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APPLIED TERMINOLOGY IN GEODIVERSITY AND GEOTOURISM ACTIVITY: A SUSTAINABLE CONCEPTUAL EXERCISE

Ana Sibelonia Saldanha Veras[1]
Nelson Azevedo Barros[2]
Maria Alzira Pimenta Dinis[3]

ABSTRACT

Objective: Promoting environmental geoconservation, geodiversity and local culture, namely through tours and research on these natural environments.

Theoretical Framework:t is based on modern scientific definitions used in geology, geomorphology, paleontology, culture, and for educational and geotourism purposes.

Method: The literature review significantly contextualizes knowledge and broad understanding, as well as advances in the terminology most used in geotourism activity, adopted in Brazil and European references in the area.It is representativeness: relational: the suitability of the geosite to illustrate a geological process or quality, which contributes significantly to the understanding of the theme, process, characteristic or (i) representation: geological context, (ii) integrity: related to the state of conservation of the geosite, (iii) rarity: number of geosites in the geological study area, (iv) scientific knowledge.

Results and Discussion: The results obtained revealed that review studies of specialized terminology applied in geodiversity and geotourism activity play a significant role in interpreting unique places where most geosites occur, attracting tourists who are increasingly surprised by geosites.

Research Implications: The implications of geosite terminology do not involve universal consensus, and there are several ways to scientifically describe a geosite in the context of a type of terrestrial relief, geological structure and minerals. This interpretation should be carried out by a specialist or by experienced people who are knowledgeable about the local specificities.

Originality/Value: This study contributes to the literature by addressing the terminology applied in geoscience that encompasses geodiversity and geotourism. The relevance and potential of geosites for education, scientific interpretation of geological characteristics in the central region of the North Amazon.

Keywords: Geological Singularity, Geotourism, Geosite, Sustainable Devopment.

TERMINOLOGIA APLICADA À GEODIVERSIDADE E À ATIVIDADE GEOTURISMO: UM EXERCÍCIO CONCEITUAL SUSTENTÁVEL

RESUMO

Objetivo: Promover a linguagem científica do universo geológico-geomorfológico e da cultura local, nomeadamente através de passeios geoturísticos e de investigação nestes ambientes naturais.

Referencial Teórico: Baseia-se em definições científicas modernas usadas em geologia, geomorfologia, paleontologia, cultura e para fins educacionais e geoturisticas.

Método: A revisão bibliográfica contextualiza significativamente o conhecimento e a compreensão ampla, bem como os avanços na terminologia mais utilizada na atividade geoturística, adotada no Brasil e em referências europeias na área. Trata-se da representatividade: relacional: adequação do geossítio para ilustrar um processo ou

[1] Universidade Fernando Pessoa (UFP), Porto, Portugal. E-mail: 39347@ufp.edu.pt
[2] Universidade Fernando Pessoa (UFP), Porto, Portugal. E-mail: nelson@ufp.edu.pt
[3] Universidade Fernando Pessoa (UFP), Porto, Portugal. E-mail: madinis@ufp.edu.pt

qualidade geológica, que contribui significativamente para a compreensão do tema, processo, característica ou (i) representação: contexto geológico, (ii) integridade: relacionada ao estado de conservação do geossítio, (iii) raridade: número de geossítios na área de estudo geológico, (iv) conhecimento científico.

Resultados e Discussão: Os resultados obtidos revelaram que estudos de revisão de terminologia especializada aplicada à geodiversidade e à atividade geoturística desempenham um papel significativo na interpretação de lugares únicos onde ocorrem a maioria dos geossítios, atraindo turistas que se surpreendem cada vez mais com os geossítios.

Implicações da Pesquisa: As implicações da terminologia de geossítio não envolvem consenso universal, e há várias maneiras de descrever cientificamente um geossítio no contexto de um tipo de relevo terrestre, estrutura geológica e minerais. Esta interpretação deve ser realizada por um especialista ou por pessoas experientes que tenham conhecimento das especificidades locais.

Originalidade/Valor: Este estudo contribui para a literatura ao abordar a terminologia aplicada em geociências que abrange geodiversidade e geoturismo. A relevância e o potencial dos geossítios para a educação, interpretação científica das características geológicas na região central da Amazônia Norte.

Palavras-chave: Singularidade Geológica, Geoturismo, Geossítio, Desenvolvimento Sustentável.

TERMINOLOGÍA APLICADA A LA ACTIVIDAD DE GEODIVERSIDAD Y GEOTURISMO: UN EJERCICIO CONCEPTUAL SOSTENIBLE

RESUMEN

Objetivo: Promover el lenguaje científico del universo geológico-geomorfológico y de la cultura local, en particular a través de recorridos geoturísticos e investigaciones sobre estos entornos naturales.

Marco Teórico: Se basa em definiciones científicas modernas utilizadas em geología, geomorfología, paleontología, cultura y con fines educativos y geoturísticos.

Método: La revisión bibliográfica contextualiza significativamente conocimientos y comprensiones amplias, así como avances em laterminología más utilizada em laactividadgeoturística, adoptada en Brasil y en referencias europeasenel área. Es representatividad: relacional: adecuacióndelgeositio para ilustrar unproceso o cualidad geológica, que contribuye significativamente a la comprensión del tema, proceso, característica o (i) representación: contexto geológico, (ii) integridad: relacionada con el estado de conservación del geositio, (iii) rareza: número de geositios em el área de estudio geológico, (iv) conocimiento científico.

Resultados y Discusión: Los resultados obtenidosrevelaron que losestudios que revisanlaterminología especializada aplicada a lageodiversidad y laactividadgeoturísticajueganun papel importante em la interpretación de lugares únicos donde se encuentran la mayoría de los geositios, atrayendo a turistas cada vez más sorprendidos por los geositios.

Implicaciones de la investigación: Las implicaciones de la terminología de geositios no implica nun consenso universal, y hay varias formas de describir científicamente um geositio em el contexto de un tipo de accidente geográfico, estructura geológica y minerales. Esta interpretación debe ser realizada por un especialista o personas experimentadas y conscientes de las especificidades locales.

