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Current Trends and Future Directions for Geoheritage Assessment Methodology in Morocco

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Abstract

Inventorying and assessing geoheritage is a prerequisite for developing measures to preserve unique geological and geomorphological sites. Several researchers have developed methods for assessing and determining the value of geological and geomorphological sites. Given rapid environmental and climatic changes, it is crucial to improve the state of geoheritage assessment and inventory development. This overview presents an analysis of research on geoheritage assessment conducted in Morocco over the past 14 years (2008–2022). The objective is to provide an overview of the main methodological approaches. The analysis is based on a search of the Science Direct, Scopus, and Google Scholar databases to identify publications dealing mainly with Moroccan geoheritage sites. We find that most studies have concentrated on the identification and characterization of various geoheritage sites across the country, employing only the descriptive method. However, as the field has progressed, earth scientists are applying quantitative inventory and assessment methods, with some initiatives to propose new methods adapted to the Moroccan context.

Keywords: Geoheritage, Geoconservation, Inventory, Assessment, Morocco.

Introduction

Since the late 1990s, there has been growing interest worldwide in the study of geoheritage sites. Geoheritage sites are objects belonging to abiotic nature, associated with the concept of geodiversity (Gray *et al* 2013; Hobléa *et al.* 2017; Bétard *et al.* 2018; Brilha *et al.* 2018), and are an integral part of natural heritage. These geoheritage sites have been broadly defined by scientists and international organizations, most notably UNESCO, which considers them to be "all natural geological sites possessing, considerable value to humans including their scientific, educational, aesthetic, cultural significance and humanity's sense of belonging" (Kubalíková 2013). Geoheritage can be defined as geological facts of global, national or local importance, and geological sites that represent phenomena (volcanism, magmatic segregation, metamorphism, weathering, sedimentation, etc.) and/or bear witness to the Earth's history (paleontology, global tectonics, climate, sea level, etc.).

The first proposals of quantitative methodologies for assessing geosites date back to the early 1990s (Grandgirard 1997; Panizza 2001; Bruschi and Cendrero 2005; Reynard and Panizza 2005; Pralong 2005; Pereira and Pereira 2007; Reynard

et al.. 2007). These initiatives aimed to demonstrate the importance of geoheritage for science and society, and specialists (geographers, geomorphologists, and geologists) took steps to develop scientific methods for the enhancement of these geoheritage sites through a precise popularization process (Cayla 2009; Sellier 2009). Diagnostic and landscape mediation tools were proposed to enhance geomorphosites and make them known to the general public. Mediation targets different categories: specialists, geographers, geologists, geomorphologists, non-specialists, tourists, residents, land managers, etc. Surveys are one of the most interesting tools in landscape mediation in helping to guide measures for the protection and enhancement of geomorphological heritage by bringing together all the players who benefit from and exploit these major elements of nature (Martin 2013).

In Western countries, geoheritage (geosites or geomorphosites) inventory work has been carried out, along with actions and programs to enhance them (Hobléa *et al.* 2017) based on scientific methodologies (Fontana 2008; Kubalíková 2013). Other research has been devoted to geoheritage mapping using different cartographic representation methods: geomorphological maps, thematic maps of scientific and additional values, and geotourism maps (Reynard and Lambiel 2015, Fox *et al.* 2022). Geotourism tours have also been proposed, as a means of enhancing geoheritage, for example, the Danube Gorge guide in Romania (Iosif 2014). Finally, there is research dealing with the perception of local stakeholders towards geoheritage.

In the countries of the greater Maghreb and Africa, on the other hand, interest in geoheritage is relatively absent, and no State inventory initiatives have been carried out to date, despite their often remarkable and unique geological and geomorphological wealth. However, initiatives are beginning in some countries as part of university research groups on geoheritage (Errami *et al.* 2013, 2015a). The African Association of Women in Geosciences (AAWG), for example, has developed an "African Geoparks Network (AGN)" project, which has organized, in collaboration with other partners, several activities to promote geoheritage and the geoparks concept in sub-Saharan Africa (Errami *et al.* 2009, 2013, 2015a).

