

Advances in Geographical and Environmental Sciences

R. B. Singh
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Global Geographical Heritage, Geoparks and Geotourism

Geoconservation and Development



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Advances in Geographical and Environmental Sciences

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Preface

Our pious planet Earth is blessed with distinguished geographical as well as geological diversity and heritage that helps us in understanding its evolutionary trend and history. This has led to the laying of much emphasis upon the preservation and conservation of the rich terrestrial heritage. Scientific and proper exploration and preservation of the rock and fossils is the key for understanding the evolutionary processes and the environments leading to the present situation of the planet (Rana 2020). According to Yang (2015) the concepts of national park, protected area system, world heritage and biosphere reserves have been constructed in the United States. Much of the research and training available on interpretation in parks comes from western tradition and literature directly or indirectly (Wilson 2013). Presently, at global level, the concept of national park is recognized from the IUCN (Peng 2018). Subsequently, it is anticipated that many more geoheritage sites will be identified and notified, thus affording these sites the necessary protection during the course of development. Human beings have achieved ecological dominance through series of long and unprecedented steps (Singh and Singh 2014). The natural calamities and anthropogenic activities have led to rapid destruction of various geosites. Consequently, new emerging concepts such as geosites, geodiversity, geoheritage, geomonuments, geoparks and geotourism, geoconservation have evolved and being patronized by the conservationists. Geoparks are well-defined areas that contain one or more geoheritage sites selected on the basis of scientific importance, rarity, scenic quality, or relation to geological history, events and processes. Geotourism is a new concept (Farsani et al. 2012). The different geoheritage sites encompassed within the various geoparks possess educational, scientific, aesthetic and cultural values.

According to UNESCO (2016), global geoparks are single, unified geographical areas where sites and landscapes of international geological significance are managed with a holistic concept of protection, educational, and sustainable development. In 2020, there are 161 UNESCO global geoparks in 44 countries in addition to a number of national-level geoparks. But the number of geoparks are increasing

(Kohmoto 2014). China leads the world in the number of geoparks (Li et al. 2018). But in South Asia there is no any single geopark conforming to the UNESCO definition has yet been created and developed, although different fragmented efforts are on to construct geoparks there.

Despite their unique geological and scientific importance, the distribution pattern of many significant geosites within the country remains poorly documented in the literature. Land use also put threat to the geographical diversity (Singh and Anand 2013). The holistic approach toward such sites will sensitize common people on the need for geoconservation of the various significant geosites and promoting those through geotourism. The geographical perspective on geoparks includes integrating landscape as its main concept requires a holistic approach and transdisciplinary research to promote multicultural participatory bridges (Wei 2013). The introduction of geoparks can be an initiative toward conservation of our prosperous geological and geographical heritage, thereby leading to economic rejuvenation and sustainable development of local communities. Geoparks use innovative strategies to promote conservation of natural heritage (Anand et al. 2014). Sustainable development is buzz word and now scientific communities are talking about the sustainability and for giving it to more emphasis, International Council of Science (ICSU) and International Social Science Council (ISSC) launched the Future Earth, international research platform in June 2012 for maintaining the sustainability (Himayama 2018).

The more spectacular is a site, greater is the potential for converting it into a geopark and renowned geotourism hub. The endeavor needed in this context is to influence the policy-makers for adopting a draft legislation aimed toward protection of the various national prospective geoheritage sites and also to encourage the various tourism departments to popularize these sites through well-designated tourism circuits. Geoheritage and geoparks should be incorporated within the fields of scientific studies and education books, research papers and review and popular articles describing the significance of geoconservation in the geoheritage sites, the need and significance, critical analysis of geoparks and the promotional aspects of geotourism.

Keeping in mind these concern and understanding of the urgency, it was planned out to bring out a springer volume on *Global Geographical Heritage, Geoparks and Geotourism: Geoconservation and Development under the Advance in Geographical and Environment Sciences*. Present edited book is a compilation of the valuable contributions made by eminent scientists, research scholars, and professionals who are trying to develop alternative strategies, solutions for the sustainability of geoheritage and geoparks and others through various empirical research and experiments ranging from local to global scale. This edition would be of immense use to the policy-makers, environmentalists, conservationist, academician, and research scholars who are directly or indirectly involved.

Elizbarashvili et al. in their chapter discussed the geographical diversity and perspectives of planning of geoparks highlighting the geoparks networks and tourist attraction of the Georgia. They emphasized that all forms of topographical features are present in the nation. To make the impression on the tourist, the country has 100

of monuments but it is disappointed that the nation is not yet been presented in the world geographical parks (geoparks) networks. In the next chapter, Sadry et al. identified and assessed geodiversities around Takht-e-Soleiman world heritage site to propose the territory as the third geopark in Iran, studied about the UNESCO listed world heritage site of northwest Iran, Takht-e-Soleiman. The place is rich from biodiversity, geodiversity, and historical and cultural point of view. According to the investigation of geoparks and geotrial map, the finding of the study is that the region has the potential for further community engagement and research in future. It is important that through private and government sector investment and sound infrastructure the region can be listed as a national and later as a global geopark in UNESCO. Next chapter has been contributed by Luger et al. entitled “Geoheritage: A Strategic Resource for the Society in the Anthropocene”, tried to give answer to the meaning and importance of geoheritage in contemporary society. They felt the requirement of the unconventional and new system of commuting, sciences, particularly earth sciences for the involvement of society in successful interaction with the environment.