Originalidad/Valor: Este estúdio contribuye a la literatura abordando laterminología aplicada em geociencias que abarca la geodiversidad y el geoturismo. La relevancia y potencial de los geositios para la educación, la interpretación científica de las características geológicas em la región central de la Amazonía Norte.

Palabras clave: Singularidad Geológica, Geoturismo, Geositio, Desarrollo Sostenible.

1 INTRODUCTION

In recent decades, there has been a growing interest in studies related to natural resources, specifically the aesthetic components and their relevant characteristics, including geology and the geo environment aspects, access, and local presentation panels, according to Zhang *et al*., (2023), panels, as a method that captures the visitor's attention (Dowling, 2013, Sánchez-Cortez & Simbaña-Tasiguano, 2018,Telbisz *et al*., 2023).

As a result of this interest, geotourism becomes more important in educational activities developed with students, researchers, tourists and the community (Vukoiči *et al*., 2020) with the aim of promoting environmental geoconservation i.e., geodiversity and local culture, namely through tours and research on these natural environments (Dowling, 2009; Newsome & Dowling, 2010, Hose, 2012, Dowling, 2013, Dowling & Sanders, 2014, Hurtado *et al*., 2014,Brilha, 2016, Pereira, 2019, Sanz *et al*., 2020,Sule, 2020, Ríos etal., 2020; Valente *et al*., 2020). Therefore, it is important to be aware and have consensus at this respect. Terminologies are also considered in this article as a scientific language of the geological-geomorphological universe demonstration of tourist distinctiveness, being widely used as a resource geographically expressive of geological- geomorphological, paleontological, mining, cultural and educational interest, representing characteristics of rarity and uniqueness, therefore, it representsing an important testimony to the stages of geological evolution on Earth, in communication as one of the key elements as ensures Frank (2022)between tourists and companies (Mamurjonovna, 2020). Terminology plays an important role in the modern technical language of the professional field support (Mirzakarimova&Tashtemirova, 2022) so this knowledge gives the geotourism sector the importance it deserves and allow experts in business, tourism, managers specialists, and areas of media such as magazines or news papers(Frank, 2022) to develop a level of understanding necessary to promote communication at a professional and academic level, so necessary in this contemporaneity in the face of geotourism activity. Adequate terminology allows to promote, expand and be used for educational purposes, a way of advancing awareness among tourism leaders and contributing to the mitigation of environmental impact (Rantala *et al*., 2020; Mirzakarimova&Tashtemirova, 2022). According to Ooi(2017), the Anthropocene is the geological era in which we find ourselves, popularized by scientists such as Paul Crutzen and Stoermer (2000) who refer to the influence of human activity on terrestrial landscapes, with widespread implications for the health and safety of ecosystems and with consequent reflections on geotourism (Gren & Huijbens, 2014, Ziegler, 2019, East & Sankey, 2020).

Thus, it is necessary to be aware of the geotourism activity and of the correct terminology, related to an environment composed of numerous geological-geomorphological records at the local scale of a geographic region (Gray, 2013). These recent terms are used in line with the expansion of activities offered in the tourism sector, that the practice of geotourism offers to the geotourist and/or *in situ* visitor disseminating educational activities on trails and as a generator of socioeconomic sustainability (Dincãetal.,2023,Górska-Zabielska**,** 2023).

In this context, this article aims to identify geotourism terminology, their definitions, and contributions to the understanding of part of Earth Sciences, considering it to be an important tool aimed in the context of sustainable development.

2 THEORETICAL FRAMEWORK

They include international terminology such as geosite, geomonument, geomorphosite, geotope (Brilha, 2005,Migoń&Pijet-Migoń, 2017,Hueso-Kortekaas & Iranzo-García, 2022) a term referring to geological-geomorphological resources, which are static, immutable and susceptible to anthropogenic actions (Rangel *et al*., 2019), e.g., excessive volume of tourist infrastructure, translating signs of intense flow of people on geotouristic trails and causing soil erosion problems (Gordon *et al*., 2018, Bollati & Viani, 2023). The mentioned terms are also considered new emerging terms in the context of geoeducation, innovative strategies developed by tourism agencies in an increasingly globalized world, allied to the advancement of science (Khalaf, 2022).

Adherence to and compliance with the norms of preservation and sustainable development recommended by Martini *et al*., (2022) constitute an appropriate way for the use of sites in regions where geology stands out in the landscape (Mikhailenko & Ruban, 2019), resulting in the act of protecting the sites from human damage (Sallam *et al*., 2020), i.e., minimizing negative impacts through implementation of specific actions on the part of geotourist management (Hose, 2012, Aoulad-Sidi-Mhend *et al*., 2020; Dincã *et al*., 2023).

Several works have contributed to the dissemination of geological-geomorphological characteristics in territories where geotourisms configured as an alternative income and opportunity for visitation within the pillars of sustainability (Dowling, 2009, Hose, 2012, Dowling, 2013).

Thus, the knowledge of the characteristics of the geomonument, i.e., non-renewable geological occurrence with a characteristic of monumentality and grandeur, highlights the geotourism and scientific importance of the heritage (Matshusa *et al*., 2021). All these qualities

disseminate geological terminologies, empowering strategies for the layman to learn and interpret, at the same time creating identity for the territory, adding local culture (Muzambiq*et al*., 2023).

3 METHODOLOGICAL PROCEDURE

This article is based on a framework that makes it possible to identify, evaluate, interpret, and assist the understanding of terminologies extracted from the analysed studies (Gray, 2013, Ólafsdóttir & Tverijonaite, 2018). To identify terminologies characterized in geotourism, the following search keywords were used: “geotourism” AND “geosite” because they are related to each other (Megerle, 2022), as geotourism is linked to the abiotic elements of geological and tourist diversity.

