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Geoparks: from conception to the teaching of Geosciences

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Abstract: The society of the 21st century is permeated by advances and diffusion of technologies that generate a way of life highly dependent on natural resources. This dependence requires a deep awareness of the importance of geodiversity and the education of the new generations and this is the way by which it will be possible to guarantee sustainable development. Geoparks are a new form of territorial management, whose characteristics are economic and social development based on the preservation and enhancement of geological and cultural heritage. This paper presents a discussion that involves this aspect in the relationship between geoparks and Geosciences teaching, divided into three parts: a discussion about the meaning of geoparks, followed by an analysis of the relationship between field work and geoscience teaching, and finally , it should be highlighted that geoparks can be excellent areas for field activities, which are essential to strengthen the understanding of geodiversity components and processes, without which the sensitization and perception of geoscientific concepts are limited. Geoparks can meet the demands of these areas for the teaching of geosciences in basic education.

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1. Introduction

Geoparks are unified geographical areas where sites and landscapes of international geological significance are managed with a holistic approach to protection, education and sustainable development (UNESCO 2016). It is a territory which combines the protection and promotion of geological heritage with sustainable local development (Zouros 2004). Following this same chain of definition, Brilha (2009) points out that a geopark has a sustainable development strategy based on conservation of the geological heritage, in association with the rest of the natural and cultural patrimony, to improve the conditions of the population living within it. From the definitions, the three pillars of a geopark are geoconservation, education and sustainable local development.

The main point about geoparks and their attributions that will be discussed in this work is education. The possibilities of teaching activities in these areas are diverse and they can count with the support necessary for teachers and researchers to work with teaching and learning. In addition, the education involves a set of values and perceptions that go beyond disciplinary content. With an individualized way of life and immense in virtual environments, the perception of nature and the environment is being reduced. In agreement with Menegat (2009), it would be great to live in a society that assumed the importance of nature for its survival and quality of life. The geoparks's theme allows us to be able to introduce geosciences into the cultural sphere, contributing to the notion that human culture is not independent of nature (Menegat 2009).

The teaching of Geosciences still lacks adequate environments and prepared for its themes. A major challenge for teachers dealing with geoscientific content is to find areas that can serve for teaching activities outside the formal learning environment. It is also worth noting that in middle-level education subjects of geosciences are little discussed, and the possibilities for practical classes are scarce. According to Toledo (2005), the education in Brazil did not worry about maintaining the contents in

Geosciences in the formation of science teachers. The result was a lack of notions about the planet and recognition of its importance in general culture (Toledo 2005). According to Carneiro, et al. (2004, p.554) in Brazil, practically does not exist geological culture in students who complete basic education (elementary and middle school levels) and try to enter higher education. Given the shortcoming of the approach to the themes of Geosciences in basic education, a transformation is in the increase of field activities. According to Carneiro, et al. (2004, p.554), the so-called non-formal ways of teaching play a notable role in the diffusion of Geoscience contents, but they are still insufficient. According to D'Aquino and Bonetti (2015, p.79), "practical classes" and "field trips" are fundamental alternatives for the teaching of sciences such as geography, geology, oceanography, among others.

Considering the essentiality of the fieldwork for the teaching of Geosciences, the geoparks, in their conception, add the necessary elements for the extraclass activities organized for the educational process. This relationship can be a viable alternative to overcome the deficiencies in the cultural formation in Earth sciences of the young students.

Considering the need to disseminate in a significant way the teaching of Geosciences, to overcome the low level of knowledge and perception of students in this area, through practical or field activities in non-formal environments. In additional the geoparks are areas with specific characteristics for the Earth Sciences themes and they can gather the necessary structures for the teaching-learning process, with emphasis on geosites, places of geological, cultural and heritage importance with good breadth to the themes of Geosciences. The present work aims to propose a discussion about the teaching-learning process from the fieldwork in an environment such as the geopark.

2. Methodology

The methodological procedure is centered in the accomplishment of a theoretical discussion on the concept of geopark and the teaching-learning of Geosciences, having it as reference the realization of classes in non-formal teaching environments and their potential for the education of high school students. To characterize this type of class will be discussed the concept of fieldwork, relating its characteristics with the teaching of Geosciences and geoparks, for effective learning. The bibliographical research and qualitative analysis support the elaboration of the work.

