

**SCIENTIFIC, DIDACTIC, CULTURAL AND SCENIC VALUE OF  
GEOMORPHOSITE WELL OF BEBIDINHA COMPLEX, BURITI OF  
MONTES, PIAUÍ –BRASIL**

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429

**ABSTRACT**

Essential substrate for the development and evolution of any form of life, the conservation of geodiversity is supported by the recognition of its values (scientific, didactic, cultural/historical, tourist, economic, among others). In a given territory, landscapes that present special characteristics, with particular and significant attributes that qualify them with heritage value, deserve and need to be preserved. This work aimed to present the potential from a scientific, didactic, cultural and aesthetic point of view of the Complex Poço da Bebidinha geomorphosite. Thus, the aim is to perpetuate the understanding of geodiversity and related topics and make residents and visitors feel sensitized about its scientific, landscape/aesthetic and cultural importance, since the geomorphosite evidenced here can foster educational practices addressing socio-environmental issues. The methodology was supported by a bibliographic survey, desk work and field inspection for identification and characterization of the geomorphosite from filling in the inventory form proposed by Oliveira (2015). It is recommended by the public manager the installation of access roads and infrastructure, with the creation of partnerships with schools, universities and the local community, in order to create visitation programs to the area, properly programmed, guided and with a view to valorization, dissemination and conservation. It is concluded that, for having a rich collection of pre-colonial engravings allied to the scientific/didactic value, the Complex Poço da Bebidinha geomorphosite, in addition to corresponding to a “place of memory” of past populations, products of culture, has great potential for the understanding of part of the evolutionary history of the earth, from the geological and geomorphological aspects evidenced in the place and that requires conservation.

**Keywords:** Geoconservation. Poço da Bebidinha Complex. Valuation.

**INTRODUCTION**

According to Gray (2013) geodiversity is understood as the abiotic nature that is constituted by the variety of environments, phenomena and processes that originate rocks, minerals, fossils, geomorphological aspects (relief features), soils, waters, among others. Mochiutti et al., (2012) state that the components of geodiversity are associated with fundamental values: intrinsic, cultural, aesthetic, economic, functional, scientific and didactic. They are linked to eco and Geosystemic functions, and can provide benefits related to terrestrial elements, features and systems. In addition to being an educational tool,

they present economic value, they are attractive for tourism, recreation, adventure sports, etc.

A geomorphosite, in turn, is a form of relief, a landscape or an active geomorphological process, with particular and significant attributes that qualify it as a component of the cultural heritage (in the broad sense) of a given territory (PANIZZA, 2001; REYNARD, PANIZZA, 2005). In addition to being scenic, they are places for understanding part of the origin and evolution of the Earth. These locations are of fundamental importance for multiple functions, such as: scientific research; educational activities; creation and strengthening of conservation awareness through environmental and heritage education (PEREIRA; SHINES; MARTINEZ, 2008).

In an attempt to reverse a situation of vulnerability aimed at the conservation of abiotic nature, geoconservation is a new paradigm of sustainability that aims at strategies ranging from basic survey actions to management practices (PEREIRA, 2010). More than protecting geodiversity, geoconservation aims to recognize the diversity of geological, geomorphological and pedological processes, and others, in order to minimize the negative impacts caused by humans, in order to promote a sustainable consumption of natural resources (SHARPLES, 2002; BIRTH; RUCHKYS; MANTESSO-NETO, 2008). It is noteworthy that geoconservation does not imply the conservation of the entire abiotic environment (CLAUDINO-SALES, 2018). In fact, it only encompasses the conservation of geoheritage in what is exceptional.

In this context, this work aimed to present the potentialities from the scientific, didactic, cultural and aesthetic point of view of the geomorphosite Well of Bebidinha Complex. Thus, it seeks to strengthen the understanding of geodiversity and related themes and make residents and visitors feel sensitized as to its scientific, landscape/aesthetic and cultural importance, because the geomorphosites evidenced here can foster educational practices. It is noteworthy that the nomenclature used for the said geomorphosite comes from toponymy/denomination already used for it by the residents of the region. The term "complex" refers to sites composed of several elements of interest in the same area, whether geological, geomorphological, hydrological, archaeological, etc. elements for example.