Morocco, situated between the Atlantic Ocean to the west and the Mediterranean to the north, is known for the diversity of its landforms, alternating Saharan reliefs, high Atlas Mountains, high plateaus, and vast plains drained by water basins and river systems, fostering an important ecological and agricultural life. However, despite the enormous importance of its geodiversity, Morocco has not yet made its protection a priority in its heritage policies (El Hamidy *et al.* 2024a, Errami *et al.* 2024). The absence of specific legislation leaves emblematic sites, including world-renowned dinosaur tracks and ancient rock engravings, vulnerable to degradation and exploitation. The absence of a national strategy for cataloging and preserving geoheritage exacerbates this problem, jeopardizing invaluable scientific and cultural resources. Urgent action is needed to implement comprehensive protection measures and raise awareness of the importance of safeguarding Morocco's geodiversity for future generations (El Hamidy *et al.* 2024c).

On the other hand, national and regional recognition of the importance of geoheritage is growing, notably with the establishment of the M'Goun Geopark in 2004, located in the Béni Mellal Khénifra region. It was the first geopark in the Maghreb to be designated by UNESCO in 2014 and approved in 2018, confirming the remarkable geodiversity represented by the central High Atlas in which the geopark is located.

In parallel with this regional dynamic around geoheritage, several university initiatives have led

to the production of a series of geological guides covering the whole of Morocco, and other initiatives led by geologists and geographers with the inventory and evaluation of around 100 geosites as part of research groups associated with universities (Fig. 1, 2; Table 1). There is growing interested in the inventory, protection, and enhancement of these geoheritage sites, in line with Morocco's new ambition to become one of the world's 20 top tourist destinations, according to the 2020 tourism development strategy. This focuses on diversifying the tourism offer, in particular by exploiting and enhancing natural, cultural, and human assets.

The main objective of this article is to provide a comprehensive review of the current state of geoheritage and geosite evaluations in Morocco. By synthesizing the relevant literature, the study aims to elucidate the main methodological approaches