Santos et al. authored a chapter on UAV’s Multimedia Technology and Augmented Reality (Geointegration): New concept and new paradigm of geodiversity presentation. The study acquired the image data with Unmanned Aerial Vehicles (VANTs) and Geographical Information System (GIS). The paradigm is that even when faced with several functionalities in some cases, this technology is not always adequate considering the available representation resources, some aspects of the structure to be imaged and the conditions of scale. Mansilla et al. in the chapter entitled “Virtual Heritage: a model of participatory knowledge construction toward Biogeocultural Heritage Conservation”, highlights that by the application of the digital imaging technology, geoheritage values and sites can be conserved. There are the association of the remarkable cultural and historical values with the ancestral communities. For the effective protection of the geoheritage site in Chile they have made the proposal. This target is being accomplished through the practices of Geovisualisation proposal of new language, fundamentally reflected as virtual heritage. Nhlabathi and Maharaj, have been described the communitarian ethics, environmental conservation and development, state that sustainable usage of both natural and man-made resources of heritage, predominantly, parks, monuments, and other natural resources are the significance for its conservation and tourism development. Both authors argued for acceptance of the communitarian ethics as a frame of reference in any development project. In the principle of common good ethics of communitarian is founded. The finding of the paper state that development would meet the sustainable development requirement only if was predicated, not on unilateral securities but on the interests of the world-wide community at large.

In next chapter entitled “Ecological and Socio-Economic Vulnerability to Climate Change in Some Selected Mouzas of Gosaba Block, The Sundarbans” written by Mukherjee and Siddique attempted to highlight the ecological and socio-economic vulnerability to climate change in some selected *mouzas* of Gosaba Block, Indian Sundarbans. By conducting intensive studies on plant morphology

and stomata index, vulnerability in the ecology has been identified. Data collected from various sources such as socio-demographic profile and livelihood vulnerability index has been used to analyse the vulnerability of the regions. A study on evaluation of Zonguldak hard coal basin (NW Turkey) fossils as geosite done by Cakti et al. stated that it is important to guard the regions of geoheritage and geosite along informing the people about their significance. It has been established that building a museum comprising fossil assemblage, presenting, protecting and transmitting the geosite to the coming generation are significant for the improvement of sustainable regional development and geotourism.

Zgłobicki et al. in his chapter discussed the advantage, disadvantage, and importance of gullies and badlands as the significant site of geoheritage. They also state that scientists all over the nation are attracted by the spectacular nature and beauty of the permanent gullies and badlands which are found all over the continents of the world. They highlight that the geoheritage sites of the Africa and India are rarely visited when compared to the site in Europe and America which are frequently visited. Escorihuela, in the chapter, analyzed that geoeducation and geoethics among the children for sustainable tourism and development of aliage geological park in Spain. It creates awareness that as most of the study conclude their finding through the secondary studies without basic notions about the earth sciences, it is important to conduct in the field studies to study about the geosites, geoparks, and geological parks. The finding of the study displays that children, who have been attending the summer courses had an advanced knowledge than adults, not only about the environment, but also about the implications of the human activities in the territory.

Clary contributed chapter on the “Location, Location, Location: Challenges of Effective Geoscience Education within Geotourism Opportunities at Coastal US Fossil Park Sites” described that in US with the fossil park a unique geotourism venue exists. The park is conserved for the purpose of imparting informal education of geoscience to the visitors as well as permitting the retention of a small number of personal fossils and promoting sustainable collection. The finding of the study is that even with additional interpretive challenges, the parks can extend visitor geoliteracy for optimized geotourism opportunities. Occhipinti described that geoparks and geosites: geological “learning objects”, mentioning that, on the school of Italy there is lack of general sensitivity toward the earth science. The author highlighted the problem resulting from the lack of sensitivity in Italian context. It directly leads to a lack of attention to the territory which whereas requires to be protected and “geo-preserved”.

Tripathi analyzed the geoheritage sites and scope of geotourism in land of Chhattisgarh, discussing that geoheritage sites are scientifically, culturally, and educationally important for civilization. The study found that the overexploitation of the minerals from the region for the utilization in the industries has led to the extinction of geoheritage site in the area. The author suggested that geotourism with right laws and ethics will not merely led to conservation, management, and protection of these geosites but also help in socio-economic upliftment of the local people. Dongying, contributed a chapter entitled “The exploration into evaluation

index system for the protection effectiveness of natural heritage protected areas”, emphasized that protected area of the natural heritage has an important role in the cultural, historical, and scientific values of the geological heritage so it is important to strengthened their protection. The paper aimed to explore the evaluation index system for the security effectiveness of natural heritage protected areas, so that the general understanding of the current situation, problems of the heritage and the rational development of nature reserves can be obtained. Wadhawan, highlighted the importance of the geoheritage and potential geotourism in geoparks with special reference to India, describing that it has a variety of domains of the geological sites ranging from Achaen/Precambrian to active Anthropocene and Neogene with various world class interesting sites of geoheritage that display unique geological features, fossils, various rock types and tectonic discontinuities, and its geological boundaries, processes and landscapes. It has been found that geotourism is generally dependent on earth’s geoheritage, educative through, geo-guides, geo-interpretation and increased consciousness, locally favorable through sustainable economic viability community involvement and foster geoconservation.

