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# Geoethics Key to Geoconservation of Geologic Heritage of India: A Critique

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## Abstract

*Visual examination of rock exposures is fundamental to the field of geological sciences. It aids in comprehending the disposition of rock sand understanding their geologic history. Current exposures must be preserved forever for future geoscientific pursuits, barring natural disruptions. Safeguarding this critical archive of Earth's past is vital for earth science's future. Embracing geoethical principles form the bedrock to ensure these natural treasures are passed down to future generations in their original in-situ conditions. Geoscientific professionals play a crucial role in this endeavour, and it is necessary to establish legally protected geoheritage sites for effective geoconservation and geotourism. This paper discusses the status of the conservation of geological monuments in India. India's extensive geoheritage, ranging from gigantic peaks to coastal plains representing the entire spectrum of geological time, reveals a rich and distinct geological history. However, the country is laggard in rapidly preserving its geologic heritage is deeply concerning. In India, geoethics is still in an incipient stage. The need of the hour is prompt geoscientific action on a geoethical basis and sustenance of the momentum created to make this concept a way of life. Governmental support and legislation are imperative to put this in place.*

**Keywords:** *Geoethics, Geoheritage, Geoconservation, Geotourism, Geoscientists, Geoparks, Geological Survey of India, India*

## 1.0 Introduction

Geologists are fortunate to investigate some of the most extraordinary, scenic, and remote areas of our planet. Geology, inherently being a visual and field-oriented discipline, there is no more effective setting to analyse and comprehend the internal structure of a reservoir than through discussions held in front of a relevant outcrop. As professionals in this field, the onus is on us to protect significant outcrops and ensure they continue to serve as valuable sources of knowledge and inspiration for future earth scientists and generations. These geological formations act as essential information repositories, and any careless actions could threaten their future availability for continued research. Each year, a multitude of individuals and educational groups visit these accessible and exemplary geological sites. Some of the geologically important sites are also tourist destinations. The consequences of these activities include the harmful impacts of rock hammers, painted section numbers, drill plug holes, and other indicators of increased visitation to these iconic locations, which can be quite severe. To maintain ongoing access for students and researchers, the geological community must act responsibly by conserving and safeguarding these classic sites and complying with land-use regulations. The public in their quest for amusement is susceptible to abusing the outcrops as a matter of habit. I attempt to address the issues at hand and propose geoethical solutions for the conservation of these significant rock exposures for future generations in the interest of earth sciences in particular and humanity in general.

## 2.0 What is Geothics?

The emergence of the concept of 'geoethics' signifies an initiative by geoscientists to enhance their engagement with professional duties and the broader societal implications

of geosciences. A responsible relationship between individuals and the earth system necessitates a thorough consideration of ethical factors. Given their specialized knowledge and expertise, geoscientists are particularly positioned to contemplate the ethical ramifications of their work, which can inform responsible interactions. Geoethics provides a structured approach for geoscientists to implement and practice this responsibility, while also guiding other professions and society in fostering responsible relationships with the Earth system. These principles comprise human, interpersonal or professional, social, and environmental factors.

The international association for promoting geoethics defines geoethics in their constitution as "Geoethics consists of the research and reflection on those values upon which to base appropriate behaviours and practices where human activities intersect the geosphere. Geoethics deals with the ethical, social, and cultural implications of earth sciences research and practice, providing a point of intersection for geosciences, sociology, and philosophy. Geoethics represents an opportunity for geoscientists to become more conscious of their social role and responsibilities in conducting their professional activities. Geoethics is a tool that can influence and upgrade the awareness of society regarding problems related to geo-resources and geo-environment"[1].

The three pillars of geoethics namely, the individual geoscientist, the geoscience profession, and the society, interact with the earth we live on. The responsibilities of each of these pillars towards earth constitute the value proposition of geoethics. The ethical standards are set to make the lives of human beings less impacted negatively by our activities including leisure and economics. India is in the process of establishing infrastructure that is suitable for its rapid economic development. Geoethics, an emerging discipline within the earth sciences, provides a new way to solve global environmental problems[2].

The concept of geoethics, framed within the operational parameters of evaluating the actions and values of human agents concerning the earth system, holds significant potential. It seeks to explore three fundamental inquiries:

1. How should 'geoethics' be defined in practical terms,
2. What elements are considered outside its scope, and
3. Is there a justification for creating a term, such as geo-humanities or geosophy, to encompass a wider range of perspectives on geoscience and its relationship with society and the natural environment, ultimately benefiting geo-professionals and others involved in the field?

