AJMER, RAJASTHAN - A POTENTIAL NATIONAL GEOPARK OF INDIA

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INTRODUCTION

The proposed Ajmer Geopark covering an area of 91sq. km in Ajmer, Pushkar, and Kishangarh cities of Rajasthan is located in the northwestern part of India. Geopark area occupy the valley areas between the *Madar, Taragarh, Ajaisar, Kharekari,* and *Nag* hills, belonging to the world's oldest South Delhi Fold Belt (SDFB). These ranges protect the Geopark area to prevent the expansion of the Thar Desert. The importance of Ajmer Geopark immensely increases as it is endowed with the world's largest building stone market, national geological monument of nepheline syenite, *Kayad* silver-rich Pb-Zn mine with many natural geoheritage elements. Besides all these specialties, the Geopark area is a culturally and historically rich legacy of India. Pushkar has great antiquity because of its great religious importance. In *Budha Pushkar,* one of the earliest human habitations has been found which is of great archeological importance. For centuries, Pushkar has enjoyed the reputation of being one of the most important sacred places of Hinduism, where the only temple of Lord *Brahma* is located. The world's famous *Ajmer Shareef* mosque is also a sacred place not only for Muslims but also for people of all religions. Owing to the significant aspects, Ajmer has recently been selected as one of the heritage cities for the HRIDAY (Heritage City Development and Augmentation Yojana), which is already a SMART City under the Government of India Smart City scheme. Endowed with such a remarkable geological, hydrogeological, archeological, religious, cultural, and administrative scenario, twenty-one geosites have been identified in Ajmer, representing five types of geoheritage (Ruban, 2010), which has regional, national, and international significance. These are i. Geological, ii. Geomorphological iii. Hydrogeological, iv. Geohistorical and Cultural v. Archaeological types. The combination of all these geoheritage types in one complex type geosite with existing tourism facilities puts the proposed area in a favourable position to develop a dynamic and successful potential national Ajmer Geopark in India.

LOCATION AND EXTENT OF GEOPARK AREA

Culturally and religiously vibrant habitations, Ajmer (26.4499° N and 74.6399° E), Pushkar (26.4886° N, 74.5509° E), and Kishangarh (26.5866° N and 74.8542° E) are situated in the central part of Rajasthan, which lies in the north-western part of India. The proposed Geopark area covers about 91sq. km area within the rocky and desert terrain forming a spectacular landscape. Ajmer is well connected by road, rail, and air to major Indian cities. Kishangarh is about 26 km in the NE direction and has an airport, and Pushkar is located about 12 km in the NW direction from Ajmer. Ajmer and Kishangarh are connected through NH 8 while Ajmer and Pushkar by NH 89. All identified geosites are connected with tar roads having good accesibility (Fig. 1).

Fig. 1. Location map of the Geopark area with its hilly terrain, valley and plain areas.

PHYSICAL AND HUMAN GEOGRAPHIC CHARACTERISTICS

Among the three towns of the Geopark, historically Pushkar and Kishangarh were ruled by the kings of Ajmer till the close of the 12th century. Ajmer city, which is surrounded by hills and ridges of SDFB and developed in valleys on the lower slopes of the *Taragarh* hill, derives its name from *Ajaymeru* (the invincible hill). The city was founded in the 7th century by Raja Ajaipal *Chauhan*. *Chauhans* dominated Ajmer for many centuries and it was only at the end of the 12th century when the great ruler of Chauhan dynasty Prithviraj was killed by Muhammad Gauri in 1192 AD and Ajmer came into the way of the Turks. After his death, though the Chauhan dynasty ceased to exist in Ajmer but the descendants of this clan established the Chauhan dynasty of Ranthambore. From the beginning of the 13thcentury, Ajmer saw many upheavals and remained feudatory to Delhi until the later part of the 14th century when it was captured by the ruler of Mewar. In 1509 AD, Ajmer became a bone of contention between the Maharajas of Mewar and Marwar and was ultimately conquered by the Marwar ruler in 1535 AD. In 1559 Ajmer was conquered by the Mughal emperor Akbar and was accorded the status of a full-fledged province. It continued to be in the hands of the Mughals, with occasional revolts, until the later part of the 18th century, when it was ceded to the Marathas. From that time up to 1818, Ajmer faced struggle, being seized at different times by the Mewar and the Marwar from whom it was often retaken by the Marathas. In 1818 the Marathas sold Ajmer to the East India Company. Since then Ajmer has enjoyed stable governance with the Governor-General overseeing *Rajputana* (Chisholom, 2011).

After independence in 1947, Ajmer retained its position as a centrally administered territory. It was eventually merged into Rajasthan State on 1st November 1956 and is now the fifth-largest city of Rajasthan. Due to the political, geographical, and strategic position of Ajmer, vital and important government offices of the state were

opened here, like Rajasthan Public Service Commission (one of the authors Dr.S.S.Rathore is a member of the commission), Board of Revenue, Directorate of Ayurveda, Board of Secondary Education; along with several institutes of Government of India, like Headquarters of the Railway Recruitment Board, Central Board of Secondary Education, Regional Institute of Education, *Rastriya* Military School; and Central University of Rajasthan (HRIDAY website, 2018).

The Population of Ajmer, Pushkar, and Kishangarh was 5,42,321, 21,626 and 1,54,886 respectively, in 2011 (http://censusindia.gov.in/towns/raj_towns.pdf). The climate of the Geopark area can be divided into four seasons; 'Pre-Monsoon', which extends from April to June, is the hottest season, with temperatures ranging from 32° to 48° C; 'Monsoon', which extends from July to September receiving an average rainfall of 551mm; the 'Post monsoon', from October to December with a maximum temperature range between 18° to 20° C; 'Winters' from January to March is the coolest season with temperatures dropping as low as to 4° C.

