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Meteor impact event from Rāmāyaṇa

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Abstract

A meteor impact event is mentioned in Sarga 23 & 24 of Rāmāyaṇa, aranyakāṇḍa. Literature suggests that the cosmic event was observed & experienced from the banks of Godāvarī river, from the location of Janasthāna, a place close to Panchavati (Nasik) in Deccan plateau of India. Various phenomena like meteor falling from the sky, shaking of the earth, formation of dark dust clouds and fear of damage to life, suggest that past civilizations had experienced a severe bolide impact event in the Deccan plateau and this was important enough to find place in the ancient literature. The region is known for a recent impact crater of Lonar which has been dated to have been formed 50k year ago.

Keyword: Lonar, blood rain, Rāmāyaṇa, Aranyakāṇḍa, Crater

Introduction

Catastrophic events like volcanic eruptions, Earthquakes, Tsunami, floods or bolide impacts have long lasting effects on civilizations and leave their imprints in the form of beliefs, traditions, literature, art forms and folk lore's. Recovering such information from these records is a difficult task. Here we try to make an attempt, to correlate the description given in Rāmāyaṇa^[1] about a meteor event in the Godāvarī basin in Deccan Plato, and try to relate it to the famous Lonar crater. Every civilization has come across the meteor events, and since the beginning it is a subject of curiosity. These celestial events occur at a regular intervals and can be a simple experience like streak of light in the night sky, or a fireball along with whistling sound or shock wave followed by some pieces of meteorites fallen on the ground. However, hypervelocity impact is a rare event. Modern science accepts less than 200 sites as impact sites, out of these accepted sites most of them are very old dating back to millions of years. In India, Lonar is one such site and has age of less than 1 Mn year which is considered as a very recent in geological terms.

Background

Rāmāyaṇa is one of the major Sanskrit literature of ancient India and the largest epic literature in the world. Traditionally it is ascribed to Maharshi Valmiki with many versions of Rāmāyaṇa in various Indian languages apart from its Buddhist, Jain, Sikh and South East Asian versions. Literature narrates the life of Rama in 7 kāṇḍas (books). Each kāṇḍa deals with major events in the life of Rāma and certain narratives of the past events. Rāmāyaṇa gives a detailed account of various geographical locations from the Indian subcontinent, some of these locations can easily be identified even today. Many of these places have preserved and are still recognized with their ancient names. Apart from geographical locations, story also gives a detailed account of rivers, flora & fauna of each region. Certain events described in the literature strongly indicate towards certain geological and astronomical events experienced during that period. Book of Aranyakāṇḍa discuss about fourteen- year exile phase of Rāma and his travels across forests in the Indian subcontinent with his wife Sītā and brother lakṣmaṇā. Book of Aranyakāṇḍa has certain śloka which explicitly talks about meteor impact and it's after effects just before an important event of war between Rāma and demon army lade by Khara and dūṣaṇa. This war took place near the banks of Godāvarī at a place called "Janasthāna". Just before this war a meteor event was observed by both the sides.

The phenomenon's described in the śloka are very close to the actual effects experienced during the hypervelocity impact event.

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Hence a detailed analysis is needed to understand, how such an ancient literature talks about events that modern science has started focusing in the last few hundred years.

Discussion:

Lonar Crater (image 1) has a diameter of 1.8Km and depth of 150m and is the only known hypervelocity impact crater in Deccan Traps. It is estimated that the meteorite came from the east, at an angle of 30- 45 degrees. Based on various dating methods like argon-argon, thermoluminescence and C-14 its age is expected between 15K-0.65MA years as discussed by Sengupta (1997) *et al.* [2], Koebrel (2004) *et al.* [3] Koebrel (2010) [4]. It has been estimated that the bolide was about 100 meter in radius. Energy released during the impact is