Sterquel et al. in the next chapter entitled “New Routes of Geotourism for the La Campana-Peñuelas Biosphere Reserve, Chile” concluded the Mediterranean ecosystem of Central Chile is reflected as the global “*hotspot*” of biodiversity due to its rapid rate of destruction of its habitats and high level of endemism. They have felt that its conservation and protection is needed to invite, local, regional, and national tour operators to evaluate critical points and gaps in tourist services and the management of the territories.

Hose, in the chapter on modern geotourism’s UK antecedents, highlighted an impression of development of geotourism from the late seventeenth century to the contemporary day, drawing an example from the United Kingdom (UK), in which the geotourism concept was first formally defined and recognized. Especially, in relation to its role in geoconservation and the provision of geo-interpretation, a twentieth paradigm. Kubalíková et al. discribed the geomorphological resources for geoeducation and geotourism, considered that main resources for geoeducational and geotourist events are closely related and support each other. They believe that increment of the reorganization of the geodiversity and geoheritage at inclusive level can be attained by the geoeducation. It can help in maintenance of the geotourism activities in rational scale and avoid the overexploitation of the geoheritage for geotourism purposes. In their chapter, Cayla and Megerle discussed in the detailed about the Dinosaur geotourism in Europe, a booming tourism niche, mentioned that very popular science topic is not only comprised of Dinosaurs, throughout the entire world but at contemporary period paleontological tourism emphasizing the paleontological sites are booming. However the finding of the study suggested that success of the tourism projects must be based on the structured network of the gathering scientists, actor networks, stakeholders of the tourism supported by the local policy-makers and local population course.

The chapter on use of geoheritage, geopark, and geotourism concepts to conserve and sustain tourism development in Zambia, Mwamulowe, and Nyambe analyzed how geopark, geoheritage, and geotourism concepts can be utilized as the

tools for the conservation and sustainable development in Zambia. This chapter introduced the various concepts in heritage of the earth, namely, geology, geological heritage, geomorphology, conservation of geoheritage site, geotourism, and geopark. It has been found that the concepts of the geoparks, geoheritage, and geotourism have not been applied till now but it will be applied in coming days for fostering conservation and sustainable development of tourism in Zambia for its socio-economic development.

In the next chapter, Tefogoum et al. in their chapter entitled “highlight of geotouristic values of a volcanic landform on the mount manengouba eastern slopes: Case of Djeu-Seh basin” discussed that along the Cameroon volcanic line mount manengouba, is one of the most significant and voluminous volcanic apparatus and it is comprised of one of the nested calderas noticeably Elegoum and Eboga. It has been found that cultural value of the site is magnificent and the site is characterized by good accessibility and quiet environment. Jangra and Kaushik estimated the carrying capacity in a high mountainous tourist area: a destination conservation strategy, emphasized that in the tourism sector entire issues are associated with the magic number of tourist that visit the certain destination. As per the calculation, it has been found that the number of PCC, ECC, and RCC of the selected spots of tourist in Kinnaur are 64835, 5928, and 9595, respectively. It has been commonly accepted that ECC type is the most acceptable type of carrying capacity and its presentation of the status of the activity of the tourism are highly underexploited in the study area. The last chapter of the book on collaborative creation of educational geo routes: a strategy for teaching and learning sciences and geography, Puchuncaví, Chile, has been contributed by Martija et al. The authors described the collaborative development of a teaching innovation called educational geo routes. Focusing on the relationship between the socio-environmental context of the students and their schools with the national curriculum.

The aforesaid chapters of the present book look into the various critical issues related to geoheritage and geoparks in the detail. The papers also suggest solutions for the sustainable development and sustainability of the geosites in the different regions of the world. Looking the situation, it is high time to conserve and manage the existing geosites and geoparks so that geotourism can speed up. This edition would be of significant use to the policy-makers, environmentalists, conservationist, academician, and research scholars who are directly or indirectly involved.

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Part I
Geographical Diversity and Geoheritage

Chapter 1

Geographical Diversity of Georgia and Perspectives of Planning of Geoparks (Geo Heritages)



Nodar Elizbarashvili, Zurab Laoshvili, Giorgi Dvalashvili,
and Rusudan Elizbarashvili

Abstract Georgia is in the middle of the area (70, 000 km²) almost 25 in the Europe. The formation of the country's territory counts for one billion years. All forms of relief are presented in Georgia, which is known worldwide. There are hundreds of natural monuments on the territory of Georgia that make a special impression on the visitors. It is also important that such monuments of nature are concentrated on a small area that increases their tourism and recreational purpose. With the diversity of nature, Georgia can be presented in the world geographical parks (geoparks) networks, and will further increase its tourist attraction. Georgia has not been presented in the world geographical parks (geoparks) networks, what is an interesting as Caucasus Office of Nature Protection World Fund, as state and local tourist organizations. The relevant nomination can be submitted by Elizbarashvili (2018): **1. Javakheti—volcanoes and Vardzia canyon** is located in southern Georgia (Akhalkalaki administrative district). It is made of lavish streams flowing from the slopes of the Mordian direction. There are several volcanic cones on this ridge that create effective peaks. The western boundary of the Plateau passes through the Vardzia canyon (the administrative district of Aspinza), with an average depth of 500 m, and a length of 7 km. It is in the middle of the medieval city of Vardzia (13-storey cave building) and monastery complex, which is nominated for a UNESCO cultural heritage monument. Some volcanic lakes are presented under geopark, which present Ramsar Convention site and are in composition of protected territories of Javakheti. **2. Imereti—The dinosaur footprint and the Imereti Cave Complex** (including the Kutaisi city and Tskaltubo administrative districts) in central Georgia—There are over 200 unique footprints of dinosaurs, which are found in 1933 on the mercury limestone. The footprint is located at 500 m above the sea level, with subtropical humid conditions and the western exposition winds (slopes from the Black Sea). Nearby, there are several karst caves, geological, paleontological, zoological, and botanical monuments. The Tskaltubo Cave is one of the most remarkable places in Europe. **3. Khevi—Glacier (Kazbegi), Gudauri volcanic plateau and Dariali Gorge**—The glacier is located on the central Caucasus in northern Georgia (Stepantsminda administrative district).