Geopark area is a prime producer of quartz and a leading producer of feldspar. The other mineral mines are of limestone, marble, granite, asbestos (amphibole variety), wollastonite, garnet, emerald, soapstone, mica, and building stones with a well mechanized *Kayad* silver-rich Pb-Zn mine (Fig. 1; DMG report, 2018; Fareeduddin *et. al.,* 1995 and Mukhopadhyay *et al.*, 2010).

GEOLOGICAL ATTRIBUTES

The Geopark area is endowed with spectacular hills, ridges, ranges, and valleys, which are locally named as *Mahabir* hill, *Madar* hill, and *Banri* valley in the north; *Bajaranggarh, Taragarh, Suliya, Bhutiya*, Ajmer valley, and *Taragarh* valley in the east; *Ajaisar, Gorikund* and main Ajmer valley in the south; *Kharekari, Nag Pahar, Parwata Dungari* hills in the western fringes with respect to Ajmer of SDFB. The Kishangarh hills and other hills of the alkaline complex occur in the NE direction from Ajmer (Fig. 2).

Geopark area is represented by the hilly terrain of NE-SW trending South Delhi Fold Belt (SDFB). These hills and ridges mainly belong to Bhilwara Supergroup (>2500 Ma), Delhi Supergroup (2000 Ma to 700 Ma), and *Ana Sagar* migmatites along with concordant and discordant intrusive and extrusive phases of igneous rock. Little outcrops of Bhilwara Supergroup comprise metasedimentary sequences with associated magmatic complex and intrusive igneous rocks forming the basement rocks in the northern part of the Geopark. These are overlaid by *Ana Sagar* migmatites in the Ajmer valley area. Delhi Supergroup is represented by rocks of Alwar and Ajabgarh Groups. Alwar Group in Ajmer is represented by phyllite, calc-gneiss, quartzite, and marble of Srinagar and Naulakha Formations. Ajabgarh Group comprises *Taragarh* quartzite and *Kalyanipura* pilitic rocks designated as Ajmer Formations (Mishra *et al.* 2013). The intrusive and extrusive phases of the Kishangarh alkaline suite mainly intrude in all the above rocks and cropsout mainly in the Kishangarh area. These rocks are occasionally intruded by Erinpura granite in the base of *Ana Sagar* (Fig. 2 and 3). Ajmer-Pushkar valley is situated in the northwest direction in the Geopark area. Geologically, it is classified into Ana Sagar gneiss and the overlying Ajmer Formation (Fig. 2 and 3). Structurally, Ajmer gneisses and migmatites formed Ana Sagar gneiss dome (AGD). It occur as an elongate rectangular

body enveloped by quartzite. Four phases of folding, three metamorphic zones, and two shearing movements characterize the rocks of AGD. AGD is intruded by granite (1600 Ma) and post-orogenic ultramafic and alkaline rocks (Roy and Jakhar, 2002).

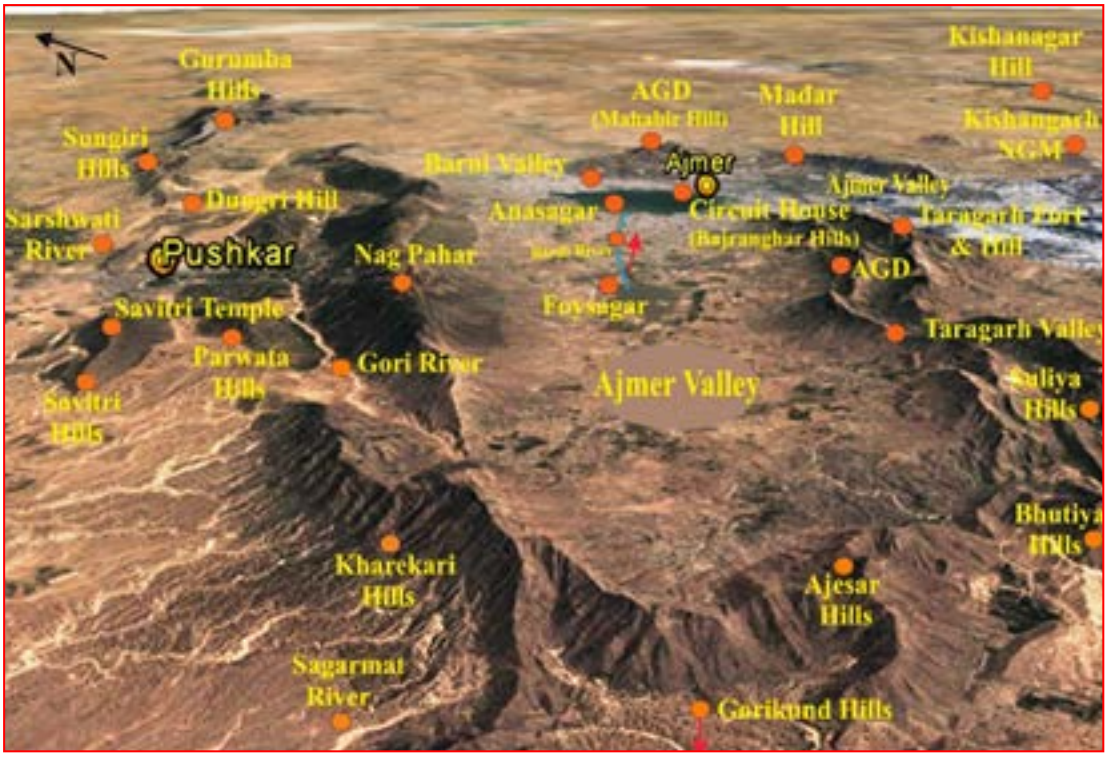
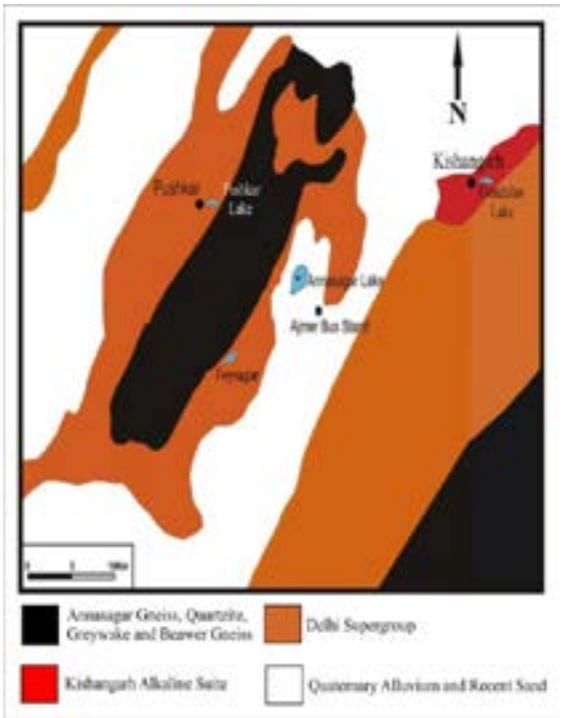


