

Potential Geoheritage & Geotourism Sites in India

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Abstract- India is endowed with unique geological and geomorphological processes. However, the positive trend of development has negatively impacted the geological wealth of our country. The aim of this paper is to convey to the reader in brief about the idea of Potential Geoheritage sites in our country present in almost every state. This comes in sync with tourism of such sites which is still hardly visible. The awareness that needs to be spread amongst the people as well as the government to recognize these sites in a better manner in itself is the 'marketing' of these sites. Today, India compares itself with the world on development front but at the same time it also needs to compare itself on the promotion of Geoheritage sites and the correct showcasing of these sites which many countries in the world have gotten right, so these sites which already have the potential to be converted to 'Geoparks', can actually be converted to such parks and mark themselves on the UNESCO Geohritage Sites Map too. Why collectively we need to understand the impact that we have on such geological sites or any other important sites for that matter, be it heritage, archaeological, natural, man-made, etc., is really important. Hence, while reading this paper one must also imagine how ill-treated such places in our country can get and how we as citizens of this nation can contribute to the restoration of these sites.

Index Terms- Geoheritage, Geoparks, Geotourism, Geodiversity, National Geological Monuments (NGMs)

I. INTRODUCTION

Geology, a word that can be broken into two main parts, Geo- means Earth and Logy- means the study of it. In application the subject deals in understanding as to why/when/where/how, living beings have evolved over time and how the planet has changed its structure over time. Thus, geology deals with all the life changes that have shaped our today over billions of years of this planet.

Geology is often categorised into Physical geology and Historical Geology. Physical Geology is the branch of science that studies the physical features of Earth, such as volcanoes, mountains, earthquakes, rocks and oceans. Historical Geology is the branch of science that studies the historical events such as formation of the Earth, major changes throughout time, and also how all these changes are going to impact the future of the planet. One thing that geology has given us very fondly today is Geodiversity. Geodiversity imperatively comprises of the geological and the physical essentials and elements of nature, which include everything from minerals, soils, rocks, landforms

to even fossils. It also comprises of the various geological and geomorphological processes of Earth.

Geomorphology is another branch of science that studies the nature and the origin of the landforms, in particular the formative processes of erosion and weathering that occur in the atmosphere and the hydrosphere. Geoparks are singular, unified geographical area (also referred to as sites), where landscapes of international significance are managed.

These sites are managed with a holistic viewpoint. Protection, education and sustainable development are the important parameters that these sites are constantly evaluated upon and worked on. Little help is required from the local communities to maintain these sites through a bottom-up approach.

The concept of Geoparks was first introduced by UNESCO in 2001 and it has rallied since. In 2015, a new label of UNESCO Global Geopark was ratified by its 195 member nations. At present there are 140 Global Geoparks spread across 38 countries, but India still hasn't managed to get any of its sites on the list.

As part of the bottom-up approach followed by UNESCO for development of Geoparks, the local communities are given the opportunity to develop a cohesive partnership to promote the features of a particular site. A long term support system in form of public as well as private support from the local communities is established and these communities meet regularly to showcase and protect the heritage of a Geological site.

II. GEOHERITAGE AND GEOTOURISM

According to Springer, Geoheritage can be defined as, "a generic but descriptive term applied to sites or areas of geological features with significant scientific, educational, cultural or aesthetic value. Scientifically and educationally speaking these Geoheritage sites have significant features resembling to textbooks such as landscapes, rocks, mineral types, etc., and culturally speaking these sites have played a role in history and culture creation. These sites are also packed with aesthetic appeal to promote local and regional tourism". Geoheritage sites become critical in advancing the knowledge about natural phenomenon like hazards, soil processes, climatic changes, groundwater supply fluctuations, mineral and energy supply levels, environmental changes, evolution of life, and other such aspects that are concerned with the history and nature of Earth. Hence, these sites have high potential for outside classroom visits, economic support to communities, recreational use and enhancing the knowledge available in the public domain.

National geographic defines Geotourism as, “tourism that sustains or enhances the distinctive geographical character of a place- its environment, heritage, aesthetics, culture and the well-being of its residents”.