estimated at 6-megaton atom bomb explosion which is equivalent to around 400 Hiroshima nuclear bombs or nuclear tests like Castle Bravo conducted at Bikini Atoll that resulted in crater of 2000 m diameter & 76 m deep. Castle Bravo fire ball was visible from Kwajalein Atoll which is 400 Km away from the testing site. Considering the magnitude of the Lonar event, the after effects like mushroom cloud, shock wave and seismic shaking would have been experienced over a large area. There is a possibility that this event was experienced by ancient human settlements in the radius of at least 300km (image2) and it became a part of belief system. Lonar Lake is surrounded by many ancient temples (image 3) and there are temples at the base of the crater too, which suggest its religious importance.

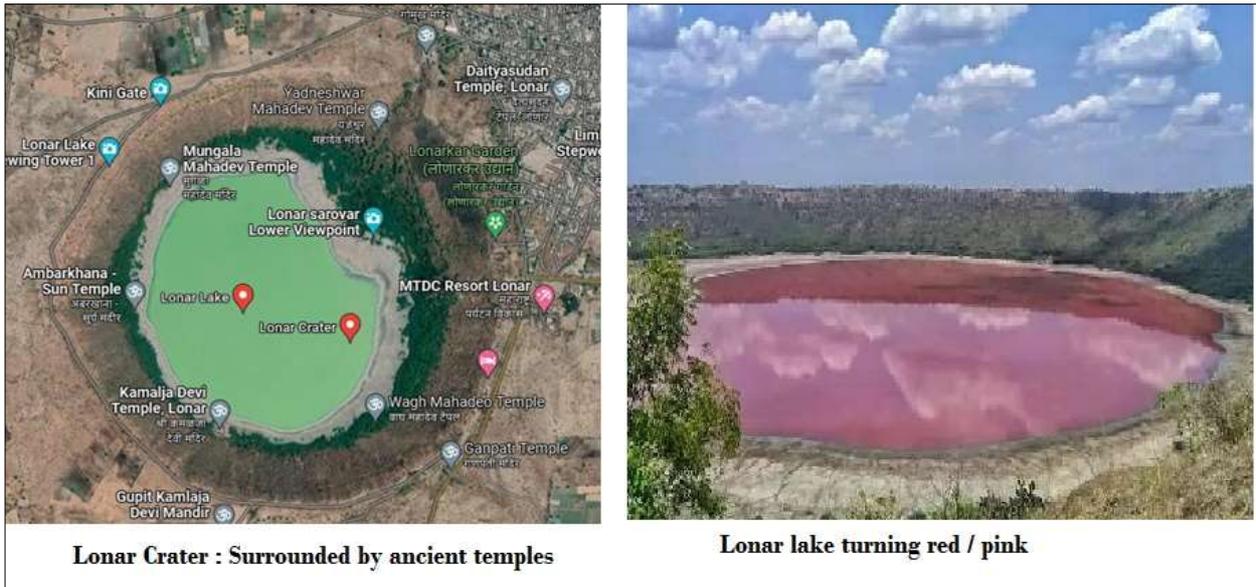


Image 1: Lonar crater satellite image from Google



Image 2: Lonar Crater and locations within 300 Km radius which will experience the impact.



Image 3: Daityasudan temple Lonar dedicated to human incarnation of Lord Vishnu

Image: Lonar lake

It won't be surprising if this event was captured in the ancient literature along with various descriptions trying to communicate phenomenon like burning meteors, plumes, mushroom clouds (image 4), trembling of earth, shock waves and thermal waves. Vālmiki Rāmāyaṇa, Aranyakāṇḍa (śloka from Sarga 23 & 24) is one such ancient text that explicitly mentions a bolide event near Godāvarī and various effects felt during the impact. These śloka also describe the reaction of humans and animals to the event. Certain śloka clearly talk about catastrophic nature of the event and possibility of mass mortality. These śloka can be broadly classified in to three categories A) Descriptions of impact events & after effects B) Reaction of Humans & Animals C) Unknown phenomenon and consequences

A) Descriptions of impact event & after effects (Śloka in Sanskrit, roman transliteration and English translation)

We quote a few relevant śloka bellow (Aranyakāṇḍa, Sarga 23 śloka 3, 7, 8, 11, 12, 13, 14, 15). These śloka talk about the various observations related to meteor and post impact effects like mushroom clouds, blast wave, thermal wave and seismic shaking.

