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# Geoconservation Survey of the Eastern Colombian Geosites Based on Geocientific and Scenic Interest

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## Abstract

**Colombia boasts extensive geodiversity thanks to complex geological processes that have shaped its landscape over geological time. The eastern region of the country is characterized by ancient rock formations, covered by a substantial layer of sediments, influenced by tectonic and erosive forces. These forces have given rise to unique geoforms that qualify as geosites. Thirteen sites were identified based on their geological context, accessibility, visibility, and tourism potential, by assessing their geoscientific and scenic interest. A methodology was applied, drawing from various experts in Geological Heritage both in Colombia and globally. Geosites in the east of Colombia encompass geological outcrops, structures, mountain ranges, reservoirs, karst formations, waterfalls, and archaeological and mining sites, all of significant geoscientific, educational, and scenic value. Each site was rated on a scale of 1 (low) to 3 (high), resulting in an average scientific value of 2.42, indicating a moderate to high geoconservation value. Geosites with the highest geoconservation rating (3) include the Structural Slopes of Guateque, El Encanto Hot Springs, Upín Salt Flats, Cerro Azul and the Orión Gate. The Mountain Ranges of San Luis de Gaceno, karstic dissolution sinkholes, and the Pink Plants of Tranquilandia fall into the moderate to high-value category (rated at 2.5). Other sites, such as the Eroded and Stepped Escarpments of Las Juntas, La Esmeralda Reservoir (Chivor), Sedimentary Slabs of Guejar River, Sandstone Tables, and the Love's Waterfall, also hold geological importance. We recommend implementing geoconservation policies for these geosites to preserve and develop them, taking into account their considerable geotourism potential. These efforts should be carried out with a keen awareness of the current resource usage and land management practices to ensure a sustainable strategy.**

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## Introduction

The Colombian East, often referred to as the region of the foothills of the plains and the eastern plains, encompasses the areas bordering the eastern flank of the Eastern Cordillera and the vast expanses of savannah, known as the Orinoquía and the Amazon.

The department of Boyacá is a region of significant contrasts. Part of it is situated in the Andean region, while another portion belongs to the central-eastern part of the country. It includes the flatlands of the middle valley of the Magdalena River and is intersected by the Eastern Cordillera from southwest to northeast, resulting in a complex and diverse topography. This topography gives the region a varied relief, spanning all thermal zones, from perpetual snow in the Serranía del Cocuy to a warm climate in the Foothill Llanero, known as the Piedemonte Llanero, where it borders the departments of Arauca and Meta (Rodríguez & Solano 2000).

The departments of Meta and Guaviare are characterized by their unique geographical features, primarily shaped by the descent of major tributary rivers from the Eastern Cordillera (Montaño 2020). These rivers play a significant role in the region's landscape: the Guayabero River flows through the southwest-northeast area; the Ariari River runs in a north-south direction; part of the Guaviare River follows a general west-east course. The relief of these departments encompasses various terrains, including flat territories with gently undulating areas such as savannahs, extensive alluvial plains, and recently deposited sediments. Notably, the Serranía de la Lindosa stands out as a prominent geological feature in the region (IGAC 1999).

The climate in these regions is diverse, and closely linked to the presence of tropical humid forests. Temperatures typically exceed 24°C, and annual average rainfall varies significantly, ranging from 400 to 4000 mm. Additionally, the very humid premontane forest experiences temperatures between 18 and 24 °C, with an annual average rainfall falling within the range of 1000 to 2000 mm.

The primary aim of this paper is to identify and propose candidate geosites in Eastern Colombia that deserve recognition for their geoconservation values. These recommendations stem from the remarkable geoscientific and scenic attributes of these sites. It is crucial to delve into the concept of geoconservation and appreciate why compiling inventories and providing detailed descriptions of natural sites distinguished by their unique features sites that foster knowledge, contemplation, and enjoyment adds substantial value to a nation's natural heritage.

Geoconservation encompasses a range of measures, actions, methodologies, and techniques aimed at preserving, monitoring, and, in some cases, restoring sites identified as geological heritage (Sen *et al.* 2023; Brilha *et al.* 2018; Fuertes-Gutiérrez *et al.* 2016; García-Cortés & Carcavilla 2009; Carcavilla *et al.* 2007; Brilha 2002). Geoconservation is particularly pertinent to non-renewable resources, where any form of intervention can irreversibly disrupt their properties and characteristics (Carcavilla *et al.* 2015). As a result, strategies focused on safeguarding and preventing the destruction of these unique geological and geomorphological elements are becoming increasingly imperative.

The valuation of territories through the lens of geodiversity has its roots in the 1990s, as discussed by Kozlowski (1999), Durán *et al.* (1998), Sharples (1993), and Wiedenbein (1993). During this period, the significance of geodiversity was equated with that of biodiversity in the Convention on Biological Diversity, in Rio de Janeiro (UN 1992). In subsequent decades, this concept gained worldwide recognition, encompassing various perspectives now known as the five Gs of geology: Geoconservation, Geoheritage, Geotourism, Geoparks, and Geodiversity (Gray 2018).

Geodiversity was introduced as a foundational element in land planning, involving the identification and characterization of geological, geomorphological, pedological, and hydrological features (Gray 2018). Additionally, the interest and necessity of bridging the evaluation of Geological Heritage with Mining Heritage were inherent in geodiversity studies and geoconservation initiatives (Puche & Mazadiego 1998; Areces 1996; Cendrero 1996; Puche *et al.* 1994). Abiotic elements per unit area, such as geology and structures, geomorphology, climate, hydrology, and hydrogeology, constitute the foundation that supports and shapes terrestrial ecosystems. These elements should be integral to the estimation of geodiversity and geoconservation inventories (Gray *et al.* 2013).

The Geosite concept links geoconservation and geoheritage. A geosite is the occurrence of one or more outcropping elements of geodiversity that present unique values from the scientific, pedagogical, cultural, and touristic perspectives, or all of these together (Brilha 2005). Further, geosites include geomorphosites (Panizza 2001; Panizza & Piacente 2003) and also geoarchaeosites (Bruno & Perrotta 2012), representing urban geological sites, having a landscape value, and also a cultural or educative value, because they represent the history of landscape changes and its influence on human behavior and uses of natural resources (Fabbri *et al.* 2011).

Evaluating geosites based on these abiotic elements involves two parameters that encompass a wide range of geological and landscape aspects. These parameters are essential for classifying the geoconservation value of natural spaces. In addition to the concept, some authors have considered a broader coverage for geosites including aspects of mining and archeological sites that are linked with geological features (Maciel-Flores *et al.* 2020; Ramírez *et al.* 2010; Ilieş & Josan 2009).

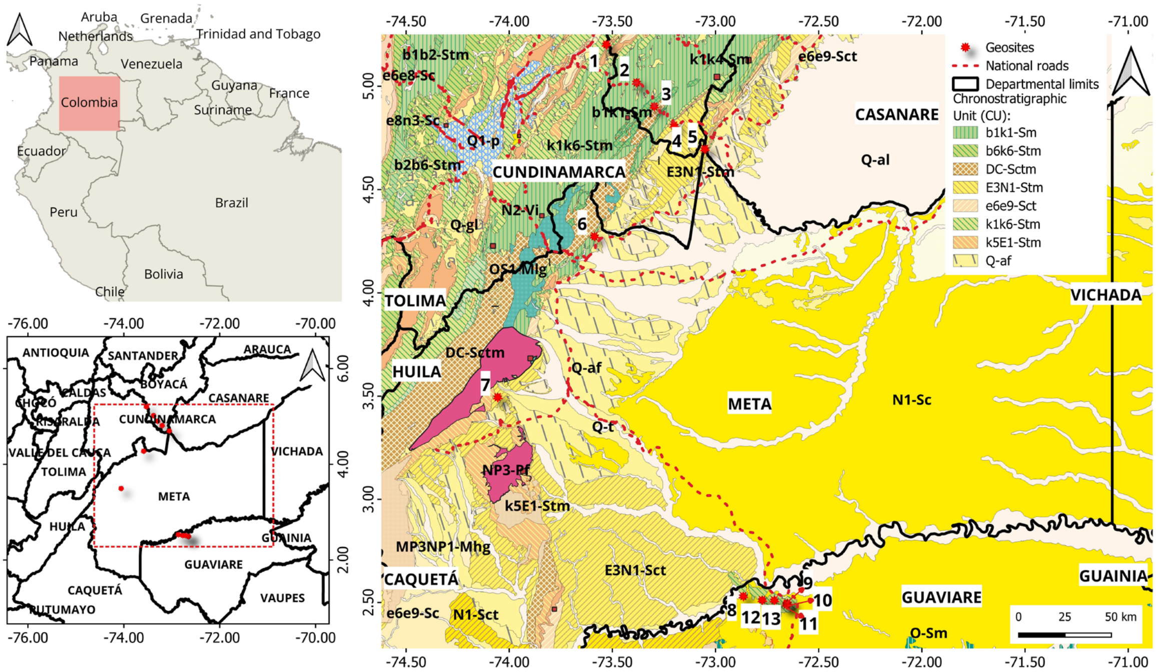
Thirteen geosites located in eastern Colombia, in the departments of Boyacá, Meta, and Guaviare, are presented (Fig. 1). These geosites were visited, georeferenced, and described based on their geological and geomorphological aspects (Gómez & Montes 2020), as well as their potential for education and tourism, due to their geoscientific and scenic characteristics.