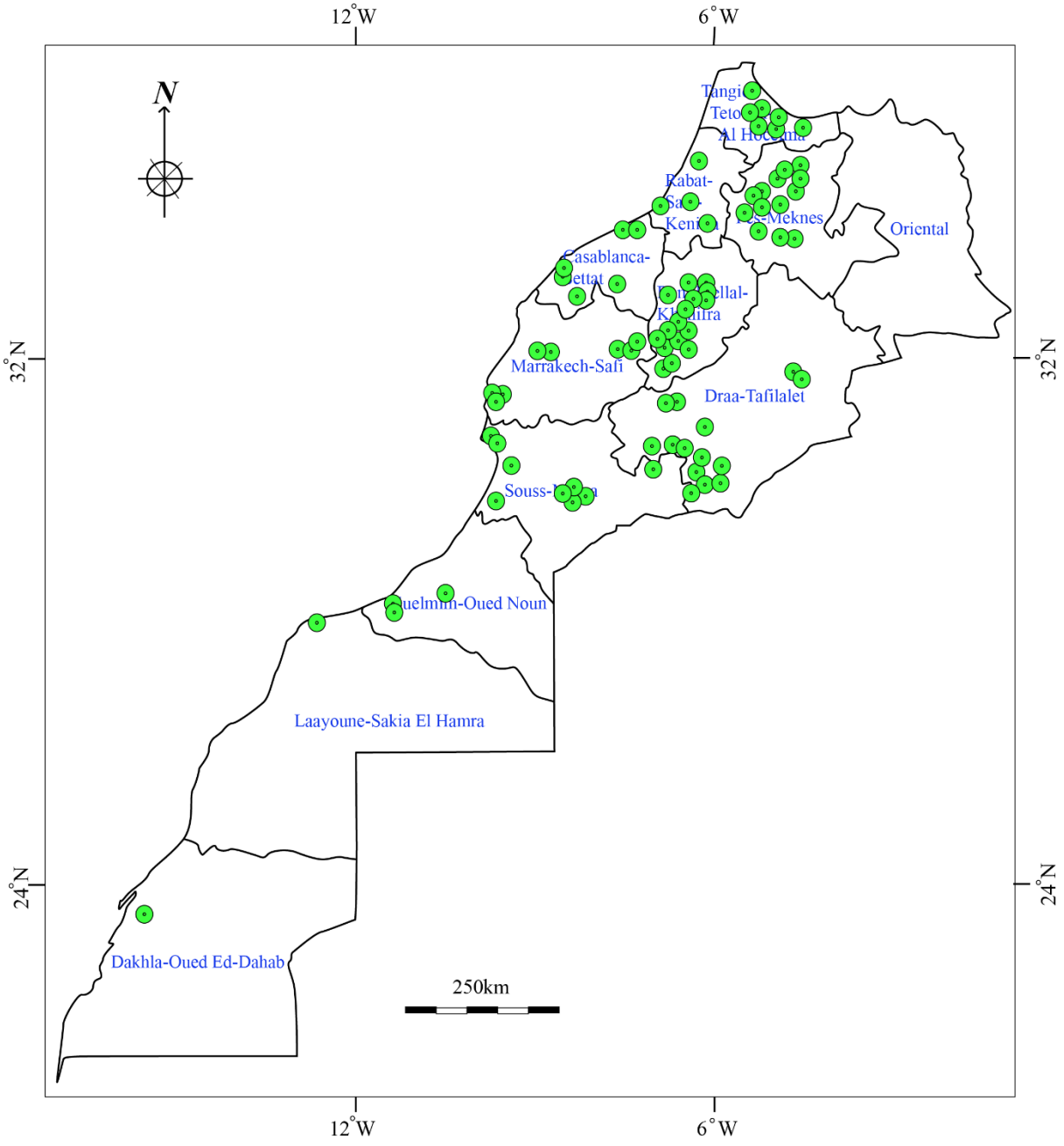

Figure 1. Map illustrating the geographic distribution of studies related to geoheritage across Morocco from 2008 to 2022.

