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Findings of may be fossil remains at Lonar Crater, Buldhana District, Maharashtra, India

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ABSTRACT

Two representative samples which seemed to be of wooded nature, found in the soil towards the northern side of the crater water body, were collected to study its nature regarding a layer of white color deposition on the woods of unknown component since the water level has decreased sharply, the surface feature has been exposed widely. To investigate the white layer component deposition seen on these dry wooded samples, XRF analysis carried out of dried wooded nature samples showed that the major content was P_2O_5 (Phosphorus Pentoxide)- 36.50% and CaO (Calcium Oxide)-55.500%, with other components in minor quantities such as SiO_2, MgO, Al_2O_3, etc., such a high percentage of P_2O_5 and CaO in the wooded nature sample has never been observed before. A search was conducted which rock or mineral has such a composition and it came to be known that Apatite mineral of Calcium Phosphate nature has the same composition as that detected in the wooded sample and this Apatite mineral of Calcium Phosphate nature is related to fossils remains. The components found in dry wooded samples and composition of fossilized rock of apatite nature of calcium phosphate was found to be similar with respect to oxide and elemental composition. The wooded sample seemed to be of wood origin, was not of wooded nature but was found to be off fossil nature. It also came to be known that the white layer deposition was not due to CaO and P_2O_5, but the sample was itself a fossil nature samples. This paper reports the first-hand information about detection of fossil remains found near the Lunar Crater's water body on the prima facial basis and to put on record the work carried out to search its source and origin.

Keywords— *Lonar crater water body, Wooded nature sample, Apatite, Calcium-phosphate, Fossil remains*

1. INTRODUCTION

Some 65 ma years ago, the large volcanic eruption took place all over Maharashtra and poured large quantities of lava which later on cooled to form a basaltic plateau known as Deccan Plateau. On this Deccan Plateau in the Buldhana District of Maharashtra, some 656 Ka[1], a circular depression of approximate 1.83 km diameter and 150 meters depth was formed and was named as Lonar meteorite impact crater. The co-ordinates are $19^0 58'$N and $76^0 30'$E. Since the depression or the crater formed is of circular nature having a raised rim, the inner environment is well protected from outer air breeze and climatic conditions. The inner part of the crater, having a steep slope, is full of green vegetation, up to the base of the crater, where in the midst of the cater water body exist having the water of highly saline and highly alkaline nature. There are gorges on the inner part of the rim; the most known gorge is the Dharatirtha, where a continuous flow of water is observed around the year. Temples built in the 12-14 centuries[2] are found on the periphery of the water body. Temples situated near the water body are found to be submerged in the waters during the rainy season when the water of the crater rises and during the summer, when the water level decreases, the surface and the temples, dry stems of trees, twigs etc., are exposed.

1.1 Early works carried on Lonar crater by different researchers.

Rocks at the periphery of the basin show quaquaversal dips varying from 14^0 to 27^0[3]. Lonar Lake is unique in the world for its alkalinity and salinity of the water[4]. The solution to rural water treatment in Lonar needs to be looked at from multiple fronts[5]. Lonar Lake is always alkaline and maximum pH 10.5[6]. The Blue green algae constitute the major plankton community and particularly Spirulina is the dominant one[7]. Low dissolved oxygen of the lake is an indication of the presence of organic matter resulting in higher Biological Oxygen Demand[8]. Both types of spherules possess high NRM intensities that are typically comparable to a SIRM, suggesting a very efficient remanence acquisition process[9]. Terrestrial basalts are formed under conditions of greater oxygen fugacity, contain more water and have been subjected to terrestrial weathering processes[10]. Alternatively, therefore, it is conjectured that the formation of the Lonar Crater by a giant meteorite or a meteorite-comet should be considered more probable, although there is no direct evidence to prove such a presumption[11]. The chemical data of major and trace elements show that they are rather similar to each other, and very similar to the composition of Lonar target basalts, except for minor enrichments in K, As, Rb, Sb and Cs-i.e., some of the volatile elements[12].

2. METHODOLOGY

Representative samples of dry wood lying in the soil were collected, where the water level has decreased sharply. (fig.1&2) and kept in a polythene bag for further analysis. The dry wooded samples were kept in the sun to remove all the waters present in the woods. After a week or so, of drying in the sun, the two representative samples (fig. 1 & 2) seemed to be of wooded nature, were taken and crushed in a powdered form in a motor pestle for further analysis. After XRF analysis, the results obtained of oxides and elements, a similar type of rocks or mineral having these components were searched upon and it was found that Apatite was the mineral, which showed similar composition. Hence blue Apatite mineral (3 Nos) were used for comparison. To confirm the samples under study are of wooded nature, burnt wood ash samples collected from two different sites were also taken. Similarly representative samples of twigs of Tamarind tree (Tamarindus indica- botanical name)[13], Custard Apple tree (Annona Squamosa – botanical name)[14] and Neem tree (Azadirachta indica- botanical name)[15] were taken and dried in the sun, because these trees are mostly found around Lonar Crater. After drying the twigs, they were burnt and the burnt ash was collected. These tree twigs were collected for confirmation of the oxides and elements in the wood samples, whether phosphorous and Calcium are really found to be in a high percentage in vegetation.