The search was carried out in the *ScienceDirect* (Elsevier) database, without time restriction, in order to cover all the terminologies used, as well as without restrictions on the type of production, including articles, dissertations, theses, books and book chapters addressing the topic. It is reiterated that the literature review significantly contextualizes knowledge and broad understanding, as well as advances in the terminology most used in geotourism activity, namely by the Mineral Resources Research Company-CPRM, supported by related institutions, such as the United Nations Educational, Scientific and Cultural Organization-UNESCO, World Heritage Committee (WHC), IUGS-International Union for the Geological Sciences, IGCP-International Geological Correlation Programme, IUCN-International Union for the Conservation of the Nature, Working Group on Geological and Paleobiological Sites (GEOTOPES), European references in the area, such as Geoparks Naturtejo, Arouca, Azores-Portugal,Central Catolonia-Spain (García-Cortés &Carcavilla, 2009, Brilha, 2016, De Carvalho & Aquino, 2022) which contributed to the methodology adopted by the Brazilian Commission of Geological and Paleobiological Sites-SIGEP as well as the Geological Sites Registry (https://www.sgb.gov.br/geossit/).

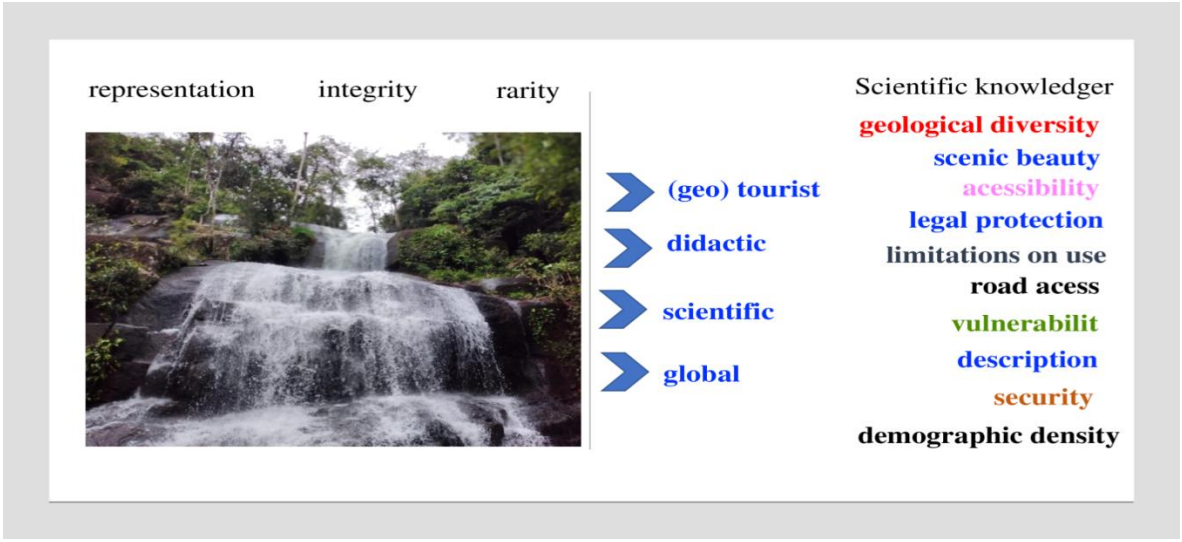
It is worth noting that thise methodological systematization was developed for geosites and the one applied in Brazil for geotourism, was adapted from several authors (Brilha, 2005, García-Cortés &Urqui, 2013, Brilha, 2016), adopted by Brazil. It concerns, representativeness: relating: relating to the suitability of the geosite to illustrate a geological process or quality, which makes a significant contribution to the understanding of the theme, process, characteristic or (i) representation: geological context, (ii) integrity: related to the state of geosite conserve ation, (iii) rarity: number of geosite in the study area geological, (iv) scientific knowledge:

based on the existence of scientific data already published about the geosite. See some of the classification criteria to be met in Brazil, in. Figure 1(Veras, Azevedo e Dinis, 2022).

Possible grades to consider are: 0, 1, 2, 3, or 4, whose weights vary from 30%, 20%, 15%, 10% and 5%. The higher the score, indicates, the greater the feasibility of using it for educational purposes as a territory suitable for levels ranging from elementary to undergraduate and postgraduate courses. As for the aesthetics of the geosite, it has greater potential for tourism and its ramifications, e.g., geotourism. Among other criteria, they involve different actors, such as: guides, local drivers who carry out work and tasks, tour operators responsible for logistics and implementation of services in favour of the conservation of the geological heritage carried out by the geotourist who observes the geosite.

Figure 1

Synthetic criteria for a geosite in relation to registration and classification, established by values. Important stagethat promotes geological heritage prioritized in local management.



Source: Veras, Azevedo e Dinis (2022).

3.1 SYNTHETIC GEOLOGICAL SETTING

The geological context of Brazil has a territorial extension of 8,514,876 km^2 and a geological structure composed of three distinct types: crystalline shields, sedimentary basins and volcanic terrains., Iin this aspect, the crystalline shields formed when the Earth was covered by magmatic-plutonic and, therefore, the Brazilian geological heritage of the Precambrian era, where non-metallic minerals are sheltered, such as granite, diorite, quartz, slate, magnesite, asbestos and feldspar – and metamorphic rocks from the Paleozoic era, where metallic minerals

are found: iron, gold, copper, manganese, lead, bauxite, tin, chromium, cobalt and nickel (Bizzi *et al*., 2003, Schobbenhaus *et al*., 2021).

With a high potential to host minerals, the Central region of Roraima, more specifically Mucajaí, the geology of the area is represented in the Central Guiana Domain (DGC) for which it registered an evolution controlled by the Trans-Amazonian event, with lithostructural reorganization in the Mesoproterozoic geological era. For this region an extensive band of rock with high metamorphism is recorded, i.e., the Urubu River Metamorphic Suite and the Mucajaí Suite, which extends in a NE-SW direction (Holanda, 2014, Veras, 2014).