In India, geoethics is a nascent stage and awareness needs to be created among the professionals and the public.

## 3.0 Role of Geoscientists

Geoscientists are essential in guiding ethical decisions regarding the stewardship of the Earth, the utilization of its resources, and the relationship between humanity and our planet. The adage, charity begins at home is more than relevant here. Geoscientists by their subject matter expertise form the foundation of Geoethics. Geoscientists must gain the public's trust and uphold confidence in both the contributions of individual professionals and the geosciences as a whole.

The fields of geoethics, social geoscience, professional ethics, geoscience education, and communication, as well as the interplay between geoscience, society, and policy, represent developing areas of study. It is increasingly evident that addressing global anthropogenic changes constitutes the most significant challenge of the 21st century, with geosciences playing a pivotal role in assisting society in identifying issues and developing viable solutions. A proposal to codify a new geological epoch based on humanity's influence on earth has been rejected by the International Commission on Stratigraphy (ICS). I understand that it is because of a deep reluctance to consider short periods in the geological time scale parlance. Anthropocene will consolidate as a true geological epoch only if we keep deteriorating the planet and this is manifested in sedimentary rock[3]. The positive vibe here is that we have scope for revival and this period will be phased out sooner or later. Otherwise, this review itself becomes redundant.

## 4.0 Scope of Field Work

Field geology refers to the practice of conducting geological work in the field. This involves direct observation of geological formations, such as outcrops, exposures, landscapes, and drill cores. Professionals in this discipline examine rocks and rock materials within their natural settings. Consequently, field geologists

strive to characterize and elucidate surface features, subsurface structures, and their relationships. Geological mapping creates detailed maps depicting the distribution and characteristics of rocks, formations, and geological features. Outcrop descriptions and data are useful in exploration studies and the output is a geological map that portrays the disposition of rocks at the surface which can help deduce regional trends and local anomalies. Fieldwork provides geoscientists with the opportunity in exploration and production to enhance their skills and deepen their understanding of contentious areas. Additionally, outcrops serve as critical analogues and data points, essential for the effective interpretation of subsurface conditions.

## 5.0 Geoheritage

India has a diverse geological realm ranging in age from Proterozoic to recent. The unique geological monuments depict the rich spatio-temporal growth the Indian sub-continent has undergone through geological time. Geoheritage refers to the geological features which are inherently or culturally significant offering insight into earth's evolution or history to earth science that can be utilized for education to deduce the genesis of the rocks. Geological Survey of India (GSI) is the parent body tasked with identifying and protecting geological heritage sites or national geological monuments in our country (Figure 1).

The draft geoheritage bill 2022 notified by the Ministry of Mines defines Geoheritage sites are "sites containing geo-relics and phenomena, stratigraphic type sections, geological structures and geomorphic landforms including caves, natural rock-sculptures of national and international interest; and includes such portion of land adjoining the site," that may be required for their conservation or to access to such sites[5]. The bill also defines a Geo-relic is as "any relic or material of a geological significance or interest like sediments, rocks, minerals, meteorite or fossils"[5].

Geoheritage sites, also called geosites, are natural locations with exceptional geological and geomorphological importance. We have 34 geoheritage sites in India and at least a hundred other sites have been identified for declaration as Geoheritages (Figures 2 and 3).

The Marble Rocks at Jabalpur is a scenic geoheritage site and a worthy spot on the tentative UNESCO's World geoheritage list that qualifies as a geoheritage (Figure 4).