2.1 Experiments

The powdered samples of wooded nature were sent for XRF analysis, after this, it was sent for pH, Chlorides and Carbonate content of Sodium and Calcium. The mineral Apatite (3 Nos.) weights were taken on a standard balance, their volume was taken by displacement of water method in a measuring cylinder of borosilicate make and finally, density was calculated, and then sent for XRF analysis. The wood ash brought from two different sites was sent for XRF analysis. The twigs of different trees i.e., Neem, Tamarind and Custard apple, after burning, the wood ash left were collected and sent for XRF analysis.

2.2 Experimental Results

The analysis results of the wooded nature samples shows that CaO being the major oxide content was 55.5 %, with P_2O_5 - 36.5 %, being the second major oxide component and other oxides such as SiO_2, MgO, Al_2O_3 etc., in minor content, (table 2). The physicochemical analysis carried out shows that pH was found to be 8.29, Chlorides was found to be 0.047 %, CO_3 was found to be 0.13 % and $CaCO_3$ was found to be <1.0 % (table 1). The physical parameters of Blue Apatite are given in table 3. From the result of Apatite mineral by XRF shows that Calcium oxide (CaO) was found to be the major component and second major component was found to be Phosphorus pentoxide (P_2O_5) with other components in minor quantities table 4, 5, 6. The analysis of burnt wood ash collected from two different sources by XRF shows that CaO content is 38.4 % and P_2O_5 is 4.85 % (table 7), CaO is 60.9 % and P_2O_5 is 4.3 % (table 8). The analysis twigs of Neem tree, CaO was 45.000 % and P_2O_5 was 13.700 % (table 9), in twigs of Tamarind tree, where CaO is 45.200 %, P_2O_5 is 16.200 % (table 10) and in twigs of Custard apple tree, CaO is 37.400 % and P_2O_5 is 14.600 % (table 11).

3. RESULTS AND DISCUSSIONS

From the results obtained through XRF analysis of the wood powdered samples, it is observed that the major oxide content is CaO - 55.500 %, P_2O_5 - 36.500 %, SiO_2 - 3.360 %, MgO - 1.860 % and Al_2O_3- 1.290 % with other oxides in minor quantities (table 2). Findings of CaO (Calcium Oxide i.e., lime) and P_2O_5 (Phosphorus Pentoxide), in such a high percentage in dry wood lying in the soil, is surprising because Deposition of CaO on the rocks at the northern side of the crater has been reported by Jadhav and Mali[16]. The waters of Lonar Crater are highly alkaline in nature. It has carbonates and bicarbonates which makes the water highly alkaline. It is possible that due to the hydrothermal process CO_3 may have been dissociated to CaO and CO_2. Hegarty and Newsom mentioned about the hydrothermal process which took place at Lonar after impact[17]. Badve has also mentioned that the lake basin either might have received water from the existing springs which were geothermally active and gradually lost their property in course of time or some of the hot springs got buried within the basin as the Lonar crater was lying in a structurally disturbed zone[7].

Since the analysis of white layer on dry wooded samples was not carried out, it cannot be stated at this moment which component is responsible for the white layer deposition on the wooded samples under study, because the earlier paper on the white rusting/white coating on basaltic rocks has been reported by Jadhav and Mali[18].

A search was conducted to find which of the rocks or minerals having similar composition as that detected in the powdered wood samples, and it came to be known that a mineral of calcium phosphate nature has the same composition as that detected in the powdered wooded samples and it was Apatite mineral having the same composition as that detected in the powdered wood samples and this apatite mineral was related to the fossil remains. To know the source of such a high percentage of CaO and P_2O_5 in the dry wooded samples (powdered), CaO and P_2O_5, the search was conducted as the CaO detected in silts by Nandi and Deo are found to be similar to the basaltic composition. But the percentage of CaO found in the dried wooded powdered samples is the highest detected and below CaO, oxide of phosphorous (P_2O_5) has been detected which is found to be the second highest amongst the elements detected, but is highest as per the analysis of basaltic rock, soil and water, which is also note worthy. Deposition of Calcium oxide (CaO) on the rocks is known and has been reported[16]. But findings of P_2O_5 in such a high percentage as that detected in the wooded powdered samples below CaO (lime) have not been reported so far. P_2O_5 found in the soil as per studies carried out by Jadhav and Mali is 2.41%, in the basaltic rocks, it is found to be in the range 0.598 – 0.899 %. Also in the salt (water of Lonar crater collected and dried in the sun. The remained salts were collected and analyzed) by XRF, the content of P_2O_5 is absent[16].