Regarding the relief forms present on the earth's surface and the processes inherent to geomorphology, and according to Veras, (2014), the area is represented by hills and hills aligned in NE-SW orientation, in accordance with the regional orientation of the (DGC) made in rocks. gneissic and morphology consisting of convex tops, convex concave slopes and ravines (Veras 2015).

The understanding of geodiversity constitutes the visibility of the notable features of Mucajaí, characterized by exceptional geosites. These archives represent the memory of the Earth since its formation and exposed aesthetics, this a strong reason for conservation (Ferrando *et al*., 2023).

3.2 CONTEXTUALIZING GEOTOURISM

The Geotourism Dictionary (Chen *et al*., 2020), was selected for this study, to have the vision of Chinese geologists who call see geotourism as a scientific and emerging discipline, it focusesing on landscape structure geology, therefore it isalso focused focusing on education and terminologies arising from the great area of Earth sciences, as it presents easily understandable terminologies for use also by non-scientists and those interested in Earth Sciences, i.e., students, governments, tourist trade, citizens and people living of the tourism sector. The focus on the large-scale dissemination of geotourism occurred from the rapid growth and evolution of the activity in geoparks, which stems from the urgent need to define tourist. The geosite global discourse terminology (Gray, 2019) considers characteristics and natural functionalities belonging to a science, an art, an author, or a social group, and is used by a specialist in a functionalities belonging to a science, an art, an author, or a social group, and is used used by a specialist in a given area for interpretation indifferent disciplines,with concept functions, communication and identity (Moreira, 2016).

It is worth noting that there is a need for technical expressions, particularly in the geosciences, one of the oldest and most relevant scientific areas, holding countless and essential meanings, formed from scientific roots, among them the genetic diversities revealed in land of rock formations (Neuendorf *et al*., 2005, Ody, 2005). Terminology in geosciences began to be intensely disseminated as those that study and contribute to the understanding of the history and internal processes of the Earth and, as protagonists in the interpretation of nature, such as, for e.g., geotourism, bringing the know-how of Europe and its geoparks (Sousa *et al*., 2020).

The geographic literature started to use the term geotope: geo=geo, tope=site=smallest spatial scale place or the smallest geographic unit to exemplify geomorphological forms, therefore, in the specialized literature the so-called geomorphosite, i.e., relief form to value the different tourist activities used by the geographer who analyses by the bias of altitude, form, evolution and economic valuation. As for the geologist, they describe the geotope, analysing the indicative lithotype histories, i.e., composition of the geological structure of the place presented to the geotourist (Ielenicz, 2009).

As for the prefix "geo", it refers to geology, geography, and geomorphology, as well as all elements of geodiversity supported (Brilha, 2005, Panizza, 2007, Henriques & Brilha, 2017), among other variations, such as geotope, geosite, geomorphosite, geomonument, geological site, place of geological interest (Brilha, 2016). These concepts are an example of the force of nature and the memory of processes in perfect harmony according to Clivaz & Reynard (2018), both locally and internationally. The geotope, terminology that names the smallest physiographic unit of space, is determined by uniform processes of matter and energy that make up the geosystem. Every geotope has a unique feature in an inventory. Consequently, selecting a geosite in these natural structures, e.g., rock facies, often detached and loosened by the effects of weathering, i.e., physical and chemical, allows them to be protected from detrimental interventions and effects, preserving the most important, i.e., the care for the safety of the geotourist (Ólafsdóttir, 2019).

In view of the great potential of geological-geomorphological heritage, i.e., notable features and vigorous places where landscape interpretation activities can be implemented and that represent the Earth's memory, key locations for understanding the dynamics of the Planet, they must be considered important characteristics in identifying the terminology of a geosite that has value for education and tourism (Winge *et al*., 2013). Thus, the crucial preservation of the geosites that stands out in the landscapes and lithological units, and distinct geomorphological features (Navarrete *et al*., 2022). Such places of scientific notoriety have gained the attention of scientists, students, tourists, and entrepreneurs, determining these as vital

elements in the understanding of abiotic nature processes (Abdelmaksoud & Metwaly, 2020), ensuring the sustainability of humanity, the greatest beneficiary of conservation results and simultaneously responsible for its safeguard (Butorac&Buzjak, 2020).

3.3 EXPLORING GEODIVERSITY DYNAMICS

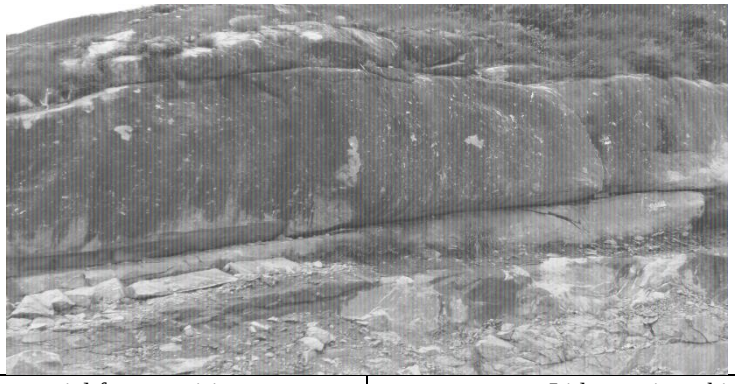
Geodiversity is a widely integrated term in everyday vernacular, composed of a natural variety of geological elements i.e., rocks, minerals, and fossils. It is associated with the theory of Gaia, which considers that the planet and all its biotic and abiotic elements constitute a unique system of interactions, being, therefore, of integrated dynamics. The inspiration for naming this theory has its genesis in Greek mythology, in which Gaia, Geia or Ge, i.e., in Greek, *ταία* is Mother Earth, as postulated by Lovelock (2020).

Still in the context of terminology, geosite represents a natural set of deposits and soil processes, i.e., out crops, quarries, mines, faults, inactive processes including their relationships, correlations, interpretations, systems, and properties (Štrba, 2019, Abdelmaksoud & Metwaly, 2020). All these terrestrial materials represent opportunities and challenges for management strategies. On the other hand, there are many elements in geodiversity whose importance is not recognized and valued (Gray, 2018; Richards *et al*.**,** 2020), and this is the immeasurable support of geotourism, representing a great challenge (Coratza *et al*., 2018, Clivaz& Reynard 2018, Mergele, 2022).