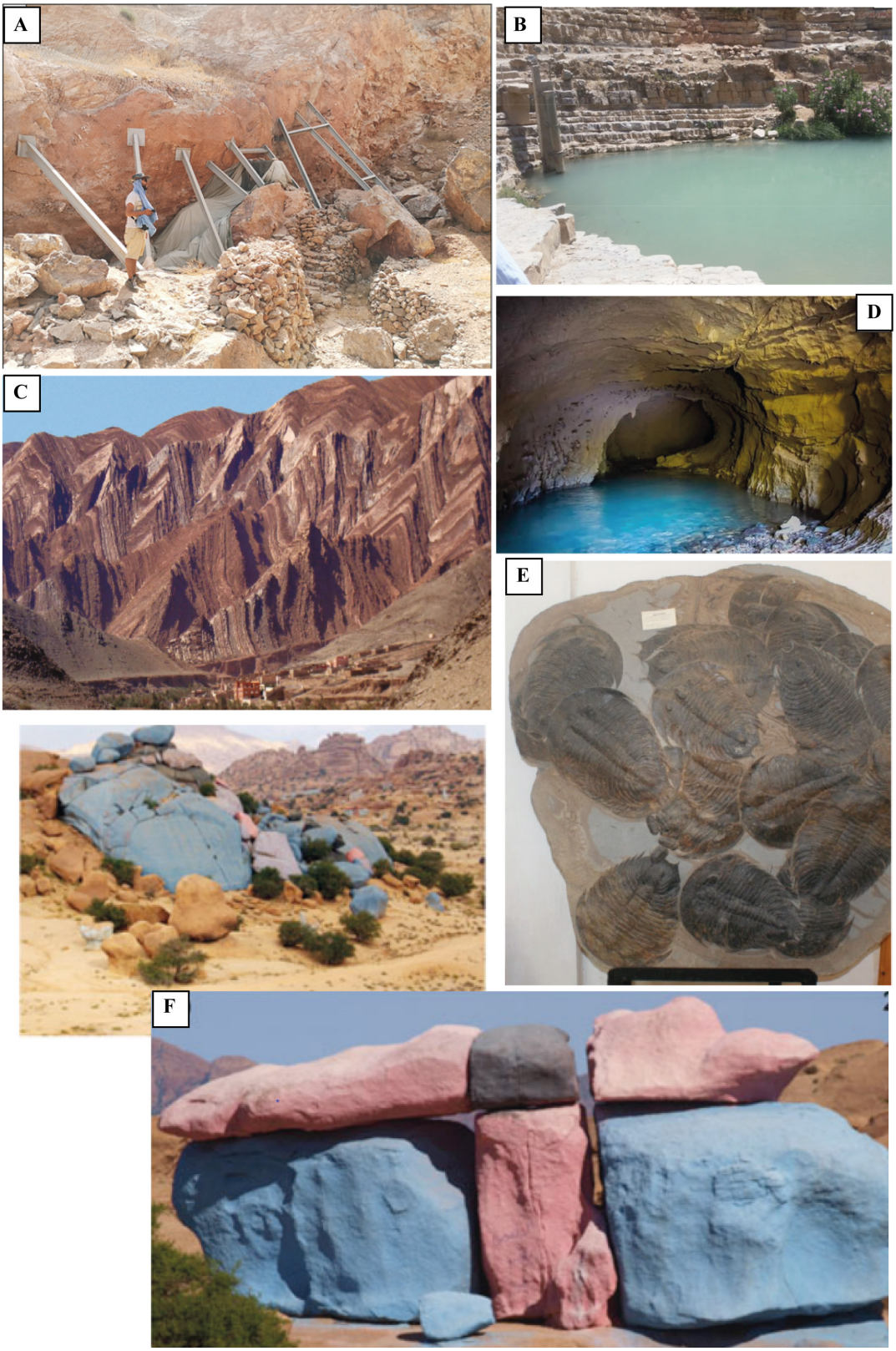

Figure 2. Examples of geoheritage sites: **A)** Jbel Irhoud Geosite, the Cradle of Humanity,Youssoufia Province (El Hamidy et al. 2024b); **B)** Source of Ain Sebou in BouIblane (Baadi et al. 2020); **(C)** Issafen's flatirons in SW of the Issafen city (Berred et al. 2019b); **D)** Ras El Oued cave in the Northern Middle Atlas (Baadi et al. 2021a); **E)** Giant trilobite specimens from the locality of Ouled Slimane (Zagora) (Beraaouz et al. 2019), Examples of one of the landscape paintings performed by the Belgian artist Jean Verame in granitic landforms near Tafraoute, known as the "Roches Peintes"(Druguet et al. 2015).

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Table 1. Publications related to geoheritage in Morocco

Publication	Methodology	Site type	Aim
El Wartiti et al. 2008	Descriptive	Geomorphosites	Inventory
De Waele et al. 2009	Descriptive	Geomorphosite	Inventory
El Wartiti et al. 2009	Descriptive	Geomorphosites	Inventory
Beraaouz et al. 2010	Descriptive	Geosites	Inventory
Camara et al. 2011	Descriptive	Geosites	Presentation
El Hadi et al. 2011	Descriptive	Geosites	Inventory
Tahiri et al. 2011	Descriptive	Geosites	Inventory
Zahra et al. 2011	Descriptive	Geomorphosites	Inventory
Belkhattab 2012	Descriptive	Geosites	Presentation
El Hadi et al. 2012	Descriptive	Geosites	Presentation
Albab et al. 2013	Descriptive	Geosites and geomorphosites	Inventory
Errami et al. 2013	Descriptive	Geosites	Presentation
Abioui et al. 2014	Descriptive	Geosites	Presentation
Belkhattab et al. 2014	Descriptive	Geosites	Presentation
Enniouar et al. 2014	Descriptive	Geosites	Presentation
Bourchich et al. 2015	Descriptive	Geosites and Geomorphosites	Inventory
Druguet et al. 2015	Descriptive	Geosites	Inventory
El Hadi et al. 2015	Descriptive	Geosites	Inventory
Enniouar et al. 2015	Descriptive	Geosites and Geomorphosites	Inventory
Errami et al. 2015a	Descriptive	Geosites and Geomorphosites	Presentation
Errami et al. 2015b	Descriptive	Geosites	Inventory
Noubhani 2015	Descriptive	Geosites	Presentation
Saddiqi et al. 2015	Descriptive	Geosites	Inventory
M'Barki et al. 2016	Descriptive	Geomorphosites	Inventory
Sadki et al. 2016	Reynard et al 2016	Geosites and Geomorphosites	Inventory and quantitative assessment
Eddif et al. 2017	Descriptive	Geosites	Presentation
El Hassani et al. 2017	Descriptive	Geosites	Inventory
Hili and El Khalki 2017	Reynard et al 2016	Geomorphosite	Inventory and quantitative assessment
Achkir et al. 2018	Reynard et al 2016	Geomorphosite	Presentation / quantitative assessment
Alilou et al. 2018	Reynard et al 2016	Geomorphosite	Inventory and quantitative assessment
Amine et al. 2018	Descriptive	Geosites	Inventory