Hence the possibility of a source of phosphorus in such a high percentage in the wooded powdered samples is unknown. It is also known that a few years back, on the eastern side of the crater, cultivations of banana plantations were carried, it is possible that the farmers may have used fertilizers of phosphate nature, where these phosphate fertilizers may have been carried by runoff during the rainy season, into the waters and may have deposited on the dry wood or dry stems of trees, twigs etc., for which it is reflected in the form of CaO and P_2O_5. Since the banana plantations are in a limited area, the phosphate fertilizers used may be in negligible quantity and hence it is not found to be reflected in the waters or soil at the crater. It is also known that the content of Phosphorous in plants is in the range between 0.1 – 0.5 %[19], which is found to be in negligible quantity.

The water quality of Lonar Crater has been studied by different researchers and they have reported Carbonates (CO_3)[3, 5, 7] and Phosphates (PO_4) in the waters[6, 7, 8]. The Phosphates reported by different researchers are found to be in negligible quantity and CaO is also found to be in minor quantities. CaO has also been reported by Nandi and Deo in the silts from different depths of Crater water body and the percentage is found to be below 11.0%[3]. The reports by Jadhav and Mali on sthe alinity of the water body, it was found that Alkalinity was higher than salinity[20] which shows that there are more carbonates and bicarbonates than sodium chloride (Nacl). Also, Phosphorous is found to be absent in the salt as per analysis by Jadhav and Mali and soil near Ramgaya temple analyzed shows that P is also absent[20]. Hence Phosphorous to come to the waters through rocks does not arise. No agricultural activity major or minor found under the rim of the crater and outside the rim of the crater, so there is no source for P_2O_5 to drain into crater water. So it is assumed or postulated that the only source may be from below the basement of the crater. The crater water is not used for any household purpose like bathing, washing etc., no source of phosphate by human activity or grazing activity by livestock at the crater water body. It may be possible through domestic waste or domestic sewage from the village which is 1 km away from the crater. But the chances of Phosphorous to come to the water body is not possible because Phosphorous being an important nutrient for the plants before coming to the water body it will be absorbed by the plants existing on the inner slope of the crater to the water body. Hence Phosphorous coming through domestic waste or domestic sewage also does not arise.

Nandi mentioned that V. Ball in 1881 had proposed a theory that the hollow or the depression was caused by the subsidence of the roof of a large cavern in calcareous rocks, obviously limestone of the Lameta series which underlies the Deccan Trap[3]. It is to be stated that the alkaline nature of water is only due to carbonates and bicarbonates, which may be possible through leachate from below the basaltic rocks. The rocks below basaltic rocks may be of carbonates type of sedimentary origin because limestone has been found near Purna river beds[21]. Also, it is possible that below the basaltic rocks at Lonar there may be carbonate rocks i.e., of limestone origin as per Ball's theory, otherwise the water being highly alkaline would not be possible. Also, carbonates and bicarbonates have been reported by Nandi and Deo[3].

Calcium and Phosphorus are important nutrients for plants and animals. Hence, the high percentage of Phosphorus cannot be through leaching out from the dry wooded samples. Basaltic rocks do not show such a high percentage of P_2O_5, neither do soil show such a high percentage of P_2O_5. Phosphorous and Calcium are important minerals for plants and animals. But high content of any one of these may be dangerous. Phosphorous basically is a major and vital nutrient for green plants and a simultaneously large amount of P_2O_5 destruct the water body by depletion of oxygen and enhances eutrophication. So that actually Lonar crater water ecosystem is fully eutrophied, dissolved oxygen is found to be nil, the result of this or due to this, the water body has a typical decomposive smell, so it is clear that extra P_2O_5 pollute the water. Plants require Phosphorous and Calcium in limited quantity for growth and development. Excess quantity of these elements may stunt their growth and eventually may die. Hence the requirement of Phosphorous and Calcium by plants is in limited quantity.

The dry stems of trees, twigs and other vegetation standing in the waters, though observed, but could not be taken for any analysis due to a high level of water during these years, these dry stems of trees, twigs were found to be submerged in the waters. It was only in the years 2017 and 2019, that the level of waters of the Lonar Crater has decreased sharply, for which, the surface has been exposed and it has become possible to take the representative samples for analysis and study purpose. Otherwise due to the high level of waters at the crater, taking representative samples was not possible.

