# **CONCEPT OF GEOHERITAGE: A REVIEW IN INDIAN CONTEXT**

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#### ABSTRACT

Scientifically, georesources of India are least understood in terms of geoheritage for sustainable economic development. It is obvious that the developing nations like India are facing tough challenges and hindrances against such development due to their higher dependency on primary resources. It is because of lack of public awareness and lack of importance given to sustainable development on earth heritage resources. Despite of that, India is significantly endowed with rich Georesources of many significant landscapes of rocks from Archean to Recent age. Among these, most important are the cratons and sedimentary Basins of Indian Peninsula, Eastern and Western Ghats, Deccan plateau, Himalaya and the Thar Desert. All these outstanding and varied Georesources bearing landscapes with their many unique features are special pertaining to Earth's geological history. These landscape features also possess unique values that need to be recognized and conserved as geoheritage to meet the present and future scientific, historical, cultural, archaeological, aesthetic and socio-economic needs of over a billion people living in the subcontinent. However, in Indian context, various terminologies, notions and understanding of the concept of geoheritage were not adequately explored and established viz a viz awareness among people on these important aspects. Hence, to address and understand such aspects, present paper embodies and discusses the development of various concepts and notions of geoheritage at international level and need to review them in Indian context. This will help to aware the general public and geoscientific fraternity to understand the importance of geoheritage by utilizing indigenous georesources through geotourism for sustainable economic development of India.

**Keywords:** Georesources, Geoheritage, Geosites, Geo-conservation, Geotourism, Geopark, Sustainable Economic Development

## INTRODUCTION

Concept of geoheritage of significant Georesources was initially conceived by the work of Joyce, (1994).Afterwards, McBriar, (1995) elaborated the term and

stated that in general, geoheritage focuses on the landforms as geological and geomorphological features that include the presence of wide spectrum of minerals, rocks, fossils and their petrogenetic features that indicate the genesis of landforms (geosite) of the Earth. It also includes geo-conservation that deals with the conservation of natural resources of the Earth. Obviously, geo-conservation has become important globally to recognise the Earth systems having a history and are linked to a sense of place, the ongoing development, the human providing resources for development with their historical, cultural, aesthetic and religious values. Further, Earth systems are considered as the fundamentals of the ecological processes which are also a part of heritage sciences (Torfason 2001). However, in context to India, both geoheritage and geo-conservation are newly conceived endeavours that have gained little momentum only in recent years in terms of their scope and objectives (GSI, 2001 a & b; Mazumdar, 2010. Biswas, 2013;Swarna et al., 2013; Phani, 2016; Ranawat, 2016; Mathur and Pradip,

#### **BRIEF HISTORY OF GEOHERITAGE**

#### **AND GEO-CONSERVATION:**

The terms, georesources, Geoheritage and geo-conservation are concerned purely with geology. It is often used 2016; Shekhar et al., 2019; Mathur et al., 2019 and Mathur et al., 2020). For instance, Mathur et al., (2020) provided a systematic methodology for the first time to select the paleontological sites (fossils site) and their conservation plan to develop a national Fossil Park/ paleopark for geotourism in India. However, Other than fossil sites, India has other many significant sites (various physiographic division of landforms) with rich geoheritage not systematically studied in that sense and also need to be explored and understood for geotourism aspects. Hence under present paper, these aspects are discussed primarily to start with the history of development of geoheritage in India viz a viz in world. At international level, various terminologies and notions are well established that have great significance to understand the importance of geoheritage in Indian context also. The document will further be helpful to educate people, students (to cover as part of their syllabus) and to spread awareness among people regarding importance of geoheritage to be utilized for sustainable socioeconomic development.