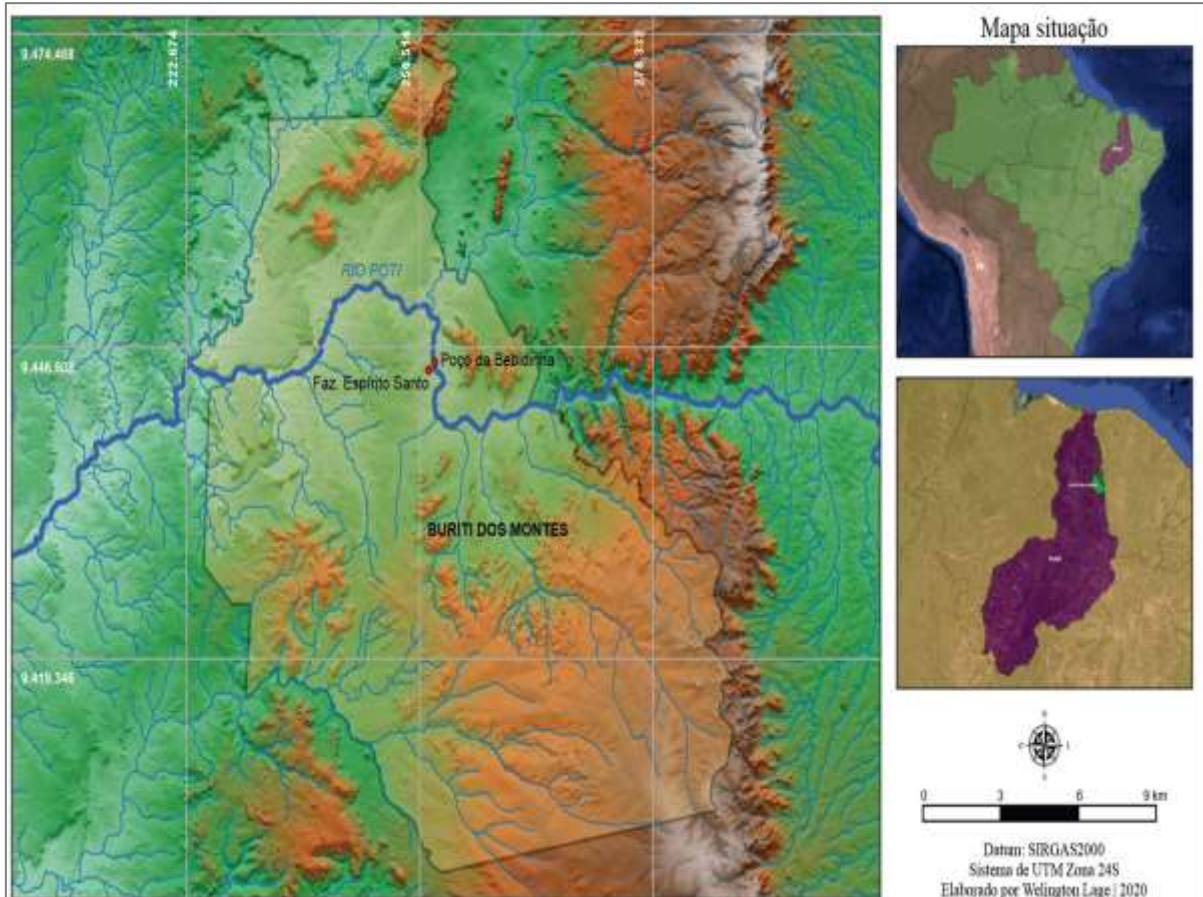
## **AREA OF STUDY**

The geomorphosite Well of Bebidinha Complex is located in the municipality of Buriti of the Montes, State of Piauí, located in the micro region of Campo Maior and comprises an area of 2,652.1 km<sup>2</sup>. Its limits to the North are the municipalities of Pedro II/Milton Brandão; to the South São Miguel of Tapuio/Castelo of Piauí; to the Eastern State of Ceará and to the west municipalities of Piauí Castelo/Juazeiro do Piauí (AGUIAR; GOMES, 2004; IBGE, 2010).

Inserted in a property designated valley of the Serra do Barreiro, near the Bicentennial Farm Espírito Santo, the geomorphosite Well of Bebidinha Complex is located in the geographical coordinates: latitude S 05°00'54.8" and longitude W 041°21'55.2". The complex is located in the Poti River Canyon, adjacent to the river bed, where it is possible to visualize rock formations that make up the same. Access is moderate, carried out by passable road (accessible by 4x4 vehicles or motorcycle), which takes up to about 700 meters from the site, or in case of other vehicles up to approximately 1km,

the rest of the route being done by trail. As for accessibility, in some points it requires small climbs (Figure 1).