The Indian Subcontinent is endowed with cultural heritage, a rich historical milieu and prominent physical attributes, which this project intends to cover.

The Geological Survey of India (GSI), founded in the year 1851 is a Government of India Ministry of Mines organization and was formed for collecting information in the field of Earth science and other fields of survey. In India, GSI has taken the responsibility of protection and promotion of the physical attributes of India and has declared 26 such sites in different parts of India as “National Geological Monuments (NGMs)”. This is where the purpose of this research took birth; to study the different NGMs The Geological Survey of India (GSI), founded in the year 1851 is a Government of India Ministry of Mines organization and was formed for collecting information in the field of Earth science and other fields of survey. In India, GSI has taken the responsibility of protection and promotion of the physical attributes of India and has declared 26 such sites in different parts of India as “National Geological Monuments (NGMs)”. This is where the purpose of this research took birth; to study the different NGMs and potential sites in India, relatable features of all these sites and draw areas of comparison with the UNESCO Global Geoparks which are currently recognized internationally. Exploring the answers to the questions such as, why hasn't UNESCO still stepped in India, and why is it that people aren't really aware of these NGMs that India so fondly possesses was the key thought driver behind this paper.

III. POTENTIAL GEOHERITAGE SITES IN INDIA (BRIEFLY)

1.1 *Belum Caves, Kurnool District, Andhra Pradesh*

Belum caves in the Kurnool district of Andhra Pradesh are the longest and the largest set of cave systems that are open to public visit in the Indian Subcontinent. These caves are particularly known for their speleothems. Speleothems are cave formations and as pointed earlier are secondary mineral deposits that form stalagmites and stalactites. This natural cave system was formed over tens of thousands of years due to a constant flow of underground water. These caves have galleries, caverns with fresh water, siphons and very long passages. The cave system has an overall length of 3300 meters and are called Belum Guhalu in the local language which is Telugu. The deepest point in the cave system is known as Pataalaganga, which is 46 meters in depth when compared to the entrance point level.

The caves received scientific attention since the year 1884 and very studied in detail even in the 1980s. In 1988 the state government of Andhra Pradesh declared the geological site as protected. And in 2002, Andhra Pradesh Tourism Development Corporation (APTDC) developed these sites fully for tourism purposes. Out of the grand total of 3.5 KM of cave length, 1.5 KM is open for tourist entry and the rest isn't at the moment.

1.2 *Floating Rock, Meghalaya*

Must see nature's wonder, in the outskirts of the village of Mawlynnong, lies a balancing rock. The balancing rock is in a

spot surrounded by small fences and in the fences lies a small rock on top of which a very large boulder is perfectly balanced. These rocks have sustained through time and ages somehow. No amount of weathering, storm or cyclones have been able to come an inch closer to unbalancing them. The place is very quiet usually and surrounded by bamboo trees.

The locals believe this was a spot where thousands of years ago lots of human sacrifices were made. And later this was a spot for the ancient shrine of the Kharsi tribal people.

1.3 *Gandikota, Andhra Pradesh*

Gandikota is a village in Kadapa district of Andhra Pradesh. In telugu, the word 'gandi' means gorge and hence the place has received its name. the village lies on the right bank of the river Pennar.

The Cuddapah Basin of Peninsular India contains places like Chittoor, Anantapur, Kurnool, Cuddapah, Nalgoda, Krishna, Mahaboobnagar and Guntur districts along belonging to the Proterozoic period.

1.4 *Gongoni, Grand Canyon of West Bengal*

In the most unusual part of India lies a resemblance of the Grand Canyon of Arizona in the United States. West Bengal boasts the presence of a beautiful gorge which is a miniature version of the Grand Canyon of US. Located in the town of Garbeta on the banks of river Silabati is a handiwork of nature. This gorge of red soil has resulted too from the weathering forces of nature such as wind and water. Why the most unusual part of the country for the situation of a Canyon is because Bengal hosts plains and development of such a gorge in plains is very unusual and rare. The canyon remained partly accessible for a long time until few years back the government of West Bengal decided to add stairs to the canyon so that everyone could easily walk down into the canyon.