Limestone is usually described as rock made from Calcium Carbonate i.e., $CaCO_3$, but most limestone rock also contains a significant amount of Magnesium, Silicates, Manganese, Iron, Titanium, Aluminum, Sodium, Potassium, Sulfur (as Sulphides or Sulphates) and Phosporous[22]. All these elements are found in the wood powdered samples under study, except Na. Phosphorous also moves in a cycle through rocks, water, soil and sediments and organisms[23]. But the phosphorous content is in minor or negligible quantity. Hence the content of P_2O_5 and CaO detected in the powdered wood samples may not be due to Phosphorous cycle. Hence the only source for such a high content of P_2O_5 and CaO can be through phosphate rocks, which are possible through geologic deposits. Its main constituent is Apatite, of calcium phosphate mineral primarily extracted from sedimentary marine deposits, with a small amount obtained from igneous sources[24]. Apatite is the most common phosphate mineral and is the main source of the phosphorous required by plants. The bones and teeth of most animals including humans are composed of calcium phosphate, which is the same material as Apatite[25]. The composition of Apatite as per Apatite Mineral Data is, its Chemical formula is $Ca_5(PO_4)_3(OH, F, Cl)$, Calcium as 39.36% Ca, 55.07 % CaO, Phosphorous as 18.25% as P, 41.82 % P_2O_5[26]. This study value as per table 2 shows Ca - 39.663 mass %, CaO – 55.5 %, P – 15.929 mass % and P_2O_5 - 36.5 % which is more or less in good agreement, which can be stated that the component found in the powdered wood sample and the components of calcium phosphate rocks are similar, which shows that phosphate rock of apatite origin may have been detected in the wood samples found in the soil. It is also known that the history of apatite is that, it is actually the mineral that makes up the teeth and bones of all vertebrate animals[27]. It is possible that the high content of CaO and P_2O_5 can be related to the teeth and bones of vertebrate animals, which may have been buried under the basaltic lava, due to a large scale of volcanic activity some 65 ma on the Indian peninsula. And due to volcanic activity what is found and observed at the crater water body basin is the reflectance of that buried era and which may have been brought up through the opening of the volcanic eruption at the time, the water body came into existence. All the features which are buried below basaltic lava flows are reflected and exposed through a volcanic activity which cannot be ignored. Otherwise, it is not possible for CaO and P_2O_5 to be found and reflect in the wood sample under study for so many years in high percentage. The findings of CaO deposition on rocks and also in the wood samples along with P_2O_5 stands a great witness to the buried era which has been opened through a volcanic eruption. All these components which have been exposed through water body are the reflectance of what lies below the basaltic lava.

Nandi and Deo in their papers have mentioned that the absence of influents and the alkalinity of the lake water would perhaps explain the fact that no fossil was detected in the silts in spite of their great antiquity[3]. The findings of wooded nature samples which seemed to be of wood samples at first and after the analysis by XRF, the oxide and elemental composition of representative samples under study, after comparison with the Apatite mineral shows that the wooded samples are in fact not a wooded samples, but is of fossil nature samples as all the components found in the representative samples under study are similar to components found in Apatite mineral of calcium-phosphate nature, which may possibly be fossilized form of teeth and bones of vertebrate animals. It is possible that due to volcanic activity of 65 ma, the hot lava may have charred the animals and plants existing at that time into ashes, but their teeth and bones may have remained and after many years, their teeth and bones underwent weathering and finally may have turned into fossils which in due course of time, may have turned into phosphate rocks of apatite nature, which may lie below basaltic lava, the findings of fossil samples are evidences of the great event, where the fossils of these animals in the form of calcium phosphate rocks, may have been buried below basalts and by volcanic eruption of unknown nature later on, leached through the openings, or the volcanic eruption may have brought with it all the buried components including CaO and calcium phosphate rock or fossil remains of apatite nature containing CaO and P_2O_5, and may have settled on the soil as sediments which are observed today.

Apatite is the most common phosphate mineral and is the main source of Phosphorous required by plants[25]. Phosphate rock is an excellent natural source of phosphorous, calcium and many essential trace elements[28].

From this it shows that what Nandi and Deo may have been expecting for, must have been found through this study[3], i.e., findings of fossil remains showing high % of CaO and P_2O_5 along with other components in minor quantities, i.e., calcium phosphate rock of apatite nature (fossilized form of teeth and bones of vertebrate animals). Fossil remains have been detected through this study, and then it is possible that more fossil remains may also be detected. Findings of fossil remains suggest that there may be fossilized rocks or fossils below basaltic lava. It is also possible that since the fossil remains have been found buried in the soils, where the water was never found to decrease, the fossil samples were buried for ages unknown, it may not have leached from below the basaltic lava, but was there buried in the soil, may be from the time the crater was formed.