**Literature Review**

Colombia has actively engaged in research efforts aimed at understanding geodiversity and assessing geological and mining heritage. One of the earliest initiatives took place at El Glaciar de Santander (Colegial *et al.* 2002), focusing on the definition, evaluation, and valuation of geological heritage. Subsequently, within the Chinchiná River Basin, sites of geological interest associated with the Nevados National Park were identified (Betancurth 2003). This marked one of the first Ibero-American initiatives for evaluating geological and mining heritage in the context of mine closure (Villas-Bôas & Gonzales 2003).

After these pioneering studies, there was a growing recognition of the importance and the need for investigations aimed at determining geological heritage. This led to the development of inventories and methodologies that encompass scientific, academic, touristic, and cultural aspects across various locations in Colombia (Jaramillo-Zapata *et al.* 2014; Rendón-Rivera & Osorio 2013; Torres-Herrera & Molina-Escobar 2012; Cárdenas & Restrepo 2006; Molina & Mercado 2003). Furthermore, these initiatives have played a pivotal role in promoting geotourism (Marín & Ríos 2019; Ríos-Reyes *et al.* 2018; Gelvez-Chaparro *et al.* 2018; Tavera *et al.* 2017).

In the realm of estimating geodiversity, EAFIT University, in conjunction with its GAT (Environmental Geology and Tectonics) Research group,




| Name | CUSymbol | Description |
|---|---|---|
| 1. Structural slopes of Guateque | k1k6-Stm | Shales, limestones, phosphorites, cherts, and quartzarenites. Predominance of fine grained facies to the north of Cocuy, and sandy facies to the south. |
| 2. Eroded and stepped escarpments of Las Juntas | b1k1-Sm | Black claystones and siltstones with minor intercalations of sandstones and limestones. Segments of fine to coarse grained quartzarenites and conglomerates. |
| 3. La Esmeralda Reservoir – (Chivor) | DC-Sctm | Quartzarenites, claystones, grey mudstones and, occasionally, limestones and conglomerates. |
| 4. Mountain Ranges of San Luis de Gaceno | E3N1-Stm | Alternations of locally conglomeratic sandstones, mudstones, and claystones. Occasionally, thin coal layers. |
| 5. El Encanto Hot Springs | e6e9-Sct | Fine grained to conglomeratic sandstones interbedded with claystones and siltstones. Occasionally, oolitic iron and coal lenses. |
| 6. Upín Salt Flats | Q-af | Alluvial fans and colluvial deposits. |
| 7. Sedimentary slabs of Guejar River | k5E1-Stm | Fine grained to conglomeratic quartzarenites intercalated with mudstones, siliceous clayey siltstones, and limestone lenses. |
| 8. Cerro Azul - Rock paintings<br>9. Kastic dissolution sinkholes<br>10. Sandstone tables<br>11. The Love's Waterfall<br>12. Orión Gate<br>13. Pink plants of Tranquilandia | b6k6-Stm | Shales, limestones, sandstones, cherts, and phosphorites. |

**Figure 1.** General location and geological context of the thirteen Geosites in Eastern Colombia (Source: Gómez & Montes 2020).

has been at the forefront of applying heuristic and statistical methods to zone Colombian territories and cities at various scales. These efforts have encompassed regional scales, including Sierra National Parks such as Nevada de Santa Marta, Puracé Volcano, Doña Juana, and Galeras. Additionally, they have extended to local scales, covering areas like Cuencas del Río Badillo, Guatapurí, Ranchería, Risaralda, Combeima, and the metropolitan area of Valle de Aburrá. The extensive findings from these studies have been consolidated and are prominently featured in the book titled 'Geoconservation in Colombia: Practical Theoretical Approximations.'

Colombia serves as both a natural museum and a multifaceted laboratory, owing to the remarkable diversity of its landscapes. This diversity is intricately linked to its climate, geology, and geomorphology, all of which are shaped by ongoing tectonic processes in western South America (Restrepo-Pace & Cediel *et al.* 2019). Despite this geographical wealth, many areas in Colombia have yet to undergo comprehensive assessments of their geodiversity, hindering efforts to promote geoconservation (Gómez-Guerrero *et al.* 2022; Hederich 2021; Anaya 2018).

Internationally, the utilization of indicators to ascertain geodiversity and then develop geoconservation strategies is on the rise (Garcia *et al.* 2022; Chakraborty& Gray 2020; Sánchez *et al.* 2018; Gordon & Barron 2012). This approach represents a novel tool for implementing environmental preservation measures that not only foster dissemination and enjoyment of these natural wonders but also promote scientific knowledge.

**Methodology**

A bibliographic search was undertaken to explore the geological, geomorphological, and geoconservation characteristics of Eastern Colombia and each possible geosite and its surrounding areas. To enhance the geomorphological characterization, we adopted the analytical approach proposed by Carvajal (2008), which employs a geomorphological hierarchy to classify the most suitable morphological environment for each site (Table 1). Following this geomorphological hierarchy, we categorized the morphological units for each geosite based on Carvajal's framework (2008). This classification considered the presence of hills, mountain ranges, alluvial plains, peneplains, archaeological sites, and the overall geomorphological province.

A field trip was conducted by the authors in April 2023 to identify significant outcrops and sites showcasing distinctive geological and geomorphological features that stand out in the landscape from Bogotá to San José del Guaviare, including the route to Chivor to identify any further significant geosites. Georeferencing and photographic documentation were carried out on-site. Informal interviews were conducted with local residents to gain insights into their perspectives on these sites, as well as to assess the current relevance and potential tourism interest associated with these locations.

The classification of geosites was conducted following this phase of bibliographic research, field analysis and interviews, to complement the geological framework of each site, as summarized in the geomorphological hierarchy classification (Fig. 2). Subsequently, the 13 identified geosites underwent a qualitative evaluation based on parameters extracted from Reynard (2016) and utilized by Tavera *et al.* (2017). This evaluation drew from on-site documentation, general data, and descriptions, aiming to assess intrinsic value in terms of scientific and ecological significance.

In addition, certain aspects of the methodology proposed by Jaramillo-Zapata *et al.* (2014) were also considered, including abundance or rarity, which pertains to the number of examples within the target area in its geological context. The assessment also considered the utility of geosites in illustrating the diversity of elements representing areas with geological, mineralogical, geomorphological, structural, and sedimentological significance.

Further, certain parameters from Betancurth (2003) were incorporated to assess the contextual characteristics related to scenic interest. These parameters encompass naturalness, uniqueness, diversity, and spectacularity. Additionally, visual possibilities, including visibility from other locations and panoramic viewpoints, were considered. Further, the presence of crucial elements to preserve, in terms of geoscientific interest, such as prototype outcrops, geologically outstanding features, and the existence of water bodies, played a vital role in this comprehensive evaluation. This wide-ranging assessment served as a reference for delineating the primary points of interest for each geosite.