To add to this, a folklore also surrounds this place, that during the exile of Pandavas the Pandava prince Bheema from the epic of Mahabharata slayed the demon Bakasura who lived in this Canyon.

1.5 *Kolodyne Castle, Mizoram*

In the western region of Saiha, lying in the Southern part of Mizoram is a marvellous and mesmerising rock formation that resemble a castle. This geological marvel is known for its craftsmanship, and the craftsman is none other than nature itself. Lying there for years in the pristine river of Kolodyne (also known as Koladyne) is this magnificent potential geological site. The Kolodyne Castle also known as the 'Castle of Beino' is a sprawling alley of white, grey, silvery rocks that range 8 to 10 meters in height. The locals of the village believe that it is a cursed castle and there are a lot of folklores about the castle, some say that the river queen of spirits lives in this place and acts as an ombudsman (a person charged with the responsibility of representing the interests for the public).

The area is not very well accessible during the monsoons but summers are the best time to visit this geological marvel, when the waters of the river and low and the rock formations can be clearly seen.

1.6 Mahabaleshwar Hill Range, Mahabaleshwar, Maharashtra

Located in the Satara district of Maharashtra in India is a beautiful hill station which lies in the Sahyadri mountain range. This hill station is Mahabaleshwar with a view of the evergreen forests which one during the British raj served as the summer capital of Bombay Province. It is at an elevation of 1400 meters and is 285 kilometers from Mumbai. It is the source of Krishna river which flows through Maharashtra, Andhra Pradesh, Telangana and Karnataka.

The entire hill range of Mahabaleshwar is geographically important because they belong to the volcanic region of Deccan Traps in India. The Deccan traps are amongst the largest volcanic features on Earth. The word 'trap' refers to step like hill formations.

It is known through scientific dating of the Deccan region that they began formation 66 million years ago when the Cretaceous period had ended. These were formed due to a bulk of lava eruptions or volcanic eruptions. This bulk of lava is called as flood basalt and is responsible for 5,00,000 square kilometers of the Deccan Traps.

1.7 Marble Rocks, Jabalpur, Madhya Pradesh

This geological marvel is an upcoming potential geosite under the consideration by the Geological Survey of India (GSI). Located in the sixth largest river of the Indian Subcontinent, Narmada (previously Nerbudda), this site lies in the city of Jabalpur in Madhya Pradesh. The Narmada river has carved gorges along its path and these gorges are of soft marble. These gorges run for nearly 8 KM in the river and is a popular tourist destination. The site is also famous for its resource sharing with the world. Many local marble mines mine in the area and transport the marbles across the globe. These marbles are rich in magnesium and are as hard as soap stone. This area of the Narmada river apart from the white marbles is also particularly rich in brown and blue coloured marbles.

This site over the past few years has explored the tourism opportunities and business opportunities equally, the gorge has a cable car to take the tourists across the beautiful river and boats are also provided in huge numbers for hiring purposes. Add to this the crafts that can be bought from the local shops of Jabalpur and the area around the river as well, where-in the crafts are made particularly from the locally available materials.

1.8 Leh Manali, Himachal Pradesh

The Leh Manali highway is one of the most spectacular views that our country has to offer to any traveller. Any person visiting this place from around the country will be left spellbound by the spectacular views of the small hills, weathered structures and curvaceous roads amongst everything else. Leh is the ground zero for the mountain deserts of Ladakh. Monasteries, pure blue lakes, and scattered villages, scenic valleys and marvellous structures all lie in this plane. These structures start from Manali itself. Manali, a slice of heaven in the midst of urbanization that is spreading quickly. A place which is filled with a mix of culture as well as growing towns. The perfect stop to get a person startled and started with what lies ahead for them as they travel from Manali to Leh-Ladakh and Spiti Valley.

The conical structure of the rocks that can be seen in the image below is a resultant of the rocks constant quarrel with the winds. The needles rise towards the sky and make a beautiful stop for any passing by person. It is also become a stop-over spot for all the buses around which travel upwards from Manali to Ladakh. In the winter season, what adds more vibrancy to this site is the added colour of white snow on these pointed structures. It is beautiful. They might look like sand but they are part of the greater Himalayas that have weathered over the greatest period of time.