**Figure 1.** Location of the Geomorphosite Well of Bebidinha Complex, Municipality of Buriti dos Montes, State of Piauí.



Source: LAGE, 2020.

## MATERIAL AND METHOD

For the implementation of this work, a bibliographic survey was initially carried out in monographs, dissertations, theses and scientific articles, as well as data collection in documents and technical reports on the environmental aspects of the site, emphasizing the approaches on geodiversity, geoconservation, geomorphosite and rock carvings (archeology).

Subsequently, cabinet work was carried out using cartographic techniques (geoprocessing) and Geographic Information Systems (GIS). For this purpose, the Qgis software (free software) version 2.8.1. The research also had work and data collection in the field. In this sense, the visit to the study area was made on October 27, 2020. For field checking, a GPS receiver (Global Position System) was used to collect coordinates. In addition, a direct observation was made with photographic records and a form adapted from Oliveira (2015) was filled out (Chart 1).

**Table 1.**Inventory sheet

<b>REGISTRATION SHEET OF THE GEOMORPHOSITE WELL OF BEBIDINHA COMPLEX</b>				
<b>1 – IDENTIFICATION</b>				
Responsible for filling out _____	On-site visit date ____/____/____		Geomorphosite N° _____	
Name: _____		Municipality: _____		
Location: _____		Latitude _____	Longitude: _____	
Altitude: _____				
Location Type:	<input type="checkbox"/> Isolated	<input type="checkbox"/> Area	<input type="checkbox"/> Panoramic	
Property Type:	<input type="checkbox"/> Public	<input type="checkbox"/> Private	<input type="checkbox"/> Not defined	
<b>2 – EVALUATION</b>				
<b>A – Values</b>				
Scientific	<input type="checkbox"/> Null	<input type="checkbox"/> Low	<input type="checkbox"/> Medium	<input type="checkbox"/> High
Didactic	<input type="checkbox"/> Null	<input type="checkbox"/> Low	<input type="checkbox"/> Medium	<input type="checkbox"/> High
Tourist	<input type="checkbox"/> Null	<input type="checkbox"/> Low	<input type="checkbox"/> Medium	<input type="checkbox"/> High
Ecological	<input type="checkbox"/> Null	<input type="checkbox"/> Low	<input type="checkbox"/> Medium	<input type="checkbox"/> High
Cultural	<input type="checkbox"/> Null	<input type="checkbox"/> Low	<input type="checkbox"/> Medium	<input type="checkbox"/> High
Aesthetic	<input type="checkbox"/> Null	<input type="checkbox"/> Low	<input type="checkbox"/> Medium	<input type="checkbox"/> High
Economic	<input type="checkbox"/> Null	<input type="checkbox"/> Low	<input type="checkbox"/> Medium	<input type="checkbox"/> High
Core Values:				
<b>B - Potential for Use</b>				
Accessibility	<input type="checkbox"/> Difficult	<input type="checkbox"/> Moderate	<input type="checkbox"/> Easy	
Visibility	<input type="checkbox"/> Weak	<input type="checkbox"/> Moderate	<input type="checkbox"/> Good	
Current use:				
<b>C - Need for Protection</b>				
Deterioration	<input type="checkbox"/> Weak	<input type="checkbox"/> Moderate	<input type="checkbox"/> Advanced	
Protection	<input type="checkbox"/> Insufficient	<input type="checkbox"/> Moderate	<input type="checkbox"/> Good	
Identified vulnerabilities:				
<b>3 - GENERAL NOTES</b>				
<b>Summary description</b> 3.2 Lithology 3.3 Main geomorphological interests 3.4 Value types/ Current use 3.5 Use and management 3.5.1 Accessibility 3.5.2 Visibility 3.5.3 State of Conservation				
<b>4 - PHOTOGRAPHIC RECORD</b>				

Source: Adapted from Oliveira (2015).