Fig. 2. Geomorphological attribute of the Ajmer Geopark area showing various hill valley, drainage and water bodies.



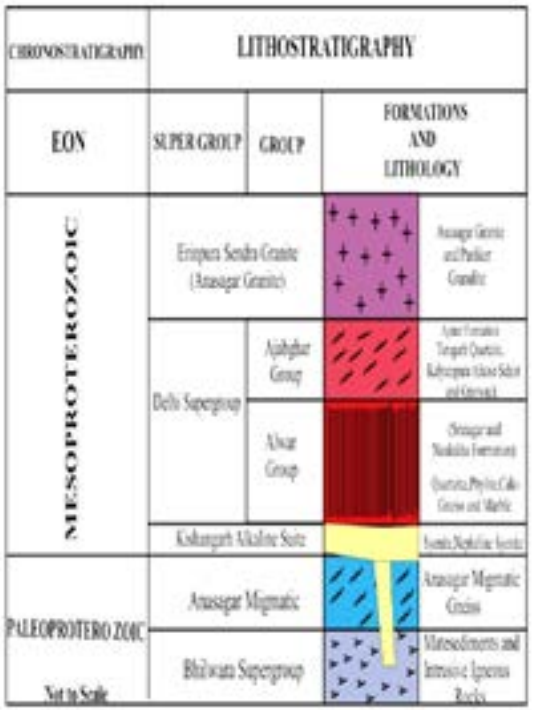


Fig. 3. Geological Map of Geopark area. **Fig. 4.** Lithostratigraphy of Geopark area (Modified after Mukhoupdyaya *et al*. 2010).

A large-scale *Kayad* underground mine of Pb-Zn is situated in the northern part of the Geopark, which is operated by the Vedanta Group. Mining of masonry stone (quartzite), Clay with small marble and granite mines are also there in the Geopark area. The main industries in the area are textile, food products, leather products, wood products, feldspar and quartz grinding, marble processing, and asbestos, cement, plastic, chemicals,and fertilizers. Tourism is also one of the main industry in this area.

GEOHERITAGE OF THE GEOPARK AREA

The local geology discussed above and our fieldwork reveals that twenty-one geoheritage sites can be recognised in Ajmer Geopark (Fig. 5). Based on Ruban, (2010), these geosites can be categorised into five geoheritage types in the proposed Geopark area: geological (eight geosites), geomorphological (one geosite), hydrogeological (five geosites), geo-historical-cultural (five geosites), and archaeological (two geosite). Ajmer Geopark with its variety of geosites of national and regional significance will certainly provide an opportunity to create a more balanced development between geoheritage conservation, public education, and socio-economic development in the region through geotourism.