3. Results and discussion

3.1. From the formation of the Geoparks and their conception

There are several academic works and documents that describe the events that occurred from the 1990s to the present and present the concept of geopark and its constitution in a global network. Among the most recent are those carried out by Zouros (2004), Eder and Patzak (2004), McKeever and Zouros (2005), Sá et al. (2006), Jones (2008), Bacci (2009), Brilha (2009), UNESCO (2014), UNESCO (2016).

It is also important to highlight the main events that culminated in the geopark conception that involves geoconservation, education and sustainable development.

Following the Digne convention in 1991, where the geopark philosophy emerged, a significant process was accomplished by some countries to protect and conserve geodiversity (Jones, 2008). According to Zouros (2004), the idea of creating a geoparks networks to protect and promote European geological heritage arose in 1996 between G. Martini and N. Zouros at the 30th International Geological Congress held in Beijing, China. In 1997, the Division of Earth Sciences of UNESCO started to develop the concept of a UNESCO Geoparks Programme to support national and international endeavors in Earth heritage conservation (Jones 2008, p. 274). The idea behind the initiative is that true sustainable territorial development can be achieved through the protection and promotion of geological heritage for scientific, educational and touristic activities (Zouros 2004, p. 165). In 2000 was created European Geoparks Network and in 2004, 17 European and 8 Chinese geoparks came together at UNESCO headquarters in Paris to form the Global Geoparks Network (GGN) (UNESCO). Recently, there are 127 UNESCO Global Geoparks in 35 countries. The last International Conference on Geoparks was performed in English Riviera UNESCO Global Geopark, in United Kingdom, where was developed the English Riviera Declaration.

Thus, it can be affirmed the geopark concept and its objectives are relatively recent, which were

constituted from the evolution of the concern for the preservation of the geological patrimony and for the search of forms of development which include populations of places with significant cultural and natural value. In short, its definition and creation took shape from the 2000s within the implementation of the first geoparks, the European Network and the incorporation and support of UNESCO. The recognition of the relevance of the concept of geopark by this organization ensured its connection to the EGN - European Network of Geoparks (Brilha 2009).

An intrinsic value to the geopark concept is sustainable local development. This is the aspect that illuminates its main objectives, arising from the obligation to include its local population. UNESCO (2016) lists ten main topics for a Global Geopark with its seal, which are: 1) Natural Resources, 2) Geological Hazards, 3) Climate Change, 4) Education, 5) Science 6) Culture, 7) Women, 8) Sustainable Development, 9) Local and indigenous Knowledge, and 10) Geoconservation. Among these main topics, what emphasizes education focuses the search for the composition of actions for teaching activities, valuable for disseminating environmental and social values for the young generations.

For clarifying the concept of geopark some authors and references will be used in this discussion, which aims to highlight the educational process involved in this theoretical construction, which it has tangible and practical results.

According to Bacci et al. (2009, p.8), the concept of geopark is dynamic and complex at the same time, due to its constructive character, since it allows to be adapted to different realities, with different forms of management, both governmental and private. In a survey on the world wide web and on UNESCO Global Geoparks website, it has access the pages of the geoparks linked to GGN, where it is possible to verify the different forms of organization and administration of geoparks. As an example, there is the Spanish Law on Natural Heritage and Biodiversity promulgated in 2007, which grants juridical status to the concepts of geopark, place of geological interest or geodiversity, giving to the Autonomous Communities the competence to manage and protect them (Simón, et al. 2011, p.75).

According to UNESCO (2016), their Global Geoparks are unique and unified areas where sites and landscapes of international geological importance are managed with a holistic concept of protection, education and sustainable development. It is a territory that combines the protection and promotion of geological heritage with sustainable local development (Zouros 2004).