## RESULTS AND DISCUSSION

### GEODIVERSITY CHARACTERIZATION OF GEOMORPHOSITE WELL OF BEBIDINHA COMPLEX: Geological, geomorphological, pedological, hydrographic and climatic aspects

With regard to the geodiversity of the study area, taking into account the knowledge of its geological substrate, the related geological formations belong to a conformation of regional dimensions – the Piauí-Maranhão Sedimentary Basin or the Parnaíba Basin. The rocks that surface belong to the Serra Grande Group (CPRM, 2006), dating from the Paleozoic Era, specifically of Silurian age (443–419 million years before the present, Cohen et al., 2013, p. 200-201). In these sandstone rocks there are also intercalations of siltites and shales, having been formed in a paleo predominantly shallow marine environment (LAGE, 2020).

Campelo (2010) emphasizes that rocks from the Serra Grande Group extend superficially along the eastern, southeastern and southern edges of the basin, limiting itself to the crystalline basement. A total outcrop area is estimated at around 38,000 km<sup>2</sup>, with variations in capping thicknesses between 50 and 1,000 m. Due to its composition and its formation time, part of it has already been eroded, presenting low altimetric dimensions and low levels of dissection in its area of occurrence, resulting in the elaboration of geomorphological features linked to open valleys and dissected relief in hills (LIMA; BRANDÃO, 2010).

As for geomorphological features, according to Aguiar and Gomes (2004), these are largely the result of the processes of pediplanation and dissection. According to the geomorphological compartmentalization of Piauí, proposed by Lima (1987, p. 21) the study area is located in the Eastern Plateau of the Maranhão Piauí Basin, which

[...]it is located in the sedimentary basin of Maranhão-Piauí, in the eastern contact with Ceará. It has an area of approximately 43,000 km<sup>2</sup>, around 17.2% of the total area of Piauí and 20.6% of the Piauí part of the sedimentary basin. Topographically, this area [...] forms a large line of cuesta, whose "front" is facing the country depressions from Ceará and the reverse to Piauí. [...].

Geomorphological this compartment is represented by the reverses of cuestas preserved in monocline structures, monoclonal depressions and embedded valleys, highlighting the canyon or of Poti, which is to the east of the study area, in addition to the relief forms, with the ruin form type, geomorphological features that represents residual character that is formed from the wear caused by the erosion of the oil/wind, according to the diasquer plans (LIMA, 1987).

Regarding pedological characteristics, the area comprises several types of soils, with emphasis on the occurrence of Litholic Neosols; Pétical or alic plinthosols of medium texture and the Chromic Luvisols.

The climate of the area according to Köppen-Geyser is of the warm tropical type with rains in winter and dry season in summer "THE". The minimum temperatures of 20°C and maximum of 38°C, with tropical warm climate. The place has about 5 to 6 rainy months and in the rest of the year a drought situation is contacted. The months of February, March and April are the wettest (AGUIAR; GOMES, 2004).

The relative humidity of the air has an annual average ranging from 65% to 75%, values that grow from southeast to northwest and rainfall is in the order of 1,250mm, with 56% of the annual total, especially for the month of March, when 20% of the total annually precipitates. The driest quarter is July-August-September, when it rains 3% of the annual total (AGUIAR; GOMES, 2004).

As for hydrography, the main watercourses that drain the municipality are: the Poti, Piauí, Capivara and Cais rivers, in addition to the Cana-Brava, Olho D'água, Seco, Salina, Cangalha, Esquisito and Saco (AGUIAR) streams. GOMES, 2004).

### **RUPESTRE NO GRAPHICS GEOMORPHOSITE WELL OF BEBIDINHA COMPLEX**

Rock art (from Latin *ars rupes* "art on rock") or rock record, holds a wide set of images produced on sheltered rocky supports (caves and caves) or outdoors (walls and slabs) (JUSTAMAND et al., 2017). It's the oldest form of communication. Representing part of man's past, they are part of the cultural heritage of humanity, they are monuments of undeniable value, in addition to historical value have aesthetic value.

Lage (2007, p. 95) emphasizes that these works of art are exposed to time, "present from one continent to another, presents stylistic and thematic varieties, proving the stay or passage of man in a certain place, far away in time, and can reach several millennia".

According to Aguiar (2002) Brazilian Rock Art is basically represented by two distinct techniques: painting and engraving. Styles range from the most naturalistic to the tangles of abstract lines. The embossed comprises various techniques of removal or opening of the rocky surface, such as soothed and abrasion. "[...] as the name suggests, are low relief recordings, made on rocks" (NASCIMENTO; SANTOS, 2013, p. 33). The painted one is represented by techniques of adding pigments of different colors, dry or pasty, through brushes, fingers, puffs or stamps (JUSTAMAND et al., 2017).