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Its height is 5033 m. The local population call it “Khevi bride”. The glacier is a “dormant” volcano that lasted 6,000 years ago. Here the lavish deer runs in three—south, east, and north-east. One of the mythological and one historical (Gergeti Trinity) monument is the monument on the edge of the glacier. Mythology is connected to Amiran (the analog of Prometheus) attached to the Caucasus. According to the tradition, God Amiran right here climbed the cliff, and “on top of the snow-ice gear and the glacier of the glacier”. At the foot of the glacier, Dariali canyonic gorge is represented in the rocks formed in the form of volcanoes developed over 300–400 million years ago, central Caucasus. Its length is 11 km, and the relative height is more than a thousand meters. There is also a volcanic plate of Gudauri, whose vertical slopes are formed by lava cooling (suspension).

Keywords Geographical · Geopark · Natural · Diversity · Volcanic · Georgia · Caucasus

1.1 Introduction

Natural diversity of Georgia is distinguished in the world, especially in subtropical and moderate midfield. Here are presented more than seven dozens type of landscape, beginning with humid subtropical or semi-arid bright woods, ending with wetland and nival landscapes. Such diversity is connected to several factors, from which are important: geographical location (tropical and on boundary of moderate midfield), effect of unfrozen black sea, height distribution of geographical factors and characteristics (from sea level till 5200 m) and thousand-year-old history of using of trust territory (Elizbarashvili and the other 2018a).

Georgia is also distinguished in the world with “initial” in other words with high comparative lot of natural landscape, which includes 17% of country’s area. We can find natural environment as an undamaged, as on protected and wetland territories, as in conditions of moderate and mountainous relief.

According to the covered territory (up to 70,000 m²) and population (3.7 million), Georgia takes 25th, almost the middle place in Europe. Here is represented all well-known forms of relief, several types of climate (humid subtropical, dry subtropical, arid, semi-arid, and semi-humid), several dozens of plants and grounds. A huge ecological resource is forests which cover 2/5 of territory of the country. More than 15,000 plants grow in Georgia of which more than 4000 are pomaceous, 75 covered in bracken, and 2600 aquatic plant. 6.0% (i.e., almost 900 species) of plants are endemic and relict. Animal world is featured with the same diversity of which more than 100 species are mammals and more than 300 are birds. Pursuant to the number of life species, endemic regions and biodiversity, Georgia is included within five of a European Countries which distinctly confirms its diversity and irresponsibility of natural environment (Geography of Georgia 2000).

Almost the whole altitude spectrum of life world of Europe is seen in Georgia within miniature sizes. Georgia with total number of flora species takes the V place

in Europe. Georgia with this index highly exceeds the UK, Ireland, Eastern Europe, and countries of Scandinavia. According to the number of mammals and bird species, Georgia takes the first place in Europe while pursuant to the life of endemic region backwards only such countries such as Spain, Greece, Italy, and Bulgaria (Biological 2000).

By the number of landscapes, Georgia holds the 12th place in the world while the first place in Europe. Georgia backwards only big countries by this index: China, USA, Russia, Australia, Mexico, India, Canada, Brazil, Argentina, Turkey, and Chile. Even though, due to proportion of territory size with landscape diversity, Georgia holds the first place in the world. It 20 times exceeds with landscape diversity the average index of the world (“Biological” 2000).

Georgia as the part of Caucasia includes (Fig. 1.1)



Fig. 1.1 Caucasus Ecoregion: priority conservation landscapes and key diversity areas (WWF Caucasus 2018). Perspective Geoparks Area in Georgia—Javakheti (1), Imereti (2), Khevi (3)

- In the richest biologically and being under danger 34 “hotpoints” of the world;
- In the most sensitive, vulnerable 200 ecoregions of the world, which are distinguished with the high biodiversity;
- In the location of endemic birds;
- In agro-biodiversity centers of the world;
- In the “hotpoints” of spreading of large grass eaters.

Georgia is distinguished in Europe with fertility of single components of nature (read earth, tertiary’s relict Colchian forests, unimpaired forests, etc.), relict and rare species, inorganic monuments of nature (volcuses, natural bridges, location of petrous flora and fauna, etc.). According to this index and subject matter, Georgia is one of the greatest touristic-recreational centers of Europe (Elizbarashvili and authors 2018).