The first parameter, geoscientific interest, encompasses a range of aspects (Martínez-Cortes & Par-

**Table 1.** Geomorphological hierarchy for Colombian classification. Translated into English from the original Spanish text (Carvajal 2008).

| Geomorpho structure | Province | Region | Unity | Subunity | Component |
|---|---|---|---|---|---|
| Guyana mountain system Andean orogenic system Coastal orogenic system and continental margins | Peneplains of the Orinoquia | **Denudational environment** | -Inselbergs glacis | - Erosion glacis | - Canyons |
| | | | | - Sliding cones | - Scarps |
| | | Denudational mountain ranges | -Residual hills | - Glacis | |
| | | | | - Denuded hillside | - Sliding crowns |
| | | **Fluvial environment** | - Floodplains | - Fluvial terraces | -Escarpment |
| | | | - Fluvial fan | - Overflow deltas | -Terraces |
| | | Fluvial plains | | - Lagoon deltas | Albardones |
| | | | - Fluvial terraces | Bars | -Channel |
| | San Jacinto mountain belt Sinú Mountain belt | **Marine environment** | - Spikes | - Abrasion Platform | - Cliffs |
| | | Coastal plains | - Marine Terrace | - Beaches | - Beach ridges |
| | | | - Tombolo | - Intertidal flats | - Beach front |
| | | | -Elevated erosion platforms | | - Paleocliffs |
| | | | - Barrier Island | | |
| | | **Eolic Environment** | - Deflation plans | -Yardangs | - Interdunal planes |
| | | Desert plains | - Parabolic dunes | -Deflation holes | |
| | | | - Salts | -Shadow dunes | - Tafoni plans |
| | | | - Wadis | | |
| | | **Structural environment** | - Homoclinal mountain ranges | - Structural slopes | - Fault scarps |
| | | Structural mountain ranges | - Anticlinal mountain ranges | - Contraslope slopes | - Triangular facets |
| | | | -Backbones | - Structural cornices | - Fault lakes |
| | | | - Slopes | | - Fault trenches |
| | Central mountain Pacific continental shelf | **Volcanic environment** Volcanic formations | - Volcanic crater | - Inner crater | - Lava tunnel |
| | | | - Volcanic cone | - Slope volcanic | |
| | | | - Lava flows | - Neck volcanic slope | - Volcanic neck |
| | | | - Lahar | | |
| | | **Glacial Environment** Glaciated mountain ranges | - Kames | - Glaciated ridge | -Glacier Circus |
| | | | - Moraines | - Glaciated structural slope | |
| | | | - Glaciated mountain ranges | | -Spline planes |
| | | **Karst environment** Karstified mountain ranges | - Poljes | -Karstified Gorges | -Sinkholes |
| | | | - Kartic towers | -Poljes Funds | -Grapes |
| | | | - Cucumber Hill | | -Kastic Depression |
| | | **Anthropic Environment** Anthropic plains | -Debris lobes | -Quarry flanks | -Channels |
| | | | -Reservoirs | -Explanation plans | -Dewclaws |
| | | | - Quarries | | -Road banking |

do 2018; Tavera *et al.* 2017; Corbí & Fierro 2016; García-Cortés & Carcavilla 2009; Betancurth 2003; and Cendrero 1996).

1. Geological Significance: The presence of lithological units that indicate tectonic frameworks or important processes contributing to geological evolution.

2. Paleogeomorphology: Unique landforms or processes such as denudation, fluvial activity, or structural processes that have shaped the landscape.

3. Stratigraphic Interest: Features in stratigraphic context, complete sequences enabling the definition of environments, facies, and sedimentary processes, as well as the presence of rock bodies of significant interest in rare outcrops.

4. Paleontological and Archaeological Interest: Sites with fossils or archaeological remains representing geological environments and historical epochs closely tied to geology.

5. Ecological or Geotope Interest: Ecosystems dependent on specific geological or geomorphological units.

6. Mining Heritage Interest: Places where mining activity has been historically significant, deserving preservation to highlight its geological, social, and economic impact.

7. Scenic Interest: The concept of uniqueness, referring to the particular or uncommon character of the geomorphological unit, and the spectacularity of a place, landscape, or landform that inevitably attracts the attention of observers (Porras *et al.* 2022; Brilha 2016; Medina 2015; Schilling *et al.* 2012; Tavera *et al.* 2017; Betancurth 2003).

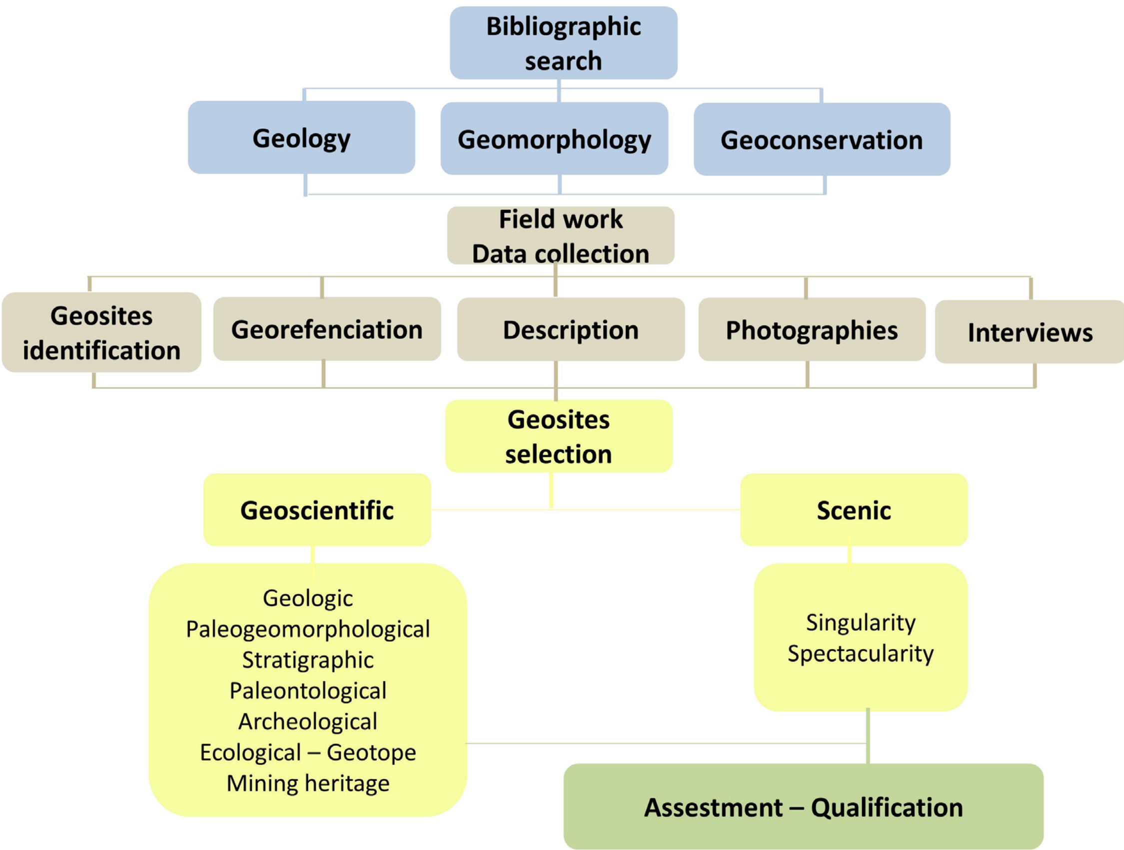



**Figure 2.** Methodology steps used for the Geoconservation inventory in the Eastern Geosites of Colombia.

As part of the author's analysis and following the fusion of previously evaluated parameters, the geosites were ultimately classified based on their Geoscientific and Scenic interest, as outlined in Table 2. To assess these aspects, values ranging from 1 (low) to 3 (high) were selected, recognizing the fundamental role of both geoscientific and scenic interest in defining geoconservation priorities. The final geoconservation value was determined through a weighted combination of geoscientific interest and scenic interest, following the formula Gc = (Geoscientific interest + Scenic interest) / 2. This approach balanced the two crucial factors to arrive at a comprehensive classification for each geosite.

Geosites with high geoscientific importance serve as invaluable sources of knowledge about geological and geomorphological processes and phenomena. Further, they provide a visual impact and opportunities for enjoyment, often representing unique prototypes at the local and even regional levels.

**Table 2.**Used parameters to evaluate the Geoconservation from the geoscientific and scenic interest (taken and adapted from Martínez-Cortes & Pardo 2018; Tavera et al. 2017; Brilha 2016; Reynard et al. 2016; Corbí & Fierro 2016; García-Cortés & Carcavilla 2009; Betancurth 2003, Cendrero 1996 and own work).

| Value | Qualification |
|---|---|
| **Geocientific interest**<br>Geologic<br>Paleogeomorphological<br>Stratigraphic<br>Paleontological - Archeological<br>Ecological – Geotope<br>Mining heritage | Low = 1<br>Moderate = 2<br>High = 3 |
| **Scenic interest** | |
| Singularity<br>Spectacularity | Low = 1<br>Moderate = 2<br>High = 3 |

## Results

### Geosite Descriptions and Valuation of Geosites

Thirteen sites were characterized in the areas of Boyacá, Meta and Guaviare Departments in the East of Colombia, most of the area is known as The Llanos Orientales (Fig. 1, Table 3). This characterization implied field work recognition, photographic registration, georeferencing, geological and geomorphological characterization and evaluation in terms of geoconservation. The assessment of the geosites in Eastern Colombia involved a semi-quantitative analysis that considered both geoscientific and scenic interest, to provide a well-rounded understanding of the value and significance of each geosite (Table 4).