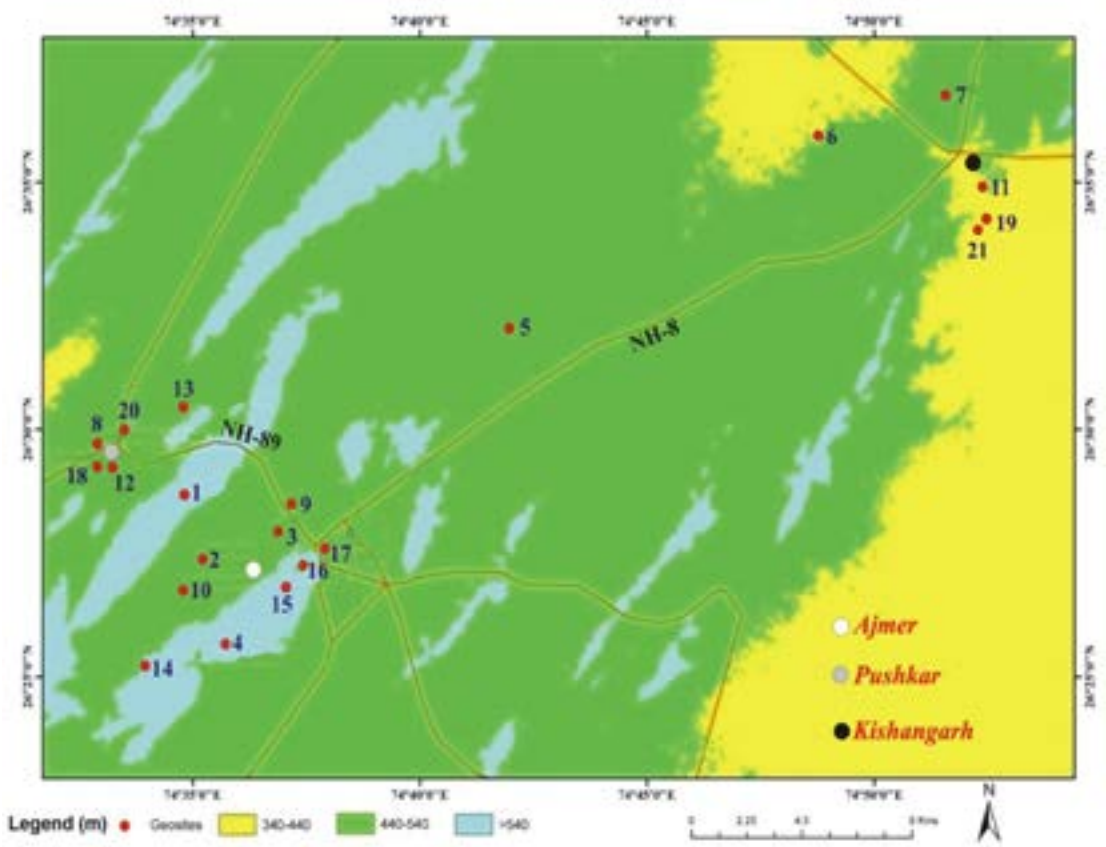


Fig. 5. DEM of the Geopark area showing various geosites (numbering as per text).

A: GEOLOGICAL TYPES

1. *Nag* Mountain Range or Snake mountain (*Nag Pahar*, Fig. 6)

Nag Mountain is located between Pushkar Lake and Ajmer and is believed that Agastya Muni lived here. Geomorphologically, in the Geopark area, Nag hill is in the east and southwest, the *Parvata* hill in the south, the *Savitri* hill in the southwest,

and *Dungri* hill in the north, forming the Pushkar valley in between them (Fig. 2). The rocks of *Nag* hill mainly constitute the AGD in which the lower plains are occupied by gneisses and quartzite at the top represented by Alwar and Ajabgarh Group of Delhi Super Group, respectively. Many sites in the *Nag* Mountainare showcasing beautiful metamorphic textures and structures. The AGD occupies the lower plains of Ajmer and the eastern part of Pushkar Valley. Geologically, *Nag* hill and *Taragarh* hill are mainly composed of rocks of Ajabgarh and Alwar Group of rocks in which quartzite is dominantly present in both. It is believed that the *Nag Kund on*, the *Nag* hill was home to Vatu, Lord Brahma's son who was confined to the hill after he was punished by *Chyavan Rishi* for being a mischief-maker. The attraction, thus, has religious significance and is also famous for trekking and natural walks. Sand hills and dunes occupy the west and north part of the Pushkar valley. Among many small streams and *nalas,* the Saraswati river (local ephemeral river) originates from *Nag Pahar* and Sagarmati river originates from *Pal Bisala* and joins at Govindgarh to form the main Luni River which thus originates from *Nag pahar.*

2. Ajmer valley (Fig. 7)

The valley, in which the city of Ajmer is situated, is a syncline, the core of which is occupied by the Ajabgarh schists. The Taragarh quartzite to the southwest of Ajmer forms the western limb of the syncline. A Similar limb of quartzites appears on the eastern side of the valley. Structurally, these form an anticlinal arch over the Ana Sagar Gneiss. The Ana Sagar granite gneiss occupies a wide, low-lying valley and is surrounded by escarpments of the quartzite of Alwar Group dipping away from the granite gneiss, which has been described by Heron as “either a laccolith or a great sill folded into an anticline. Due to erosion, the top of the anticline has been removed leaving behind bold escarpments of quartzite overlooking the valley on all sides except in the northeast (Fig. 2).

Fig. 6. Nag Mountain in background of Ana Sagar.

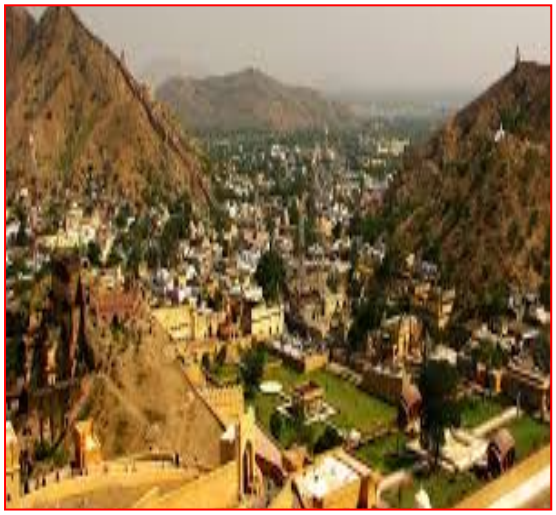


Fig. 7. Ajmer Valley and its settlement.

3. *Ana Sagar* Gneiss Dome (AGD, Fig. 8 & 9)

The AGD occurs as an elongate rectangular body, enveloped by quartzite of *Nag pahar* and *Taragarh* hills occuping low-lying hills dominantly occur in Ajmer valley (Heron, 1953). Good outcrops near Ana Sagar form a large and spectacular landscape. The hillocks and ridges of AGD are made up of Ana Sagar gneiss and the intervening valleys and are occupied by amphibolites and mica schist. Granite gneisses which occupy the flat land between the eastern and western ridge systems display four

phases of folding. It is similar to the world-fame mantled dome gneiss (Escola, 1949). It is a core of the metamorphic complex and is a thrust related dome. Because of these unique characteristics, AGD is a good educational site for geology students. Ana Sagar gneiss suggests a crystallization age of 1849 ± 8 Ma. (Lopez *et al.* 1996).

Fig. 8. Outcrops of Ana Sagar Gneissic Dome.

Fig. 9. Outcrops of Ana Sagar Gneissic Dome.

