

ORIGINAL ARTICLE

Ecuadorian Committee of Geoparks (CEG) and its contribution with conservation and sustainable use of geo-heritage in Ecuador

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ABSTRACT

Given the important geodiversity present in Ecuador, it is complex to establish criteria related to the scope of geo-heritage conservation in this country; nevertheless, notwithstanding what we might believe, geo-conservation in Ecuador is a pending issue, which is being worked on. An attempt has been made to use most of the tools available for geo-conservation, since in this country, there are countless initiatives with a broad impact on local development, education, and tourism, linked to geological elements; these efforts of geo-conservation, including conservation areas to public and private initiatives. Besides, Geoparks play a starring role in these dynamics, since geoparks are invigorated at both level institutional and territorial, considering the scope and coordination capacity that geoparks can establish. The articulation of Geopark projects, and the support of UNESCO, in coordination with government institutions and the academy, allowed Ecuador to have an Ecuadorian Committee of Geoparks (CEG) since February 2019, framed in the UNESCO Geopark Guidelines, being the second in all Latin America. Exist strong limitations for the comprehensive development of geo-heritage in the country, nevertheless, the formation of the CEG creates an achievement that seeks to fortify territories with interests in generating geoparks, being an entity that supports and manages in front of government institutions.

KEYWORDS

Ecuadorian Committee of Geoparks, Ecuador, Geoparks, Geoconservation, UNESCO

ARTICLE HISTORY

Received 16 August 2023;
Revised 19 September 2023; Accepted 26 September 2023

Introduction

Ecuador is a nation with great ecosystem variability, related to its geological diversity, which allows it to boast a privileged biodiversity. Being the Andes Mountain range the axis and backbone of this set of natural heritage that characterizes this South American nation. The Andes Mountain range divides Ecuador into three different regions from a Geological and geomorphological aspect: Littoral or Coast, Highlands, and Amazonian [1]. Thus, stratigraphic, structural, lithological, and geomorphological diversity represent geological features of regional, national, and international importance [2,3].

Some elements of the geo-heritage and several national-scale geo-sites have been considered or are part of protected areas, due to the lack of management and protection elements specific to these heritage elements. For example, mining heritage in Ecuador represents the mining districts of Zaruma and Portovelo, a historic territory that has been exploited since pre-colonial times, using artisan techniques, which later evolved in the treatment of the material and the existing veins [4]. These elements are part of the national geo-heritage, whose study and protection have gained greater prominence and visibility in the last decade, mainly from the conjunct work developed for the Ecuadorian Geoparks territories.

In this sense, the important geodiversity that this Andean and Amazonian country has is the propitious framework to establish multiple synergies of use and exploitation of resources of geological origin. Given that geodiversity is attributed to any

systematic natural feature, whose characteristics are purely geological [5-7] and from geodiversity are demarcated, concepts such as geological heritage and geo-tourism, which have been considered the backbone of all the processes of Geopark territories in this nation. Geodiversity covers the elements of scientific, tourist, cultural, and educational value, which will define the importance of a Geopark territory [8-10].

In Ecuador, geoparks are living manifestations of all types of heritage and their true richness is shown in the natural elements that make up the territory, in conjunction with the ancestral knowledge of the local peoples; geo-conservation is one of the mechanisms for facilitating the interconnection, usufruct, and sustainable use of the territory, in pursuit of present and future generations [11]. Ecuador is currently experiencing an important heyday in this topic.

The present work exposes the road that Ecuador followed, before the consolidation of the Ecuadorian Committee of Geoparks (CEG, by its acronym in Spanish); starting from the development of geological heritage research groups, to obtaining the title of the first Ecuadorian UNESCO Global Geopark.

Development of initiatives aimed at geo-conservation

The first geo-conservation initiatives in the country are related to protected natural areas, although indirectly since it is

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known that the main conservation strategies in Ecuador's protected areas are directed towards biodiversity. Sites of geological interest within these areas have been protected by national legislation as accessory elements of territories that have significant biodiversity. Almost 90% of the protected areas in Ecuador present some type of geological interest, be it structure, geomorphological, lithological, paleontological, or mining; even some of these areas have superlative geological elements of national, regional, and global importance, such as the Galapagos National Park, Cotopaxi National Park, and the Chimborazo Fauna Production Reserve [12].