Georgia in the list of the world-historical heritage is presented with 2 objects including Village Chazhashi (Zemo Svaneti, unique combination of natural landscape, middle centuries architecture and traditional agriculture) and Mtskheta’s (historical capital (up to fourth century) world heritage monuments (status granted in 1994). Georgian alphabet, traditional polyphony (singing), wine-jar, and Meskhian “Tenili” cheese is included in the non-material heritage of world by UNESCO. Georgia also is considered as the homeland of grapevine (316 cultural species of grapevine), location area of endemic species of cultural plants and domestic animals (5 of 14 species of world well-known wheat is Georgian, endemic Georgian bee, sheep, horse, cow is also well known). Oldest honey (5500 years old) and oldest textile (35 thousand years old) manufactured in the world is discovered in Georgia. Georgia is also considered as the homeland of first Europeans. Results of Dmanisi archeological excavations changed the geography of humans spreading from Africa to Eurasia (“Human Odyssey”) and, respectively, historical–geographical development tendencies of mankind. The oldest skull of human recorded in the continent of Eurasia is 1.8 million years old and is discovered in Dmanisi. Georgian writing system and language is unique in the world. Georgian alphabet and writing system is oldest while writing system is included within 14 writing system of the world.

1.2 Results

Georgia has not been presented in the world geographical parks (geoparks) networks up to this date, what is an interesting Caucasus Office of Nature Protection World Fund, as state and local tourist organizations. The relevant nomination can be submitted by

1. Javakheti—volcanic plateau of Javakheti, canyon of the River Mtkvari, Vardzia Monastery Complex

Territory represented for first nomination of Geopark in Georgia is concluded with three main parts.

First or volcanic plateau of Javakheti involves several volcanic conus of Abul-Samsari Ridge (Big and Small Abuli, Chikiani, Tavkvetila, Samsari, Shavnabada, etc.) and that drift flow which creates volcanic carcass of the region. Height of Big Abuli is 3303 m above sea level. Now it represents extinct volcano which actively operated 10–12 thousand years ago. Mountain Small Abuli (2800 m) is located in South from it of which hillsides and foundation are covered with interesting denudative forms so-called “rock flows”. At the south hillside of Small Abuli, 2670 m above sea level is located dry-constructed cyclopic castle which is unique in Caucasus. Chikiani Mountain located in the north part of Javakheti Ridge is constructed with volcanic glass. Word “Chika” meant glass in Old Georgian Language (both artificial and natural). Chikiani is almost wholly constructed with obsidian and the name of mountain is resulted hence. This peak reflects sun rays in the sunny weather and magnificently shines. Obsidian had a huge role in the history of human: as yet in Stone Age, the ancestor of human started creating labor and battle instruments from obsidian. Deposit of obsidian and workshops for manufacturing different instruments is left on the hillsides of Chikiani. Artificial, cultic rock columns of 3.5 m height is found near Chikiani Mountain which is dated in II millennium B.C.

Second, i.e., canyon of the river Mtkvari is located from several kilometers of Javakheti Volcanic Plateau. Its depths sometimes exceed even 500 m. The main part of canyon is steep which creates irreconcilable view. It is the biggest canyon in Georgia. It had the greatest historical meaning because roads connecting Middle East and Caucasus were passed nearby (Fig. 1.2).

Third Object directly connects to the Canyon of the river Mtkvari. Several complexes of artificial caves (Vardzia, Vani Caves) and fortress (Tmogvi, Khertvisi) remained here. They belong to eleventh–twelfth centuries monuments. Vardzia is rock-carved monastery ensemble, located 1300–1460 m above sea level. It has 13 floors and represented closely populated city. Middle ages residential and social infrastructure is founded in Vardzia which attracts thousands of visitors.

Within the First Nomination of Geopark may combine the National Park of Javakheti (trans-border territory between Georgia, Armenia, and Turkey), 6 Wildlife refuge (represented in the crater of volcanic origin lakes), several over-saturated



Fig. 1.2 Vardzia Canyon and Monastery, Volcanic plato and Volcanic conusys

territories (which represent the site of Ramsar Convection), four type landscapes (middle mountain bushes and arid sparse forests, mountain volcanic plateau with steppe plants, fields of high mountain sub-alpine and high alpine), and part of two historical–geographic province (Meskhети, Javakheti).

Meskhети and Javakheti products traditional “Tenili” cheese which is distinguished with the most complicated production techniques and is enrolled in the World Heritage list of UNESCO. Cheese material is framed for aging in the pot (of which the name is originated) and is covered with milk cream. It is produced in single families and small enterprises. Cheese is a delicatessen.

2. Imereti—Okatse Canyon, dinosaur footprint, Thermal waters of Tskaltubo, Caves of Imereti and Katskhi Column.

Territory represented for the Second Nomination of the Geopark in Georgia includes four main parts.

In the central part of Georgia, within the historical–geographic province of Imereti, at a several km distances is located the longest and narrowest canyon of the river Okatse and the highest waterfall—Kinchkha. River Okatse runs from Askhi limestone massive. Its length is 16 km while average width is 4 meter. Sides of canyon almost connect each other at several places and create natural rock-bridges. At the natural rock bridge (“Kvakhida”) the depth of canyon reaches even 100 m. The river creates lakes which have blueish-greenish color. There are many waterfalls in gorge of which Kinchkha waterfall reaches 80 m. It has the status of nature monument.