4. *Taragarh* Range (T*aragarh* Hills, Fig. 10 & 11)

The Taragarh range represents the western limb of Ajmer syncline, which is mainly composed of *Taragarh* quartzite. Taragarh quartzite forms the high scarps and hillocks and the lower part of *Taragarh* hills are occupied by mica schist and greywacke of Ajabgarh Group. The foothills and plains are occupied by AGD. The *Taragarh* quartzite displaysa beautiful variety of ripple marks on the way to *Taragarh* fort. These unique outcrops are spotted on the road going to *Taragarh* fort from Ajmer city and mark significant educational sites in the Geopark.

Fig. 10. Taraharh Hill and rampart of Taragarh Fort.

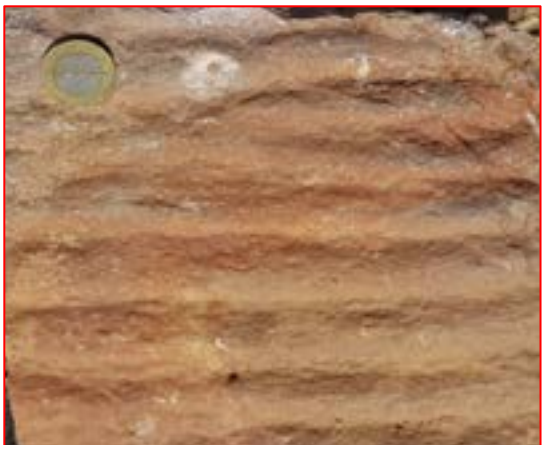


Fig. 11. Ripple Marks in Quartzite at Taragarh Hill.

5. Mining activities in Geopark: Kayad (Fig. 12 & 13)

i. Pb-Zn and associated Ag and Cu deposits are mined out at *Kayad* village situated at about 9 km NNE of Ajmer. The mine was earlier operated by India's largest Pb-Zn mining company i.e. Hindustan Zinc Limited and now by the Vedanta Group. The

deposit is hosted by quartz mica schist and calc silicates of Ajmer Formation of Ajabgarh Group of Delhi Supergroup. These rocks host three main lenses of 250-900 M length and 5-35 M width covering a 480-hectare area with mineralization of Pb (1.17%), Zn (7.23%) with the minor occurrence of chalcopyrite, pyrrhotite, and pyrite. It is a mechanised underground mine and an important centre for the training and education of geology and mining engineering students. Mining is carried out by the decline-stopping method. It has a total reserve of about 9.7 million tonnes of ore contributing to the socio-economy of the area (Zinc News, 2019).

ii. Marble deposits belonging to Ajmer Group are extensively found in the Ajmer and surrounding areas and are quarried at several places. These marble occurrences can be grouped as the eastern belt and western belt. The eastern belt of the area belongs to the Sawar Group of Bhilwara Supergroup and the western marble belt belongs to Ajabgarh Group of Delhi Supergroup. Both are good quality building and decorative stones extensively utilized in the state.

iii. Kishangarh is the largest producer and resource holder of marble in India. Marble City, Kishangarh is one of the largest producers in the world with hundreds of cutting and polishing plants of dimensional stones. The production of dimensional stone accounts for almost 30% of the world's stone and 90% of Indian production indicating huge business and economic activity in the Geopark area.

Fig. 12. Entry of *Kayad* underground Pb-Zn mine.

Fig. 13. Granite Mining in Geopark Area.

6. Nepheline Syenite

Kishangarh National Geological Monument (NGM, Fig. 14)

Kishangarh is situated on NH-8, about 26 km northeast of Ajmer. It is well connected by railway and airways to major cities of India (Fig. 1). Due to the rarity of alkaline rocks in SDFB, the nepheline syenite of Kishangarh was declared as NGM (GSI, 2001; INTACH, 2009). It is a large pluton emplaced along with the core of an antiform of metamorphites of SDFB. NGM outcrops marked by GSI are situated about 500 m after the bypass bifurcation of Kishangarh towards Jaipur on NH-8. This significant outcrops has been destructed to large extent during construction of NH-8 and need urgent conservation. However, its outcrops can be seen upto Gondulao Lake at Kishangarh. The occurrence of nepheline syenite is unique for the reason that there is no such other known occurrence in Rajasthan. Kishangarh syenite has been dated

1590 million years to 1910 million years of age. Its unique outcrops also occur at Harmara along with *Buharu, Rampura, Chhota-Narena, and Tonkra* hills. Nepheline syenite is intrusive in to older rocks (Fig. 4) and occurs in three geological settings: (a) as isolated conformable bodies within the basement of Bhilwara Supergroup at Harmara-Buharu area, (b) as conformable bodies, co-folded with a sequence of metasedimentary and metavolcanic rocks of Aravalli Supergroup at Kishangarh-Mandawaria–Gundalav Lake, and (c) at the base of Delhi quartzite at Tonkra. In Geopark area a massive variety of nepheline syenite is present near Harmara-Buharu area. Petrographically, medium to coarse-grained nepheline syenite of greyish white to bluish in colour composed of K-feldspar, amphibole, biotite, nepheline, garnet, fluorite, and sodalite. Nepheline syenite also traversed by numerous pegmatites and thin feldspathic veins at Kishangarh (Roy and Jakhar, 2002; Abhishek. 2016) are the significant outcrops available for education to students.

7. Marble Dumping Yard (Fig. 15)

It is a huge dumping yard of marble slurry (calcium carbonate). During marble cutting and polishing 70% of the stone is gathered as waste (slurry) and only 30% of marble is recovered. As a result, a huge slurry of marble is produced and dumped near the industrial area of Kishangarh. This dumping resembles the white snow of Kashmir and Switzerland and gives a scenic view to the geosite. The site excellently resembles a vast snow-clad ground. That is why it is a popular location for shooting of films of Bollywood and also pre-wedding shoots. Hence, it has now become a hot tourist destination in Kishangarh. However, huge dumping of marble wastes contaminates the soil which has an adverse effect on the flora and fauna of the region. It has been found that the presence of ultra-fine $CaCO_3$ can be reused after utilizing some industrial application as discussed by Vaishnav and Sharma (2018). This waste can be used as ultra-fine $CaCO_3$ in Personal Health and Food Production, Paper, Plastics, Paints, Coatings stained glass and ceramic industries.