1.9 Natural Gateway Near Lachung La, Himachal Pradesh

Lachung la (also known as Lachulung la) is the second pass on the Leh Manali highway. At its peak of 4891 meters it is a place filled with mountains that have so many shades of brown in them that one might have to bring multiple palettes of the colour brown to paint the vivid beauty of the mountains and small hills. The natural gateway (shown below) is a must watch for any traveller in Lachung la. This natural tunnel, is right opposite to a trekking route from Leh to Manali.

1.10 Natural Coral Bridge at Neil Island, Andaman & Nicobar Islands

The Andaman-Nicobar accretionary ridges (islands) have a varied geography and geomorphology which has resulted from a complex interaction with climate, tectonic plates, surface uplifts, weathering processes and eustatic sea level. Similar to the Bay of Bengal and the Indian Ocean the Andaman & Nicobar Islands too have a subtropical climate with hot to humid sea breeze conditions.

The beautiful natural bridge is a lovely site to visit in the Neil Islands and the local Bengalis of the island have also named it Howrah Bridge. The best time to visit and see this rock bridge is on the days of low tides. Otherwise the approach to the bridge is not possible. On low tide days, people have to walk on rocks to reach this place and they can easily spot crabs and octopuses on their way to the bridge. Any local guide can be hired to better explain the features of this natural formation.

1.11 Oravakallu Rock Garden, Andhra Pradesh

Located in the Kurnool district of Andhra Pradesh is a beautiful mix of geology and sculpture garden. In the village of Oravakallu (also Oravakal) lies the Oravakallu Rock garden which is a formation of igneous rocks, pools of water and an ancient cave amidst a 1000-acre sculpture garden.

The Andhra Pradesh Tourism Development Corporation (APTDC) has developed this site too over the past few years. The rocks in the garden contain quartz and silica. Quartz and silica happen to be very important raw material for the glass industry.

Few ecological concerns that are faced currently by the garden are:

1. Companies filing petition to mine the quartz and silica
2. This site is also famous for film production, but once the shootings are done, POP (Plaster of Paris) is left behind by the production and this spoils the garden.

A good thing done by the APTDC is the provision of rooms and cottages inside the garden itself for staying purposes. It is located 20 kilometers from the Kurnool district on the National Highway- 18 (NH-18).

1.12 Varkala Cliff, Thiruvananthapuram, Kerala

Varkala is a beautiful place in 'God's own Country' Kerala. It is the only place in the Southern part of Kerala where 'cliffs' are found. These cliffs are adjacent to the Arabian Sea. The entire cliff runs down with sedimentary formations in it. These Cenozoic sedimentary cliffs are commonly known as 'Varkala Formations'.

Varkala also happens to be home to a temple that is more than 2000 years old. This is the famous tourism spot of Janardana Swami Temple.

The varkala cliff is made up of beds of sands and beds of shale. Along with a thin seam of lignite which make this a good spot for natural vegetation and hence natural springs and scattered vegetation is common to the area.

The Varkala Cliff is adjacent to the sea and has a beach which offers a lot of tourism in this part of Kerala specifically. Sports like paragliding are quite common in the area, followed by other water sports.

The most urgent threat faced by this site is the heavy tourism activity. This activity though very helpful for economic purposes for the state and the city, makes it difficult for the authorities to manage the area. Because of which poor disposal of garbage, ill-treatment of waste and other problems cause by people is very common.

Another problem is that the site was only recently posed as a National Geological Monument and hence awareness amongst the people for this site for geological purposes is less, which too needs to be worked on.

1.13 Yana Rocks, Yana Village, Karnataka

Yana village is located in the forests of Kumta in North Canara district of Karnataka. It is known primarily for its karst rock formations. Karst rocks are formed by the dissolution of soluble rocks such as dolomite, gypsum and limestone. The yana rocks are a set of two massive rocks outcrops that are known as Bhairaveshwara Shikhara and Mohini Shikhara. Shikhara word comes from Hindi and means hill. These two rocks are a composition of the karst limestone in a crystallized state. The Bhairaveshwara Shikhara is 120 meters in height and the Mohini Shikhara is 90 meters in height.