Geodiversity Day was recently created on 10/06/2022 (UNESCO, 2022), considered the birth place of several species, therefore, a true library of geosites (Brilha, 2016) contributing to geoscientific research in support of the Sustainable Development Goals (SDGs) (Reynard & Zwoliński, 2018, Harley & Wexner, 2022) and everyone's responsibility (Muringa, 2022). See some geosites in table 1, 2, 3 and 4.

Table 1

Geosite of great relevance that offers potential for education, economic interpretation for society and civil construction, translating a scientific interpretation of geological characteristics for geotourism. It is located in the central region of the northern Amazon, Mucajaí-RR, Brazil (North Latitude 02º 25' 48", West Longitude 60º 55' 11" (images by the authors). (all imagens bytheauthors).



Geological potencial for geotuirism	Lithostratigraphic unit
Geosite and natural environment (*in situ*) and function rocky outcrops (on the Inselberg coast) or isolated massif exposed in a terrestrial environment constitute quarries and produce crushed stone and cobblestones of quartz-feldspathic gneiss and mafic domains (biotite and amphibole) that generally occur folded. Belonging to the Urubú River Metamorphic Suite Stratigraphic Unit (Brazil**,** 2009).Accordingly, and according to Veras, **(**2014**)**, as part of the ecosystem, they are home to countless endemic live ssuchas birds, living organisms, snails, seaweed and vegetation that support the local environment. Sustainable Development Goals (SDGs): Lithology stands out in the region, for. its economic value and interpretation for geotourism. Furthermore, there are rock inscriptions, cliffs, i.e., possible viewpoints (Veras et al., 2022). Avoid predatory damage, for example, not handling fire, combating vandalism and graffiti.	Geologically, the region of the State of Roraima that includes the municipality of Mucajaí located northo the Amazonas craton, in the central portion of the Guiana shield, therefore, the Guiana Domainis represented in the NE–SW range where large supracrustal rock of high altitude are found. Degree of metamorphic, orthogneisses and varied nature and Orosirian charnockites (Reis et al., 2014) Belonging to the Rio Urubu Metamorphic Suite. The occurence of the outcrop, i.e., isolated massif, mountains or also known as sugarloaf and reach 300 m, carved on igneus and metamorphic rocks of the Guiana shield (Brazil, 2009, Ladeira Dantas, 2014). In this territory, the unit's relief features are individualized in residual Inselberg format, these morphologies, some with flat tops and some with rocks exposed with jetties, such characteristics will create imposing geological landscapes that support the interpretation of geotourists and visitors (Veras, 2014).

Table 2

Fresh water in an irreplaceable resource of great important in Mucajaí, essential for the river ecosystem of northen (images by the authors).

Geological potencial for geotourism	Lithostratigraphic unit
The Mucajai River, belonging the Guinan Shield relieve formation, and Precambriam origin makes up the Rio Branco hydrographic basin, a tributary of the Amazon River.With 21,602 km^2 in lenghth, its route is quite winding, through dense forests and low altitude with sections of waterfalls and rapids. Its upper course runs through red-yellow podzolic soils (Ferreira et al., 1988). It fulfils, the natural function of transporting water by gravity from the headwater to the ocean. They irrigateagriculture, thirstyanimals, freshwatersuppliers Sustainable Development Goals (SDGs): The role of local geology must be emphasized in the interpretations to be presented to the visitor or geotourist. In the current context, the climate issue SDG 13 in compliance with the 2030 Agenda is highly relevant, followed by the deforestation of the vegetation composition, as its eradication will favor the maintenance of the carbon retained by trees. Geotrails are excellent tools for working, understanding and protecting geological heritage	It is found in the geological unit related to the Paleoproterozoic and Phanerozoic, highlighting the Central Guiana Domain (DGC) Rio Mucajaí is geographically located in the center-west region of Roraima, lithological domains Pleistocene sandstones are sometimes located in an area covered by rocks Mesoproterozoic igneous rocks where biotite-hornblende granites and quartz monzonites from the Mucajaí Batholith predominate, therefore, the iconic distribution of streams characterizes the geology of the region (Feitoza et al., 2007).

Table 3

Lithological landscape structure and its Residual Plateau unit composed of mountain ranges, aligned hills and inselberg (images by the authors).

Gelogical for geotourism	Lithostratigraphic unit
They tree species, form barriers of winds, rich in resources of biodiversity. Citizens living around these geosites experience the environmental services of the vast vegetation in a well-preserved state (Versa, 2014). Belonging to the PlanaltoResiduais de Roraima compartment. The highest elevations in this morphostructural unit, i.e., in themorphosculptural domain, are igneous rocks, e.g., from the Mucajaí mountain range carved into rocks from the Mucajaí Intrusive Suite,meters in altitude, Inselberg is presen (Holanda et al., 2014). Sustainable Development Goals (SDGs) For this lithological Unit, emphasis on interpretations of the mountain area, regarding deforestation, fires, removal of native vegetation from these environments, litter, lichens on rocks and slopes hide minerals, and freshwater springs, in addition to, importance for climate change priority of Agenda 2030 and SDGs 13 and 17.	Geologically, this region is represented in the Central Guiana Domain (DGC), the surface recorded in geological history an evolution counteracted by the Transamazonian Event, with lithostructural evolution during the Mezoproterozoic era, as can be seen from the extensive band of rock with a high degree of metamorphism that extends with NE-SW direction (CPRM, 2002).

Table 4

Clay product extracted from rocks formed by hydrated silicates and its various uses by indigenous populations (images by the authors).