Fig. 14. Outcrops of Nephiline Syenite.

Fig. 15. Marble dump station at Kishangarh.

8. *Budha Pushkar* Sand Dunes (Fig. 16)

Sand dunes at Budha Pushkar are located about 4.5 km NE of Pushkar. The wind-blown sand invades the plains of Budha Pushkar because of the prevailing winds from SW windows in the Aravalli-Delhi fold belt of the western Thar Desert. A variety of sand dunes include sand sheet, fossils sand dunes, linear dunes, stabilized sand dunes

and are tourist attractions mainly for camel safari similar to the world-famed Sam sand dunes in Jaisalmer (Mathur et al. 2020c).

Fig. 16. *Budha Pushkar* Sand Dunes.

B. HYDROGEOLOGICAL TYPE

9. *Ana Sagar* Lake (Fig. 17 & 18)

It is a man-made lake built by *Arnoraja*, the grand father of Prithviraj Chauhan, during 1135-1150 CE. It is formed by throwing up an embankment between two hillocks named *Bajranggarh and Khobra-Bhehru* hills (Fig. 2). The lake covers an area of 5.25sq. km with the imposing Mahabir hills in its background. Erinpura granite forms its floor and a number of *nalas* from all directions flow into it. The *Banri* River flowing from the southwest is the longest. The southern side is fringed by steps (*ghats*) and gardens. On the hill, near its weir, stands the circuit house (Residency of AGG during the colonial period). Ana Sagar supplied drinking water to the city of Ajmer before the construction of Foy Sagar (Fig. 2). A Beautiful building of marble with carving is situated on the northern side of the lake known as Daulat Bagh. The beauty of the lake reaches its zenith during winters when migratory birds come to the lake. Recently, under the Smart City project, Marine Drive and Jogger Park were constructed surrounding the lake. Additionally, beautiful palm trees, walkways, and heritage lights here make the place an attractive site for visitors and tourists.

Fig. 17. Walking track and palm trees at *Ana Sagar.*

Fig. 18. *Ana Sagar* with buildings of *Daulat Bagh.*

10. *Foy Sagar* (Fig. 19)

It is situated about eight km SW of Ana Sagar in *Banri* valley between the *Nag pahar* and the *Taragarh* ranges. *Banri* river has a dam constructed in the middle of its course to give rise to a lake which is called Foy Sagar. It is named after Mr. Foy, a British engineer who designed it and the lake was constructed under his supervision, during the period 1891- 92 by the Municipal Committee of Ajmer as a famine work. It was primarily aimed to supply drinking water to Ajmer city. The over flow of this lake goes to Ana Sagar (Fig. 2).

11. *Gundolav* Lake (Fig. 20)

It is situated in the centre of Kishangarh town. It was used for drinking water as well as for recreational activities in the olden days. Boating and fish feeding in this Lake are the main attractions for visitors. On the bank of the Lake, beautiful palaces were built which have been converted into hotels and another part is the residence of the royal family. The Physico-chemical and planktonic composition of the Lake reveals that it is tending, fast towards 'eutrophism'. The quality of water is deteriorating day by day due to the inflow of domestic sewage, municipal waste, agricultural runoffs, and effluents of organic waste of animal and human origin into the Lake. Hence, it is in a pathetic condition and requires conservation and protection.

Fig. 19. *Foy Sagar.*

Fig. 20. *Gundolav* Lake, Kishangarh.

12. *Pushkar* Lake (Fig. 21)

Pushkar Lake is an important pilgrimage centre in Rajasthan. It is surrounded by the *Dungri* hills in the north, the *Gurumba* hills in the northwest, the *Nag* ranges in the east and southeast, the *Parvata* hills in the south, and the *Savitri* hills in the southwest direction. There are sand hills and dunes in the west and north (Fig. 2). It also receives a few streams of which the biggest one is the *Gori* river flowing from the south. It has great religious importance for *Hindu* pilgrimage.

13. *Budha Pushkar* Lake (Fig. 22)

It is the richest cultural node of Rajasthan. The snake hill (*Nag* Hill) separates it from Ajmer city. *Budha Pushkar* lake occupies the vast valley which is formed between the parallel and high ranges of *Gurumba – Sungiri* and *Nag*hills (elevation range of 650-856m) running in southwest and northwest direction respectively. It is considered as one of the most religious places for the holy bath for Hindus.

Fig. 21. *Pushkar* Lake and Temples at its bank.

Fig. 22. *Budha Pushkar* Lake.

Rivers

There are two prominent rivers in the area *viz.*, *Sagarmati* and *Saraswati* Rivers. The *Saraswati* River originates from the southwest part of the *Savitri* hills, while *the Sagarmati* River originates from *Pal Bisala,*. Both these rivers in the south-west direction of the Geopark area join at *govindgarh* to form the main Luni River course, the largest River of western Rajasthan (Fig. 2).

C. GEOMORPHOLOGICAL TYPES

At several places, including *Ajaisar* hills and *Sreenagar* hills, the granite is intruded into the gneisses of AGD. The intrusion is structurally controlled, occurring in the hinge of Anticline givens hook-shaped profile. Beautiful various types of folding, faulting, schistosity, cleavages, lineaments, mullions, and boudinage features can be observed which are the main structural elements at this geosite of great educational value.