Over time, between 2007 and 2012, after succeeding national meetings and the relationship with the Spanish Society for the Defense of Geological and Mining Heritage (SEDPGYM, by its acronym in Spanish), the Ecuadorian Society for the Defense of Geological and Mining Heritage (SEDPGYM-Ecuador); this period was inter-institutional strengthening time, in which it gave way to forums, development of methodologies, case studies and the development of international symposiums and conferences.

Investigations directed to the geological and paleontological heritage also has been one of the item's strengths at the national level; The National Institute of Cultural Heritage and higher education centers have set standards in research, prospecting, and small paleontological excavations in places such as Tanque Loma (Santa Elena Province), Chalan gully (Chimborazo Province) and San Vicente (Manabí Province), Petrified Forest of Puyango (Loja and El Oro Provinces), among others. Undoubtedly, the Petrified Forest of Puyango, in southern Ecuador, has emerged since 1988 as an icon in the conservation of paleontological heritage. This dry forest is one of the largest petrified wood deposits in the world, and the one with the best state of conservation [13]. In this area, it is possible to find marine fossils of ammonites, bivalves, and gastropods, along with petrified tree trunks [14,15].

In Santa Elena Peninsula, stands the Megaterio Museum, managed as a research project developed by the Santa Elena Peninsula State University, being an innovative proposal in the country. This museum keeps hundreds of samples of fossil remains of the Pleistocene megafauna, found in deposits located around the urban core of the cities of Santa Elena and La Libertad [16]. In the same case of museums, in the city of Quito, Gustavo Orces Museum, of the National Polytechnic School, has hundreds of fossils remains of vertebrates and invertebrates in permanent exhibitions, which have been used to establish infographics and 3-dimensional animations.

The geo-conservation initiatives previously exposed and others of similar with lesser development, in the past, have been seriously limited by the action of the Law. It is important to remember that the concept of geo-conservation is relatively new, about the issuance of laws directed toward the conservation of the natural and cultural heritage in this country. For example, the Forestry and Conservation of Natural Areas and Wildlife Law [17] (promulgated in 1981 and directed towards the conservation of flora and fauna) and the Cultural Heritage Law [18] (promulgated in 1978, with a component directed to the conservation of the paleontological heritage), were established more than 20 years apart, about the beginning of the geo-conservation boom, through the

Geoparks. Currently, these laws have been repealed and replaced by organic laws that maintain the same fine scopes as their predecessors: the Organic Code of the Environment and the Organic Law of Culture [19,20].

On December 21, 2021, the most important milestone in the legislation related to geo-conservation and geoparks, when it was published in the Official Registry of Ecuador, the Reforming Organic Law of the Organic Code of the Environment and of the Organic Code of Territorial Organization, Autonomy, and Decentralization, in which terms such as geodiversity and geoparks are incorporated into national legislation [21].

Methodology

Based on the information collected by the author, and the information available in the CEG databases, a documentary search was developed based on a narrative bibliographic review [22]. That is, a classic narrative and systematic review was carried out, to demonstrate the facts in an orderly manner. This retrospective analysis allowed us to establish the soft organizational systems that gave way to the development of the Ecuadorian Committee of Geoparks. The search strategies were based on primary and secondary information, in a general way. With this information, we proceeded to establish the narrative of events presented in the current work.

Results

The Geopark concept in Ecuador

At the Latin American level, Geoparks are an alternative for the development of the conservation of geo-heritage [23], and in this South American republic, this process requires special mention, since, as of February 2019, it was decided to have an Ecuadorian Committee of Geoparks (CEG), according to the founding act, added to Resolution 001-2019 of the National Commission for Cooperation with UNESCO. Thus, it arose the second national committee of Geoparks in Latin America, with UNESCO recognition [24]. The CEG was created from a strong interaction between all the geopark projects in Ecuador, together with the support of the Ecuadorian National Commission for Cooperation with UNESCO, and various State institutions (Ministry of the Environment, Ministry of Tourism, National Institute of Cultural Heritage, and the Institute of Geological and Energy Research), in a unified act, signed the act of conformation of this committee.