These graphics, because they are products of culture, that is, the materialization of a form of thought that require in their analyses the investigation of the relations between culture and nature, therefore, between different agents. These messages are species of social memory of the human groups that produced it, whose meaning has been lost over time and history (FAGUNDES; FLAG; GRECO, 2018).

In this context, in the geomorphosite well of Bebidinha complex are found engravings on sandstone rocks in the open air on the banks of the Poti River suffering strong action from the weather. Landscape of exuberant scenic beauty, framed by sandstone monuments of the Serra Grande Formation the place is surrounded by vegetation of the ecotono zone with different ecological communities rich in species, whether they come from the biomes that form it or unique (endemic) species arising in it. The dominant vegetation belongs to the Caatinga biome (savanna-estepic), which according to Rizzini (1963, p. 23) "typifies as arboreal caatinga and shrub". It presents patches of Cerrado field comprising a range of metamorphic rocks on the eastern shore of the basin, also occupying the Chapada do Araripe and part of the Serra da Ibiapaba (NUNES; Lima, LIMA; NEGREIROS B. Filho, 1973).

Among the most relevant geodiversity values identified are: the cultural with an expressive collection of rock carvings, already registered by the National Institute of Historical and Artistic Heritage (IPHAN), also presents potential from the scientific, didactic, economic, ecological and aesthetic point of view.

According to a descriptive form adapted from Oliveira (2015) the said geomorphosite presents good visibility, moderate accessibility, and high scientific/didactic, cultural, historical and aesthetic value. From the cultural/historical point of view, the place allows the understanding of primitive peoples from the historical (archaeological) evidence, since there is a large amount of rock carvings (images in incisions in the rock/slab itself), which adds patrimonial value to this geomorphosites.

A significant amount of graphics that can be of the type not recognizable or deferred recognition (rectangular, circular and dotted shapes) stand out in the area, as well as recognized/figurative graphics (human figures, animals, plants and objects) (PESSIS, 2002; MAGELLAN, 2011; LAGE, 2018). It is worth mentioning the large number of anthropomorphic, zoomorph and phytomorphic representations.

These pictures represent the memory of prehistoric peoples who used these manifestations as a way of expressing themselves graphically. They are thus of paramount importance for understanding the temporal dimension and spatial dispersion of human groups that did not have the mastery of writing. This process in which the elements of culture and nature are transformed and gain special meanings, which are "out of time", which deserve to stay for future generations and that will not therefore be placed next to normal items (FIGUEIREDO, 2012).

According to Lage (2020, p. 157) the rock engravings of the geomorphosite well of Bebidinha complex are impacted "constantly by the action of water, either by the dynamics of the Poti River or by rain. As it is an exposed area, with little presence of vegetation, a condition that hinders infiltration and evaporation, the rocks present in the site are highly vulnerable to these natural attacks", which facilitates erosion, since the river wears out the rock by slow abrasion. "The sand and pebbles transported by the river generate a crushing action that can wear down to harder rocks" (NEVES, 2004, p. 55).

These engravings are found in an environment, where the dynamics of the waters of the Poti River, the insolation and the constant temperature variations compromise the structure of the rocks and thus the engravings, thus it is necessary to elaborate a monitoring plan that contemplates preventive and interventional actions, so that such preservation interventions (LAGE, 2020). It is also worth mentioning the need for effective implementation of legislation dealing with Brazilian heritage. Legislation is a set of fundamental structures that seek with regard to cultural heritage "to ensure the physical integrity of archaeological sites and all the objects and expressions they contain, safeguarding them from natural, social and economic interferences" (PARDI, 2002, p. 59).

Considering that the archaeological records found at the study site are the result of human labor, serving as a parameter for the understanding of Piauí society, considering its importance from the scientific/didactic and cultural point of view, it is worth mentioning following the laws and/or resolutions that affirm the need for conservation of this area.

- Federal Law No. 3,924, of July 26, 1961, the "law of archeology" that, in article 1, points out that archaeological or prehistoric monuments of any nature existing in the national territory and all the elements that are in

them are under the custody and protection of the Public Power [...] (BRAZIL, 1961).