**Table 3.** Summary of the East Colombia Geosites.

| Geosite | Locality | Coordenates |
|---|---|---|
| 1. Structural slopes of Guateque | Boyacá Department | 5°12’ 06.15N |
| | | 73°31’ 46.31W |
| 2. Eroded and stepped escarpments of Las Juntas | Boyacá Department | 5°01’ 02.99N |
| | | 73°22’ 57.28W |
| 3. La Esmeralda Reservoir – (Chivor) | Boyacá Department | 4°54’ 06.4N |
| | | 73 °17’ 50.4W |
| 4. Mountain Ranges of San Luis de Gaceno | Boyacá Department | 4°48’33.91N |
| | | 73 °12’ 02.79W |
| 5. El Encanto Hot Springs | Meta Department | 4°41’ 44.49N |
| | | 73 °03’ 07.31W |
| 6. Upín Salt Flats | Meta Department | 4°16’ 22.96N |
| | | 73°35’12.86”W |
| 7. Sedimentary slabs of Guejar River | Meta Department | 3°29’ 39.02N |
| | | 74 °03’ 21.84W |
| 8. Cerro Azul - Rock paintings | Guaviare Department | 2°31’ 47.17N |
| | | 72 °51’56.11W |
| 9. Kastic dissolution sinkholes | Guaviare Department | 2°29’ 43.43N |
| | | 72 °39’ 04.50W |
| 10. Sandstone tables | Guaviare Department | 2°29’ 35.14N |
| | | 72 °39’ 12.41W |
| 11. The Love’s Waterfall | Guaviare Department | 2°29’ 18.84N |
| | | 72 °39’ 17.81W |
| 12. Orión Gate | Guaviare Department | 2°30’ 39.42N |
| | | 72 °42’ 25.16W |
| 13. Pink plants of Tranquilandia | Guaviare Department | 2°30’33.78”N |
| | | 72°42’55.00”W |

**1. Structural slopes of Guateque**

The outcrop of structural slopes in Guateque is located on the road from Bogotá to Chivor, 9 km southeast of the town of Machetá, on the right-hand side. These slopes represent a geomorphological unit of mountains and structural hills composed of rocks with high resistance and relatively few denuding processes (Montaña-Cárdenas 2015). The geological formation is associated with tilted rocks that are visible, comprising sandstones from the Une Formation, dating back to the Cretaceous, which generally exhibit medium to high resistance to weathering (Fig. 3).

The structural slopes emerge on the eastern flank of the Eastern Cordillera, which comprises a set of Paleozoic, Cretaceous, and Cenozoic rocks, occasionally overlaid by Quaternary sedimentary deposits of colluvial and alluvial origin (Montaña-Cárdenas 2015). The Une Formation consists of gray and yellow quartz sandstones with fine to coarse textures, interspersed with gray claystones. Some sandstone layers can reach thicknesses of up to 60 m. The terrain surface shows very steep to steep slopes, of moderate to considerable lengths, with flat shapes, and concave and convex counter slopes, typically displaying a subparallel dendritic drainage pattern. It exhibits intense erosive processes such as gully furrows and solifluction on soil or rock materials (Carvajal 2008).

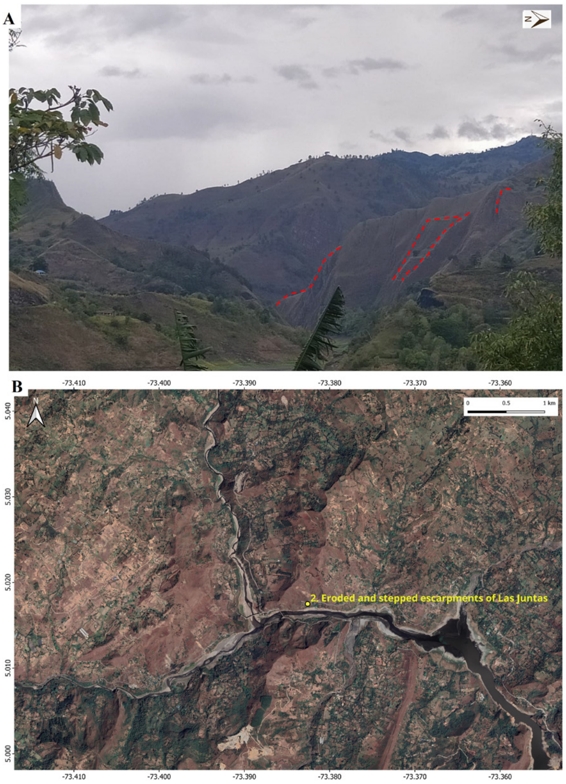



**Figure 3.** Structural slopes of Guateque. Photos: A) Liliana Betancuth and Jorge Molina, B) Google Earth overview.

The Structural Slopes of Guateque have been assigned a high geoconservation value (3) primarily because of their significant geoscientific interest, particularly in stratigraphy and tectonics. These slopes showcase the tilting of rock strata influenced by regional tectonic forces, and they are also located near synclinal and anticlinal structures, which are visible. While the visual impact of this geosite is evident, it is primarily considered valuable for educational purposes in geological topics rather than for recreational or tourism activities. Therefore, it is well suited for specialized audiences interested in geology and earth sciences.

## 2. Eroded and Stepped Escarpments of Las Juntas

The outcrop of Eroded and Stepped Escarpments of Las Juntas is located on the road from Bogotá to Chivor, known as the Transversal del Sisga, approximately 10 km east of Guateque municipality, on the west side of the road. This geosite is part of an impressive denuded and structural landscape along the Garagoa River, which showcases a significant variety of geoforms highly visible in the surrounding landscape.

The Las Juntas Formation consists of very substantial outcrops composed of medium to coarse-grained quartzite sandstones, with banks up to 1m thick and intercalations of dark mudstones (Ulloa & Rodríguez 1976). This formation is divided into three members. The upper member comprises very thick sandstone beds ranging from a few meters to approximately 25 m. The intermediate member consists of dark clays interspersed with limonites, and the lower member features very thick sandstone layers. The formation exhibits pronounced escarpments within the sandy members (Fig. 4).

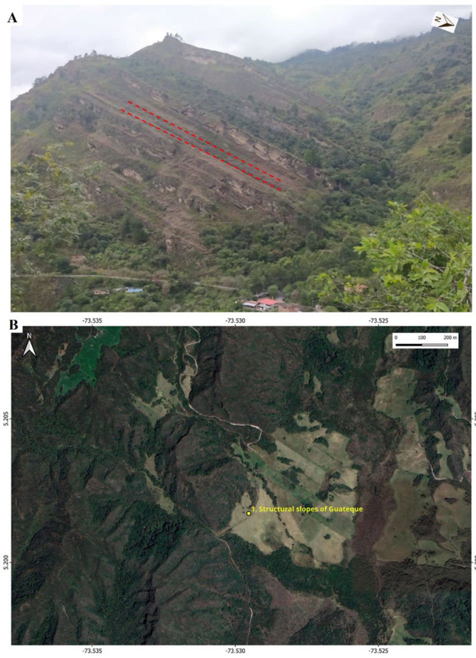



**Figure 4.** Erosion and stepped scarp of Las Juntas. Photos: A) Liliana Betancuth and Jorge Molina, B) Google Earth overview.

Geomorphologically, the surface is defined by strata arranged both parallel to and against the slope of the terrain, in straight, irregular, and stepped forms, with long lengths and very steep to sheer gradients (Carvajal 2008). Abrupt cliffs are observed at different heights. Its origin is related to the incision of drainages or the fracturing perpendicular to the dip in lithological levels where processes of differential erosion occur.

The Eroded and stepped escarpments of Las Juntas received a moderate combined value (2), corresponding to scientific interest linked to paleogeomorphology. The presence of specific structural processes that have generated unique landforms in the area, explains the influence of local and regional tectonics. It has a high educational interest in geological topics. The scenic interest of this geosite is low, as visibility is not extensive or obvious to observers, except for those who know geological features.

### 3. La Esmeralda Reservoir - Chivor

La Esmeralda (Chivor) Reservoir is used as a hydroelectric provider, located 160 km northeast of the capital of Colombia, Bogotá, at 13 km from the municipality of Guateque, near the municipality of Santa María, in the department of Boyacá. This geosite is used for tourism activities related to water sports, camping, canoeing, and water skiing.

The La Esmeralda Reservoir is located over the Chivor Formation from the Cretaceous period. These rocks rest on the Santa Rosa Formation and underlie the Macanal Shale Formation, and they have evaporitic textures related to low-energy marine environments. In the Chivor River, important outcrops of these rocks are observed, showing thicknesses of approximately 160 m, with a calcareous lower section (95 m) made up of limestone (wackestone and mudstone–micrites and biomicrites) and an upper interval (65 m) where layers of boundstone are interbedded with layers of wackestone, mudstone, nodular evaporitic rocks, and claystones (Fig. 5).