Looking retrospectively is considered that the concept of Geoparks was disseminated in Ecuador for the first time in 2003, when the celebration of the First International Conference on Ibero-American Cultural and Geological and Mining Heritage took place, organized in the city of Machala, by the Higher Polytechnic School of Litoral. Afterwards, the dissemination of projects in countries such as Brazil, Argentina, and Venezuela, consolidated national and regional interest in this topic. In May 2008, in the celebration of the First Andean Meeting for the Protection of Geological, Mining, and Paleontological Heritage, held in the city of Loja; the concept of Geoparks, the characteristics of these territories, as well as examples and case studies of projects under development at the Latin American level, were exposed openly and in-depth. In June 2010, the International Seminar on Geological, Mining, and Metallurgical Heritage, celebrated in the city of Loja, organized by the Ministry of

Non-Renewable Natural Resources (currently the Ministry of Energy and Non-Renewable Natural Resources) and the National Institute of Geological, Mining and Metallurgical Research-INIGEMM (currently Institute of Geological and Energy Research-IIIGE). This platform was used by INIGEMM to promulgate the Geological-Mining Heritage Project, and other invaluable contributions were generated regarding the potential that Ecuador has for the generation and management of Geoparks. Currently, the IIIGE forms part of the CEG as an active member and permanently collaborates in the development of research within Geoparks.

In 2010, the Tungurahua Volcano Geopark initiative started to take its first steps, receiving direct support from the central government of Ecuador, and with the impulse to transmit the concept to the community, after several dialogue tables. Several national ministries, autonomous governments, and universities have taken part in the development of this proposal, and after thirteen years the initiative is maintained, awaiting approval as a UNESCO Global Geopark. Its main interests revolve around the Tungurahua Volcano (5,023 m.a.s.l.), a stratovolcano with more than twenty years of intermittent magmatic activity, which generated a strong incentive for tourist activities.

Imbabura Geopark was another initiative that was developed with an important perspective. Characterized by reliefs and geomorphology of volcanic origin, which is interwoven with Andean traditions and culture, to generate a very Andean worldview of the landscape. Thanks to this geological and cultural framework, deepened by the permanent work since 2014, the way was made for the formal presentation of its candidacy for membership to the Global Geoparks Network in 2015. After changes in the management of the project, in 2017 they presented their candidacy again. In September 2018, the report of the UNESCO Global Geoparks Council defined the approval of the entry of the Imbabura Geopark into the Global Geoparks Network [25], in April 2019 it was officially declared a UNESCO Global Geopark, being the first in Ecuador. In 2015, after an inventory project of karst cavities, the Napo Sumaco Geopark Project was implemented. Located in the sub-Andean zone, and form part of the Amazon platform. Napo Sumaco has features of the eastern Andean structures and the Amazon basin; In addition, its location coincides with one of the most biodiverse areas nationwide. The main geological elements are akin to Quaternary volcanic processes, as evidence of Andean tectonism, further to large packages of sedimentary rocks from the Cretaceous depositional system and back-arc basin of Ecuador; an important karst relief, with great diversity of endogenous and exogenous structures [26]. All this geo-heritage is combined with a strong local Napo Kichwa ancestral culture.

Finally, it is worth mentioning other existing initiatives of geoparks in Ecuador, such as the cases of the Santa Elena Peninsula, Ruta del Oro, Puyango Petrified Forest, Galapagos, Quito, and Jama Pedernales. These initiatives have different levels of development and work; however, they have expressed to official channels the desire to work to consolidate geoparks in their territories. This list will probably increase the number in the future, considering the dissemination of the topic in Ecuador has increased in recent years; also, the creation of the Ecuadorian Committee of Geoparks seeks to boost and

motivate new projects and territories that can be identified with the vision of UNESCO Global Geoparks. This consolidation has required almost 15 years of work, with multiple actors, institutions, and various related processes and projects.