- Article 25, § 2, which states that it is the common competence of the Union, states, the Federal District and municipalities: "to protect documents, works and other assets of historical, artistic and cultural value, monuments, remarkable natural landscapes and archaeological sites" (BRASIL, 1988, p. 40).
- Article 216 of the 1988 Constitution (BRASIL, 1988), which considers: Rock art sites, as well as archaeological sites of other categories, are part of the country's cultural heritage;
- According to Soares (2007) and Santos (2015) the normative system for the protection of archaeological heritage in Brazil is thus integrated by the Federal Constitution, by specific legislation on archaeological heritage (Decree-Law No. 25/37, Law No. 3,294/61, Law No. 7,542/86 and Ordinances of the National Institute of Historical and Artistic Heritage -- IPHAN), throughout the environmental legal system, especially the National Environmental Policy Law and the Environmental Crimes Act, resolutions of the National Council for the Environment (CONAMA) (in particular, Resolutions 001/86 and 237/97) and the procedural system that advocates the defense of diffuse and collective rights.

It is worth mentioning that it is up to the powers in the different spheres (national, regional and local) to value and preserve the different types of heritage of our country, among them the archaeological sites that integrate the cultural heritage.

The importance of Iphan is the organ responsible, at the national level, for the management, supervision and preservation of archaeological heritage, based on legal devices, operating devices, with the Archaeological Heritage Management System (SGPA) and the National Register of Archaeological Sites (CNSA).

In this context, it is from the recognition of the uniqueness of these rock records that conservation work should be guided. According to Lage (2007) for the conservation of these engravings in addition to the work of registration, supervision, it is necessary studies on the nature of the rock support and the environmental conditions in which they are. It is essential to carry out works to recognize the local geodiversity to propose actions that delay the degradation of sites with engravings and/or paintings, because different types of erosion can reach the rocky base depending on its petrographic nature, its geological history, its physical-chemical properties and climatic factors.

Thus, because it has a rich collection of pre-colonial prints allied to the scientific/didactic value, the geomorphosite well of Bebidinha complex, besides corresponding to a "place of memory" of past populations, products of culture, has great potential for understanding part of the evolutionary history of the earth, from the geological and geomorphological aspects in evidence.

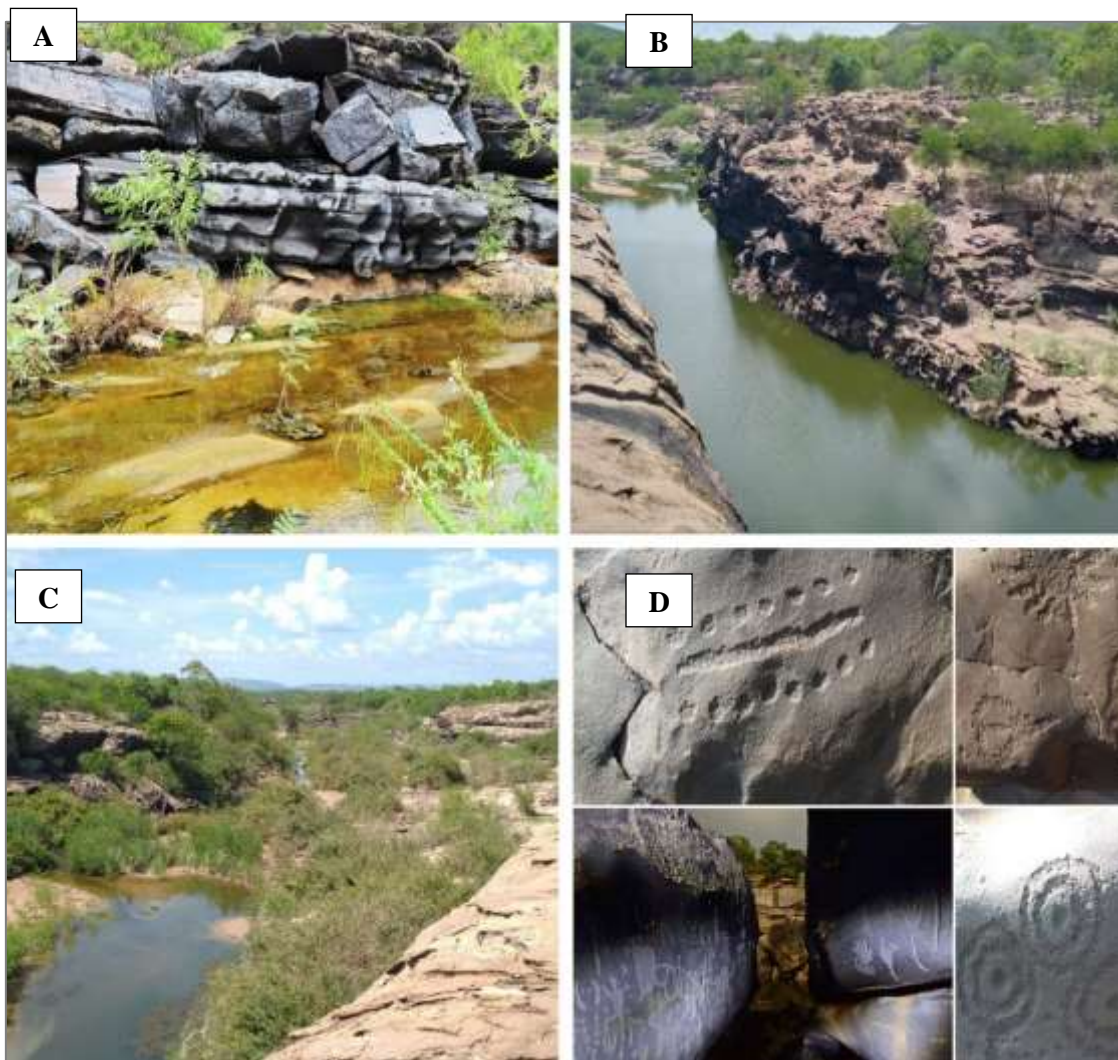
It is in this context, added to the special characteristics and significant attributes that qualify it with patrimonial value that the said geomorphosite deserves and needs to be conserved, since it is configured as an important space that can be used in scientific and educational activities (SILVA; AQUINO, 2021). Its use in environmental education



