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Geoconservation strategies in a changing world



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Photo on title page: Laugahraun lava field at Landmannalaugar. Photo: Kristján Jónasson, 2014

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P-12 The inventory of geological heritage of the State of São Paulo, Brazil: Methodological basis and preliminary results

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It is generally agreed that an inventory of geological heritage must be the first step of any geoconservation strategy. Globally, the identification of geological heritage has as one of its basis the Global Geosites Project, launched in the 1990's by the IUGS Global Geosites Working Group and supported by UNESCO (Wimbledon, 1996), which a main objective to produce a comprehensive inventory of geosites according to a systematic methodology. Works associated with this project and carried out in countries such as Portugal (Brilha et al., 2010) and Spain (Garcia-Cortez & Carcavilla-Urqui, 2009), show that such data can provide support for the integration of geological information into land management plans.

In Brazil, in part due to the large extent of its territory and to a heterogeneous geological knowledge, only recently have some initiatives for carrying out geoheritage inventories emerged. The ongoing project 'Geological heritage of the state of São Paulo: identification, conservation and valuation of geosites with scientific value with national and international relevance' is the first to follow a systematic method and with the participation of a geoscience community that agreed to contribute to the inventory. The project aims to select geosites that represent the geological history of the state and to establish the background for future conservation actions. The project is based at the Institute of Geosciences, University of São Paulo (IGc/USP) and is supported by the Science Without Borders Programme (Project 075/2012 (MEC/CAPES/CNPq).

Experiences of other countries have led to the improvement of the inventory methodologies. According to Lima et al. (2010), the basis for the development of inventories across large areas should include a good geological knowledge of the whole area, well-defined objectives and selection criteria, participation of the geoscientific community and the involvement of geological institutions. The present inventory is based on the scientific value of sites representing specific frameworks that were defined taking into account previous geological knowledge of the territory (Wimbledon, 1996). These sites have supported many scientific studies and their protection is essential to preserve the scientific memory of the state and to ensure future research.

This three-year project (2012-2015) integrates researchers from top universities of the state, from the Geological Institute of the State Department of the Environment, from the Geological Survey of Brazil, from the University of Minho in Portugal and from a private company (Geodiversity). The main activities related to its implementation include:

1. *A call to researchers in educational and research institutions in the state, by means of a letter containing basic information on the subject and an invitation to participate in a workshop;*
2. *Workshops to present the project to the geoscientific community, in order to define the preliminary geological frameworks and respective coordinators and subsequently to assess the results obtained and evaluate the project guidelines. A model for the description of the geosites was prepared and sent to all coordinators;*
3. *Local meetings with researchers to obtain geological information, to clarify concepts related with geoconservation and to discuss proposals for potential geosites;*
4. *GIS-based map and preliminary list of potential geosites;*
5. *Field work to characterise and evaluate potential geosites (with the participation of the frameworks' coordinators, when possible);*
6. *Quantitative evaluation of the geosites.*

According to the methodology described by Brilha (2015), this evaluation was based on two main aspects: scientific value and risk of degradation. The scientific value was assessed according to five criteria: representativeness, scientific knowledge, integrity, geological diversity, and rarity. The risk of degradation was quantified using the following five criteria: deterioration of geological elements, proximity to areas/activities with a potential to cause degradation, legal protection, accessibility, and density of population.

In broad terms, almost 30% of the São Paulo's territory is composed of crystalline basement (rocks older than Neoproterozoic), whilst 70% corresponds to Devonian to Cretaceous deposits of the Paraná and Bauru basins. Cenozoic intracontinental and coastal basins, as well as Quaternary sedimentary deposits also occur. In this context, eleven geological frameworks (table 1) were defined taking into account the geological and tectonic units represented on the Geological Map of the State of São Paulo published by the Geological Survey of Brazil (Perrotta et al., 2005). Presently, 159 geosites representing these 11 frameworks have been identified.

Table 1. Geological frameworks defined for the inventory of geological heritage of the state of São Paulo, Brazil and number of representative geosites for each framework (preliminary numbers).

Geological frameworks	No. of geosites
Geomorphological units and landforms	13
Coastal and continental Quaternary evolution	9
Continental rift system – Cenozoic	12
Bauru basin – Neocretaceous	16
Paraná basin – Devonian to Mid Cretaceous	31
Precambrian terrains – crystalline basement	25
Metallic mineralisations	7
Granitic rocks – pre-, syn- and post-tectonic bodies	7
Mesozoic magmatism – dykes and plateaus	7
Strike-slip Shear zones	7
Karst systems	25

These are preliminary results for the geosites inventory of São Paulo state – an area of approximately 250,000 square kilometres. This project is a pioneering initiative in Brazil and Latin America and is intended to establish the methodological basis for future inventories in other Brazilian states and other countries, especially those with large territorial areas. Additional aspects involve the setup of an online geosites database in order to develop a dynamic character for these inventories by means of constant updating, hence serving as an effective tool for the protection of sites of geological interest.

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