Chakrabarti and Basu mentioned that the Archean component in the breccias cannot be from the incorporation of paleosols that are weathering products of the target basalts or from the inter-trappean sediments that are most commonly cherts and limestones of Mesozoic age[29]. They also mentioned that the basement beneath the Lonar region is believed to be similar to the Dharwar Craton of Peninsula India. Based on their similar Pb-isotopic compositions with the breccia rocks, they suggested that the Archean Chitradurga Group of rocks of this craton be present in the basement beneath the Deccan lavas of the Lonar region[29]. Their study shows that below the basaltic lava flows, there are rocks of Archean origin, which shows that through volcanic eruption, the buried geology may have been exposed, where rocks of $CaCO_3$ (limestones), cherts, fossilized rocks of calcium phosphate remains buried are found on the surface of the crater in the form of deposition on the rocks and fossil remains. Apatite rock is nothing but a sedimentary type of rock, which is naturally occurring in nature. Apatite rock is nothing but a combination of P_2O_5 and CaO. The samples under study contain the same amount of P_2O_5 and CaO as found in apatite, so it can be said that the basement of the crater, it is possible that large quantities of apatite nature of rocks may be found.

If considered that high percentage of CaO and P_2O_5 has come through meteorite then as per Misra et al., average value in impact spherules of melt-rich zone of CaO is 9.12 wt % and magnetite-rich zone is 9.35 wt %, whereas of P_2O_5 in melt-rich zone is 0.06 wt % and in magnetite-rich zone is 0.07 wt %[9]. Studies carried on meteorites by Jadhav and Mali, it is observed that Ca is absent in iron meteorites, But CaO is found to be present in stony meteorite, the value being 2.07%, whereas P is found to be present in iron meteorites in the range between 0.21-1.77% and the oxide i.e., P_2O_5 is found to be 2.88%[30], which is found to be in minor quantities. Also from the studies on Tagish Lake Meteorite by Brown et al., the value of P is found to be 927 ppm and the value of Ca is found to be 0.99 wt %[31], which suggest that the high percentage of CaO and P_2O_5 found in the wood powdered sample cannot come from meteorites.

After the analysis of the representative sample by XRF and the work carried out, it was doubtful whether P_2O_5 in such a high percentage can be found in the wood sample. CaO can be found in a high percentage in vegetation but not Phosphorous. When the burnt wood ash samples from two different places were collected and analyzed by XRF, it then only came to be known that the representative wood sample first analyzed showing a high percentage of P_2O_5 is doubtful or there may be some mistake or error in analyzing the sample. Hence, to come to proper conclusion regarding the nature of wood samples to be of CaO and P_2O_5 really contained CaO and P_2O_5 in high percentage or not, a detail study was conducted by adopting different types of samples like burnt wood ash (2 samples) collected from two different places to find the content and percentage of CaO and P_2O_5 (table 7), where in sample 1, CaO -38.4% & P_2O_5 - 4.85%, and in sample 2 , CaO – 60.9% and P_2O_5 - 4.3% (table 8). In twigs of Neem tree burnt ash CaO – 45.000 % and P_2O_5 - 13.700 % (table 9), In twigs of Tamarind tree burnt ash CaO – 45.200% and P_2O_5 - 16.200% (table 10), in twigs of Tamarind tree burnt ash CaO – 45.200% and P_2O_5 - 16.200% (table 10) and in twigs of Custard Apple CaO – 37.400 % and P_2O_5 - 14.600 % (table 11).

From this analysis, it shows that the wood samples analyzed which showed a high percentage of P_2O_5 and CaO is not a wood sample, but the representative sample of fossil origin (table 2). Fossil nature samples have CaO and P_2O_5 in a high percentage, which has been observed in the first two samples (table 2) and figure 1 & 2. The exercise carried out through this study was to see whether, dry wood samples found in the soil was of wooded nature with high % of CaO and P_2O_5, or the samples under study was of fossil nature origin, which has been proved to be right that the samples found which was at first thought to be of wood sample was not actually a wood sample but was of fossil nature. The buried fossil sample for unknown years must have been below the soil as sediment. As the level of the water of the crater decreased drastically, these fossils were found. Thus the layer of CaO and P_2O_5 cannot come from below the basaltic lava, but it is the fossils which may be buried in the soil and may have been exposed, as the water level receded or decreased to a large extent.