**Figure 5.** La Esmeralda Reservoir – Chivor. Photos: A) Liliana Betancuth and Jorge Molina, B) Google Earth overview.

The La Esmeralda reservoir corresponds to a landform with an anthropic influence, also known in Spanish as the Chivor Dam. It is classified as a geoform of an anthropogenic environment (Carvajal 2008), where waters accumulate due to the obstruction of one or several water bodies, in this case, the Somondoco, Garagoa, and Sutatenza Rivers, as well as the Cuya, Negra and Datil streams. It is considered one of the most important hydroelectric and water supply projects in Colombia.

The Esmeralda Reservoir - (Chivor) obtained a moderate geoconservation value (2) primarily attributed to scenic interest, which is notable. The exposure of rocks during dry periods, revealing strata, tilting, and differentiating lithologies, adds an educational dimension that can be valuable for learning about geological processes on a broader scale. The popularity of tourism activities further emphasizes its importance as a significant site in the region.

### 4. Mountain Ranges of San Luis de Gaceno

The impressive outcrop of the Mountain Ranges of San Luis de Gaceno is located 3.5 km northwest of the municipality of San Luis de Gaceno. It can be observed on the right side of the road, on the eastern flank of the Lengupa River.

This geoform includes rocks from the Caja Formation (Van Der Hammen 1958), such as sandstones and conglomerates interspersed with loam and schist clays (Fig. 6). The thickness of this unit reaches 1800 m, with some fine sandstones containing plant fossils (Segovia 1963). In the lower part of the Serranía, claystones outcrop, overlain by conglomeratic sandstones. It is attributed to the Middle to Late Miocene.

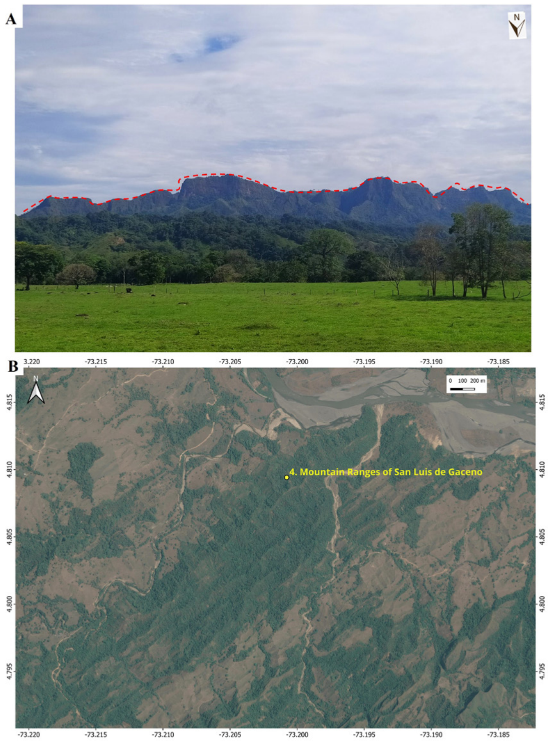



**Figure 6.** Mountain Ranges of San Luis de Gaceno. Photos: A) Liliana Betancuth and Jorge Molina, B) Google Earth overview.

This landform of structural origin is a topographic prominence with a hump-like morphology, wide and elevated, formed in the axis of a syncline, bounded by counter-dip slopes (Carvajal 2008). The current arrangement is a result of differential denudational processes that have dismantled the flanks of the structure, reversing the original relief. The slopes can have considerable length and exhibit concave, convex, and straight forms with a steep to very steep gradient and multiple stepped levels.

The Mountain Ranges of San Luis de Gaceno obtained a moderate to high value (2.5), with slightly higher scenic interest than scientific. The geosite representing the western flank of the Nazareth syncline is deemed significant due to its indication of tectonic activity in the area. Its elevated scenic interest is derived from the landform's continuous presence in the landscape, creating a contrast with the flat surroundings. Although it may not be a designated tourist attraction, it plays a crucial role as a prominent visibility point in the regional landscape. Additionally, its importance in determining geomorphological contrasts at both local and regional scales adds to its significance.

### 5. El Encanto Hot Springs

The hot springs of "El Encanto" are 23.5 km from Barranca de Upía (department of Meta), along the road that leads to El Encanto village, on the way from Villavicencio to Yopal. It can also be accessed by the Upía river, approximately 3 hours from the Upía river port. It is a highly visited geosite, with a great geotourism boom, due to the beautiful landscape of its waterfalls and the convergence of cold fresh water with hot springs (Chicangana *et al.* 2020). The site is reached along an unpaved road, deviating from the main road that connects the city of Villavicencio with the city of Yopal (Fig. 7). Currently there is a local tourist association very organized and led by the inhabitants of the region.

Fine to coarse-grained sandstones and limestones outcrop in this area, belonging to the Socha Formation, of Paleocene age (SGC 2013). This sector is crossed by the Guaicaramo Fault. The hot springs present temperatures of approximately 40°C, attributing this thermal characteristic to a possible magmatic source that transmits heat to the surface. This particular geoform is associated with a significant alteration in the slope of the terrain, particularly within a structural context (Carvajal 2008). The presence of the Guaicáramo Fault is responsible for inducing a sudden change in the slope of the land, resulting in the formation of prominent waterfalls.

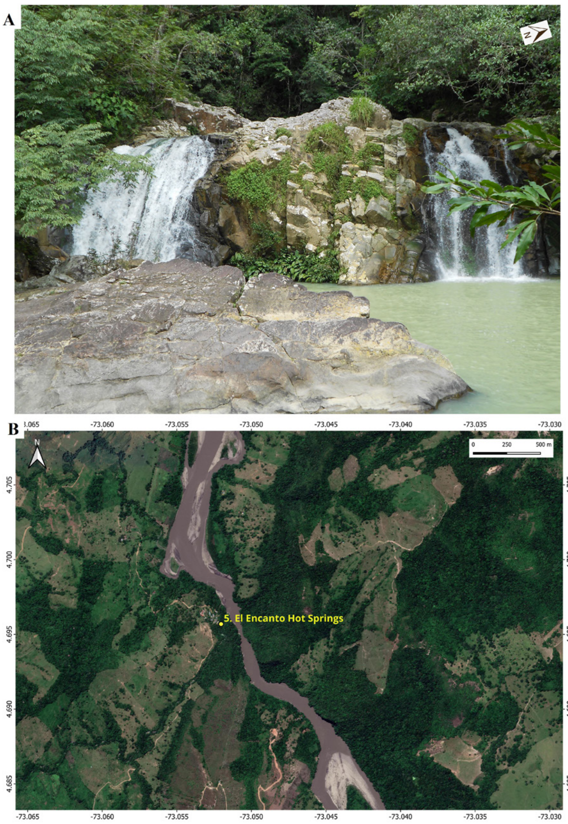


**Figure 7.** El Encanto hotspring. Photos: A) Liliana Betancuth and Jorge Molina; B) Google Earth overview.

The El Encanto Hot Springs obtained a high rating (3) with equal values for geoscientific and scenic interest. The presence of thermal waters in the area, gives it a particular geological interest, in addition to the spectacular landscape and its significant tourist appeal in the region.

## 6. Upín Salt Flats

The Upín Salt Flats, known as Salinas de Upín, are situated 10 km from the city of Villavicencio, approximately 3.3 km northwest of the municipality of Restrepo in the Meta department. From a geological perspective, the Salinas de Upín are associated with a salt diapir, which has intruded the rocks of the Lutitas de Macanal Formation dating back to the Lower Cretaceous (McLaughlin & Arce 1971). This formation is primarily composed of clays with occasional layers of sandstones and siltstones (Montaña-Cárdenas 2015). The intrusion of the diapir has resulted in the deformation and fracturing of these sedimentary sequences.

This geosite has been crucial in defining unusual structural geological geometries, leading to the conclusion that, before the compression that formed the Andes Mountain range, the sedimentary basin of the Cretaceous contained salt diapirs, which were concealed by the rocks themselves and the effects of compression (Teixel 2016). The geological sections prepared in the study by Parravano *et al.* (2015) reveal a significant geological structure comprising large folds with inverted flanks that crushed the salt structure.

This geosite holds remnants of an old salt mine that operated for 42 years, from 1950 to 1992, with a history dating back to the Hispanic conquest times (Fig. 8). The underground mine utilized a chamber and pillar system and maintained an average production rate of 6,000 tons per month. Unfortunately, the mine had to be shut down due to a flood (Chicangana *et al.* 2020).