Geoparks in Ecuador

As mentioned previously, Geopark territories are booming in Ecuador, however, these territories have different types of development or advancement, in terms of their work processes [27]. In this ambit, at the Committee level, terminologies are used to define that level of work. Thus, at the national level, are defined UNESCO Global Geoparks (those that have already obtained the official designation of geoparks from UNESCO), aspiring Geoparks (those that have submitted the application and maintain an active file process at UNESCO, and that to date have not received official opinions), Geopark project (those territories that have submitted their official membership to the Ecuadorian Committee of Geoparks and/or that have the development of a well-defined work infrastructure) and Geopark initiative (territories that have been in contact with the Ecuadorian Committee of Geoparks, however, are developing ideas and building action plans based on similar experiences at the national level).

Both Table 1 and Figure 1, detail some characteristics of the territories and is also shown the geographical location of the various geoparks at the national level. As additional information, the geological attributes of each geopark in Ecuador tend to be quite different, even though in many cases, the territories are separated by a few kilometers (Figure 2).

Conclusions

Although Ecuador has important features in its geodiversity, is considered vital the will and political support for development strategies directed towards geological components, however, it is still complex to stop understanding the geo-resources as a productive or industrial element in strategic sectors and to visualize it as a natural component that could be protected and conserved. Of course, this does not mean that the geo-resources cannot or should not be susceptible to economic exploitation, what should be promoted is the consideration that develops sustainable exploitation processes. In Ecuador, work is being done to change these visions.

This process is also part of consequent actions at the administrative, academic, and social level, which have been taking place in Ecuador for a decade, but which lost prominence with time. The greatest efforts and strategies towards the dissemination and protection of the geo-heritage in Ecuador have been generated from individual, personal, and academic initiatives, with less participation from the State [28]. The creation of the Ecuadorian Committee of Geoparks has been a great achievement for geoparks at the national level since it seeks to interconnect the initiatives of the territories and the State, to seek mechanisms that strengthen the conservation of heritage and eliminate gaps that limit the development of legislation and relevant regulations to ensure the conservation of the few manifestations of natural heritage (including geo-heritage) at different scales.

Currently, the Ecuadorian Committee of Geoparks, within the framework of its competencies and attributions,

Table 1. Main geopark territories in Ecuador. Is detailed a summary of the geoparks in Ecuador with their different levels of development.

Geopark	Level of development	Main features	Location-province
Imbabura	UNESCO Global Geopark	The territory of 4.599 km ² , which houses lakes, lagoons, volcanoes, and geo-sites of scenic beauty in which the presence of communities and cultures typical of the province of Imbabura, located in the north of the Ecuadorian Inter-Andean region.	Imbabura
Napo Sumaco	Aspiring UNESCO Global Geopark	Include approximately 1.800 km ² . It has sites of interest that show the various natural, geological, and cultural attributes that the geopark territory has. In addition, about 68 local about 68 local communities belong (Napo Runa).	Napo
Tungurahua Volcano	Aspiring UNESCO Global Geopark	This territory is a strategic area, which includes unique geological riches because it includes the Andes Mountains transversally (from West to East), which is a clear example of the effects of the complex tectonic interaction in Ecuador.	Tungurahua and Chimborazo
Santa Elena Peninsula	Geopark Project	In Santa Elena, there are different aspects of an aesthetic, geological, historical, cultural, touristic, and archaeological nature. It was also the center of the first oil exploitations in Ecuador.	Santa Elena
Puyango Petrified Forest	Geopark Project	Puyango shows great geological diversity of national, regional, and international connotation since the slab-shaped rocks correspond to foliated structures of metamorphic rocks that evidence the tectonic efforts that occurred during the emergence of the Andes Mountains.	El Oro and Loja
Ruta del Oro	Geopark Project	The environment of the upper part of the province of El Oro has a great mining tradition in Ecuador and is also highlighted by sites of geological, paleontological, archaeological, and natural importance, which contribute to sustainable tourism development.	El Oro
Quito	Geopark Project	The Quito tectonic trench has geological features of great national and regional value, its great geological diversity involves volcanic, tectonic, and geomorphological elements.	Pichincha
Galápagos	Geopark Initiative	The Galapagos Archipelago corresponds to dozens of volcanic islands, which are a true geological treasure, which served as part of the inspiration to establish the theory of the evolution of species.	Galápagos
Jama-Pedernales	Geopark Initiative	In addition to the imposing geology of the Manabí and Borbón sedimentary basins, this territory was the epicenter of one of the most important earthquakes of the modern age.	Manabí