In the land of imereti, within several kilometers from each other, is situated one of the tallest Karchkhi waterfalls in Georgia and the deepest Okatse Canyon. Right tributary of river Tskhenistskali—river Okatse—flows from Askhi massif. In the area surrounding the village of zeda Gordi, it sires 16-km long canyon with the depth of 35–50 m and width mean 4 m. In some places, the walls of the canyon nearly align with each other and create natural stone bridges. One of them is “Boga” wherefrom it is possible to see even the bottom of the canyon. In the environs of the village of zemo Gordi, the river gives birth to a wonderful natural monument—2-km-long canyon, on the bottom of which natural bridges, caves, and karst sources are placed. By one of the natural bridges (called “Kvakhida”, “stone bridge” in Georgian), depth of the canyon attains 100 m. River creates lakes, and beyond their transparent bluish-greenish water white bottom is reflexed, and also numerous waterfalls, the biggest being more than 80 m tall. This waterfall known under the name of Kinchkhi waterfall has been entered into the red List as a miracle of nature (Fig. 1.3).

Sataplia-Tskaltubo’s limestone massive is located near the river Okatse with 92 m² area. Here are represented the prominent caves of Imereti and almost 200 footprints of dinosaurs on the limestone surface.

Natural monument of Prometheus (Kumistavi) karstic cave reaches with stalactites, stalagmites, helictites, petrified waterfalls, and hang rock drapes. The area of cave is 46.6 ha, length of some halls reaches 80–100 m. The total length of Sataplia Cave Complex is 900 m, depth 10 m, width 12 m. It has been forming for 30 million



Fig. 1.3 Canoy of Okatse and waterfall of Kinchkhi

years. In 1935, Sataplia National Park was created which covered geological, paleontological, speleological, zoological, and botanical monuments. 95 % of the territory is covered with relict Colchis forest which is unique in Caucasus.

Within the villages of Imereti, one of the oldest and most beautiful is village Katskhi which has rich and interesting history. Natural limestone column is towered there with height of 40 m while top area is 150 m². The column mainly is towered sheer. Column is eroded and more narrow near the column while its higher part. This shape created negative hillside which is apparently unscalable. Vicinities and top of Katskhi Column is covered with broadleaf plants which creates irreconcilable landscape. During previous middle-ages, there were hermits place and church house. A small church is constructed on the upper place of the column.

Among the villages of upper Imereti, village of Katskhi is one of the oldest and most beautiful with rich and interesting history. The term “Katskhi” stems from the Svan vernacular and means “peak”. This is proved also by geographic location of the village. The Pillar is approximately 40–45 m high, while the space of its square top surface is nearly 150 m². The Pillar stands upright. However, in its upper part, there are several small-size terraces. Near the foot, the Pillar is emaciated and narrower than its upper part, creating negative tilt and making it even more inaccessible. The environs of the Pole of Katskhi and its top are dressed in deciduous plants and lianas creating an inimitable landscape (Fig. 1.4).

Dzudzuan Cave is widely known in the the world’s historical and archeological scientific circles, where was found the oldest linen thread in the world (34 thousand years ago). International expedition, which consists Georgian, American, and Jewish specialists constantly work here. The purpose of scientists is identifying of migration ways of Homo Sapiens of Paleolithic and studying of their activity. During the last 20 years, were revealed seven residential layers of upper Paleolithic on the cave’s territory, where was discovered about 100 samples of tools of bone, hangers, amulets, stone.

It is well known that karst development is expressed with full force in the limestone sediments. The big part of Chiatura municipality area is built exactly with this kind of sediments. That is why there are a lot of caves and cavities of different kinds



Fig. 1.4 Katskhi pillar and Dzudzuana Cave

on the territory of this municipality. Notwithstanding, the big part of them has not been explored and reviewed, yet. Dzudzuana cave which is located in 2 km from the village of Mgvimevi to the East, in the gorge of river nekrisi, is well known in the world's dzudzuana cave happened to be home to the oldest known flax fibers in the world scientific circles. Since 1996, it is under the scrutiny of international expedition consisting of the Georgian, American, and Israeli specialists. The goal of these academics is establishment of migration ways of homo sapiens, belonging to Paleolithic period. Seven domestic layers were discovered on the territory of this cave belonging to this age whereby up to 100 items like ornamented bones, hangers, mascots, lucky pieces, stone tools were unearthed. Explorer found also remnants of stranded fibers made of wild flax fibers. Lab research has shown that due to certain technology, fiber was processed and dyed by a human being manually at about 34 thousand years ago.

3. Khevi—Volcanic massive of Mkinvartsveri, Lava bed of Khorisari, Dariali gorge

Territory represented for the Third Nomination of the Geopark in Georgia includes four main parts.

Tkarsheti lava bed created with the throwing up of Mkinvartsveri (5033 m above sea level) volcanic massive congested river Tergi. At the terraces of right bank of Tergi is bared row of lacustrine coverings where petrous plants of forest are represented. Stem of vertically standing trees witnesses the fast dynamic of accumulation of lacustrine sediments. These plants are high mountain aspen, birch, and juniper. Fossil forest was seen in 1968 due to catastrophic deluge of Tergi when water smashed down nearby hillside. Radiocarbon analyses of tree bark determined its age with 5950 + 60 age which specifies the date of volcanic actions.