3.1 Conclusion

From the results obtained by XRF analysis, the images of the fossil remains found buried in the soil of Lonar crater water body, shown in the figures and the discussions, it was first thought that after analyses of representative wood samples, where CaO being the highest and P_2O_5 being the second highest, which is closely associated with existence of life and where such a high percentage has never been detected or recorded through studies carried out by different researchers on Lonar Crater. The studies carried out through this work was to search the source and origin of high content of CaO and P_2O_5, detected in the wood samples (which seemed to be of wooded nature at first, but later on a detailed study conducted showed that the wooded samples is not a wooded nature but of fossil origin), under study, whether high content of CaO and P_2O_5, was through basaltic rocks or through the soil or through the waters of crater, but from the analysis of the rock samples through this study and from the analysis of basaltic rocks by different authors, Phosphorous or Phosphorous Pentoxide has been reported but not that found in the study carried out through this work, and Ca and CaO though has been detected but not in high percentage. Also, CaO and P_2O_5 found in the soil are in negligible quantity. In the analysis of water sample, Phosphorous is found to be absent. Hence from all these observations, analysis, studies and discussions, it is stated that the components found containing high % of CaO and P_2O_5 with other components in minor quantities, are the same components that are found in a fossilized rock i.e., Calcium Phosphate rock of apatite nature and hence it is therefore concluded that the findings of wooded nature sample are not a wood sample but a true samples of fossil origin which may represent the fossilized form of teeth and bones of vertebrate animals.

It was not understood how such a high percentage of Phosphorus can be found in the wood samples, hence a detailed study was carried out to know the percentage of phosphorus, therefore analyses of burnt wood ash samples were carried out, then only it came to known that phosphorus contained in the burnt wood ash sample is not as high as that found in the samples under study. Also twigs of Tamarind tree, Custard apple tree and Neem tree was collected, dried and then burnt and the ash form was analyzed by XRF, where P_2O_5 was not as high as that found in the samples under study and hence, to come to proper conclusion detail work was carried out through all these studies and analysis, it is now confirmed that the first samples seemed to be of wooded nature is not of wood but of fossil nature because in fossils percentage of P_2O_5 and CaO is found to be high which agrees well with the calcium phosphate nature of apatite origin which are of fossil nature.

Whatever components are found in calcium phosphate rock of apatite nature, the components of the same nature are also found in the samples under study, which is not of wood origin, but of fossil origin. Hence it can be said or concluded that the components found in the soil of Lonar crater water body, seemed to be of wooded sample is not of wood origin but is of fossil nature.

Reflection of fossil remains detected being of Apatite mineral of calcium phosphate rock shows that the possibility of teeth and bones of those vertebrate animals being charred by the volcanic eruption of 65ma and their teeth and bones remained in the form of fossils and formed phosphate rock of calcium phosphate origin which remained buried below basaltic lava flows.

Since fossil remains showing a high percentage of CaO and P_2O_5 (calcium phosphate of apatite nature) with other components in minor quantities, found in the waters of Lonar crater, is the fossilized rock formation of calcium phosphate of apatite nature, which may be the fossilized form of teeth and bones of vertebrate animals. The findings of fossils at the crater water body were possible when the level of water has almost decreased to a large extent and where fossils are likely to be found.

It is also to be stated here that the whole paper was worked out first on the basis of the results obtained by analysis of the wood sample found to be of wooded nature, which was not the case, and it only came to be known after analyses of burnt wood ash samples that P_2O_5 in wood sample was not found to be high as that detected in the wooded samples, hence a thorough study conducted through analysis of different samples and finally through analysis of different samples did the picture became clear, that the samples under study is in fact not a wood sample but samples of fossil remains, otherwise it was thought that the wood samples found are of wooded nature showing high percentage of CaO and P_2O_5 with other components in minor quantities, which was not the case.

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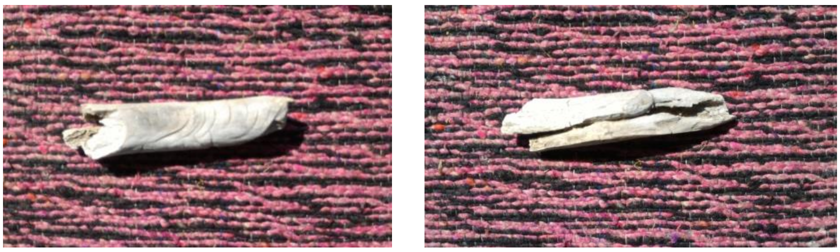
APPENDIX



(a) (b)

Fig. 1: (a) (b) Fossil samples previously thought to be of wooded nature, found at the Crater water body Lonar (Sample Number 1)

(a) (b)

Fig. 2: (a) and (b) Fossil samples previously thought to be of wooded nature, found at the Crater water body, Lonar (Sample Number 2)

Table 1: Physicochemical analysis of a powdered wood sample from Lonar Crater.

S. No.	Parameters	Results	Units	Method
1	pH	8.29		By pH meter
2	Chlorides as Cl	490	mg/kg	Titrimetry
3	Carbonates (CO_3)	621	mg/kg	Titration method
4	Calcium Carbonate ($CaCO_3$), limestone	<1.0	mg/kg	Titrimetry

Table 2: Analysis of a powdered wood sample of Lonar Crater by XRF in %.