according to the founding act, develops candidacy monitoring and technical support for both geopark projects and initiatives, as well as for decision-makers in the Geopark territories. In addition, this working group promotes discussion activities and

technical contributions about processes of developing legal tools at the national and local level, whose objectives are directly or indirectly linked to the concept of Geoparks. All this is to strengthen and continue the process of national empowerment of Geoparks in Ecuador.

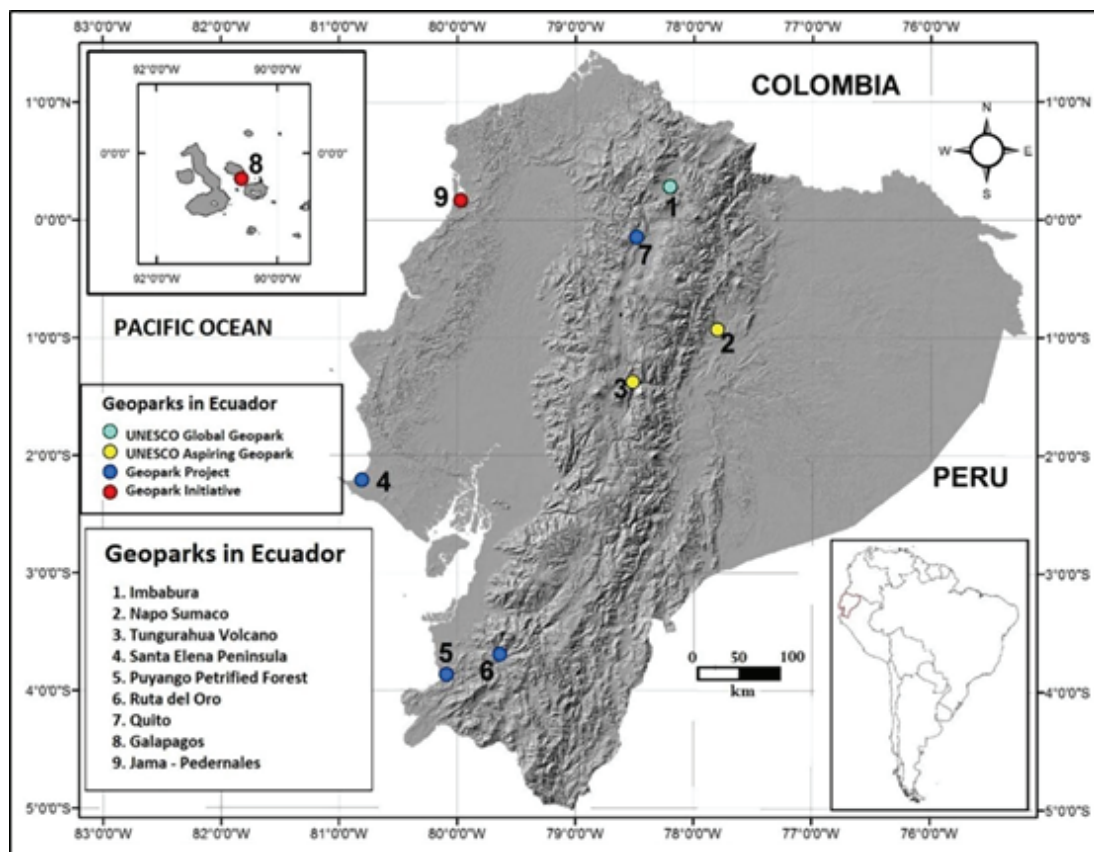


Figure 1. Location map of Geoparks in Ecuador. It is worth noting that these are the territories that have reported their work, being part of the Ecuadorian Committee of Geoparks, or have held working meetings with the UNESCO Office in Quito.