A 1 Śloka on Meteor Description

In Sanskrit meteor is known with multiple names like Ulkaah, marut or ketu. When meteor enters the Earth's atmosphere it start burning due to compression of air causing the heat and glow. Here we present description from literature

श्यामं रुधिरपर्यन्तं बभूव परिवेषणम्
अलातचक्रप्रतिमं परिगृह्य दिवाकरम्॥3.23.3॥

śyāmaṃ rudhiraparyantaṃ babhūva pariveṣaṇam.
alātacakrapratimaṃ parigṛhya divākaram॥3.23.3॥

A dark ring, blood red in colour appeared on the border of the Sun's orb, dark in the middle. This phenomenon of the Sun appeared like a ring of moving charcoal covering the Sun. (This indicate a burning meteor approaching from the sunny side)

कबन्धः परिघाभासो दृश्यते भास्करान्तिके॥ 3.23.11॥

जग्राह सूर्यं स्वर्भानुरपर्वणि महाग्रहः॥

प्रवाति मारुतश्शीघ्रं निष्प्रभोऽभूद्विवाकरः॥ 3.23.12॥

kabandhaḥ pariḡhābhāso dṛśyate bhāskarāntike ॥3.23.11॥

jagrāha sūryaṃ svarbhānuraparvaṇi mahāgrahaḥ.

pravāti mārutaśśīghraṃ niṣprabho'bhūddivākaraḥ॥
3.23.12॥

The planet Ketu (comets are called dhūmaketu) appeared like an iron beam near the Sun. Although it was not the full moon or moonless day, Rahu eclipsed the Sun. Marut (Marut also refers to meteors) blew hard and the Sun was lusterless. (The lusterless sun suggest a brightness of the meteor during the burning process.)

Śloka 3.23.12 refers to Kabandha near sun and rapidly moving marut. According to Bṛhatsaṃhitā written by Varāhamihira, Kabandha refers to luminous bodies such as comets and meteors. Traditionally word marut is used for vedic deities associated with "winds, thunderstorm and rains" but in many references word Marut is associated with shower of meteorites, a study by R.N.Iyengar^[5] on Meteoritic shower in Rigveda provides a detailed explanation. Hence it appears that a bright and rapidly moving meteor (image 4) was observed.



Image 4: Artistic impression 3a) Meteor Approaching from Sunny Side 3b) post impact mushroom cloud Credit: Arya Patil

A 2 Śloka on Mushroom Cloud / Ejecta

Mushroom clouds are reported in the events like Nuclear weapons, powerful blast of conventional weapons, volcanic eruptions or impact events. It is formed by result from the sudden formation of a large volume of lower-density gases at any altitude. The stem of the cloud is gray to brown in a ground burst, as large amounts of dust, dirt, soil, and debris are sucked into the mushroom cloud. This cloud form very rapidly, in the nuclear test of castle Bravo mushroom cloud was 47000ft (14 km) in height and reached height of 130000 ft (40 km) with diameter of 100 km in less than 10 mins. If we look at the shlokas in Ramayana then they talk about meteor event along with brown and grey clouds appearing like falling mountain (term mushroom cloud was introduced post nuclear era) these clouds were moving rapidly causing fear

प्रभिन्नगिरिसङ्काशास्तोयशोणितधारिणः।
आकाशं तदनाकाशं चक्रुर्भूमा वलाहकाः॥3.23.7॥
prabhinnagirisaṅkāśāstoyaśoṇitadhāriṇaḥ।
ākāśaṃ tadanākāśaṃ cakrurbhūmā valāhakāḥ॥ 3-23-7॥

The clouds looked like shattered mountains pouring down bloodlike rain which filled the sky and made it appear frighteningly different.