S. No.	Element Name	Mass %	Formula	Oxide Content
1	Calcium	39.663	CaO	55.5
2	Phosphorus	15.929	P_2O_5	36.5
3	Silicon	1.571	SiO_2	3.36
4	Magnesium	1.121	MgO	1.86
5	Aluminum	0.683	Al_2O_3	1.29
6	Iron	0.443	Fe_2O_3	0.634
7	Sulfur	0.163	SO_3	0.407
8	Chlorine	0.235	Cl	0.235
9	Titanium	0.099	TiO_2	0.165
10	Strontium	0.022	SrO	0.026
11	Zinc	0.011	ZnO	0.013
12	Copper	0.007	CuO	0.009
13	Cadmuim	0.001	CdO	0.002
14	Oxygen	40.052		
	Total	100		100.001

Table 3: Physical Parameters of Blue Apatite mineral.

S. No.	Sample Name and No.	wt in gms	density g/cc	Dimensions in cm	Shape	Color
1	Apatite (sample no. 1)	20.6213	2.9459	2.1 x 1.5 x 1.4	Irregular	Blue
2	Apatite (sample no. 2)	6.8271	3.4135	2.5 x 1.2 x 0.5	Irregular	Blue
3	Apatite (sample no. 3)	10.5238	3.0068	2.1 x 1.2 x 1.3	Irregular	Blue

Table 4: Elemental and Oxide composition of Apatite (sample No.1)

S. No.	Element Name	Mass %	Formula	Oxide Content
1	Calcium	37.519	CaO	52.5
2	Phosphorus	17.849	P_2O_5	40.9
3	Aluminum	1.371	Al_2O_3	2.59
4	Silicon	0.715	SiO_2	1.53
5	Sulfur	0.437	SO_3	1.09
6	Cerium	0.297	CeO_2	0.365
7	Chlorine	0.36	Cl	0.36
8	Thorium	0.157	ThO_2	0.217
9	Lanthanum	0.13	La_2O_3	0.152
10	Neodymium	0.088	Nd_2O_3	0.103
11	Iron	0.059	Fe_2O_3	0.085
12	Manganese	0.058	MnO	0.075
13	Strontium	0.056	SrO	0.067
14	Zirconium	0.031	ZrO_2	0.042
15	Oxygen	40.873		
	Total	100		100.076

Table 5: Elemental and Oxide composition of Apatite (sample No. 2)

S. No.	Element Name	Mass %	Formula	Oxide Content
1	Calcium	36.661	CaO	51.3
2	Phosphorus	18.984	P_2O_5	43.5
3	Silicon	0.776	SiO_2	1.66
4	Sulfur	0.589	SO_3	1.47
5	Aluminum	0.297	Al_2O_3	0.561
6	Cerium	0.323	CeO_2	0.397
7	Chlorine	0.366	Cl	0.366
8	Thorium	0.179	ThO_2	0.247
9	Lanthanum	0.143	La_2O_3	0.168

10	Neodymium	0.095	Nd_2O_3	0.111
11	Strontium	0.073	SrO	0.086
12	Iron	0.03	Fe_2O_3	0.043
13	Manganese	0.033	MnO	0.043
14	Yttrium	0.025	Y_2O_3	0.031
15	Oxygen	41.426		
	Total	100		99.983

Table 6. Elemental and Oxide composition of Apatite (sample No. 3)

S. No.	Element Name	Mass %	Formula	Oxide Content
1	Calcium	38.448	CaO	53.8
2	Phosphorus	16.802	P_2O_5	38.5
3	Aluminum	1.09	Al_2O_3	2.06
4	Silicon	0.897	SiO_2	1.92
5	Sulfur	0.649	SO_3	1.62
6	Cerium	0.544	CeO_2	0.668
7	Thorium	0.251	ThO_2	0.346
8	Chlorine	0.329	Cl	0.329
9	Lanthanum	0.252	La_2O_3	0.295
10	Neodymium	0.147	Nd_2O_3	0.172
11	Strontium	0.057	SrO	0.067
12	Zirconium	0.042	ZrO_2	0.057
13	Iron	0.038	Fe_2O_3	0.055
14	Yttrium	0.043	Y_2O_3	0.054
15	Manganese	0.039	MnO	0.05
16	Praseodymium	0.033	Pr_6O_{11}	0.04
17	Oxygen	40.339		
	Total	100		100.033

Table 7: Elemental and oxide composition of burnt wood ash (sample Number 1)