The Upín Salt Flats received a high rating (3), with significant geoscientific importance linked to the salt diapirs that have played a crucial role in the

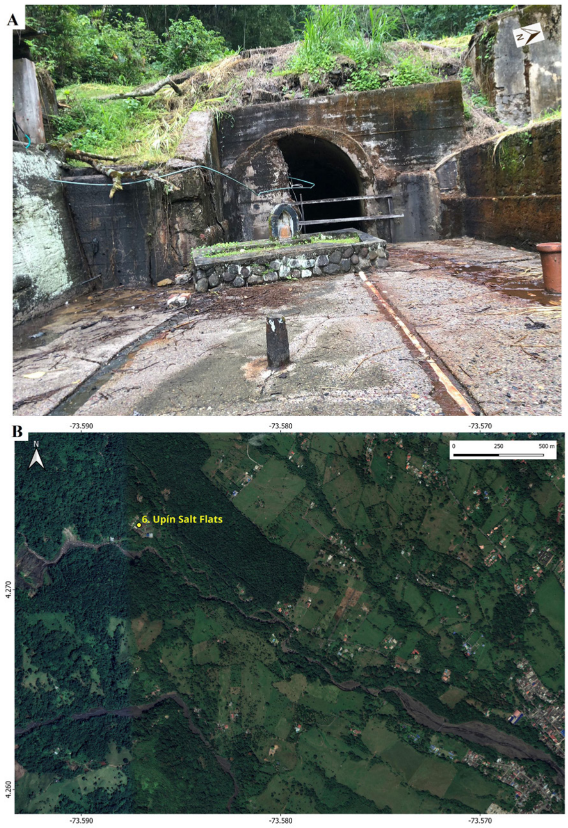



**Figure 8.** The Upín salt flats. Photos: A) Pablo Emilio Sanchez; B) Google Earth.

tectonic evolution of the eastern plains, contributing to the formation of anomalous geometries. This geosite holds substantial educational value, particularly in understanding tectonic processes and evolution. Additionally, the site boasts scenic interest, with historical remnants of mining infrastructure from the time of the Spanish conquest, providing insights into the significance of this deposit.

### 7. Sedimentary Slabs of Guejar River

The sedimentary slabs of Guejar River are situated 5 km from the municipality of Lejanías in the Department of Meta, approximately 128 km from the city of Villavicencio. While this route is primarily used by traction vehicles, it has become a popular tourist destination due to the appeal of its waters, offering opportunities for extreme sports such as rafting, diving, and general swimming. Visitors are also drawn to the stunning landscape, rocky cliffs, and the deep blue hue of the river waters (Chicangana *et al.* 2020).

This site is characterized by the formation of natural pools within the Guejar River's bed (Fig. 9). The exposed rocks belong to the Guayapita Formation, dating back to the Ordovician (Trumpy 1943). This lithology comprises alternating layers of siltstones and sandstones, primarily found on the right bank of the Guejar River. Additionally, rocks from the Guadalupe Formation are present, consisting of coarse sandstones and conglomeratic sandstones from the Cretaceous period (Guerrero


**Figure 9.** Caño Lajón – Guejar River. Photos: A) Arley David Zapata , B) Google Earth overview.

creates waterfalls and cascades.

This geosite is a denudational environment geoform (Carvajal 2008), characterized by a flat surface with a very gentle slope, surrounded by equally inclined slopes. It is the result of intense fluvial erosion denudational processes and features a long, flat upper portion. The stratification of sandstone contributes to the preservation of its flat morphology over extensive areas.

The sedimentary slabs of Guejar River obtained a moderate rating (2), with greater emphasis on scenic than geoscientific interest. Several outcrops in the area are accessible for studying the geological units and stratigraphy of these rocks. However, the scenic value of the site is highly spectacular, attracting considerable tourism due to the presence of the river canyon and various water activities that can be enjoyed there.

**8. Cerro Azul - Rock Paintings**

Cerro Azul is located 26 km west of San José del Guaviare and 5 km south of the right bank of the Guayabero River in the department of Guaviare. Access to this site is via a secondary road in fair condition, primarily suitable for four-wheel-drive vehicles.

Geologically, Cerro Azul is composed of fine white-yellowish sandstones intermixed with red claystones, likely from the Lower Cretaceous. These sedimentary rocks cover an approximate area of 301 km2. The sandstones exhibit distinctive table-shaped raised plateau morphology with limited evidence of erosion, a sparse drainage network, and escarpments. Notably, this area is marked by an intrusive contact between the San José del Guaviare Nepheline Syenite and the lower member of the San José Sandstone, hinting at a Paleozoic age (Vesga & Castillo 1972; Trumpy 1943).

Cerro Azul is renowned for its rock art, including evidence of cave paintings on the rock walls that were discovered by missionaries in the 16th century (Becerra-Becerra *et al.* 2018). This Rock Art site is complemented by the presence of Cerro Azul, which boasts exceptional morphological features in the surrounding environment.

These features likely made it an attractive location for groups of hunters and gatherers during ancient times (Fig. 10). Notably, most of the Cerro Azul rock art panels are situated 300–350 m above sea level, suggesting a deliberate choice of elevation for the placement of rock art. The panels also fea-

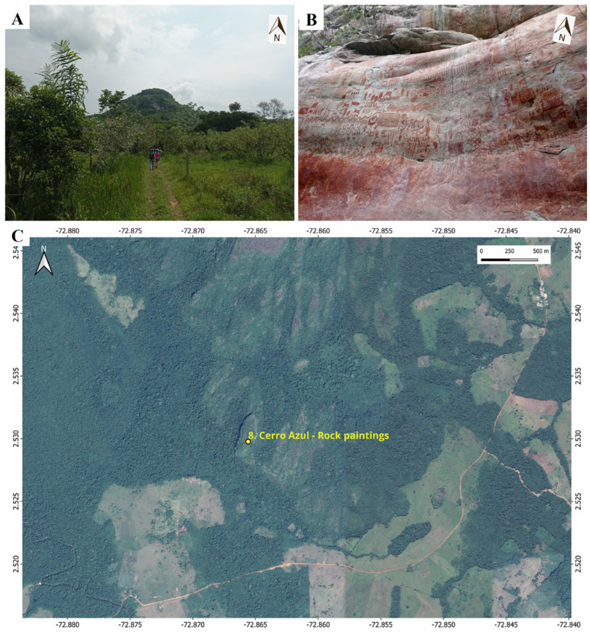



**Figure 10.** Cerro Azul. Photos: A) Arley David Zapata, B) Liliana Betancuth and Jorge Molina, C) Google Earth overview.

ture depictions of extinct megafauna, adding to their historical and cultural significance (Sánchez 2022; Iriarte *et al.* 2022).

Cerro Azul exhibits characteristics of a denudational environment geoform (Carvajal 2008). It is a prominent and isolated topographic feature with a rounded to flat summit and long slopes that are straight to convex in shape, typical of a residual hill. The hill's steep slopes are a result of the durable sandstones that resist differential weathering processes in the humid tropical climate of the region.

Cerro Azul - Rock paintings obtained a high rating (3) due to the significance of both geoscientific and scenic interest. Geoscientific interest is related to the prominent rock formations in the savannah landscape and the use of rocks for rock art, which is an outstanding national and worldwide exhibition. It is a highly frequented site from an educational perspective. Scenic interest is related to the rarity or uniqueness of the place, where archaeological site of the rock paintings drives high tourism activity.

**9. Kastic Dissolution Sinkholes**

The karstic dissolution sinkholes, known as "Los Pozos," are located 384 km from Bogotá, along the paved road from Bogotá to Villavicencio, which continues southward toward the Guaviare department. "Los Pozos" is 8 km south of the San José del Guaviare municipality via a well-maintained secondary road.

The geological formations in the sinkholes belong to the San José Formation, specifically the Caño El Retiro Member, and they consist of sandy mudstones to muddy sandstones with colors ranging from violet to yellow. They have a medium thickness and often display flat, parallel internal layering along with lamellibranch fossils. Additionally, it is common for them to contain fine quartz sandstone intraclasts embedded in a muddy sandstone matrix. These rocks have a low degree of cementation, making them friable, especially when they are wet, allowing for dissolution processes to occur.

The geoforms in this region, resulting from karstic dissolution in a hot and humid climate, are formed through the removal of cementing materials. This process leads to the creation of cavities and subsidence in the landscape, giving rise to a corridor of pools and natural wells. These features extend for approximately 4 km in length, with some of the wells reaching depths of up to 8 m (Fig. 11).