14. Elephant Shape Sculpture (Fig. 23)

At *Ajaisar* hills near *Ajaipal* and lord *Shiva* temple, there are spectacular landscapes and sculpture shapes in granite like the mouth of *Ganesha* or elephant and many spheroidal and onion shell weathering structures along with pot holes formed due to weathering and erosional processes. Landscape of such shapes has given it religious importance. This place which is developed as the location of the famous *Ganesha* Temple, is also a recreational place of Ajmer city and is also famous for tracking and nature walk for nature-loving groups. The granite outcrops of Geopark areas shows many wind and water erosional structures like pot holes, spheroidal and exfoliation weathering features.

D. GEOHISTORICAL- CULTURAL TYPES

15. *Taragarh* Fort (Fig. 24)

Taragarh Fort stands on *Taragarh* quartzite ridge at a height of about 395 m on the tar road that goes via Chandra Vardai nagar and Prithvi Raj Chauan Smarak from Ajmer city. On the way, well-preserved ripple marks can also be observed at several places. Taragarh fort was built in 1113 CE by *Ajaipal* of the *Chouhan* dynasty. The fort has immense archaeological and historical importance. It is considered as the oldest hill fort of India. Its outer walls effortlessly merge with quartzite hill ranges and make it extremely difficult to get in. It has a rampart with prominent six gates named-*Laxmi Pol*, *Phuta Darwaza*, *Bada Darwaza, Bhawani Pol, Mathi Pol,* and *Arcot Darwaza* (gate). It is interesting to note that in the fort area, a number of ponds are situated in which water drained from natural small perennial streams from *Taragarh* hills is accumulated. The fort is accessible through an adventurous ride through a tar road amidst the Happy Valley. A mosque is situated at the top of ridge in the fort. The whole area is now converting into ruins hence, needs cleaning and conservation.

Fig. 23. *Ajaisar,* Elephant sculpture shape.

Fig. 24. Taragarh Fort.

16. *Adhai Din Ka Jhopra* (Fig. 25, 26, 27 & 28)

Adhai Din Ka Jhopra is one of the most noticeable buildings in Ajmer in the context of historical importance. *Adhai Din Ka Jhopra,* was built by *Visaldev* in 1193 CE, is now the finest and the largest example of anancient Muslim mosque showcasing Indo-Islamic architecture. Earlier, it was a Sanskrit learning college. In 1153 CE. *Pir Panjab Shah* from Punjab stayed here for two and a half days and thus it was named *Adhai Din Ka Jhopra*. Besides *Adhai Din Ka Jhopara*, there are several other very important tourist places like *Soniji ki Nasiya*, Prithviraj *Smarak*, Pratap *Smarak etc.* for the tourists visiting Ajmer.

Fig. 25. *Adhai Din Ka Jhopra.*

Fig. 26. *Soniji Ki Nasiyan* at Ajmer.

Fig. 27. Prithvi Raj *Smarak*, Ajmer.

Fig. 28. Maharana Pratap *Smarak*.

17. Ajmer *Sharif* (Fig. 29)

It is a shrine, considered of importance next only to *Macca/ Madina* in the world. The sacred shrine was built in the early 13th century. It is the final resting place of *sufi saint Khwaja Moinuddin Chisti*, better known as '*Garib Nawaj'*. It attracts millions of visitors and tourists from all over the world. The shrine is situated at the foot of the *Taragarh* hill and separated from the hill only by a water tank, known as *Jhalra* tank.

18. *Brahma and Varaha* Temple (Fig. 30, 31 & 32)

Brahma Temple is a very ancient and important pilgrim center of India situated at Pushkar (Fig. 5). It is the only temple in India which is dedicated to the Creator of the Universe, *Jagatpita Brahma,* built in the 14th century. In 1866 CE, it was re-built using marble and decorated with silver coins. There is also a silver turtle (*Vahan*, the mount of Brahma) on the floor of the temple. The *Shikhar* (top) of the Brahma temple shows many smaller *Shikharas* which enhances the beauty of the temple. Another important temple near Brahma temple is known as *Varaha* Temple having a height of ~45 m. *Varaha* is a rare avatara (incarnation) of Lord *Vishnu*. It was constructed by king *Arnoraja* in the Year-1123-1150 CE. It is built superbly with remarkable architecture consisting of a dome, walls and golden pillars, and hanging eaves of ancient times.

Fig. 29. Ajmer *Sharif.*

Fig. 30. *Brahma* Temple, Pushkar.

Fig. 31. Carvings and sculptures at *Varaha* Temple.

Fig. 32. Statue of cow at *Varaha* Temple.

19. Kishangarh Fort (Fig. 33 & 34)

Kishangarh Fort, also known as *Roopangarh* Fort, was built in 1649 by *Maharaja Roop Singh*, and is an epitome of the Rajput and Mughal styles of architecture, situated in Kishangarh. The nine turreted fortifications of the fort encompass within it several battlements, jails, granaries, armories, and foundries. Entry to this fort is restricted and is open only for the tourists and guests residing in the adjacent hotel *Phool Mahal* Palace, which is owned by the former ruling family.

Fig. 33. Kishangarh Fort.

Fig. 34. Kishangarh Fort on the Bank of *Gundolav.*

E. ARCHAEOLOGICAL TYPE

20. Sand dunes (Fig. 16)

Budha Pushkar Sand Dunes occur within the inter-hill valleys in the SDFB near *Budha Pushkar* about 10 km northwest of Ajmer. Stratigraphically, yellowish-brown sand dune horizon is aeolian in nature, followed by 1 to 3 m thick calcareous pale brown fine sand having numerous carbonate nodules. The oldest unit is a palaeosol consisting of yellowish-brown fine sand. Budha Pushkar is also known for lenses of detritus that include rolled lower and upper Palaeolithic artefacts and tools which occur in the lower sandsheet of wash debris deposits. These include many objects like cores, burin, and keeled scraper, end scraper, flake, blades, and flakes of Mousterian tradition (Allchin and Goudie, 1978). Based on microliths found within the aeolian units and other archaeological evidence, Agrawal *et al.* (1980) gave 2000 to 4000 years of age, while Singhvi *et al.* (1994), based on the obtained TL dates, have concluded that the dune activity in this part has been confined to two epochs around ca. 25 and ca. 15 ky.