Bouzekraoui et al. 2018a	Reynard et al 2016	Geomorphosites	Inventory and quantitative assessment
Bouzekraoui et al. 2018b	Descriptive	Geosites	Presentation
Bouzekraoui et al. 2018c	Descriptive	Geosites	Presentation
Eddif et al. 2018	Descriptive	Geosites	Presentation
Khoukhouchi et al. 2018	Reynard et al 2016	Geomorphosite	Presentation / quantitative assessment
Tahouri et al. 2018	Reynard et al 2016	Geosites and Geomorphosite	Presentation / quantitative assessment
Abioui et al. 2019	Descriptive	Geosites	Presentation
Ait Omar et al. 2019	New proposal	geomorphosites	Inventory and quantitative assessment
Aoulad Sidi Mhend et al. 2019	Brilha 2016	Geosites	Inventory and quantitative assessment
Beraaouz et al. 2019	Descriptive	Geosites	Inventory
Berred et al. 2019a	Descriptive	Geosites	Presentation
Berred et al. 2019b	Descriptive	Geomorphosite	Inventory
Kaid Rassou et al. 2019	Reynard et al 2016	Geosites	Inventory and quantitative assessment
Mounir et al. 2019	Descriptive	Geosites	Presentation
Milu et al. 2019	Descriptive	Geosites	Inventory
Oukassou et al. 2019	Descriptive	Geosites and Geomorphosites	Inventory
Oulmakki et al. 2019	Descriptive	Geosites	Presentation
Amine et al. 2020	Descriptive	Geosites	Presentation
Arrad et al. 2020a	Reynard et al 2016	Geomorphosite	Inventory and quantitative assessment
Arrad et al. 2020b	Reynard et al 2016	Geomorphosite	Inventory and quantitative assessment
Arrad et al. 2020c	Descriptive	Geosites	Presentation
Baadi et al. 2020	New proposal	Geosites	Inventory and quantitative assessment
Berred et al. 2020	Descriptive	Geosites	Presentation
Lahmidi et al. 2020	Brilha 2016	Geosites	Inventory and quantitative assessment
Lkebir et al. 2020	Descriptive	Geosites	Presentation
Mehdioui et al. 2020	Brilha 2016	Geosites	Inventory and quantitative assessment
Mirari et al. 2020a	Brilha 2016	Geosites and geomorphosites	Inventory and quantitative assessment
Mirari et al. 2020b	Descriptive	Geosites and geomorphosites	Inventory and quantitative assessment
Salhi 2020	Reynard et al 2016	geomorphosites	Inventory and quantitative assessment
Sayad et al. 2020	Descriptive	Geomorphosite	Presentation

Ait Omar et al. 2021	Descriptive	Geosites and geomorphosites	Presentation
Baadi et al. 2021a	New proposal	Geosites	Inventory and quantitative assessment
Baadi et al. 2021b	New proposal	Geosites and geomorphosites	Inventory and quantitative assessment
Bouari et al. 2021	Descriptive	Geosites	Presentation
Lahmidi et al. 2021	Brilha 2016	Geosites	Inventory and quantitative assessment
Mounir et al. 2021	Descriptive	Geosites	Presentation
Mountaj et al. 2021	Descriptive	Geosites	Presentation
Rais et al. 2021	Descriptive	Geosites/geomorphosites	inventory
Aichi et al. 2022a	Descriptive	Geosites	Presentation
Aichi et al. 2022b	Descriptive	Geosites	Inventory and quantitative assessment
Ait Barka et al. 2022a	Reynard et al 2016	geosites	Inventory and quantitative assessment
Ait Barka et al. 2022b	Descriptive	Geosites	Presentation
Ait Omar et al. 2022a	New proposal	Geosites and geomorphosites	Inventory and quantitative assessment
Ait Omar et al. 2022b	New proposal	Geosites and geomorphosites	Inventory and quantitative assessment
Aoulad Sidi Mhend et al. 2022	Reynard et al 2016	geosites	Inventory and quantitative assessment
Berred et al. 2022	Reynard et al 2016	geomorphosites	Inventory and quantitative assessment
Bussard et al. 2022a	Reynard et al 2016	geomorphosites	Inventory and quantitative assessment
Bussard et al. 2022b	Descriptive	Geosites	Presentation
Ech-charay et al. 2022	New proposal	Geosites and geomorphosites	Inventory and quantitative assessment
Lahmidi et al. 2022	Descriptive	Geosites	Presentation
Louz et al. 2022	Reynard et al 2016	geosites	Inventory and quantitative assessment
Mehdioui et al. 2022	Brilha 2016	Geosites	Inventory and quantitative assessment

employed in the evaluation of geoheritage sites in the Moroccan context. In addition, it seeks to identify gaps and challenges in existing methodologies, paving the way for future research directions and the development of more objective and universally applicable evaluation criteria.