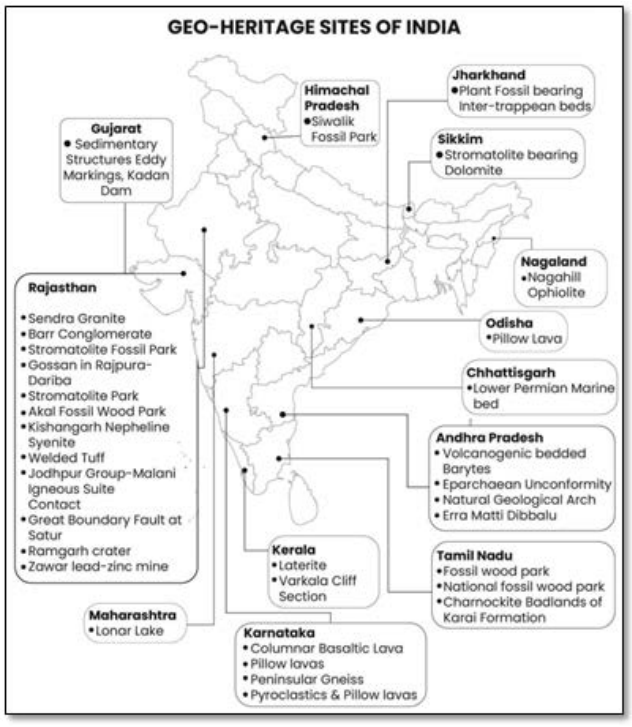



**Figure 1.** Geoheritage sites of India[4].



**Figure 2.** Granitic hillock of Lal Bagh, Bengaluru, geoheritage site.

However, the Geological Survey of India (GSI) lacks the authority to enforce preservation measures and needs empowerment. Sustainable growth and development are crucial not only for the extraction of India's mineral and energy resources but also for safeguarding and conserving the nation's geoheritage. This can be achieved through the establishment of well-regulated geoparks, geo-ecotourism, and agritourism initiatives. The Ministry of Mines recently notified the draft Geo-heritage sites and Geo-relics (preservation and maintenance) bill,



**Figure 3.** Charnokite in St. Thomas Mountain, Chennai, geoheritage site.



**Figure 4.** Marble Rocks, Jabalpur a scenic geoheritage site and a worthy spot on the tentative UNESCO's World geoheritage list.

2022. There is a proposal for the establishment of a more inclusive entity, akin to a National Geoheritage Authority. Reports indicate that the government is still considerably away from presenting the bill in parliament and is presently considering various factors. While there are advantages and disadvantages to the governance approaches, it is crucial to remember that legislation, while serving as a protective measure, should not be utilized to hinder independent research.

## 6.0 Geoconservation

Geoconservation deals with the protection and conservation of earth science features. It concerns rock monuments, fossil parks, geological marvels or features, and geomorphological landforms. In a broader sense, geoheritage also includes cultural sites (such as mining sites) or archaeological sites (made of stones) that have an integrated value in response to a particular region. Great outcrops deserve respect. While modest and discreet sampling of some outcrops is critical to advancing our science, there is no limit is imperative that we safeguard the Earth's repository of knowledge; a photograph cannot replicate the experience of observing a geological feature in its natural setting. Geoconservation focuses on recognizing and preserving unique sites and landscapes that have important scientific value and add to our quality of life[6]. Vandalism of outcrops on public land has occurred on several sites.

Varkala, located in the Thiruvananthapuram district of Kerala and facing the Arabian sea, is characterized by ancient rocks, and is recognized by the geological survey of India as a geological heritage. However, the district administration has partially demolished sections of this area due to the potential risks associated with landslides (Figure 5).

Geoconservation depends directly on human beings namely geoscientists and the public. Geoscientists study georelics while others use this geoheritage sites for geotourism. Geoscientists as a community must amend the rules to conduct their fieldwork in a manner that preserves the georelics for posterity. As it involves both academic and commercial organisations there needs to be a body empowered legally to advise and monitor the concerned activities. Laws have to be enacted for geotourism and geoconservation to preserve the geoheritage of India and could consult the existing law on the Biological Diversity Act of 2002.



**Figure 5.** Defaced Varkala Cliff in Thiruvananthapuram district, Kerala, a geoheritage site.

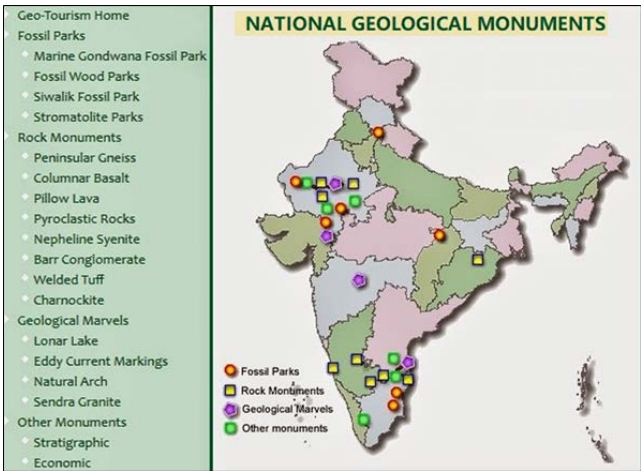



**Figure 6.** National geological monuments of India[8].



**Figure 7.** Badami caves in Belgavi, a geoheritage site in the making.

The government ought to consider the creation of a 'National Geo-conservation Authority' similar to the National Biodiversity Authority. Such an authority would facilitate independent oversight, eliminate bureaucratic delays, and maintain the autonomy of researchers and private collectors engaged in scholarly work.