बभूव तिमिरं घोरमुद्धतं रोमहर्षणम्।
दिशो वा विदिशो वापि न च व्यक्तं चकाशिरे॥3.23.8॥
babhuuva timiram ghoram uddhatam roma harSaNam |
disho vaa pradisho vaa api suvyak{ }tam na cakaashire || 3-23-8॥

A terrific darkness, spread all over, produced frightening horripilation. Even the four directions (*disha*) and the intermediate zones were not discernible.

उद्धूतश्च विना वातं रेणुर्जलधरारुणः॥3.23.14॥
वीचीकूचीति वाश्यन्त्यो बभूवुस्तत्र शारिकाः।
uddhuutaH ca vinaa vaatam reNuH jaladhara aruNaH || 3-23-14॥
ciicii kuuci iti vaashyanto babhuuvuH tatra saarikaH |

Although there was no wind, dust rose like a brown cloud (This dust may be the result of post impact effect of the ejecta mushroom cloud image 3b). and the sarika birds sang (vichikuchi) thoughtlessly.

अमी रुधिरधारास्तु विसृजन्तः खरस्वनाः।
व्योम्नि मेघा विवर्तन्ते परुषा गर्दभारुणाः॥3.24.4॥
amī rudhira dhārāḥ tu visṛjanta khara svanaḥ |
vyomni meghā nivartante paruṣā gardabha aruṇāḥ || 3-24-4

These rumbling clouds, brownishred having the colour grey of a donkey, are moving about in the sky showering streams of blood.

A 3 Shock Wave & Heat Wave

śloka 3.23.8 & 13 talks about phenomenon similar to shock/thermal wave experienced post impact in the peripheral region. The Impact of such magnitude will cause shock wave and thermal wave that can cause flash blindness for several minutes and burn the things in the near vicinity, it is estimated that in case of 1MT explosion such effects can be felt up to 20Km so in the event of 6MT explosion this effects will be felt over a much larger area causing drying up of lotus tanks and people may report temporary blindness. The shock waves can easily knock of trees, flowers and fruits as mentioned in the śloka “the trees stood bereft of flowers and fruits”. In Tunguska event we have recorded area of 2000sq.km. flattened by such wave.

उत्पेतुश्च विना रात्रिं ताराः खद्योतसप्रभाः।
संलीनमीनविहगा नलिन्यशशुष्कपङ्कजाः॥3.23.13॥
तस्मिन् क्षणे बभूवुश्च विना पुष्पफलैर्द्रुमाः।
utpetuśca vinā rātriṃ tārāḥ khadyotasaprabhāḥ।
saṃlīnamīnavihagā nalinyaśśuṣkapaṅkajāḥ ||3.23.13॥
tasmin kṣaṇe babhūvuśca vinā puṣpahalairdrumāḥ।

The stars rose in the sky and glittered like fireflies (may be falling fragments) even before night arrived. The fishes and the aquatic birds in the lotus ponds hid themselves under water. Lotuses dried up in tanks and the trees stood bereft of flowers and fruits. (in 1908 Tunguska meteor event, large number of trees were flattened)

A4) seismic shaking

Post Tunguska explosion, the resulting shock wave was equivalent to an earthquake measuring 5.0 on the Richter magnitude scale. The literature talks about shaking of Earth which is not unusual in the event like Lonar

उल्काश्चापि सनिर्घाता निपेतुर्घोरदर्शनाः॥3.23.15॥
 प्रचचाल मही सर्वा सशैलवनकानना।
 ulkaaH ca api sa nirghoSaa nipetuH ghora darshanaaH ||
 3-23-15||
 pracacaala mahii ca api sa shaila vana kaananaa |

Dreadful to watch were the thunder storms and the meteors that dropped down from the sky. The earth trembled all over with mountains, groves and forests.