activities, scientific research and the enrichment of knowledge about geological, geomorphological and archaeological characteristics are fundamental.

Based on what was discussed in Figure 2, photographic records are presented for the study area.

**Figure 2.** Photographic records of the geomorphosite well of Bebidinha complex, Piauí, Semi-arid Norytheast



A. Rocks consisting of sandstone in the geomorphosite well of Bebidinha complex; B. Geomorphological feature Bebidinha Lookout, with emphasis on a stretch of the Poti River Canyon; C. Arboreal caatinga and shrub in the geomorphosite well of Bebidinha complex; D. Cultural/historical value of the place from the presence of numerous rock carvings. Source: A and D: LAGE, 2020; B and C: Authors, 2020.

## CONCLUSIONS

Studies on geodiversity are relevant with regard to the knowledge of natural heritage, fundamental information for the management and use of the territory and consequent conservation. The geomorphosite well of Bebidinha complex presents a rich heritage, besides allowing geoscientific knowledge related to its evolution over geological time the large amount of rock carvings adds historical/cultural value from the archaeological point of view allowing to evidence, didactically, the historical time. It is

worth mentioning that because it is a reference of the past, and also a component of the collective memory of current populations, both natural and anthropic factors reach the geomorphosite and especially the engravings, with regard to its degradation.

Thus, the archaeological preservation of this area becomes fundamental, expressed in the form of rock carvings in rocky outcrops, which are part of the memory of a people who lived there. The investigation of a past as remote as the one that left its signs on the rocks is, at the same time, a way to know ancestry and believe in the relevance of your experience to the construction of our future.

In view of the relevance of this site as a potentiator of activities aimed at scientific and didactic purposes (scientific research, field activities), the evaluation of this geomorphosite provides support for the definition of geoconservation strategies (such as: inventory, quantification, valorization and dissemination) based on previous integrated planning considering the realization of ecological and environmental load capacity studies.

Thus, it is worth emphasizing the need for partnerships with the local community and educational institutions (schools and universities), in order to create visitation programs to the area, properly programmed, guided and with a view to valuing, disseminating and conserving it, with pedagogical projects that seek to combine geoscientific knowledge with the historical-cultural rescue, through actions aimed at Environmental Heritage Education, for it is only possible to preserve and value what is known and respected. It is necessary to create in schools a space that allows the connection of these themes with the teaching practice, providing mechanisms for students to know, in order to value and disseminate local geodiversity, starting with the reality of the place where it is inserted. Through Environmental Heritage Education (EPA) it is expected to have greater engagement and dialogue to think of a unique way to manage the geomorphosite well of Bebidinha complex, so that public, private institutions can be integrated with local communities. What is observed are several limitations such as access issues, infrastructure, monitoring, supervision by public agencies; ignorance of it by the local population, the state and the municipality, etc.

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