## 7.0 Geotourism

Geotourism is the provision of interpretive and service facilities to enable tourists to acquire knowledge and understanding of the geology and geomorphology of a site (including its contribution to the development of the earth sciences or geographical sciences) beyond the level of mere aesthetic appreciation[7]. Geotourism can significantly enrich the study of the earth and its historical development. By exploring natural and geological sites, individuals can gain a deeper insight into the formation of the earth and its evolutionary changes over time. This will help bridge the gap between the geoscientists and the general public. In India, potential geotourism venues could be fossil parks, rock monuments, geological marvels, and other stratigraphic sections of importance in geology (Figure 6). Additionally, geotourism serves as a valuable avenue for appreciating the planet's natural splendour and can foster awareness regarding the condition of our environment and the interconnectedness of humanity and nature.

The treatise on the geology of India by M.S Krishnan is an all-pervading document on the geology of India[9]. Sites of type sections of Indian stratigraphy and geological transects of stratigraphic importance are listed and described. This can form among others the records to be consulted to focus on georelics. The book identifies various litho sections described above that qualify as geo-heritage sites (Figure 7). The field sites contain classic vertical sections of strata which will immensely benefit students, researchers, and professionals both for training and research. The study sites of the Triassic of Spiti, Jurassic of Kutch, and Cretaceous of Tiruchirappalli have diversified fossil groups, and they are a field museum of paleontology and a practical learning ground for geology students.

## 8.0 Need for a New Paradigm

We, as geoscientists must look at issues of both geoethics and geoheritage. Georelics, being non-renewable resources, represent a significant aspect of geological heritage that necessitates protection from a geoethical perspective. The geoscientist at large must help educate the community on the field. This can be achieved through geotourism.

The preservation, enhancement, and understanding of geoheritage sites can be effectively accomplished through a threefold strategy encompassing education, legal protection, and the promotion of geotourism. It is particularly important at a time of increased pressure on

nature. The strategy necessitates careful consideration of the three essential elements outlined here.

1. Geoethical treatment of geoheritage sites by students and industry experts.
2. Prevention of abuse of rock exposures in geotourist destinations.
3. Preservation of geoheritage sites by introducing geoethical rules and regulations.

A critical requirement exists to elevate public consciousness regarding the value of geoheritage and the importance of geoconservation.

Some of the suggested measures to improve geoethical practices that could lead to the geoconservation of georelics are.

1. Introduction of geoscience at school to nurture at a young age itself.
2. Teaching geoethics across the geoscience curriculum.
3. To achieve a holistic preservation of Indian geoheritage, it is essential to adopt changes in the pedagogical approaches utilized in both primary and higher education.
4. Treat nature geoscience, one earth.
5. Responsible sampling by geoscientists toprotect important geoheritage sites,
6. Respect indigenous cultures, and in consideration of other societal issues.
7. Legislate geoheritage protection and conservation.
8. Creation of well-regulated geoparks.
9. Prevent the public abuse of rock exposures.
10. Building eco-citizen capacities for sustainable development.
11. Identify and declare geoheritage sites.
12. Include UNESCO sites in the geoheritage list.
13. Prevention of degradation of irreplaceable geological resources.
14. Promotion of geotourism within the framework of geoethics.
15. Foster the cultural relevance of geoheritage.
16. Establishment of geo-ecotourism, and agritourism initiatives.
17. Conservation of heritage structures is an interdisciplinary effort.
18. Recognise the value of geoheritage structures by the people of India.
19. Awareness should be built among the local people about their local natural tourism resources.
20. Publicity about the geoheritage sites should be done using various media platforms *i.e.* television, newspapers, and websites.
21. A collaborative attitude should be built within the local people, NGOs, and local administrative bodies.
22. Having diversified fossil groups, it is a field museum of paleontology and a practical learning ground for geology students.
23. Earth heritage sites must be suitably delineated and protected.
24. Several sites are subjected to illegal mining, which destroys their natural beauty and should be prohibited. Stringent measures are necessary against such miners. Strict prohibition on illegal mining in endangered sites.
25. Installing proper signage boards along with cleaning activities should happen periodically at these sites.
26. Water bodies around these areas are influenced by garbage disposal, industrial waste, or improper sewage treatment, which should be regulated.
27. It is essential to foster collaboration among the geoscience community, governmental bodies, and local administrations by establishing operational protocols and creating a structured flow of information from the scientific community to the relevant authorities.
28. Collaboration between geoscientists and the public in scientific initiatives should be encouraged, as advocated by the concept of "Citizen Science," to foster knowledge, understanding, awareness, and a sense of responsibility within the community.
29. It is imperative for geoscientists to prioritize informing the public about geological risks, as this represents both a responsibility and an ethical obligation.
30. Scientific data, findings, and potential scenarios must be communicated in a manner that is accessible to the general population while maintaining scientific integrity.
31. The initial step for realizing this is creating awareness and providing people with information.
32. Proper fencing should be done around the area to protect geological monuments.
33. 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.