B) Reaction of Humans & Animals

These Śloka are focused on reaction of birds and animals who were terrified with the events and were producing cacophony which is an abnormal reaction. In certain śloka central character of the story highlights the risk of mass mortality and necessity to take shelter in mountain caves.

जनस्थानसमीपे तु समागम्य खरस्वनाः।
 विस्वरान्विविधांश्चक्रुर्मासादा मृगपक्षिणः॥3.23.5॥
 janasthaana samiipe ca samaakramya khara svanaaH |
 visvaraana vividhaana ca cakruH maa.msa aadaa mR^iga
 pakSiNaH || 3-23-5||
 Flesh eating beasts and birds flocked at Janasthāna producing a cacophony.
 व्याजहुश्च प्रदीप्तायां दिशि वै भैरवस्वनाम्।
 अशिवं यातुधानानां शिवा घोरा महास्वनाः॥3.23.6॥
 vyaajahruH ca padiiptaayaam dishi vai bhairava svanam |
 ashivaa yaatudhaanaanaam shivaa ghoraa mahaasvanaaH
 || 3-23-6||

The dreadful jackals making ghastly howls turning towards the illuminated direction and produced frightening sounds indicating inauspicious time for the demons.

तानुत्पातान्महोघोरानुत्थितान्मोहर्षणान्।
 प्रजानामहितान्दृष्ट्वा रामो लक्ष्मणमब्रवीत्॥3.24.2॥
 taan utpaataan mahaaghoraana raamo dR^iSTvaa ati
 amarSaNa |
 prajaanaam ahitaana dR^iSTvaa vaakyam lakSmaNam
 abraviit || 3-24-2||
 When Rāma saw the most dreadful, horrifying phenomena foreboding calamity, he said to lakṣmaṇā
 इमान्पश्य महाबाहो सर्वभूतापहारिणः।
 समुत्थितान्महोत्पातान्संहर्तुं सर्वराक्षसान्॥3.24.3॥
 imaan pashya mahaabaaho sarva bhuuta apahaariNaH |
 samutthitaan mahaa utpaataan sa.mhartum sarva
 raakSasaan || 3-24-3||
 O long armed lakṣmaṇā! see these calamitous phenomena that forebode destruction of men and demons.
 यादृशा इह कूजन्ति पक्षिणः वनचारिणः।
 अग्रतो नो भयं प्राप्तं संशयो जीवितस्य च॥3.24.6॥
 yaadR^ishaa iha kuujanti pakSiNo vana caariNaH |
 agrato naH bhayam praaptam sa.mshayo jiivitasya ca || 3-
 24-6||
 The way the forest birds are screeching makes me foresee danger and makes survival doubtful.
 सम्प्रहारस्तु सुमहान्भविष्यति न संशयः।
 अयमाख्याति मे बाहुस्फुरमाणो मुहुर्मुहुः॥3.24.7॥
 sannikarṣe tu n shśur jay śatro: paraajayam |
 saprabham ca prasanna ca tava vak.htram hi lakSyate ||
 3-24-8||

sa.mprahaaraH tu sumahaan bhaviSyati na sa.mshayaH |
 ayam aakhyaati me baahuH sphuRāmaaNo muhur
 muhuH || 3-24-7||
 sa.nnikarSe tu naH shuura jayam shatroH paraajayam |
 suprabham ca prasanna ca tava vak.htram hi lakSyate ||
 3-24-8||

A severe damage to life of men is going occur. There is no doubt about it. O brave lakṣmaṇā! my right shoulder trembles again and again, indicating the defeat of the enemy. Your beaming visage presages victory.

