7</sup>.

### **2.1 Observation**

The river pebbles are dirty white in color, the size of these pebbles are approx. 1.0cm, circular in shape, having amorphous nature, earthy luster, (table 1) (fig. 1).

The color of Lonar pebbles/silica pebbles is white, the size of these pebbles are also 1.0cm, circular in shape, having amorphous nature, earthy luster<sup>7</sup> (fig. 2 & 3).

### **2.2 Experiment**

The representative samples of white pebbles brought from the river were washed thoroughly, dried and then physical parameters like weight was taken on a standard balance calibrated duly, the volume was taken by using measuring cylinder of borosilicate make by displacement of water method and density was calculated. The shape, size, luster, dimensions were taken and noted down. Since the river pebbles are of spherical in shape, their measurements were taken by Vernier Calipers of Besto make Cat No. 5 with Least Count 0.01 cm. After this the representative samples were sent for XRF analysis. River pebbles 3 Nos.

### **2.3 Experiment results.**

The physical parameters carried out for river pebbles are shown in table 1. XRF analysis carried out shows that the highest oxide composition is SiO<sub>2</sub> - 97.200%, with Al<sub>2</sub>O<sub>3</sub> - 2.050%, SO<sub>3</sub> -1.390% and CaO - 0.376%, Fe<sub>2</sub>O<sub>3</sub> - 0.303%, K<sub>2</sub>O - 0.178%, Cl - 0.184%, ZnO - 0.01%, MnO - 0.008%, NiO - 0.007%, CuO - 0.006%, TiO<sub>2</sub> - 0.048% and ZrO<sub>2</sub> - 0.001% in lesser percentage (table 2). Lonar Crater Lake pebbles SiO<sub>2</sub> - 97.985%, CaO - 0.571% and Fe<sub>2</sub>O<sub>3</sub> - 1.445%, Lonar crater rim pebbles, SiO<sub>2</sub> - 97.805%, SO<sub>3</sub> - 1.581%, Fe<sub>2</sub>O<sub>3</sub> - 0.428%, CaO - 0.154% and Cr<sub>2</sub>O<sub>3</sub> - 0.032<sup>7</sup>.

## **3. RESULTS AND DISCUSSION**

The physical parameters taken, of the white pebbles from Bhima river is showed in table 1, whereas Lonar pebbles physical parameters is given in the paper of Jadhav & Mali - polymorph of silica in the form of white pebbles detected at Lonar Crater, Maharashtra, India<sup>7</sup>. From table 1, the color, the size, the shape and luster of river pebbles are found to be similar to Lonar silica pebbles. The chemical composition of white pebbles from Bhima river obtained through XRF analysis, showed in table 2, the major oxide is SiO<sub>2</sub> with average 96.27%, and other oxides in lesser percentage, whereas the results of Lonar pebbles shows that SiO<sub>2</sub> is found to be the major component, with other oxides in lesser compositions<sup>7</sup>. Table 3 shows comparison of river pebbles to that of Lonar pebbles.

### **(a) Pebbles :**

Pebbles found in Lonar Crater and river pebbles are similar in physical features and chemical compositions. (fig. 1,2 & 3). Pebbles are associated with lotic water body (moving water). It mechanically converts stones into pebbles, during the movement along the water. In Lonar Crater, there is no such water movement, it is a static water body, i.e., the water is not moving, in other words, it can be said that it is a stagnant water body (pond or lake) or it is rightly said that it is a wetland of stagnant water body, without moving water current, it is a pond in nature, from the time the crater was formed. So Lonar crater is not responsible for the source, origin and formation of pebbles, found at Lonar crater.

Correspondence with Dr. B. M. Karmarkar, a Senior Geologist, Pune said that the white pebbles found at Lonar Crater are due to volcanic eruptions. As the lava came up of viscous nature some gases got trapped in the lava forming bubbles and rather spherical cavities. During escape of hydrothermal emanations silica got deposited in such bubbles. The deposited silica may be amorphous or cryptocrystalline or crystalline form<sup>8</sup>. If considered that white pebbles of Lonar were formed by volcanic eruptions as suggested by Dr. Karmarkar, it was not reported till 2018. In different parts of the world, volcanic eruption takes place, but till date formation of white pebbles/silica pebbles from volcanic eruption has not been reported. Dr. Karmarkar has also mentioned that white pebbles are also found near the Girna river side between Chalisgaon to Jalgaon<sup>8</sup>.

Hagerty and Newsom mentioned about hydrothermal process occurring at Lonar after the impact<sup>4</sup>, but they have also not mentioned about formation of any white pebbles/silica pebbles due to hydrothermal process<sup>4</sup>, which infers that the white pebbles/silica pebbles found at Lonar Crater are not related to either volcanic eruption or meteorite impact.

Shawn Wright suggested that silica pebbles found at Lonar Crater, are not formed in the lake, but they were deposited elsewhere, before impact, and the impact (along with geologic time) just resulted in them falling downhill (due to gravity)<sup>9</sup>. This implies that silica pebbles found at Lonar crater did not originate at Lonar but originated elsewhere.

### **(B) Boulders**

In case of white colored boulders found at Lake Periphery, they are huge and heavy weight (fig. 4, 5 & 6). It is possible that these boulders must have remained in Lonar Crater near water body from the time the crater was formed or these huge boulders may have been transported by human for various activities at Lonar, they are not of Lonar origin, they are of foreign origin.