34. Forest department can be checked to include the areas to sites under their jurisdiction.,
35. Apart from mining for minerals these sites are subjected to construction, overcrowding, and other anthropogenic activities. These activities should be minimized.
36. 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 the public's interest in these sites.
37. Capturing the essence of the 'Digital age,' these sites should be promoted using various social media platforms.
38. The Government should promptly identify national geological monuments that have the potential to be transformed into geoparks and initiate such projects as soon as possible.
39. The ultimate goal should extend beyond merely conveying scientific information; it should also aim to enhance public awareness and accountability.

A strategy that harmonizes the three key commitments includes: a) Promoting open science and ensuring open access to research data; b) Contributing to the evaluation of geo-hazards and risk mitigation, which may also encompass risk communication to various stakeholders and the broader community; c) utilizing scientific research to facilitate the safe extraction of geo-resources, necessitating transparent collaboration with the private sector for the assessment of human-induced hazards (Figure 8). The balance among these components is contingent upon the weight attributed to each obligation, which in turn defines the ethical aspect. Impartiality in the interest of the public good transcends being merely an ethical principle; it embodies a fundamental value necessary for establishing credibility and maintaining societal trust in scientific endeavours. The balance among these components is influenced by the weight assigned to each obligation, which establishes the ethical dimension. Impartiality in the interest of the public good transcends being merely an ethical principle; it embodies a crucial value necessary for gaining authority and maintaining societal trust in geoscientific and research institutions.

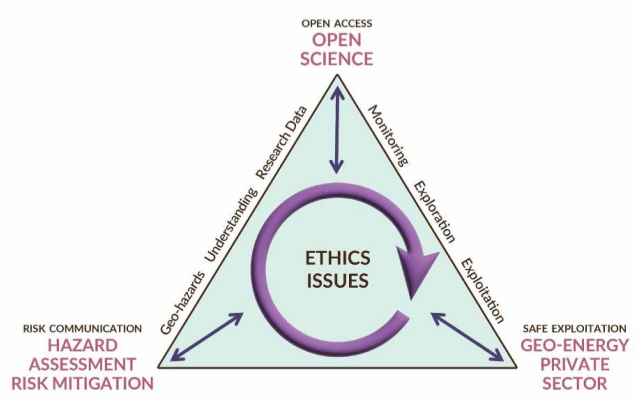



**Figure 8.** Approach to ethics and impartiality for public good[10].

Their perception within society bolsters the credibility of science and the position of geoscientists: As this perception increasingly reflects the tangible benefits that geoscience can offer, society will be more inclined to recognize and appreciate the essential role of geoscience.

The Society of Earth Scientists (SES) and the Indian National Science Academy (INSA) have been working towards putting legislation in place for the conservation of India's geological sites. No concerted efforts have been made so far for geoheritage preservation and the promotion of geotourism in India. As a result, India does not have even a single geopark to date. A considerable amount of work is required to ethically preserve the geoheritages of India and a geoscientific movement for this is essential immediately.

The significance of creating a legal framework for the safeguarding of geoheritage is emphasized by the reality that their promotion and prudent management foster opportunities for sustainable development and enhance their potential as quality tourist destinations (geotourism) through the avenues of nature conservation and education.

## 9.0 Concluding Insights

India is a nation rich in unique geological formations that span across various geological epochs. Geoscientists must spearhead the efforts in the geoconservation of these geoheritages, as they possess the expertise to recognize the significance of these geological relics. By fostering a scientific mindset among the populace, they can encourage individuals to engage as geotourist, thereby enhancing appreciation for the wonders of nature and

ensuring their preservation for future generations. While baby steps have been taken, there is a pressing necessity for increased momentum in this area, supported by government initiatives.

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