The area of a geopark may exceed the internal administrative divisions and territorial boundaries of a country. Second explanation contained in UNESCO Global Geoparks webpage, "about the borders, in many cases, geological boundaries, shaped by rivers, mountain ranges, oceans and deserts, do not follow the boundaries drawn by people". The same perception appears in the discussion of Onary-Alves et al. (2015) on the delimitation. According to the authors, the areas destined to the creation of a geopark must necessarily a place of sufficient size to encompass the integration of biodiversity, geodiversity and culture, and may sometimes exceed state boundaries (Onary-Alves et al. 2015, p.96).For Brilha (2009, p. 28),

> A geopark is a geographically defined territory with a sustainable development strategy based on the conservation of the geological heritage, within association with the other elements of natural and cultural heritage, with a view to improving the living conditions of the populations that inhabit the interior. (translated by the authors)

In the same line of definition is the European Geoparks Network, where a European geopark is a territory that combines the protection of geological heritage with the sustainability of local development (Zouros 2004). This agreement is also found in Martini (2009, p.87), which in geoparks, are not just territories for teaching geology, they can become an experimental domain where the perspectives of the philosopher, the writer and the artist can be integrated. Thus, rather than a "scientific" or "nature" territory, they emerge as "cultural" territories of far wider importance (Martini 2009). It is clear that geoparks come with a broad spectrum of development possibilities, which aims to include the citizens of their areas in a productive system, with an appreciation of the attributes already mentioned.

Corroborating with the previous definitions, Ruchys (2009) points out that a geopark must have not only geological significance but also ecological, archaeological, historical or cultural values, which are seen as important components. According to Ruchys (2009), the geopark integrates and gives meaning to the set of geological sites

of special scientific importance, beauty or rarity, and its management must be determined by the need to preserve, enhance and popularize existing geological evidence, representative of geological history. These conceptual definitions underpin the factors for the creation of geoparks and even their integration into the global network. This becomes clear in the explanation of Bacci, et al. (2009, p.8),

> For the creation of a geopark, it is necessary that the selected region has exceptional geological and paleontological attributes and its implementation contemplates geotourism and develops the local economy, in order to modify the socioeconomic reality of its inhabitants. Therefore, a geopark, which starts from a pre-delimited area, should have sustainable development programs and educational projects. (translated by the authors)

The criteria for a geopark to become a member of the UNESCO Global Geopark Network must have the concepts and characteristics intrinsic to this recent institutional form of territorial development described in the Statutes and Operational Guideline of the UNESCO Global Geopark. In the criteria established in the UNESCO guide of UNESCO Global Geoparks guidelines the concept of geoparks is set out in detail. There is a transposition of the constructed ideas to direct the formalization and the practical activities to legitimize a geopark. That is why the importance of building this concept.

For concluding this brief review, one feature that distinguishes geoparks in a differentiated way, it is in the fact of allowing the accomplishment of economic activities for the sustainable development, stands out. According to Schobbenhaus and Silva (2012, p.6),

> a geopark is not a protected area, nor is it a new category of protected area, but it offers the possibility of associating the protection of the fatherland and natural monuments with tourism and regional development. The absence of a legal framework for a geopark is a reason for the success of this initiative at the global level. (translated by the authors)

Lastly, geoparks are new possibilities, which unite development and preservation, and must be understood by government authorities, researchers and local society, for their implementation. "The concept of Geoparks would represent a direct response as a means of protecting and promoting geological heritage and sustainable local development through a global network of territories possessing a geology of outstanding value" (Schobbenhaus and Silva 2010, p.2).

3.2. Fieldwork for the teaching of Geosciences

It is necessary to highlight the potential of the geoparks for the teaching of Geosciences, not only as a place of visitation, but prepared and instrumentalized for this.

A concern regarding to geoscientific formation is related to the youngest citizens of secondary education who, due to lack of opportunities and curricular forecasting which ends into an adult life without the training and sensitization necessary for understending of geodiversity and the importance of geoconservation. In the case of Brazil, Carneiro et al. (2004) points out that practically nonexist a geological culture in students who do complete basic education at primary and secondary levels and try to enter higher education. According to Carneiro et al. (2004, p. 554), simple questions involving geological topics are potent "filters" in this selection, for the effectiveness of eliminating "less well-prepared". This and other problems related to the teaching of geosciences, especially for basic education, may have as a point of inflection activities that go beyond the formal classroom environment, work directed in out-of-school environments, in so-called non-formal educational spaces.