The place is a famous tourist spot not only because of the crystallized karst rocks but also because at the bottom of the Bhairaveshwara Shikhara lies a cave temple where a self-manifested Shiva linga is present. To add to the sanctity of the place, water from the cave roof drips over the Shiva linga drop by drop all the time, making it an apt pilgrimage spot that it is today.

The two rock monoliths are surrounded by streams, forests and are a part of the Sahyadri range of hills in the Western Ghats of South India. Inside the Bhairaveshwara Shikhara cave also lies a bronze statue of Goddess Durga.

And to add to all this is a natural waterfall located at a mere distance of 8 KMs from the Yana Rocks and the waterfall is called Vibhuti Falls which too attracts tourists to this spot.

The natural creation of the Shiva linga has been attributed by geologists as a geological phenomenon formed by the Stalagmites and Stalactites in a limestone formation. Stalagmites are various types of rock formations composed of lava, mud, minerals, sand, peat, pitch, etc., that rise from the floor of a cave due to the accumulation of such materials on the cave floors. On the other hand, Stalactites too can be composed of lava, mud, minerals, sand, pitch, peat, etc., but instead they hang from the ceilings of caves or hot springs

1.14 Ramgarh Impact Crater Site, Baran District, Kota, Rajasthan

Since the inception of the GSI (Geological Survey of India) in 1851, the scientists were always intrigued by this potential geological site in the Baran district of Kota in Rajasthan. This meteorite impact crater site has a diameter of 3.2 KMs and has an elevation of about 200 meters from the ground terrain level. It was first discovered way back in the year 1869 by the GSI and the site was recognized an impact crater site in the year 1960 by the Geological Society of London as well.

The process of further worldwide recognition for this site was led by Dr. Pushpendra Singh Ranawat recently. This recognition from the Canadian agency will mark this site as the 191st crater site in the world. The process has been fast tracked by INTACH (Indian National Trust for Art, Culture & History) and soon with the help of this site's significance the village of Baran will be marked on the global map.

1.15 Zawar Mines, Udaipur, Rajasthan

The famous Zawar mines located in the Udaipur district of Rajasthan is a zinc and lead extraction site with even greater significance in both geology and history. This potential National Geological Monument has its contribution in history, science, economics, archaeology as well as geology. Zawar is a settlement in located about 40 KM from the city of Udaipur. This township was created by Hindustan Zinc Limited company about a while back.

This site has an ancient underground set of mines and to add to it the remains of an ancient smelting industry and hence it is regarded as a potential site for not only geological recognition but also the first site in India to have a Geopark built around it.

Zinc is a metal that can be difficult to extract from the core, the process being known as 'Smelting'. This metal has a low boiling point of 907°C and can be extracted only through a mastered smelting process. And it was India out of all the countries in the world which was the first one to master this technique of Zinc Smelting and all this happened in the Zawar Mines of Udaipur district. The technology was so difficult to achieve that even in India at the time the mine was unique for Zinc smelting and faced no eminent threat from anyone trying to copy the method of this metal's extraction.

Even the Archaeological study by the British Museum, London, M.S. University of Baroda and Hindustan Zinc Ltd, have proved that Zawar metallic zinc was the first ever production in the world by distillation.

IV. RECOMMENDATIONS

A. Proper signage should be the starting point to developing these sites. Most of these sites whether potential or listed don't have proper and well maintained signage boards in front of them. These boards are often blocked by trees, shrubs, or get dirty. Thus even if a site has a board it should be maintained.

B. Illegal activities such as mining in these sites should be prohibited. A lot of places in our country have lost their mineral wealth to miners and mining activities. Thus stringent rules need to be laid down and adhered to so that these sites can be preserved.

C. Regular cleaning of premises and regulation needs to be conducted. Even though natural calamities can't be handed, the aftermaths can be. So, a dedicated team of people should report if geological sites are exposed to natural degradation or calamity.