synonymously with Earth Sciences. If we analyse the Geology and its various subdisciplines in details, largely it overlaps with other disciplines. For example, Chemistry (e.g., crystal chemistry and geochemistry are both the sub disciplines

of Geology and of Chemistry, and the study of crystal deformation and crystal lattice defects is carried out in Geology, Material Sciences. physics and in Engineering). Similarly, Economic Geology is similar as to the subject Economics, both played an important role in sustainable social development. Therefore, if we think with this aspect, many sub disciplines of geology are oriented in their endeavour to the study of the Earth for social benefits. Present paper also contends that the scope of Geology should be taken in consideration, that what could be considered to be of heritage values and to be of conservation values of for socioeconomic georesources In this development. regard, the geoheritage values of Georesources were first understood by the geoscientists of United Kingdom which is considered to be the birthplace to understand the heritage values of georesources and their conservation (Anon 1991). After this concept, the term geoheritage was first conceived by Joyce, (1994). Later on, literature published on international level show that geoheritage is mainly focused on geology and geomorphology. However, many different aspects developed in the United Kingdom were exported, spread and adopted globally, particularly the inventory-based classification system and

listing of sites as geosites of geoheritage significance (Duff 1994; Wimbledon et al. 1995; 1999 and Semeniuk 1997). The idea of geosite tag with national heritage suggested by Prosser and Hughes, (2001) was recognised as the major achievement in protection and management (geoconservation) of geosites of geoheritage significance. Subsequently, geosites have progressively involved many important aspects of local cultural, historical and archaeological, natural resource management, land management, research, education and tourism (Frey et al., 2001; Ibrahim, 2003 and Brocx & Semeniuk, 2007 and Burek and Prosser, 2008). subsequently, the type sections, minerals and fossilsclassic locations as per the international literature characterizes geoheritage. These are primarily related to the sites that illustrate Earth history and locations where Earth processes were operated in the past where some principles of geology were first reported e.g., the site of Hutton's angular unconformity at Scotland (Hutton, 1788). Further, criteria to establish geosites were according to their scientific, educational and aesthetic condition. values. rarity, current accessibility with special protection status, maintenance, monitoring and planning of tourism (Ruban and Kuo 2010). After that, it was further defined that the geosite is essentially a locality or an area of

geological significance for the knowledge of Earth history (ProGeo 2011; Wimbledon and Smith-Meyer 2012). Similarly, the term geodiversity was first used after the convention on Biodiversity at the Earth Summit in Rio de Janeiro in 1992 by the geologists of Tasmania, Australia. They established that both "biodiversity" and "geodiversity" help to indicate that "Nature" consists of equal two components, living and non-living things and should be taken together to help to promote a more holistic approach to nature conservation (Sharples 1993; Dixon 1996; Kiernan 1997). Subsequently, the term "geodiversity" has spread from Australia to Scandinavia (Johansson et al., 2000) and in the United Kingdom and to many countries (Gray 2004). After establishment of the term geodiversity, Brilha. (2005)postulated that making inventory of geodiversity was the first and crucial step in any geo-conservation strategy. A geoconservation strategy is based on several successive steps: inventory, qualitative and quantitative assessment, conservation, interpretation, promotion and finally, monitoring of geosites. These aspects then gain momentum of study step by step on international level in which, the inventory aim was essential for the selection of the correct method and criterion to identify and select the geosites. These criterions were evolved and mentioned in many

papers concerning geoheritage (Brilha, 2005; White and Mitchell, 2006; Pereira and Pereira, 2010; Wimbledon, 2011; Reynard and Gray, 2013 and Brilha, 2016). As a result of which, many countries simultaneously have developed national inventories of geosites, mainly in Europe (Wimbledon and Smith-Meyer 2012), Poland (Alexandrowicz and Kozlowski 1999), Portugal (Brilha et al., 2005), Spain (Carcavilla et al. 2009), Switzerland (Grandgirard, 1999), Russia (Lapo et al. 1993), UK (Wimbledon et al. 1995), Malaysia (Ibrahim, 2003 and Nazaruddin, 2017) and in many other countries. Surprisingly, despite of enormous work at international level, India did not have developed the national inventories of geosites till date (Mathur et al., 2020).