This geosite is a denudational environment (Carvajal 2008), where fluvial erosion is intense and promotes the dissolution of sandstones, forming sinkholes. These sinkholes are circular depressions with variable dimensions, ranging from 1 to 6 m in

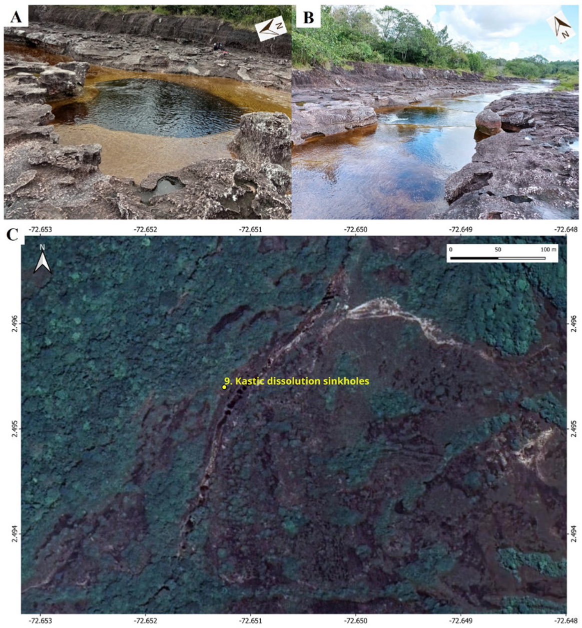



**Figure 11.** Karstic dissolution sinkholes. Photos: A, B) Arley David Zapata, C) Google Earth overview.

diameter and 1 to 8 m deep. They typically have vertical or inclined walls, forming a conical shape. Additionally, some ponors connect the interior of these sinkholes with the exterior of the karst system.

The karstic dissolution sinkholes were rated with a medium to high value (2.5), in which geoscientific interest is in the prevalence of extreme dissolution processes in the sandstones, forming large sinkholes and a corridor of natural wells that reveal fossils and sedimentary geological structures. The scenic interest is related to the spectacular nature of the site in terms of the landscape, attracting an increasingly growing number of visitors.

**10. Sandstone Tables**

The Sandstone Table, also known as "Mesa de Piedra," is situated 8 km southwest of the municipality of San José del Guaviare, along the same road leading to the karst area. It can be reached via a secondary road in good condition suitable for all types of vehicles. From the reception site, which includes a tourist center, it requires an approximate 1 km hike.

The geological formation in this area consists of sandstones from the San José Formation, which are adjacent to the sedimentary members of Ciudad de Piedra and the Caño el Retiro Member (Trumpy 1943). The Ciudad de Piedra Member overlies the San José del Guaviare Nepheline Syenite. These sandstones are exceptionally thick, with a thickness of nearly 203 m. They are characterized as coarse-grained arkose, varying in color from yellow to pink. The sequence also includes medium to coarse-grained quartz-sandstone layers, with a tabular layering pattern. Within the strata and on their bedding surfaces, there is evidence of bioturbation, along with an abundance of trace fossils. The sandstone sequence exhibits low hardness in areas where erosion has occurred (Arango et al, 2011).

The stone tables are rock formations that appear to have been shaped by water erosion, resembling storaques (hoodoos) but on a smaller scale. What makes this site particularly appealing is the presence of several natural formations that resemble tables surrounded by chairs, where the rocks have taken on shapes resembling tables with smaller diameter rocks surrounding them. These formations are thought to have persisted while everything else around them eroded, leaving behind only these exposed rock structures. (Fig. 12).

This geosite shows denudational landforms in an erosion environment, as described by Carvajal (2008). These landforms are characterized by their relatively small to moderate extent and elevated, flat surfaces with horizontal topography. They were formed by intense weathering under stable ancient climatic and tectonic conditions.

The sandstone tables obtained a moderate rating (2), with moderate geoscientific and scenic interest in comparison to other geosites in the region that exhibit similar geological characteristics on a larger scale. However, the sandstone tables are interesting from a paleogeomorphological perspective, evidencing the water and wind erosion processes that have shaped these distinct surfaces. From a landscape perspective, these landforms are not evidently visible, yet they are unique.

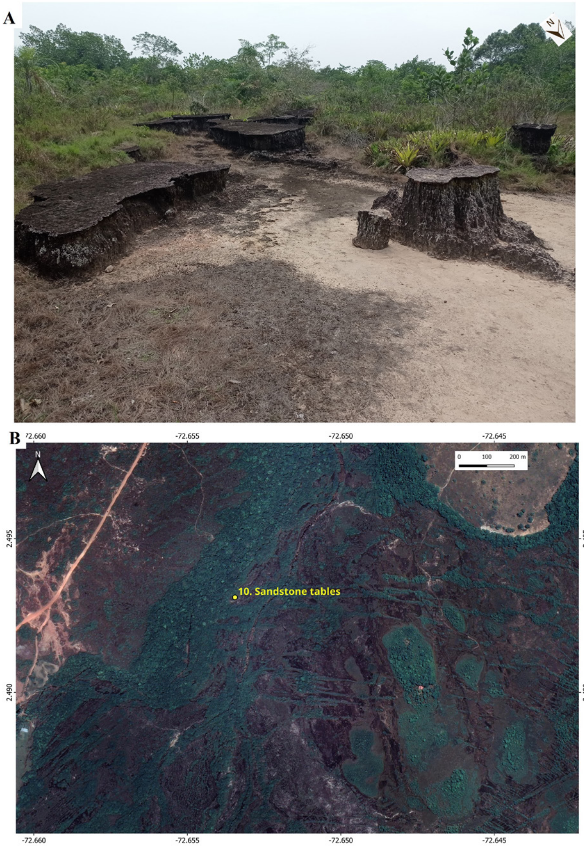



**Figure 12.** Sandstone tables. Photos: A) Arley David Zapata, B) Google Earth overview.

## 11. The Love's Waterfall

The Love's Waterfall, known as "Cascada del Amor," is located 7.5 km from the municipality of San José del Guaviare and can be accessed via a paved road leading to the El Retorno area (Fig. 13). This waterfall is known for its impressive water drop, which creates a visually stunning effect, resembling a curtain of water cascading into a natural pool. It has become a popular tourist destination due to its scenic beauty (Sanabria 2020).

The rocks exposed in this area belong to the lower part of the San José Formation, which overlies the San José del Guaviare Nepheline Syenite. This rock unit has a thickness of 203.2 m and consists of arkosic conglomeratic sandstones ranging in color from yellow to pink, attributed to weathering effects. The matrix of these rocks varies from medium sand to mud (Arango *et al.* 2011). These sandstone beds are interspersed with sandy mudstones, and in some parts of the sequence, you can find layers of harder conglomerate sandstones that stand out due to weathering, creating a stepped topography in the area.


**Figure 13.** The Love's Waterfall. Photos: A) Arley David Zapata, B) Google Earth overview.

This geoform is associated with a change in terrain slope, particularly in a structural setting (Carvajal 2008). The significant changes in slope are a result of local tectonic activity, leading to abrupt variations in terrain gradient and the formation of waterfalls. Additionally, it is considered part of a fluvial environment (Carvajal 2008) since it is shaped by the erosional processes of flowing water, which gradually wears away the rock, accentuating the difference in slope and contributing to the formation of the waterfall.

The Love's Waterfall obtained a moderate rating (2) with a moderate geoscientific value but a high scenic value due to its singularity and spectacular nature in the landscape, promoting tourism activity in the area.

## 12. Orión Gate

The Orion Gate, known as "Puerta de Orión," is situated 8.5 km southwest of the municipality of San José del Guaviare. To reach it, visitors take a combined route involving both paved and unpaved roads. This geoform is composed of thick layers of quartz sandstone, interspersed with both hard and soft layers that are susceptible to erosion. These layers form rocky escarpments (Arango *et al.* 2011).

The Orion Gate is an impressive geoform, standing 12 m in height and 15 m wide at its semicircular base. It boasts two superimposed entrances


**Figure 14.** Orión gate. Photos: A) Arley David Zapata, B) Google Earth overview.

(Fig. 14). This location features labyrinths, cavities, and cornices, making it an intriguing and attractive setting for adventure enthusiasts. Visitors can enjoy panoramic views of the savannah stretching across a vast horizon (Sanabria 2020).

Geomorphologically, the Orion Gate is associated with arches and natural bridges resulting from dissolution processes in a combined denudational environment. This environment is primarily influenced by aeolian (wind) and hydraulic (water) processes (Carvajal 2008). Over time, weathering and erosion have worn away the friable or easily erodible layers located beneath more resistant strata. This differential erosion has led to the formation of tunnels or passageways through the less resistant layers, while the more resilient layers have remained intact, creating the towering arch-like structure of the Orion Gate.

The Orión Gate was given a high rating (3) due to its geological characteristics that demonstrate intense water and wind weathering processes, associated with paleogeomorphological attributes. The scenic interest provides a special singularity and spectacularity, making it one of the few sites in the locality and region with such exuberance. La Puerta de Orión is a major tourist attraction in Eastern Colombia.

## 13. Pink Algae of Tranquilandia

Tranquilandia is situated approximately 9 km from San José del Guaviare, along the road leading to Villavicencio. To reach Tranquilandia, visitors follow a signposted detour towards Puerta de Orión and Tranquilandia for about 3 km.