In the end of the stream, in terrace precipices of Tergi river bank, there is a host of naked pool deposits collected here as a result of conjection of river Tergi by lava



Fig. 1.5 Mkinvartsveri and Gergeti's Sameba, Lava stream of Kazbegi Region

stream. In a slew of these water pools, we come across fossilized forest. Vertically standing trunks of trees speak for swift collection of lake deposits. These trunks belong to asp-trees, birch-trees, juniper, and other plants of high mountains. Petrified Forest was revealed in 1968, during catastrophic flooding of Tergi River, when water destroyed terrace edge. Carbonaceous test of the wood determined its age at 5950 ± 60 years old that gives us grounds to date the time of eruption of Tkarsheti lava stream as happening approximately 6000 years ago (Fig. 1.5).

Here in 1976 with the purpose of protection flora and fauna was created Kazbegi National Park. Almost treeless park is the shelter of rare species of fauna—East-caucasian tur, chamois, gazelle, and brown bear. There are birds of Georgian red list: culture, Caucasian heath cock, Caucasian snowcock, lammergeyer, war eagle, etc.

“Bat” volcanic cave popular within tourists is located 3 km north of Daba Stepantsminda. The ceiling of lava cave is created with quaternary andesite-basalt lava which cracked into six-sided prisms, i.e., columns within turning cold process. It resembles “lava organ” for fan-siting of columns. Cave is located in Darial Gorge. The name “Dariali” originates from Persian “Dar-i Alan” (Gate of the Alans). Roads connecting North and South Caucasus were passing through the gorge from the oldest times. Relative altitude of relief reaches 3300–3500 m for which the gorge was deemed practically impenetrable.

Popular among tourists, Volcanic Cave of Gamura is located in 3 km to the north from Stepantsminda. The ceiling of lava cave was formed by Quaternary system andesite and basalt lava which in the freezing process was broken into six-sided prisms, or pillars. “Pole separation” of the lava is known in many places. Special character of “Lava organ” developed on top of the Gamura cave is in the fan-like succession of poles giving it an original and beautiful appearance. The cave is created in the friable gravel under the lava as a result of erosion and with the help of a man—in old times flock of sheep was often kept here at night.

Gamura cave is located in Darial Gorge. The word “dariali” came to us from Persian “Dari Alani” (the gates of Alans). From the times immemorial the gorge was always a conduit of links between Western and Eastern Caucasus. In Dariali Gorge, near the village of Gveleti, in 7 km from the township of Stepantsminda, is located Gveleti waterfall. In Dariali Gorge, on the high rocky mountain on the left bank of river Terji, northern and eastern sides of which are unapproachable, while to the west the mount neck is covered by walls, is situated a monument of Georgian architecture—Dariali fortress. Georgian historic tradition ascribed construction of this fortress to Vakhtang Gorgasali (fifth century A.d.).

The Christian Cathedral is located near Mkinvartsveri, where a beautiful view of the Dariali Gorge is found. It is visited by ten thousand visitors every year. There is also a cave of Bethlehem located at an altitude of 4100 m above sea level.

Quaternary volcanic activity is widely represented at the tableland of crater with up to twenty volcanic centers. Two volcanic centers of this tableland are well visible from the east (from Gudauri settlement)—Big and Little Nepiskalo. Besides, within axial zone of Greater Caucasus mountain range, up to the Gudauri Settlement, is also well-known volcano centers Sadzele and Sakokhe. Mleta–Gudauri lava flow runs from the volcanic center of Sadzele which is about 12 km and ends in the Village Kvesheti at the left bank of river Aragvi.

The Georgian sheep breed is produced by multi-year folk selection in the region in the nomadic cattle breeding conditions (thirteen–fourteen centuries). It freely withstands relocation at the long distance, feeding on the sparse pasturelands, has high-quality meet and white flexible elastic wool. From thread obtained from this sheep is used for knitting highest quality carpets and warm clothes.

1.3 Conclusion

Reviewed regions nowadays represent one of the most important touristic units in Georgia. Awarding geoparks status will more increase their international awareness for which is interested as the Government of Georgia also touristic organizations and local population.

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Chapter 2

Identifying and Assessing Geodiversities Around Takht-e Soleyman World Heritage Site to Propose the Territory as the Third Geopark in Iran



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Abstract In the twenty-first century, humans paid special attention to applying criteria for the assessment of geodiversity and the introduction of the country's geoheritage to conserve this valuable abiotic natural heritage and to use it in a sustainable way, especially via new emergence of the geotourism industry. In Iran, scientific discussion of geotourism was not introduced in academic textbooks until the registration of the Qeshm Island (for the first time) in the Global Geopark Network (GGN) in 2006. However, in spite of being delisted in 2012, it made it to be listed again in GGN in 2017. Meanwhile, the academics, including students, have made valuable unorganized national efforts to identify more territories as potential national/global geoparks by choosing to work on the topic as a master's or Ph.D. thesis. These efforts accompanying the published textbooks have played a significant role in eliminating the merely aesthetics point of view toward geotourism and geopark own-made philosophy which was first introduced mistakenly by the Geological Survey & Mineral Explorations of Iran. Today, the number of those interested in the field is growing and thanks to the academic books published, the awareness of the issue has been increased. Fortunately, this is the first successful academic project related to a region's Geopark feasibility study in Iran completed in 2014, which had been completed partly by the financial support of Geological Survey & Mineral Explorations of Iran and by the cooperation of some geo-colleagues from this organization as a teamwork with this university project. The study area is located around the UNESCO-listed World Heritage Site, namely Takht-e Soleyman in the northwest of Iran that is rich in terms of geodiversity, biodiversity, and historical-cultural diversity. However, unfortunately, the study area is in a poor condition economically. Accordingly, the establishment of a geopark in the region can increase job creation, prevent immigration of the villagers to the cities, and flourish the economic conditions of the region. In this study, two assessment methods have been used for evaluating selected