The radical "geo", from the Greek "earth", brings the necessary connection of the concept of geopark to the relation with the peculiarities of the planet Earth. These parks can/should be considered as part of the curricula of the schools in their region for those disciplines that work on the subjects of geosciences in basic education, such as geography and biology. In this integration, there is a didactic activity equivalent to laboratories with technological equipment, such as chemistry and physics, which is the fieldwork. Far beyond a visit or a walk, the fieldwork requires a thorough preparation and knowledge of the place to be investigated, so that it can fulfill its educational role for learning in geosciences. However, it is not all spaces outside the school that have the potential to teach geosciences, as explained by Carneiro et al. (2004, p.554),

> So-called non-formal means of education (museums, parks, the press and the cultural industry in general) play a significant role in the diffusion of Geoscience contents, but they are still insufficient and may even be mistaken to accommodate the necessary knowledge for

> a person of medium schooling if he considers himself well informed and able to make decisions supported by modern science. (translated by the authors).

The educational program corresponding to a process of formation and personal development, in the context of a structured and certified program (Marques and Praia 2009), can be carried out in the context of the school environment, formal education, plus an extracurricular activity, not formal, carried out in complement to the educational program, external to the school environment, which are indissociably, particularly for Earth Sciences. In this aspect, "formal and informal educators do not work in isolation but often complement each other, for example, school groups participating in field trips at informal learning sites as a method of science instruction" (Buhay and Best 2015).

Starting from the idea of inseparability between the teaching of Geosciences and the activities in non-formal environments, it is agreed with D'Aquino and Bonetti (2015, p.79) that "practical classes" and "field trips" are fundamental alternatives for the teaching of sciences such as Geography, Geology, Oceanography, among others. In comparison, Marques and Praia (2009, p.16) point out that it is difficult for any experimentalist in the laboratory to overcome the hermeneutic nature, which is the guiding force of field activities. As well as for a chemistry or biology course to become complete in its analysis proposal within the use of equipment and reagents in a laboratory, for a geography class, which highlights a theme of the geosciences, the field class completes the understanding of their concepts in practice. According to Dourado (2006), both laboratory work and fieldwork are recognized practical work modalities, either by teachers or researchers, as resources of undeniable value in teaching and learning the sciences. In this same perspective, we can point out that "practical field activities play a central role in the development of observational skills and interpretation of phenomena linked to Earth sciences" (Carneiro et al. 2008). Practical activities in the teaching of Geosciences can be considered as the key factor in the discovery and understanding of the processes that have formed and continue to construct and shape the Earth. Bonito et al. (1999), consider that a higher quality of science teaching is currently advocated, it assumes that this will be directly related to the number and type of practical activities that are carried out with the students. These authors point out that it is not because of any practical activity that the learning outcomes are better. Therefore, being able to identify the procedures and organize a field activity is fundamental so that the result is satisfactory in relation to the learning objectives that it is intended to achieve. A proposal of field activity for the teaching of geosciences is based on the fact that "the natural field, in other word, nature, is the privileged place of contact with real objects, concrete phenomena and the environment" (Bonito and Sousa 1997, p.2). It is important to discuss the type of didactic orientation adopted, as well as the type of learning that is intended to be generated, since often the field activities are conceptually decontextualized from the theoretical part that is developed in the classroom (Bonito and Sousa 1997). This situation can de-characterize what we consider as field practice or field work, in its pedagogical and educational functions. In addition to this problem, Viveiro and Diniz (2009, p.4) point out that "although field activities can provide important contributions to school education, how they are developed can limit the full exploitation of the potentialities that characterize them".

We can affirm that the role of the field activities is centered in the students' experience with the real environment outside the traditional school environments. Viveiro and Diniz (2009), consider that field activities allow direct contact with the environment, enabling the student to engage and interact in real situations. Thus, in addition to stimulating curiosity and sharpen the senses, it makes it possible to confront theory and practice (Viveiro and Diniz 2009, p.3-4). Furthermore, according to Esteves et al. (2013, p.318), these activities allow the understanding of more abstract concepts, which are generally more difficult for students to understand and more difficult to explain within the classroom. It should be considered that for the effectiveness of the teaching-learning process in this type of activity, it is necessary that the proponent teacher has a minimum experience of field activities in his area of formation. This experience will give subsidies to the chain of organization and preparation of the class/field work so that the central objective of achieving a more sophisticated scope of Geosciences teaching, in this case, especially for students of basic education, generally lacking this type of. Because they are extraclass activities, practical classes and field trips involve a huge planning, demanding of the teacher a complementary effort

for their accomplishment (D'aquino & Bonetti 2015, p. 79). To overcome the difficulties that will be encountered between the process of preparation of the field activity and learning as a result, a basic sequence can be indicated, shown in figure 1.