### **(C) Appearance of white color or white layer on basaltic rocks**

These types of basaltic rocks were transported from somewhere else and made into building stones for construction work of religious temples existing at the periphery of the Crater Lake, (fig. 7 & 8). Some of them were laid down by previous kings or sovereign authority. Hence pebbles, boulders and temple stones of white appearance are not Lonar Crater origin or are not the byproduct of meteorite impact or volcanic eruptions. They were transported by human beings to carry out certain activities at Lonar Crater.

#### **4. CONCLUSION**

The results of physical parameters of river pebbles, their results by XRF analysis, the results of physical parameters of Lonar silica pebbles, the XRF analysis of these pebbles, the comparison of the Lonar pebbles to that of river pebbles, the discussions, the images of river pebbles and images of Lonar silica pebbles, it is therefore concluded that these three things i.e., Lonar pebbles found at Lonar Crater, Boulders of big size, lying on the lake periphery and white appearance of rocks found at Lonar Crater lake, are not related with Lonar Crater, it means that it was not formed as a byproduct of meteorite impact or volcanic eruptions, they are fully foreign origin, human activity may be responsible, or possibly natural calamity may be responsible to transport these things here. So it is not an evidence of meteorite impact or volcanic eruptions. White pebbles, white boulders of big size and white appearance on temple stones these components cannot be attributed to Lonar events just because these components were found at Lonar Crater.

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**Fig. 1. River pebbles collected from the river Bhima, Pandharpur, Maharashtra.**



**Fig. 2. Lonar silica pebbles before cleaning. Fig. 3. Lonar silica pebbles after cleaning.**



**Fig. 4 Big size boulders observed at LonarCrater lake periphery.**



**Fig.5. Big size boulders observed at Lonar Crater Lake, towards northern side, which has not been reported so far.**



**Fig. 6. Big size boulders observed at Lonar Crater Lake, towards northern side, which has not been reported sofar.**



Fig. 7 Roof top of Ramgaya temple covered by a white layer appearance of unknown nature.



Fig. 8 The bottomhalf part of the temple of Lonar Crater is found to be covered by white layer appearance of unknown nature.

Table 1. Physical parameters of pebbles from Bhima river, Pandharpur, Maharashtra.

Sr. No.	Details of pebbles	Size in cm	Color	Shape	Lustre	wt in gms	Density g/cc.	nature
1	River pebbles No. 1	1.2	dirty white	spherical	earthy	1.7521	3.5042	amorphous
2	River pebbles No. 2	1.203	dirty white	spherical	earthy	1.5709	1.5709	amorphous
3	River pebbles No. 3	1.104	dirty white	spherical	earthy	1.7494	3.4988	amorphous
4	River pebbles No. 4	1	dirty white	spherical	earthy	0.9349	1.8698	amorphous
5	River pebbles No. 5	1.102	dirty white	spherical	earthy	1.7316	1.7316	amorphous
6	River pebbles No. 6	1	dirty white	spherical	earthy	1.0623	2.1246	amorphous
7	River pebbles No. 7	1.003	dirty white	spherical	earthy	0.8276	1.6552	amorphous
8	River pebbles No. 8	1.103	dirty white	spherical	earthy	1.5589	3.1178	amorphous

Table 2. Oxide Composition of River pebbles by XRF in %.

Sr. No.	Oxide Composition↓/Legend→	Sample 1.	Sample 2.	Sample 3.	Total	Average
1	SiO <sub>2</sub>	95.9	95.7	97.2	288.8	96.26667
2	Al <sub>2</sub> O <sub>3</sub>	1.95	2.05	1.68	5.68	1.893333
3	SO <sub>3</sub>	1.23	1.39	0.5	3.12	1.04
4	CaO	0.376	0.27	0.245	0.891	0.297
5	Fe <sub>2</sub> O <sub>3</sub>	0.303	0.205	0.203	0.711	0.237
6	Cl	0.184	0.178	0.13	0.492	0.164
7	ZnO	0.01	0.01	0.006	0.026	0.008667
8	MnO	0.008				
9	NiO	0.006	0.007	0.007	0.02	0.006667
10	CuO	0.006	0.006	0.006	0.018	0.006
11	ZrO <sub>2</sub>	0.001	0.001	0.001	0.003	0.001
12	K <sub>2</sub> O		0.178			
13	TiO <sub>2</sub>		0.048	0.04	0.088	0.044
	Total	99.974	100.043	100.018		99.96433

Table 3. Comparison of Oxide composition of River pebbles to that of Lonar Crater pebbles. Values in %.

Sr. No.	Oxides in %	River pebbles (avg.)	Lonar Lake pebbles	LonarCrater Rim Pebbles
1	SiO <sub>2</sub>	96.27	97.985	97.805

2	Al <sub>2</sub> O <sub>3</sub>	1.89		
3	SO <sub>3</sub>	1.04		1.581
4	CaO	0.297	0.571	0.154
5	Fe <sub>2</sub> O <sub>3</sub>	0.237	1.445	0.428
6	Cl	0.164		
7	ZnO	0.0086		
8	MnO			
9	NiO	0.0067		
10	CuO	0.0053		
11	ZrO <sub>2</sub>	0.001		
12	K <sub>2</sub> O			
13	TiO <sub>2</sub>	0.044		
14	Cr <sub>2</sub> O <sub>3</sub>			0.032
	Total	99.9636	100.001	100