	
Geological potential for geotourism	Lithostratigraphic unit
Clay mineral considered important, found in environments considered as true stages of knowledge, not for aesthetics, but because it is found in nature and belongs to the group of minerals that are widely used in the manufacture of paints, rubber, chemical and pharmaceutical products and cosmetics. For interpretation in geotourism, this terminology clarifies the origin of the pots made by indigenous women who extract following a ritual in the collection of this raw material belonging to the abiotic world (SGB, 2014, Rocha, 2019) Sustainable Development Goals-(SDGs) This resource is widely used by associations and groups of indigenous women with the aim of promoting artifacts and varying productions sought by non-indigenous people. By manufacturing their clay products, they add value to the piece made and sold to tourists. In this sense, the National Environmental and Territorial Management Policy-PNGATI, Brazil, (2012), should be taken as a reference, preserving the geological nature in conjunction with local culture and prioritized by SDG 15.	The genesis of these sediments has its origins in the Cenozoic era, uncosolidated deposits were deposited in aqueous environments, therefore, they are found in thick packages of sand and soft clays in plain environments and alluvial terraces (Vale Júnior et al., 2014).

Notably, geotourism works in three basic categories: geological processes, geological features and cultural elements. This led to the movement of awareness among the interested public, therefore, the involvement of the tourist chain through the elaboration of trips, educational tours that occur and the use of technical terminologies contribute to define geosite in multilingual versions within the approach of modern geology (Kaur, 2022).The refore, geotourism contributes to organize and systematizes knowledge about language throughout the chain of its practice, e.g., in groups and individually, to welcome the geotourist who travels

from urban environments to where the attraction is located, with the objective of knowing or researching the geosite, and in this route, peculiar terminology of tourism is used, becoming possible inevery robust segment of the provision of services used by specialists (Tomczewka-Popowycz & Taras, 2022).

It is important to emphasize that the surrounding communities must be involved in the process of valuing the heritage where the interpretation and conservation activity takes place (Gordon *et al*., 2018, Gray, 2018).The economic sustainability of these regions also occurs through the activity of geotourism and the formal condition is through a geopark that fulfils the function of environmental and social conservation of a territory, which is recognized globally, that is, they must be registered in the Global Geoparks Network, subject to criteria issued by the United Nations Educational, Scientific and Cultural Organization (UNESCO). Territories with lush landscapes suitable for geotourism activity, composed of a municipality where geosites with occurrences of greater scientific, educational and geotourism value are concentrated (Brilha, 2016). Among the fulfilment of requirements e.g., geoparks must have a management plan designed for sustainable development geoparks unified areas (Chen *et al*., 2020; Li, Ng & Wu, 2022) as for sustainable development, it advocates protection as it is aimed at the SDGs (Kawamoto & Kanie, 2020).

Follow agreements in global environmental agreements, such as those on climate change, geodiversity, biodiversity, world heritage and conservation of wetlands, inorder to guarantee environmental quality (Selmi *et al*., 2022). In the case of developing regions and with relevant geosites, the resulting impacts caused by tourists and visitors must be considered in these natural environments, and thus guarantee sustainable development moving forward with outexhaustingor depleting resources for the future, according to Tessema *et al*., **(**2022), considering noise too, and care with the physical load capacity of the planned location.

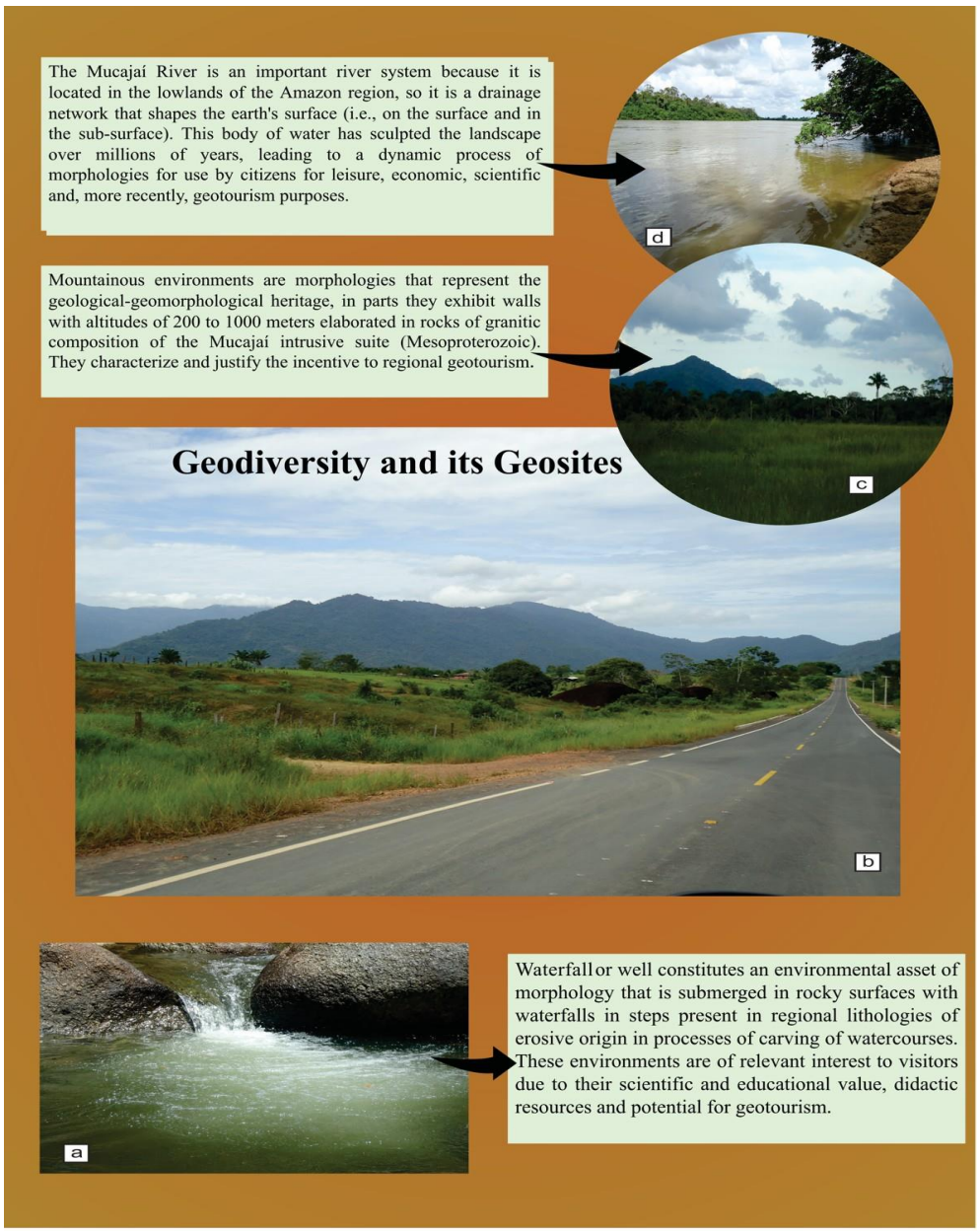
As part of the triad of geoconservation, geodiversity and geotourism, an integral part of sustainable principles has the role of equity, to impartially recognize the triad enshrined in the principle of equity between generations (Pijet-Migoń & Piotr Migoń, 2022) and a priority, as part of the triad of geoconservation sustains (Selmi *et al*., 2022) geodiversity and sustainable geotourism, with geoconservation having the role of identifying and protecting abiotic elements (Gray, 2018, Crofts, 2022). Previously officially inventoried and operationalized, national and global geoparks are valuable assets in natural environments, *loci* of varieties of values, aesthetic, economic, educational, and cultural (Williams *et al*., 2020). Generally, these protected areas provide economic possibilities to local communities that promote geoheritage