D. Sites are also closer to roads in many cases, ex: Eparchaen Unconformity, thus an expansion of roads in the future can damage these sites and hence larger buffer zones between such sites and road or railways construction needs to be provided.

E. Proper fencing should be done around the area to protect geological monuments.

F. More than often the maintenance of the roads leading up to these sites becomes a big issue. This drags down the consumer from visiting these places too. Proper roads leading up to the monuments should be constructed and should be maintained in frequent intervals.

G. Water bodies around geological sites often are subjected to sewage, garbage and industrial waste dumping. This needs to be resolved and checked, to better maintain these sites.

H. Conservation measures require Site Management Plans, Visitor Management Plans, Garbage Management Plans, Lake Management Plans, building Interpretation centres and providing information in form of signage boards in local as well as universal languages.

I. Proper flyers and brochures should be made available at these places.

J. Social Media channels should be optimized for information delivery to the public regarding these sites.

K. Government should work in tandem with Private enterprises or Businessmen to develop these sites in a better manner.

L. Awareness amongst general public must be increased so that they don't ill-treat or disrespect these sites by throwing waste or drawing graffiti, etc.

M. Local communities of people and villagers often litter these sites by defecating in their vicinity, this needs to be stopped by educating them about these places.

N. Apart from mining for minerals these sites are subjected to construction, overcrowding and other anthropogenic activities. These activities should be minimized.

O. Forest department can be checked with to include the areas to sites under their jurisdiction, this can help a lot.

V. CONCLUSION(S)

In conclusion, Geoheritage and Geotourism have significant impact on us as well as our economies. I can't help but compare

geological monuments in India to be compared to other sites in parts of the world. Countries like China, Japan, Republic of Korea, France, Austria, Germany, Italy, Greece, Poland and others have worked a lot on bringing out the best of these sites and maintaining them in forms of Geoparks and we should do the same. It is not as if our country doesn't have these wonders, it has more wonders to be transformed in to Geoparks than any other country but a simple act of will is missing from the system. This needs to be reinforced so that these places don't go to waste. Monuments like these cannot just lead to sustainable development of communities around them but also offer business development opportunities and it needs to be kept in mind while uplifting these sites. Maintenance can come in form of proper authorities monitoring these sites or by the simplest way of not littering these sites. In all we as a community need to hold this responsibility and act together.

Services can be established in these sites in the future once they receive their fair share of attention. ATMs can be set up in these areas, if banks assess the need to do so. Shops can be established so that consumers can buy brochures, gifts and takeaway goodies from these places. Motels can be constructed so that lodging doesn't become a problem. All this can be attributed to "Goods related Services" concept of "Services Marketing Mix". In other nations this potential is well realised and still it isn't when it comes to India.

Even though development of service and tourism related activities can be a little slow for the time being, an initiation is a must. Otherwise it won't be long before people actually don't care about these geological sites of importance and once that happens it would be a total failure to brand these sites for tourism purposes at all. The finest example can be taken from Botanical Gardens of Bengaluru. How the place has been converted in to a garden, with annual flower shows, a picnic spot for people, jogging track for fitness enthusiasts, this can be done with most of the sites as well. Even though many sites would still remain exclusive to interested people, who want to actually visit them, lots of other sites still have potential to be turned in to places of recreation or Geoparks.

Museum facilities can be opened to popularize these sites and geology at large as well. Lots of Geoparks around the world do offer this facility and we need to jump on it as well.

The point of this paper being that it is a proof that a market exists for these places. No doubt a further study of an even larger audience would yield in similar results. But it won't be of any use is we don't allocate funds, strategies, human resources and technology to the development of our geological heritage. It is time for us to learn from other nations, what they are doing right, what they are doing wrong, how they have built these places and places of interest, these questions need to be asked and answered so that we don't miss out on our opportunity, which for the time being we do have.

Stakeholders for these sites need to be identified, administrators need to be sensitized, tourism departments need to gather up to date information, measures of protection need to be deployed, public's negligence to these places needs to be tuned to public's interest for these sites.

Agreed that we have a long way to go to achieve everything. But it can happen one day at a time.

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