21. Kishangarh Ancient Art Palace (*Bani-Thani* Paintings)

The most famous Kishangarh painting is called Bani-Thani. The Indian government has displayed it on one of its postal stamps. According to folklores, *Bani-Thani* was a beautiful singer who was the love (interest) of *Nagridas*, a famous Artist of the court. Painting's main subject is the lady with anaesthetic use of bright red and blue colours. The natural scenery is also well portrayed in this style of painting where ducks, flamingos, a beautiful pond, and birds are emphatically drawn. The story of the discovery of Kishangarh paintings is quite thrilling. When Eric Dickinson, professor of English literature visited Mayo College, Ajmer in 1943, he was taken to Kishangarh palace to see the collection of paintings. He greatly admired them and some of the paintings he later exhibited at the National Museum, New Delhi. After that, it became famous worldwide and an altogether independent style of painting was recognised as Kishangarh school.

Fig. 35. *Bani Thani* paintings, Kishangarh.

CURRENT STATUS IN TERMS OF PROTECTION AND MANAGEMENT

Most of the historical and cultural geoheritage sites of Geopark are managed by individuals, trusts, and societies. Several hydrological geosites are under Government or religious trusts and are well managed, except for *Foy Sagar* and *Gondulav* Lake. Hence, most of the geosites of Ajmer Geopark are well protected and conserved. Geosites of NGM and hills of nepheline syenite are situated on Government and partially on private land. Due to illegal mining for masonry stone and road construction; these sites are threatened by these anthropological activities. Hence, rare and most significant NGM outcrops of nepheline syenite should be conserved on priority by state and/or central Govt. as it is of graet scientific values. These geological sites with NGM after conservation will certainly become popular educational and geotourism sites, specially shape sculpture and Buddha Pushkar dune sites. Most importantly, *Kayad* Pb-Zn underground mine is a remarkable geosite of Ajmer Geopark because it is a centre of training for UG, PG, and research students of Earth Science, and Mining Engineering. Many Universities and institutes conduct their educational tour and training programmes every year and owners provide supporting facilities of boarding and lodging to them. Hence, it has come up as a big educational and training centre in India. Besides this, the majority of tourists visit hilltop temples and the fort have the opportunity for nature sightseeing, adventure and nature walk, hence these geosites have unique geotourism potential to attract tourists. Pushkar is a hub for tourists from abroad and many stay for longer periods and some are even permanently settled here for peace. Creating some necessary infrastructural facilities such as a visitor centre, ticket counter, money exchange counter, a hall, audio commentary facilities, restaurant, souvenir shop, brochures and sign boards (details of NGM, various rocks their features, flora, and fauna) and guides *etc.* will help in the promotion of geotourism in the region. Importantly, all geosites can be easily accessible through tar roads on suggested route maps and this is a positive aspect of the proposed Ajmer Geopark (Fig. 5). However, few geosites which are unclaimed or not under Government management need conservation. In the quartzite terrain, the anthropological activities and rapid urbanization are severely threatening these sites especially outcrops of sedimentary structures in quartzites.

For promotional activities, many videos of tourist and religious geosites of Ajmer, Pushkar, and Kishangarh are available on YouTube, websites of temples of Pushkar with details. Besides this, the unique and representative geosites of Ajmer Geopark satisfies the requirements of UNESCO with its five types of geoheritage of educational, aesthetic, historical, cultural, and geotourism values of national and international significance. Since a majority of historical-cultural geosites are well managed, a legal body should be established to achieve the goal of Geopark. This body may ensure partnerships and involvement of researchers, academic bodies, state Government, and local communities with a firm conservation plan. After fulfilling these criteria along with other aspects, a national body should evaluate it to provide a national Geopark tag to potential sites to be qualified for the UNESCO global Geopark for socio-economic development through geotourism in the region *viz* a *viz* in India.

CURRENT OR POTENTIAL THREATS AND REMEDIAL MEASURES FOR GEOCONSERVATION OF GEOSITE

Geological and some hydrological geosites outside the management of religious, historical trusts and agencies are poorly managed and are under serious anthropological threats due to local mining activities, rapid urbanisation, and various geological processes. To save these geosites, protected status to these areas can help in mitigation of negative anthropogenic influence on them (Mathur et al. 2020a and b). On the whole, all the twenty-two identified geosites combined into a unified area under the Geopark management system can be a better option for their conservation in the future to promote geotourism for the sustainable development of the region.

ACKNOWLEDGEMENTS

SSR is highly thankful to Chairmen, RPSC, Ajmer for his encouragement and support for the present work. SM is grateful to Dr. Sudhanshu, Ph.D. supervisor and Director, C3WR, S.G.V.U, Jaipur, for his encouragment, support and permission to work on geoheritage of Ajmer and for future academic activities for development of Geopark in Western Rajasthan. It gives us immense pleasure to express deep and sincere thanks to Dr. S.K. Singh, Associate Professor, C3WR, S.G.V.U. for support in editing the present MS with help in preparation of DEM and other work related to remote sensing. We are also thankful to Dr. K K Sharma, Dr. S D Mishra, Dr. V.N Mishra, Dr. Pranay Diwate and Mrs. Priyanka Roy for their help in one or the other ways. Authors are thankful to Google Webs for using some of their photographs and information. The support and help rendered by Pt. Nathu Lal Shastri, Prof. J S Sokhi, Er. Sushma Mathur, Mrs Pramila Rathore, Er. Gaurav Mathur, Mr. Rahul Kanga, Mr Saurabh, Mr Sompal, Kartikey Singh and Jaivardhan Singh is also gratefully acknowledged.

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