तस्माद्गृहीत्वा वैदेहीं शरपाणिर्धनुर्धरः।
 गुहामाश्रय शैलस्य दुर्गा पादपसङ्कुलाम्॥3.24.12॥
 tasmaat gR^ihitvaa vaidehiim shara paaNiH dhanur
 dharaH |
 guhaam aashraya shailasya durgaam paadapa sa.mkulaam
 || 3-24-12||

Therefore, take shelter along with Sītā in an inaccessible mountain cave, overgrown with trees, ready with your bow and arrows.

C) Unknown phenomenon

Two śloka mention a phenomenon of red colour or blood like rain which is usually not associated with meteorite fall but needs further investigation.

तस्मिन्याते बले घोरमशिवं शोणितोदकम्।
 अभ्यवर्षन्महामेघस्तुमुलो गर्दभारुणः॥3.23.1॥
 tat prayaatam balam ghoram ashivam shoNita udakam |
 abhyavarSat mahaa meghaH tumulo gardabha aruNaH ||
 3-23-1||

As the army marched from there (Janasthāna), a huge dark cloud of the donkey colour (ash-grey) rained dreadful Inauspicious water, red as blood.

अमी रुधिरधारास्तु विसृजन्तः खरस्वनाः।
 व्योम्नि मेघा विवर्तन्ते परुषा गर्दभारुणाः॥3.24.4॥
 amii rudhira dhaaraaH tu visR^ija.nto khara svanaaH |
 vyomni meghaa nivartante paruSaa gardabha aruNaH ||
 3-24-4||

These rumbling clouds, brownish red having the colour grey of a donkey, are moving about in the sky showering streams of blood.

B) Location Described In Rāmāyaṇa

While describing the meteor event, the literature has described the region of Godāvarī. Janasthāna is one such place on the banks of Godāvarī which is known for a few important events like conflicts between Rāma & Demon army, abduction of sītā and meteor impact event observed before the battle. However, today we don't have the exact location of Janasthāna except the reference that it is on the banks of the River Godāvarī. During the exile, Rāma reached on the banks of Godāvarī near Panchavati (Nasik). It is believed that during this period of exile there are two prominent locations in the region which Rāma had visited. First is Rakshasbhuvan, where Rāma installed idol of Lord śani and even today there is an ancient temple on the banks of Godāvarī which is considered as an important temple. This temple is also referred to in an ancient literature of

mahābhārata & recent history of famous king Shivaji. Second place in the region is Jalana, locals believe that sītā has resided in this place for some time. The original name of Jalana is believed to be Janakpur. Thus Janasthāna should be a place on the banks of Godāvarī between Nasik, Rakshasbhuvan & Jalna (image 2). If this place is more towards Jalna & Rakshasbhuvan, then both the locations are within 100km radius of impact and will experience the effects of impact. Most of the region of Godāvarī is within 300Km radius of Impact. Literature clearly mentions some of the effects like meteor observed in the sky, shaking of earth, dark brown, grey clouds (colour of Donkey) & rising of dust cloud, but it does not mention the impact which suggest that this was observed and experienced from a distance. This region is part of Deccan plateau which is known for recent impact crater of Lonar.

E) Direction & Angle of Impact & Literature reference

Current scientific research suggests that Lonar bolide came from East at an oblique angle of 30-45 degree to horizontal Misra (2006) [6]. Ancient literature has certain interesting notations on the same line. śloka 3.23.3 & 3.23.1 if read in correlations can help us to understand the direction and possible angle.

तस्मिन्याते बले घोरमशिवं शोणितोदकम्
अभ्यवर्षन्महामेघस्तुमुलो गर्दभारुणः॥3.23.1॥
tat prayaatam balam ghoram ashivam shoNita udakam |
abhyavarSat mahaa megahaH tumulo gardabha aruNaH ||
3-23-1||

As the army marched from there (Janasthāna), a huge dark cloud of the donkey colour (ash-grey?) rained dreadful Inauspicious water, red as blood.