(Lazzari & Aloia, 2014) and conservation and enhance awareness of the underlying geodiversity resources and processes, as well as enable planning and measures to transform geosites into tourist attractions (Gordon *et al*., 2018; Crofts, 2022). Some examples are concentrated in geoparks (e.g., aroucageopark.pt, juntadeandalucia.es, geoparkararipe.urca.br, canionsdosul.org) implemented in some European countries and alsoin Brazil, bringing to gether the local community, promoting the synergy of culture with the components of nature (Carrión Mero *et al*., 2018) and contributing to global sustainability, associating them directly with geotourism.

Thus, the singularities in the context of geotourism, i.e., formations that exert fascination, curiosities, amazement, and interest in visiting to know important regional or national landscape (Bruno *et al*., 2014), natural heritage that can be found in huge territorial extensions, with testimonies of the Earth's geological history and including the presence of hominids according to Gray (2018) and, therefore, found in mountains too (Tessema *et al*., 2022), range with exposed rocks and cave and, paintings, canyons, waterfalls and their steps carved into rock, hills, all with high potential of ecosystem service. Vegetation complements the harmony and life of these environments, as illustrated in Figure 2.

Figure 2

Geodiversity and its geosites (mountain environment) in Mucajaí-RR, Brazil. Figure (a) fresh and transparent water well that runs between rocks, (b) large mountains home to many geosites, (c) preserved highwaythat gives access to geological heritage in the central region of Mucajaí, Roraima-Brazil. A true library to be used for environmental awareness and education, (d) Mucajaí geosite is a Brazilian river of great magnitude, covering a large extension of the river basin of 21,600 km^2. (images by the authors).



Source: Veras, Azevedo e Dinis (2022).

4 DISCUSSION AND IMPLICATIONS

This article aims to contribute and add knowledge to the popularity of geotourism in recent years, indicating the need to review the scientific literature related to the geosite, making it possible to understand that this is a terminology widely used around the world, and that *in situ* identification allows selecting and setting usage goals by geoparks *loccus* of geoconservation practices and measures for present and future generations. The geosite terminology does not involve a universal consensus, and there are several ways to scientifically describe a geosite in the context of a type of terrestrial relief depending on the geological structure and minerals to clarify that the resource is important and contains information about the dynamics of the Earth. For that, geoconservation implemented in educational and geotourist activities, is necessary. Therefore, the explored terminology is essential in terms of knowledge, conceptual practice and use in geotourism, and arise especially valuable with respect to geosites, considered particularly suitable to understand geological processes, either active or non-active, to the geotourist. Yet, this interpretation must be carried out by an expert or people who areexperienced and knowledgeable about local specificities.

4.1 TERMINOLOGY OF GEOLOGY-GEOMORPHOLOGY INTERTWINED WITH LOCAL CULTURE

Terminology such as geosite, geoconservation, geodiversity and geotourism in the still recent tourist activity in Mucajaí, i.e., a remote municipality, sound somewhat strange when verbalized. I, inn this context, educational promotion to popularize this term and related concepts is necessary to scientifically describe scientifically geosites or, geomorphosites, so that they become known, respected towards attitudes in favorfavour of conservation (Frank, 2022; Selmi *et al*., 2022). Therefore, the abiotic world that everyone needs are professionals from multiple areas related to tourism, culture, geomorphology, i.e., landforms, geology comprising a large number of minerals and rocks, hydrology, the abundant water in the region makes.These geosites become visible and synonymous with life for everyone, they need to be registered and classified with due planning and management so that visits can take place led by specialized guidesespecially in geology accessible language covering geotourism, argues Gorofano, (2015).

Therefore, it is opportune to improve the regional vision of terminologies used in the northern Amazon, very particular in the culture, states as stated by Nascimento & Carvalho, (2016), and widely verbalized quite naturally and integrate the geological aspect when describing geosites i.e., mineral objects, rocks resulting from processes exogenous and endogenous processes occurring in the Central Guiana Domain (DGC) with high metamorphism sculpting the Rio Urubu and Mucajaí Metamorphic Suite (CPRM, 2002).

The evolution of regional terminology is a dynamic process, primarily influenced by the younger generation's practices. However, traditional inhabitants adhere to terminologies deeply rooted in the regional language, which significantly contribute to the social and historical formation of the population regional terminology as a dynamic process has some changes generally practiced by young people, however traditional inhabitants use terminologies rooted in the regional language and characterize the social and historic al formation of the population regional. terminology as a dynamic process has some changes generally practiced by young people, however traditional inhabitants use terminologies rooted in the regional language and characterize the social and historical formation of the population. The verbalization of terminologies covers tourism, asshowinin. See Table 1.