After preparation of inventory, subsequently, two main methods of assessment (qualitative and quantitative) of geosites and geoheritage start developing in many countries. First one is characterised by the selection of geosites based on the qualitative procedures. The quantitative classification approach is related to the need to rank the geosites (Grandgirard, 1997; Rivas et al., 1997). Thus, different groups of researchers have various proposed methodological procedures of both types of classifications focusing on specificities present in geosites

(Bruschi and Cendrero, 2005; Pralong, 2005; Pereira, 2006; Reynard et al., 2007; Reynard, 2009). Further, according to Bruschi Cendrero. and (2009)the quantitative assessment of geosite is developed taking into consideration the best practices which were published earlier including work of authors (Cendrero 1996; Brilha, 2005; Carcavilla et al., 2007; Reynard et al., 2007 and 2009; Lima et al., 2010; Pereira and Pereira, 2010) were significant. The qualitative and quantitative approaches can be considered as direct and indirect methods respectively which can be practised further to establish geosite of educational and tourism values in terms of its geological types (Ruban, 2010 and Fassoulas et al., 2012) and through geodiversity to establish significance of local, regional, national and international significance (Brilha, 2016 and 2019).

Earlier, the term geodiversity was initially coined by Gray, (2004), who redefined it from Sharples (1995) as the range (or diversity of geological (bedrock), geomorphological (landforms) and soil features. assemblages, systems and "Geodiversity processes." Later on, include the evidences of the past life, ecosystems and environments in the history of the Earth as well as a range of atmospheric, hydrological and biological processes currently acting on rocks,

landforms and soils (Luoto, 2010). Several authors and workers from different parts of the world have proposed methods of geodiversity assessment differently, so the concept was undergone a consolidation process of paramount importance for long time (Bruschi, 2007;; Parks and Mulligan, 2010). However, according to Pereira et al. (2013), many key points remained unsolved in these assessments. One of the greatest issues was the difficulty in creating a model capable to be implemented in different areas. To resolve this difficulty, Forte, (2014) did excellent work to create a Geodiversity Index Map, which shows the richness of geodiversity elements at a landscape scale and its distribution throughout the area (i.e. 40-50 years), was overlaid with the Geodiversity Index Map to assess the impacts of urban growth on the physical environment. The importance of this research is in the fact that it contributes to the consolidation of geodiversity quantitative assessment methods which is a novelty within this subject and can applicable to different areas. This innovative and multi dimensional approach allows the inclusion of geodiversity as a specific and objective measure in management plan at geosites as tested by Santos et al. (2017). According to Melelli (2014), mapping a geodiversity index is clearly an open issue, that all the abiotic elements can be analysed together

or not. However, recent progress in remote sensing and GIS technology with the development of new tools for spatial analysis allowed new approaches in the quantitative analysis of abiotic diversity is new procedure to estimate the а geodiversity through the calculation of a geodiversity index (Forte 2014). These analysis are based on GIS techniques and not supported on a spatial grid system which was a solution adopted in many previous studies (Santos et al., 2017). Earlier, many studies followed the gridbased systems for such studies (Hjort Luoto, 2010; Pereira et al., 2013; Silva et al., 2015). In this method, the overlay of a grid on to a map provides square spatial in which the occurrence units of geodiversity elements can be counted. Richness indices are then created inside each cell, resulting in a matrix displaying the richness and spatial distribution of geodiversity within a territory. According to Pellitero et al. (2014), the use of a gridbased methodology discards the use of

## **GEOTOURISM:**

The term geotourism was evolved long time ago when Gray, (2004) utilized it for visitors who visited natural sites that were important from the geological or geomorphological point of view during tourism. Subsequently, geotourism has distribution models (a statistical model that considers richness and equitability of the element distribution) because they cannot be calculated on a pixel network and the distribution can be seen graphically on the resulting map.