श्यामं रुधिरपर्यन्तं बभूव परिवेषणम्
अलातचक्रप्रतिमं परिगृह्य दिवाकाम्॥3.23.3॥
shyaamam rudhira paryantam babhuva pariveSaNam |
alaata cakra pratimam pratigR^ihya divaakaram || 3-23-
3||

A dark ring, blood red in colour appeared on the border of the Sun's orb, dark in the middle. This phenomenon of the Sun appeared like a ring of moving charcoal covering the Sun. (This indicate a burning meteor approaching from the sunny side)

As the śloka 3.23.3 read, "Ring of moving charcoal covered the Sun and a dark ring, blood red in colour appeared on the border of the Sun's orb, dark in the middle." Indicating that, meteor was coming from the Sunny side and was covering the Sun. This was observed when Army was marching towards the battlefield (3.23.1). As per ancient Literatures of Rāmāyaṇa, mahābhārata and other texts, battles were fought only during the day times and Sun set was marked to hold the battle till the next day morning. Hence, army marching towards the battle ground, suggest this phenomenon was observed during the morning hours. Hinting that meteor was approaching from east covering the Sun and angle of approach will be less than 45 degrees.

F) Red / Blood like Rain, And Meteor Activity

Some of the śloka from the literature indicate a dark cloud that rained a red colour water (red as blood), this is a little strange symptom, since so far there is no proven scientific

data that can correlate such phenomenon with meteor or comet activity. However this is not the only case where such activity is reported. As per Mc Cafferty P. (2008) [7], there are at least 80 historical accounts of the red rain that occurred through the centuries in different parts of the world. Out of this 23 were linked with meteor or comet activity. In some cases this occurred immediately after the airburst and in some cases this was reported within the same period/ year of activity e.g. AD 107, when Comet was observed for 4 months and in the same year it rained blood (red colour water) in France. 30BCE, Egypt has an example similar to Rāmāyaṇa meteor event, where flash was seen in the sky and blood along with water poured from the sky, witnesses also reported hissing sound produced by huge serpent (may be trail of fireball) and sound of trumpet. Similar hissing sound was heard In case of Dhajala meteorite Bhandari (1976) [8], which fell in Surendranagar district of Gujarat and detonations sounds were heard in much larger area. Even in the past 200 years we have observed red rain phenomenon in various parts of the globe including India, and every time many explanations & possibilities including meteor/comet activity emerged but we don't have an exact answer for this phenomenon, hence neither this can be accepted or rejected as feature related with meteor activity. Co incidentally in the recent past Lonar lake turned pink (Image 2), though there is no recent meteor activity in the region there is no harm in verifying the correlation of this phenomenon with its formation by meteor impact event.

G) Age Paradox

Age of Lonar crater range from 15k Years to 0.65MA±0.81ka which is a very wide range and questions may be raised on the ability of humans to record such event. This needs to be factored in before arriving at any conclusion. However, even age of Rāmāyaṇa is a topic of discussion. On one hand modern scholars estimate Rāmāyaṇa is 7500 to 14500 year old the original belief is that Rāmāyaṇa is from tretāyuga. Hence for the purpose of this paper we have kept aside the age paradox and focused on the literature and its possible correlation with the Lonar crater.

Conclusion

Based on certain śloka from Rāmāyaṇa, it seems that people staying on the banks of Godāvarī, have experienced an impact event. Based on the various descriptions, it appears that people experienced a life threatening catastrophic situation during the impact event. Certain descriptions of clouds suggest that a mushroom cloud was formed which covered the region and might have created darkness followed by rain. Though red rain is not a confirmed phenomenon associated with impact events, its possibility can't be ignored considering various historic accounts. Hence it is quite likely that the event described in the literature is associated either with the Lonar impact event or similar event in the recent history. However, age paradox is a major question and requires a detailed study to ascertain the co- relation and decide on the period of event as well as literature.

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