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geodiversities in the field, where each of them includes some parameters and sub-parameters. Based on calculated scores for each geological/geomorphological site and making use of interpolation methods in a GIS environment, the geopark territory, and the best preliminary geotrail in the study region were selected. The results of the study show that both methodologies prove high conservation importance of the geoheritage and other cultural–environmental (geographical) heritage perspective for this territory which represents the importance of sustainable application of resources by registering a geopark as a managerial strategy in this area. Consequently, related maps for future studies and filed works have been produced. According to the geopark and geotrail preliminary maps, the area has the potential for more studies, further community engagement (about 44 villages) studies, and consequently governmental and the private sectors' investments and preparing sustainable tourism infrastructures to be listed as a national geopark and later as a global geopark.

Keywords Geotourism · Geodiversity · Geotrail · Geo-assessment · Takht-e Soleyman geopark · Iran's third geopark · GIS

2.1 Introduction

Geoparks have been increasingly proved to be effective in alleviating poverty around the world (Sadry 2020a). Therefore, geopark development at the internal state scale could be an effective strategy to alleviate poverty in developing countries, raise awareness among people, and conserve geological heritage and socioeconomic improvements of villages and small towns especially in the Middle East.

There has been a growing interest in the twenty-first century to care for the abiotic nature which had been neglected previously. This interest is also growing among Iranian academics and also some governmental executives to develop geotourism, identify potential sources to establish geoparks via master's or Ph.D. theses, and more recently via the feasibility studies in governmental projects such as free zones, provincial governments, governorates, and recently in the Geological Survey & Mineral Explorations of Iran and apparently in the near future, via municipalities to establish urban geotourism. The diversity of landscapes and geological forms and processes along with the knowledge related to the story and history of the earth has given birth to abiotic nature-based tourism called "Geotourism" (Sadry 2009a, 2020a). However, protecting the geological heritage before and during the geotourism development is not only compatible with sustainability but also essential in various regions. Currently, the assessment methods have the highest priority not only for scientific goals, but also for the management and conservation of geoheritage. Therefore, it seems necessary to qualify and document the value of geoheritage and the assessment of geodiversity by making use of a standard method that is acceptable for geologists and related international or national accredited associations.

Regarding the culture and geographical features of the regions, even those of a vast country, applying a standard method would increase the effectiveness of the

measures related to the geoheritage for both conservation, as the main goal of these measures, and geotourism, as a means to realize this objective, depending on a reliable assessment process (Fasoulas et al. 2012). Therefore, quantitative evaluation of geoheritage provides solid evidence for the authorities to make decisions on allocating monetary resources for geotourism development and conservation in the frame of geoparks based on the numerical data and also based on the geographical features of the region to establish a geopark within it.

Considering the absence of a domestic model of evaluating geological diversity in Iran, the present study investigates geosites of the Takht-e Soleyman region which are determined by making use of geoheritage evaluation methods used in Europe and Brazil.

In summary, this chapter is aimed at introducing a vast area located in the northwest of Iran for heritage preservation and geotourism development as a concept defined and emerged in the twenty-first century. The authors believe that this geopark is the third potential area to be listed in the national geopark committee and later as a network member of UNESCO Global Geoparks. Therefore, in this chapter, following a brief review of geotourism and geopark concepts, a historical review of their progress in Iran, the study area, and then the methodology have been introduced and subsequently, it will lead to the findings of the field assessment, conclusion, and produced maps.

2.2 A Glimpse into Geotourism and Geopark Concepts

Modern geotourism has been defined by many scholars from 1994 till now including Bahram N. Sadry who defines the term, on English summary of his work, *Fundamentals of Geotourism* (SAMT 2009); and later concluded and extended the concept in the recent book edited by him to vertical attractions and destinations, briefly as, geotourism focuses not only on the earth's abiotic attributes such as any geo-objects, geosites, and cultural geosites but also on smaller geological features such as a grain of sand, small fossil, etc., to geomorphological landscapes on Earth to Mars and other planets in the universe (Sadry 2020a). Also about the geopark concept, according to Sadry (2011): "Geopark is an under protection area which is enriched with geosites and may contain historical-cultural sites and eco-sites; making use of effective management (e.g.: facilitation) and proper training of local people and emphasizing on the edutainment of geological and environmental concepts would probably attract tourists to fill their leisure times through listening to the interpretation of all attractions in a way that these measurements cause improvement in the socio-economic situation of the local community as well as all people in the country in a whole image." As stated by Turner (2006): "The Geopark concept has brought a revitalization of economics to many rural regions assisting local communities and indigenous populations." According to Sadry (2020b), in plain language, "geopark is a place, full of the geological heritages with a local community living nearby, which contributes to tourism and non-formal education of geology while the main