Rocks of the San José Formation outcrop in Tranquilandia, are made up mainly of sandy mudstones to muddy sandstones of violet to yellow colors, with parallel flat lamination (Trumpy 1943). The fine-grained lithological characteristics and friability allow a higher level of deformation in these mudstones, where abundant thin shear zones of variable thickness between 1 and 20 m are evident (Arango *et al.* 2011).

Tranquilandia is a fluvial landform, whose main attraction is the Macarenia clavigera plant that grows in the bed of the Sabana channel, between June and December. These algae are red, pink and greenish tones (Córdoba 2002).

Tranquilandia, situated in the riverside area near the village of El Retiro, offers a tranquil natural setting abundant with vegetation. This peaceful environment provides visitors with opportunities for relaxation, recreation, and an immersive experience in environmental culture (Fig. 15). However, what truly makes Tranquilandia captivating is the enigmatic spectacle it presents. The visitor will

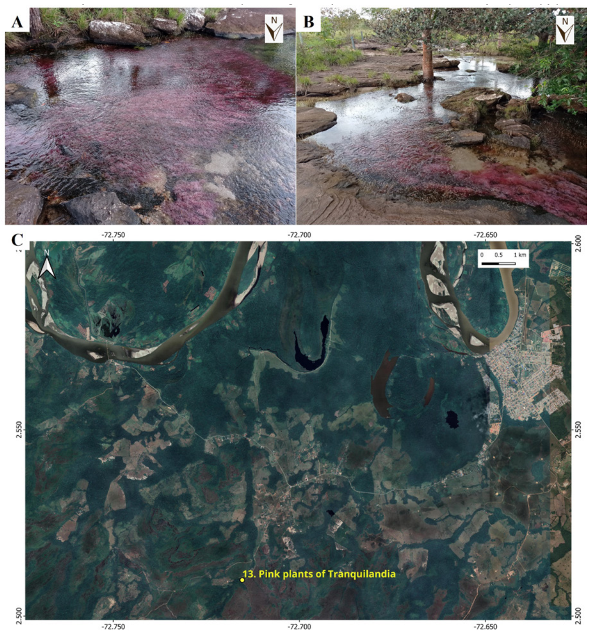



**Figure 15.** Pink plants of Tranquilandia. Photos: A-B) Arley David Zapata, C) Google Earth overview.

and red, which largely cover the surface of Caño Sabana (Macarenia clavigera). The phenomenon is produced by the growth of this freshwater algae (Sanabria 2020).

The Pink Algae of Tranquilandia is rated as moderate to high (2.5) in terms of geoscientific interest, primarily linked to the geological relationship and impact of sandstone rocks on the growth of Macarenia clavigera, a unique and visually stunning pink alga. The minimal erosion and hardness of the sandstone enable the alga's rhizoids to attach to the rock, facilitating the absorption of sunlight through its leaves. Moreover, the site holds very high scenic interest, attributed to the extraordinary and spectacular nature of the pink algae. This, coupled with the site's popularity for tourism in the region, contributes to its overall significance.

**Table 4.** Summary of the Geoconservation value determination (Own authorship).

| Geosite | Scientific interest (ScI) | Scenic interest (SI) | Geoconservation value (ScI+SI/2) | Qualitative Value |
|---|---|---|---|---|
| 1. Structural slopes of Guateque | 3 | 3 | 3 | Stratigraphic |
| 2. Eroded and stepped escarpments of Las Juntas | 3 | 1 | 2 | Paleogeomorphological |
| 3. La Esmeralda Reservoir – (Chivor) | 1 | 3 | 2 | Spectacularity |
| 4. Mountain Ranges of San Luis de Gaceno | 2 | 3 | 2.5 | Paleogeomorphological |
| 5. El Encanto Hot Springs | 3 | 3 | 3 | Geologic, Spectacularity |
| 6. Upín Salt Flats | 2 | 2 | 2 | Mining heritage |
| 7. Sedimentary slabs of Guejar River | 1 | 3 | 2 | Paleogeomorphological, Spectacularity |
| 8. Cerro Azul - Rock paintings | 3 | 3 | 3 | Archeological, rareness |
| 9. kastic dissolution sinkholes | 2 | 3 | 2.5 | Geologic, Spectacularity |
| 10. Sandstone tables | 2 | 2 | 2 | Paleogeomorphological |
| 11. The Love's Waterfall | 1 | 3 | 2 | Spectacularity |
| 12. Orión Gate | 3 | 3 | 3 | Paleogeomorphological, Singularity Spectacularity |
| 13. Pink plants of Tranquilandia | 2 | 3 | 2.5 | Ecological – Geotope |
| * Values: 1 Low, 2 Moderate, 3 High | | | | |

## Discussion

Making inventories for geoconservation has gained significant momentum worldwide and is an important activity in many countries. It is generating special interest in preserving geological natural environments and promoting tourism (Brilha 2016; Wimbledon 2011; Wimbledon 1999; García-Cortés & Carcavilla 2009).

A simple semi-qualitative evaluation was applied to the chosen geosites, considering the fundamental geoscientific and scenic features for determining geoconservation values. A geosite may have high geoscientific value while its scenic value may be low, and vice versa. The most valuable aspect of these differences lies in the fact that ultimately, these differences can determine their real potential use (Tavera *et al.* 2017).

The assessment of these 13 geosites aligns with initiatives for selecting unique locations as geotopes for scientific education, generating knowledge for the Earth Science community, and, in addition, their scenic quality is impossible to ignore for any observer (Wimbledon *et al.* 1996). Some of these places still experience political, social and military conflicts.

The 13 inventoried and evaluated geosites in Eastern Colombia received predominantly high ratings, given that the parameters of scientific interest and scenic interest are relevant. Their justification for being considered significant places within the concept of geoconservation is closely related to geological and geomorphological information, as well as their rarity and spectacular nature, acquired through the geological processes that have taken place in this area of the country, at the local and regional levels. This is in accordance with the initiative that geotourism promotes educational tourism with a scientific offer (Carcavilla 2012) and reinforces the objective of geoconservation with an educational scheme and enjoyment of natural spaces.

In the foothills of Los Llanos region (Boyacá Department), in the municipalities of Guateque, Las Juntas, San Luis de Gaceno, and Chivor, agricultural, livestock, commercial, mining (especially in Chivor with emerald extraction and trade), and artisanal activities are carried out. Tourism has also gained importance in these areas due to their natural attractions (Sanabria 2020). It is considered that the enhancement of the evaluated geosites and many others not included in this inventory adds great value to the geological and geomorphological potential of the region.

In the Eastern Plains (Meta and Guaviare Departments), in the municipalities of Lejanías, Guejar, and San José del Guaviare, agricultural, livestock, fishing, and commercial activities are carried out. Particularly, tourism is a growing activity in San José del Guaviare due to the presence of rivers, forests, waterfalls, and rock formations, which attract the public.

Access to these sites was very complex in the past, due to political, social and military circumstances. That is why some of the geosites still have incipient technical information but could be enhanced to become part of the places to visit and protect, officially declaring them as sites of geoscientific and scenic interest.

## Conclusions

The geosites of Eastern Colombia include areas of Boyacá, Meta and Guaviare departments, which exhibit a set of evidence related to tectonics, weathering, climate, and geomorphic diversity, framed in a wide landscape of Los Llanos Orientales.

This document reviewed the geodiversity framework that poses the East of Colombia as a potential hotspot of geoconservation to enrich the knowledge of unique geosites with special geoscientific interest, but also their unique nature. The most common geomorphological environments in the region can be understood in terms of their tectonic, fluvial, eolian, karstic and archeological influences in agreement with the principles of geodiversity.

Eastern Colombia, which includes part of the foothills of the plains and the eastern plains, has places that are gaining momentum as tourist destinations, such as the Guejar Canyon, Cerro Azul, Los Pozos, Cascadas, Puerta de Orión, to which we can add the sites inventoried in the department of Boyacá, such as the San Luis mountain ranges, the slopes, the structural slopes, which are mainly of geoscientific interest, but which stand out in the landscape as a type of outcrop of important sedimentary sequences region of the country.

The selected geosites in Eastern Colombia also have a great advantage in terms of easy access and connectivity through roads and trails adapted for the public. Similarly, any visitor with a suitable vehicle can directly access or be very close to the 13 inventoried geosites. The geotourism development of many of these geosites would also allow for better welfare and social development for these regions.

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**Conflict of interest**

Authors do not have a conflict of interest in the development of this article.

**Author contributions:**

Dr. Liliana Betancurth: Conceptualization; field investigation; technical ideation and main research structure; manuscript drafting, editing and finalization. Dr. Jorge Martin Molina Escobar: Conceptualization, field investigation; manuscript editing. Arley Zapata: Field investigation; Figures edition, manuscript review.

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