However, the new approach based on centroid analysis and kernel density (Forte 2014) is applied rather than spatial grid system, for the understanding of the number, frequency, and the distribution of the variables additionally. Presently, this method of calculating geodiversity index of Pereira et al. (2013) is adopted with subindex map concept which is adopted at international level (Santos et al., 2017 and Brilha, 2018). Unfortunately, till date no geodiversity index maps are prepared and available despite of having such a rich and significant geoheritage in India. However, efforts should be made by geoscientists to utilize this method which is based on remote sensing and GIS techniques and is also suitable to calculate geodiversity in Indian context.

been practised for a various aspects of geodiversity related aspects (natural) and have been comprehensively explained in three books that explore then exus between tourism of geological and geomorphological features have been Mathur, S.

published (Dowling and Newsome, 2006, 2010; Newsome and Dowling, 2010). Subsequently, Reynard, (2008) analysed the relationship between geomorphology and tourism i.e. geomorphological site as an attraction or geomorphological site as a support for tourist activities and tourist infrastructures. These include e.g. didactic trails, instruments, educational booklets, services, guided tours etc. developed for the effective use in tourism. Ultimately, these factors contribute to the development of sustainable forms of tourism called as geotourism which also help the economic development of the region (Migoń 2009; Dowling 2013 and Pásková 2012; Sadhu 2017). Geotourism can be defined in several ways; probably, the mostly used is definition of Dowling the (2013): Geotourism is a tourism which focus on experiencing the Earth's georesources which impart significance of environment, culture, historical, conservation and should be locally beneficial. In recent years, a rapid expansion of tourism interest in

## **GEOTOURISM AND GEOPARKS**

Geotourism is developing at a very rapid rate around the world since more than one decade through Geopark development (Dowling, 2011; Dowling and Newsome, 2010; Newsome and Dowling, 2010; Pratyush et al., 2018). Geoparks are different to other forms of traditional geological features and landscapes are increases. Identification of geosites via geo-conservation activities and governmental recognition of geoheritage resulted in to emergence of a complex tourism sector of geotourism which provides with new, unique and educative experience to visitors (Kirchner and Kubalíková, 2015). In this regard, according to Gray, (2013) the geodiversity is of immense value for geo-touristic and geo-educational activities; however, it is evident that geodiversity as a whole cannot be used for geotourism purposes. However, tourist use of geodiversity is generally made through the exploitation of unique and natural geosites (Pralong 2003; Pralong and Reynard 2005). After that, the associated historical. cultural and archaeological issues also have a big influence on the geotourism development (Panizza and Piacente 2008; Tomar et al., 2017) as they often increase the attractiveness of the geosites to promote geotourism through Geopark.

national parks. According to guidelines of UNESCO, (2006), Geopark is a nationally conserved and protected area containing a number of significant geological heritage sites. These sites should have particular importance, rarity or aesthetic appeal (cultural, historical and religious elements)

with an integrated concept of protection, education and sustainable development. A Geopark has three main approaches: conservation, education and geotourism (McKeever, 2010). With these aspects geotourism promoted enormously via Geopark in Europe and then in China simultaneously since 2004 (Dowling, 2008). Till 2019, there were 147 UNESCO Global Geoparks in 41 countries with 49Geoparks in China as a result of which it is at the top in the list. However, India does not have even a single Geopark till date (May, 2020). Significantly, on international level with the time, it local community involves the with combination of local businesses and civic groups work together to promote and provide distinctive services to visitors at

# **UNESCO GLOBAL GEOPARKS:**

The Geopark concept was first initiated at the Digne Convention in the year 1991 for sustainable local development through the global network of areas having geology of extra-ordinary values to protect and promote geoheritage. Subsequently, in the year 1997, UNESCO also conceived the concept of a Geopark Programme to support nationally and internationally significant Earth resources for their conservation. In 2000, four European agreed together to countries address regional economic development through

Geopark. It has been noticed that geotourism in Geoparks also provide enormous economic benefits to local community. It also creates new job opportunities for income generation as well different services as and products 2009). In many (Dowling, countries geotourism is contributed significantly to economic benefits successfully (Ruban, 2017) as also witnessed by reports of UNESCO's Global (unesco.org) and European (europeangeoparks.org) Geoparks Networks, the International for Geotourism Association [IAGt] (iageotour.com), ProGEO, The European Association for the Conservation of the Geoheritage(sgu.se/hotell/progeo) and the Association of Geology Italian and Tourism (geologiaeturismo.it).