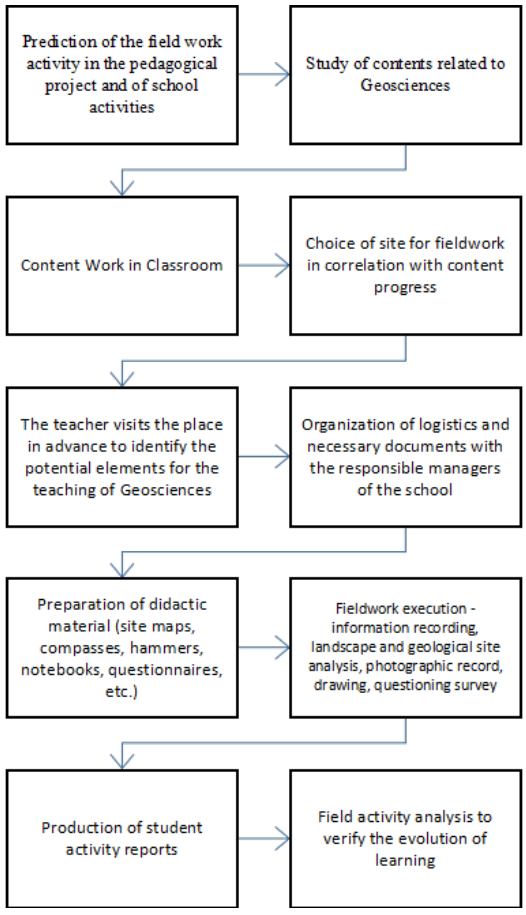

Figura 1. Sequence of procedures/events for the accomplishment of fieldwork for Geosciences teaching

It is thus demonstrated that for the process of teaching learning in field activities it is necessary to systematically prepare the teacher in collaboration with other professionals, both the school and the area to be visited. This planning may be different from that shown in figure 1. However, without this preparation, the activity will hardly deliver the expected results to the evolution of knowledge in Geosciences, so necessary for understanding the environment and the support of life and social organization.

According to Liccardo & Pimentel (2014, p.18), "non-formal educational spaces vary enormously in their social characteristics and functions, and may not even be intended primarily for education". These non-formal spaces for the field activities can be substantially represented by the Geoparks, they bring together their educational characteristics functions with potential for the approach of the geodiversity and for the Geosciences. The cohesion between activities outside the classroom and areas which are prepared for teaching, such as geoparks, allows them to be considered as part of a pedagogical project of the schools in their region.

3.3. Geoparks for the teaching of Geosciences

The Geoparks have among their main attributions the education and, consequently, the teaching actions. In this aspect, there is a synergy between the educational potentialities in a Geopark and the non-formal teaching of Geosciences.

According to Brilha (2009, p.32), "the non-formal education of the general public is a very relevant aspect in the perspective of sustainability, to which a geopark should not be alienated". It should be highlighted that educational actions in geoparks go far beyond those aimed at students and teachers. Its comprehensive aspect allows citizens of the most varied formations to have their first perceptions regarding geodiversity. This geodiversity, besides exerting fascination or charm, sustaining the biodiversity and society activities or even having economic value, it has a great importance as a repository of the geological history of the planet (Guimarães and Liccardo 2014). Thus, a landscape, for example, is no longer appreciated solely for its aesthetic value, but also for what it represents in terms of the evolution of geological, biological and human processes (Brilha 2009). Boggiani (2010, p.3) points out that a necessary characteristic for the characterization of a Geopark is the formulation of educational projects, so in practically all geoparks there is a museum and several places of visitation, such as geosites, and wide production brochures, publications, teaching materials and documentaries. Examples of educational projects and activities can be seen on geopark outreach sites such as Araripe Geopark in Brazil and Arouca Geopark in Portugal.

The relationship geoparks + education is expanded when it is considered that the geoscientific educational programs are important tools for building the foundation for the protection of material and immaterial heritage sites and for promoting the desired development and sustainability (Piranha et al. 2011, p.289). As illustrated in

the very concept of geopark, it is emphasized its inseparability with education, especially education in geosciences. This inseparability is embodied in the explanation of Piranha et al. (2011), which collaborates to unveil the objective of this work. According to the authors,

> Without this educational basis, the relationship between economic and cultural development required to create a geopark according to the UNESCO (United Nations Educational, Scientific, and Cultural Organization) concept will be impossible to achieve because the lack of knowledge of the Earth System will prevent any understanding of the importance of geological heritage preservation and the recognition of Geoparks (Piranha et al. 2009, p.290).