Table 5

Expanding the copeofgeo cientific terminologies, we list thoseusedin the region during tourist visits and which can be refined by inserting then in to geology-gemorfology are listed. Adapted from Nascimento & Carvalho (2016).

Geology	**Regional term**
Savannah	Lavrado- area of open vegetation that crosses the borders of Guyana and Venezuela, revealin grichness and diversity
Adobo	kneaded clay for making handmade bricks
Wetland	Periodically flooded terrain
Drizzle	Fine and quick rain
Barreir	Hole made in the ground to remove clay
Cruvian	Strong and cold windoccurs during the morning
Stream	Small fresh water course with its own spring
Tabatinga	Clay soil of different colors
Geomorphology	
Swamp	Vegetation entangled and linked by buritizais (*Maruthia Fleuxuosa*)
Chavascal	Water logged environment or wet ground
Painted stone	Rocky outcrop
Tense	Dissected relie fin the form of as hallowhill, a

Terroada	characteristic landscape of the *lavrado* Small depression in flat areas
Culture	
Mother of water	My thical entity that inhabits lakes an drivers in theAmazon
Curumin	Boy, teenager and young man
Macuxi	Name of the ethnic group that inhabits the eastof Roraima and the surroundings of the capital Boa Vista-Roraima
Relative	Companion, comrade

It is crucial to emphasize that geodiversity elements and their geological-geomorphological designations manifest on the Earth's surface, subjected to wear induced by the weathering process. In the research area, this phenomeno no ccurs predominant lyina NE-SW direction. While these features are frequently visited, their explanations often lack the necessary refinement. However, the integration of (geo)geosite terminology and (geo)forms with the terminology rooted in the regional culture enriches the understanding for citizens familiar with the areas comprising geomonuments.

These landscapes, housing river courses, mountains, and granite rocks that reveal marmites shaped by abrasion, canserve a significant didactic role. Suchan integration bridges the gap between the environment and culture, as highlighted by Veras **(2014).** It is important to highlight that the elements of geodiversity and their geological-geomorphologic al denominations appear on the earth's surface with wear caused by the weathering process and for the research area this phenomenon occurs in a NE-SW direction, they are objects of visits that are often explained in a very simple way without due refinement. However, mention is made of the interface of (geo) geossite terminology, (geo) forms with the terms of the regional culture of citizens who know the areas that make up the geomonuments, landscapes where river courses, mountains and rocks of composition are found. granite and expose marmites formed by the abrasion of blocks of rocks in the past can play an important didactic role in uniting the environment and culture (Veras, 2014).

5 CONCLUSIONS

This article delves into the geology of a remote region characterized by geological-geomorphological resources, including structures, minerals, rocks, and soils. These elements possess scientific, educational, and geoscientific values, holding potential for classification. The primary objective is to preserve these resources through their interpretation using

specialized terminologies. This article addressed the geology of a remote region made up of geological-geomorphological resources such as structure, minerals, rocks, and soils, which have scientific, educational and geoscientific values with potential for classification which aims to preserve when using interprettation with specialized terminologies.

Legal instruments ensuring the preservation of geosites and supporting local cultures have been identified. As articulated in the scientific literature, global initiatives like the 2030 Agenda and the SDGs necessitate commitments from all stakeholders for sustainability and the future of the planet, making them absolutely crucial in this context. Within this framework, the concept of landscape acquires distinctive significance, not only in rural regions but particularly in protected areas.The environmental sustainability of these geosites, including forests, introduces new challenges.

Future research endeavours to enhance the enduring qualities of these sites, incorporating scientific, educational, and geotouristic appeal. This underscores the importance of contributions aimed at increasingthe visibility of geological resources in a valuable region. The applied methodology is situated within a contextual review of widely used literature in geotourism, exemplified by sources likethe Mineral Resources Research Company (CPRM), supported by the United Nations Scientific, Educational, and Cultural Organization (UNESCO).

Legal instruments were identified that guarantee the preservation of geosites and support local cultures. As described in the scientific literature, global calls and agreements such as the 2030 Agenda and the SDGs must mak ecommitments from every on eregarding sustainability and the future of the planet are absolutely crucial in this regard. In this context, landscape takes on a distinctive meaning, not only in rural regions, but especially in protected. Environmental sustainability presents new challenges for these geosites, such as forests as future research aims to improve the lasting qualities of the site with scientific, educational and geotouristic appeal.

Therefore, the importance of the contribution in the aim of increasing the visibility of the geological resources of a valuable region is highlighted. The methodology applied was contextualized in the review of the most used literature in geotourism, for example, Mineral Resources Research Company-CPRM supported by the United Nations Scientific, Educational and Cultural Organization-UNESCO.

All this demand for studies of the so-called geosite terminology has gained repercussion due to the search for geotourists who are increasingly amazed by unique places where most geosites occur, in an area with geological importance that meet established criteria classifyingthem as valuable, rare or vulnerable threatened. SDG 15 isconcerned with life on

Earth, contributing to understand and uphold the truth of these areas as an integral part ofsurvival and perpetuity.

As described in the scientific literature, global appeals and agreements, and commitments by all towards sustainability and the future of the world planet are absolutely crucial at this respect. In this context, the landscape takes on distinctive significance, not solely in rural regions but especially in protected areas. Environmental sustainability presents fresh challenges for these geosites, aimed at enhancing the enduring qualities of the location with aesthetic, educational, and geotouristic appeal.

This endeavour necessitates training for both public and private managers, focusing on geological and geomorphological knowledge, as well as comprehensive documentation as an initialrequirement. These geosites areendo wedwith both aesthetic beauty ands cientific value. Itisin cumbentu ponthe public authorities to recognize and appreciate these resources, reflecting the fundamental rights of the citizens. In such context, the applied terminology in geodiversity and geotourism activity discussed and analysed in this article plays a significant role to global sustainabilit.

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