the protection of geological heritage and the promotion of geotourism. It resulted in the creation of the European Geoparks Network (EGN). After that, EGN signed an official agreement of collaboration with UNESCO in 2001. It resulted into the development of five Geoparks in Europe and one in China simultaneously in the year 2004. Subsequently upto 2008, seventeen Geoparks of Europe joined with eight Chinese national Geoparks to form a Global Network of Geoparks (GGN) under the auspices of **UNESCO** (Jones,

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2008). They also defined the UNESCO Global Geoparks as a single and unified geographical area on Earth where sites and landscapes of international geological significance are managed with a holistic concept of protection, education and sustainable development. Geopark also involve local community support and their involvement. According to UNESCO charter (2005), local people are trained to act as Geopark Rangers, Ambassadors and tour Guides additionally where they can sell their local products and crafts, provide visitor services and accommodation etc. Beside that Geoparks situated in tectonically active areas, also act as focal points for explaining about the risks of geohazards such as landslide, earthquakes, volcanic eruptions and tsunami. Now all Geoparks are governed by GGN (Global Geopark Network) and are required to meet criterion relating to size and setting; management and local involvement; economic development; education and protection and conservation (UNESCO 2010). Accordingly, Geoparks are under four-yearly reviews of their performance and management and if they fail to fulfil the criterions, parameters and points raised by Geopark evaluation committee, within two years, then, its name is removed from the GGN list.

# GEOHERITAGE IN INDIAN CONTEXT:

With respect to the above discussions, it is necessary to review geoheritage in Indian context because despite of rich georesources, no concerted efforts have been made so far for development of geoheritage and geotourism aspects as developed at international level. It is well known that India is endowed with rich Georesources of many landscapes of rocks from Archean to Recent age. Among these georesources, most important are the cratons and sedimentary Basins of Indian Peninsula, Eastern and Western Ghats, Himalaya, Indo Gangetic plains, Thar Desert and the Deccan plateau (Balasubramanian, 2017). These landscapes are very precious and are formed by long geological processes that take millions of years to form. It is also not possible to restore or make such landscape features artificially again if we lose them due to anthropogenic activities such as uncontrolled exploitation of earth resources during construction of the civil structures (Ahluwalia 2006). Under such geological scenario, the future of conservation of significant Indian georesources are very uncertain and wretched because of lack of protection and

conservation policies; the sites are likely to die on their own fate (Ahluwalia 2006; Swarna et al., 2013; Shekhar et al., 2019 and Mathur et al., 2020). However, in India, looking to their significance, Geological Survey of India (GSI) initiated the first step in this direction to declare thirty-three sites as National Geological Monuments (NGM). Out of these sites, Rajasthan has 10 sites with two in Jodhpur (GSI 2001a & b) and one in Jaisalmer. Among thirty-three NGM. ten are paleontological sites, out of which Rajasthan has three NGM and Western Rajasthan has only one i.e. Akal fossil park, Jaisalmer with petrified wood of Jurassic age (Mathur et al., 2020). Despite of this declaration as , no systematic classification and methodology has established so far to select geosites in India viz a viz geotourism and Geoparks. In this regard, recently, Mathur et al., (2020) established a systematic methodology first time to select the paleontological sites (fossils site) and their conservation plan to develop a national Fossil Park/ paleopark for geotourism in India. This particular work can be applied to select geosites with some modifications as per the local geological aspects. Despite of this work and declaration of NGM along with some work (Ahluwalia, 2006; Mazumdar, 2010. Biswas, 2013; Swarna et al., 2013; Phani, 2016; Ranawat, 2016; Mathur and Pradip,

2016; Ranawat and Soni, 2019; Shekhar et al., 2019; Mathur et al., 2019a; Mathur et al., 2020), no concerted efforts have been made so far for geoheritage conservation and for promotion of geotourism in India. As a result of which India does not have even a single Geopark till May, 2020.

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