S. No.	Element Name	Mass %	Formula	Oxide Content
1	calcium	27.442	CaO	38.4
2	Silicon	8.974	SiO_2	19.2
3	Iron	7.903	Fe_2O_3	11.3
4	Magnesium	5.378	MgO	8.92
5	Aluminum	3.705	Al_2O_3	7
6	Potassium	4.333	K_2O	5.22
7	Phosphorus	2.117	P_2O_5	4.85
8	Titanium	1.312	TiO_2	2.19
9	Sulfur	0.737	SO_3	1.84
10	Chlorine	0.811	Cl	0.811
11	Manganese	0.153	MnO	0.197
12	Chromium	0.025	Cr_2O_3	0.037
13	Zirconium	0.024	ZrO_2	0.032
14	Zinc	0.025	ZnO	0.031
15	Copper	0.023	CuO	0.029
16	Barium	0.024	BaO	0.027
17	Oxygen	37.014		
	Total	100		100.084

Table 8: Elemental and oxide composition of burnt wood ash (sample Number 2)

S. No.	Element Name	Mass %	Formula	Oxide Content
1	calcium	43.522	CaO	60.9
2	Potassium	9.463	K_2O	11.4
3	Magnesium	5.42	MgO	8.99
4	Silicon	3.314	SiO_2	7.09
5	Phosphorus	1.877	P_2O_5	4.3
6	Aluminum	1.413	Al_2O_3	2.67
7	Sulfur	0.793	SO_3	1.98
8	Chlorine	1.22	Cl	1.22
9	Iron	0.571	Fe_2O_3	0.817
10	Titanium	0.146	TiO_2	0.244

11	Strontium	0.152	SrO	0.18
12	Manganese	0.055	MnO	0.071
13	Zirconium	0.023	ZrO_2	0.031
14	Zinc	0.022	ZnO	0.028
15	Copper	0.02	CuO	0.025
16	Barium	0.015	BaO	0.017
17	Nickel	0.005	NiO	0.006
18	Bromine	0.003	Br	0.003
19	Oxygen	31.966		
	Total	100		99.972

Table 9: Oxides composition in burnt wood ash of Neem tree twigs by XRF in %

S. No.	Element Name	Mass %	Formula	Oxide Content
1	Calcium	32.159	CaO	45
2	Potassium	16.602	K_2O	20
3	Phosphorus	5.979	P_2O_5	13.7
4	Silicon	2.473	SiO_2	5.29
5	Magnesium	2.369	MgO	3.93
6	Chlorine	3.84	Cl	3.84
7	Sulfur	1.486	SO_3	3.71
8	Aluminum	1.455	Al_2O_3	2.75
9	Iron	0.944	Fe_2O_3	1.35
10	Titanium	0.091	Tio_2	0.152
11	Strontium	0.074	SrO	0.087
12	Manganese	0.049	MnO	0.064
13	Zinc	0.044	ZnO	0.055
14	Copper	0.02	CuO	0.025
15	Zirconium	0.012	ZrO_2	0.016
16	Barium	0.008	BaO	0.009
17	Oxygen	32.395		
	Total	100		99.978

Table 10: Oxides composition in burnt wood ash of Tamarind tree twigs by XRF in %

S. No.	Element Name	Mass %	Formula	Oxide Content
1	Calcium	32.302	CaO	45.2
2	Potassium	17.93	K_2O	21.6
3	Phosphorus	7.07	P_2O_5	16.2
4	Silicon	2.931	SiO_2	6.27
5	Aluminum	1.731	Al_2O_3	3.27
6	Magnesium	1.351	MgO	2.24
7	Sulfur	0.837	SO_3	2.09
8	Iron	1.014	Fe_2O_3	1.45
9	Chlorine	1.33	Cl	1.33
10	Titanium	0.116	TiO_2	0.194
11	Strontium	0.068	SrO	0.08
12	Zinc	0.048	ZnO	0.06
13	Manganese	0.036	MnO	0.047
14	Copper	0.026	CuO	0.033
15	Zirconium	0.01	ZrO_2	0.013
16	Nickel	0.008	NiO	0.01
17	Barium	0.004	BaO	0.005
18	Oxygen	33.188		
	Total	100		100.092

Table 11: Oxides composition in burnt wood ash of Custard apple tree twigs by XRF in %

S. No.	Element Name	Mass %	Formula	Oxide Content
1	Calcium	26.728	CaO	37.4
2	Potassium	26.895	K_2O	32.4
3	Phosphorus	6.372	P_2O_5	14.6
4	Chlorine	4.52	Cl	4.52
5	Sulfur	1.306	SO_3	3.26

6	Silicon	1.323	SiO_2	2.83
7	Aluminum	1.196	Al_2O_3	2.26
8	Magnesium	1.079	MgO	1.79
9	Iron	0.489	Fe_2O_3	0.699
10	Zinc	0.056	ZnO	0.069
11	Titanium	0.041	TiO_2	0.069
12	Strontium	0.047	SrO	0.056
13	Manganese	0.029	MnO	0.037
14	Copper	0.023	CuO	0.029
15	Oxygen	29.896		
	Total	100		100.019