Geoparks can be considered areas specially focused in geoscience teaching, since the small number of areas with their characteristics. According to Brilha (2009), the creation of geoparks has revolutionized the way on how to spread the Geosciences. The author points out that in the management strategy of a geopark, not only geological heritage, but also biodiversity, archeology and other aspects of the cultural heritage are integrated, with this the Geosciences gained public visibility (Brilha 2009). Geoparks, inventing and conserving geosciences in their territory, are thus promoting the teaching of Geosciences (Brilha 2009, p.29).

In addition, other landscape`s elements in its complexity, such as relief and hydrography, contribute to expand options of educational activities in Geosciences, as already highlighted by Buhay and Best (2015, p.174): the geoparks include a variety of geosites that afford different learning opportunities. The authors point out two aspects to teaching activities through geoparks, considering that they can serve both formal and informal education. "Some of these opportunities may focus on active learning (ie kayaking through an area of Precambrian stromatolites), and others may focus on more passive learning (ie indoor learning, reading geological signage" (Buhay & Best 2015, p.174). These different possibilities of learning in Geosciences can vary according to the geodiversity characteristic in each geopark.

This is a focal point that highlights the relevance of geoparks, in their conception, to re-signify the value of geodiversity to the society. This resumption of the perception of nature by the population is amplified by the educational activities. Menegat (2009, p.91), draws attention to the importance of the place for human cognition and highlights that more than half of the world's population lives in cities, which means, the humanity is losing the ties of face-to-face cognition with the natural landscape. Therefore, the teaching activities that bring together the Geosciences should be strengthened. However, intense work is needed to put Geosciences in evidence. According to Toledo (2005, p. 32),

> What occurs concretely in education, with the lack of opportunity for integral development of Geosciences is that students are deprived of the knowledge necessary to acquire the vision of global and interdependent functioning of nature, running the risk of developing, contrary to the ideal, an immediate and utilitarian view of nature (Toledo 2005, p.32). (translated by the authors).

It is evident its worrying regarding a technological society highly dependent on the natural resources, the perception about the environment and its peculiarities still remain unknown on the part of the population. Empowering the teaching of Geosciences since basic education can reverse this problem. The use of geoparks in their attributions as areas promoting the teaching of Geosciences and the diffusion of geodiversity knowledge will make a significant contribution to society in order to overcome this challenge throughout the 21st century.

4. Conclusions

This work has highlighted the educational aspect of the geoparks in three aspects, with a synthesis of the history, constitution and expansion of the geoparks, associated to the dimension of the field activities for the teaching to substantiate and highlight the potential of the geoparks for the teaching of Geosciences. Geopark is a concept which stems from the extensive work of researchers and professionals concerned with geological heritage, geoconservation and geodiversity. In addition, it has as principle the sustainable development of the populations of its areas, adding culture, geotourism and education. In Brazil there is still much to be explored with this new way of developing the territory, given the most varied qualities of geodiversity that can be used for the establishment of geoparks. Despite this latent empowerment and the existence of several proposals for the creation of geoparks, after more than ten years of the creation and integration of the Araripe Geopark to the UNESCO

Global network, it remains the only geopark in Brazil to compose this list of international recognition.

The so-called field activities or fieldwork are indispensable for the understanding of geodiversity and the processes that have occurred and continue to occur on Earth. These activities transcend theoretical classes in the classroom and allow geoscientific concepts to have real meaning for students, especially in the phase of questions and discoveries of basic education. In order for the teaching-learning process in a fieldwork to obtain good results for the students, an adequate organization of the logistical and pedagogical procedures is required, which includes the choice of places as preparation of the didactic material. In this way, geoparks can be identified as potential areas for field activities and geosciences teaching, as it integrates into their characteristics for the preservation of the geological heritage of geosciences and to carry out educational activities on these topics. Geoparks can be areas of great pedagogical value for schools and universities in their region, providing subsidies for formal and non-formal education in extra-class activities. The education in Geosciences is elementary in sensitization and awareness of what nature means for human development, which is essential to the process of formation and transformation of the student as a citizen.

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