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Geoconservation strategies framework: analysis from case studies in Brazil

Maria da Glória Motta Garcia¹, Kátia Leite Mansur², Marcos Antônio Leite do Nascimento³, Ricardo Galeno Fraga de Araújo Pereira⁴

¹ Institute of Geosciences, University of São Paulo, Centre for Research Support on Geological Heritage and Geotourism, Brazil. mgmgarcia@usp.br

² Institute of Geosciences, Federal University of Rio de Janeiro, Brazil. katia@geologia.ufrj.br

³ Department of Geology, Federal University of Rio Grande do Norte, Seridó Aspiring Geopark, Brazil. marcos@geologia.ufrn.br

⁴ Institute of Geosciences, Federal University of Bahia, Brazil. fraga.pereira@ufba.br

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Introduction

Geoconservation can be understood as a group of actions focused with the aim of the conservation of the abiotic heritage of nature, and that may be implemented by means of a series of steps (Cendrero Uceda 2000, Sharples 2002, Brilha 2005, Henriques et al. 2011, Carcavilla 2012). These steps may be integrated as sequential and/or simultaneous sets in a framework that includes data collection, selection and assessment of geosites, evaluation of conservation aspects, and outreach strategies. The observation of this strategic framework might improve the chances to achieve the best practices in any actions involving conservation and use of geoheritage. However, excluding a few exceptions, these steps are rarely completely put into practice in the world (Prosser et al. 2018). The main aim of our work herein is to analyse key local examples of geoconservation actions in Brazil under the light of these integrated sets, in order to identify strengths and weaknesses that might be associated with the non-observation of these steps, and to evaluate the role of these systematic methods in the whole geoconservation chain.

Methods and results

Six Brazilian representative case studies were chosen, and their status regarding the classic geoconservation framework and associated steps is shown on Table 1.

- Inventory of geoheritage of the state of São Paulo: The first inventory in Latin America to follow a systematic methodology at a state scale and with the participation of the geoscience community. Its main aim is to select geosites with scientific interest and to set the background for future geoconservation actions.

- Inventory of geoheritage of Chapada Diamantina: This inventory proposed the first method exclusively structured for the Brazilian scenario. Its main aim is to assess sites of scientific and touristic interest, and to propose a geoconservation plan for the most relevant or endangered sites.

- Holocene stromatolites in Lagoa Salgada: One of the few rare occurrences of Holocene stromatolites in the world, located in the territory of the Costões e Lagunas Geopark Project. Due to a seaport enterprise, only half of the lagoon's surface was included into a protected area by state decree.

- Poty Mine Geosite: Part of a series of publications by the Brazilian Commission on Geological and Palaeobiological Sites (SIGEP), this geosite is located in an active quarry and has been recently opened for public visit, along with interpretive panels and other means of valorisation.

- Seridó Aspiring Geopark: One of the two new Brazilian aspiring projects for UNESCO Global Geopark, its geosites range from Neoproterozoic to Cambrian, alongside with Paleogene and Neogene. There is already an important cultural involvement between local communities and their geoheritage.

- Projeto Caminhos Geológicos (Geological Paths Project): A pioneering project in Brazil, with the initial aim to popularize the geology of the State of Rio de Janeiro through interpretive panels, and which later evolved to adopt geoconservation principles. More than one hundred panels were implanted.

Steps		State of São Paulo Inventory	Chapada Diamantina Inventory	Holocene Stromatolites in Lagoa Salgada	Poty Mine Geosite	Seridó Aspiring Geopark	Caminhos Geológicos Project
Diagnosis	Inventory	Yes, systematic	Yes, systematic	Yes, systematic mapping	Yes, ad hoc	Yes, systematic	Yes, systematic
	Quantitative assessment	Yes	Yes	Yes	Yes	Yes	In part
	Characterisation	Yes	Yes	Yes	Yes	Yes	Yes
	Indications of use	Yes	Yes	Yes	Yes	Yes	Yes
Conservation	Legal protection	In part	Yes	In part	Yes	In part	In part
	Geosite conservation	Locally	Yes	Yes	Yes	In part	In part
	Monitoring	No	No	Yes	Yes	No	In part
Promotion	Valorisation	Locally	In part	Locally	Yes	Yes	Locally
	Interpretation	Locally	In part	Yes	Yes	Yes	Yes
	Dissemination	Locally	Locally	Locally	Yes	Yes	Yes
	Education use	Locally	No	Yes	Yes	Yes	Yes
	Tourism use	Locally	Yes	Yes	No	Yes	Yes

Table 1. Status of selected Brazilian case studies regarding their geoconservation framework and associated steps.

Discussion and conclusions

Our data show that the items related to the diagnosis are the most prevalent in relation to conservation and promotion. Inventory, characterisation and indications of use were carried out in all the case studies, although some of them lack quantitative assessment of geosite value. Regarding promotion, except for the Holocene Stromatolites and the Poty Mine, which constitute specific geosites, the other examples show good levels of valorisation and dissemination, especially for the Seridó Aspiring Geopark and Caminhos Geológicos, which constitute primarily geotourism/educational projects. The conservation seems to be the most complex set of steps, especially when considering monitoring, but legal protection and geosite conservation are also insufficient, which might be worrying because these aspects are directly related to the integrity and safeguard of the sites. These results reflect the fact that most of the people involved in diagnosis and related items, as well as in promotion actions, are academic geoscientists with multidisciplinary skills and expertise. On the other hand, conservation is an issue that involves the participation of national and local government administrators, and which also requires the existence of adequate legislation concerning geoheritage. In this context, an integrated approach will only be achieved by means of the cooperation between academia, public administrations and society.



Selection of geosites in the Aspiring Geopark Project of Seridó: 1, Underground gallery open to visitors at the Mina Brejuí Geosite; 2, Pico do Totoró Geosite, with the Pedra do Caju (Cashew Stone) geoform in front; 3, paintings on quartzite at the Xiquexique Geosite; 4, aerial view of the Nascente do Potengi Geosite, where the main river of the state is born, ending 170 km downstream at Natal, the state capital.

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