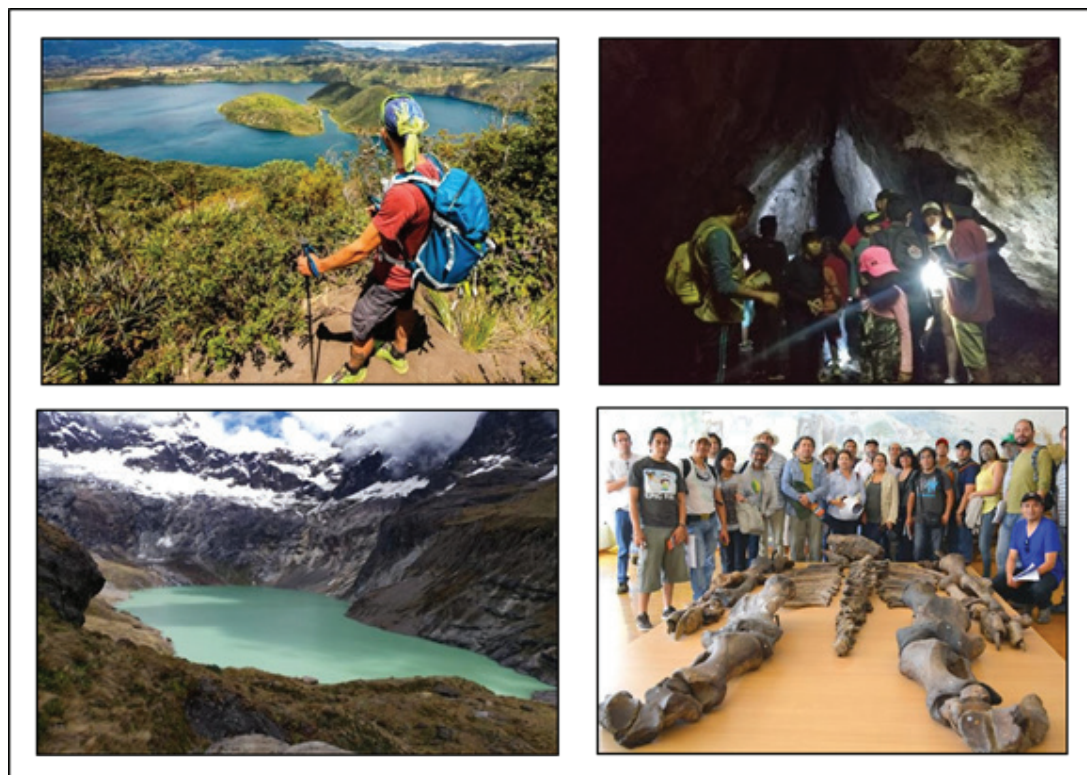


Figure 2. Collage of images from several Ecuadorian geoparks: (Top Left) Panoramic of the Cuicocha Lagoon in the Imbabura UNESCO Global Geopark; (Top Right) Summer courses in the Uctu Iji Changa cavern of the Napo Sumaco UNESCO Aspiring Geopark; (Down Left) Yellow Lagoon in the crater of the Altar volcano, within the Tungurahua Volcano UNESCO Aspiring Geopark; (Down Right) Museography workshop at the Megatherium Museum of the Santa Elena Peninsula State University, part of the Santa Elena Peninsula Geopark Project.

Acknowledgments

Special thanks to the institutions and representatives of the entities that are part of the Ecuadorian Committee of Ecuadorian National Commission for Cooperation with UNESCO, Institute of Geological and Energy Research, National Institute of Cultural Heritage, Ministry of Tourism, Ministry of the Environment, Water and Ecological Transaction, Imbabura UNESCO Global Geopark, Napo Sumaco UNESCO Aspiring Geopark, Tungurahua UNESCO Aspiring Geopark, Santa Elena Peninsula Geopark Project, Puyango Petrified Forest Geopark Project, Ruta del Oro Geopark Project, Quito Geopark Project and Central University of Ecuador. Also, thanks for the permanent support of the UNESCO Office in Quito.

Disclosure statement

No potential conflict of interest was reported by the author.

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