Materials and Methods

Geoconservation cannot be successful without the development of a geosite inventory and assessment as a first step. Several methodologies have been proposed (Grandgirard 1995, 1996, 1999; Cendrero 1996; Wimbledon 1995, 1996; Alexandrowicz and Kozlowski 1999; Panizza 2001; Bruschi and Cendrero, 2005; Coratza and Giusti 2005; Pralong, 2005; Pralong and Reynard 2005; Zouros 2007; De Wever *et al.* 2006; Pereira *et al.* 2007; Reynard *et al.* 2007, 2016; Panizza and Piacente 2008; Bruschi and Cendrero 2009; García-Cortés and Carcavilla 2009; Erhartič 2010; Fuertes-Gutiérrez & Fernández-Martínez 2010; Lima *et al.* 2010; Pereira and Pereira 2010; Ruban 2010; Pereira *et al.* 2010; Bâca & Schuster 2011; Poirier and Daigneault 2011; Bruschi *et al.* 2011; Feuillet and Sourp 2011; Vujičić *et al.* 2011; Wimbledon *et al.* 2011; Bollati *et al.* 2012, 2013, 2016; Fassoulas *et al.* 2012; Doktor *et al.* 2015; Brilha 2016, 2018; Sellier 2016).

These proposals for quantifying elements of geodiversity attempt to establish criteria for assessment and to define priorities for site conservation and enhancement. Researchers have attempted to minimize, if not eliminate, the subjectivity inherent in quantifying elements of geodiversity. Most methodologies present a set of values that are subdivided into a set of criteria to be scored and assessed through a formula that enables geosites to be compared.

In our study, we carry out a literature review to provide a framework for future research efforts through a comprehensive review of the literature, data and subsequent evaluation. There are three phases: (1) an exhaustive search, (2) a selection of relevant publications related to Morocco, and (3) a review and analysis of the selected literature (Fig. 3).

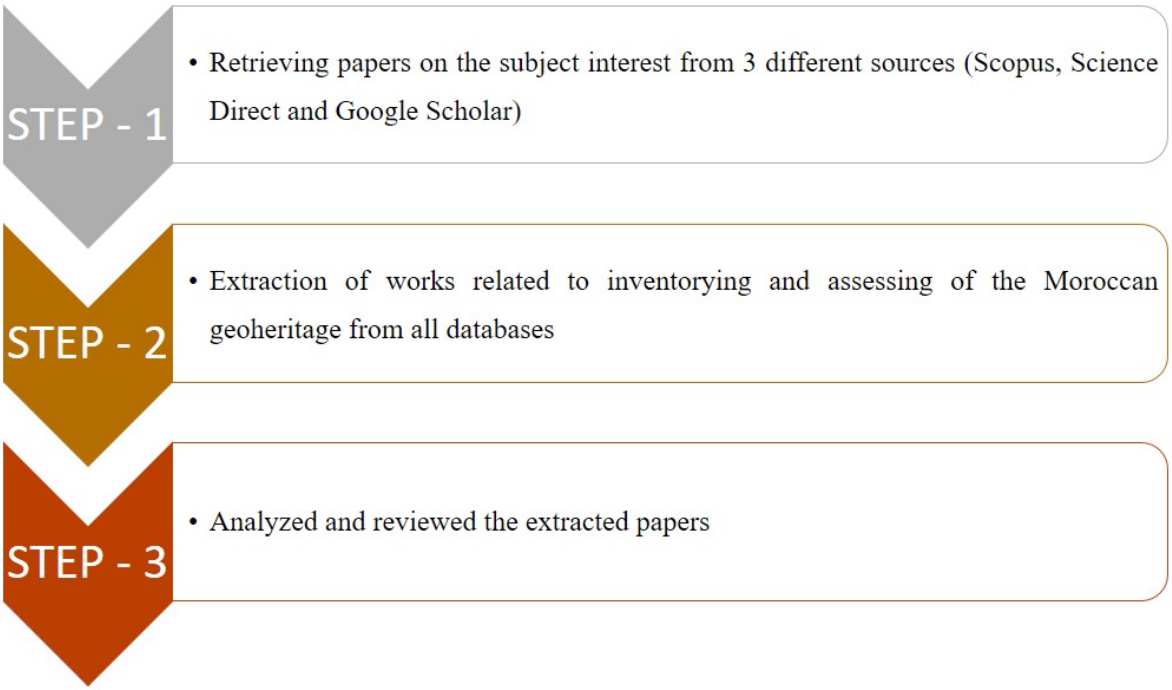

Figure 3. Methodology adopted for the study.

We used three online scientific literature databases: Science Direct, Scopus, and Google Scholar, searching articles, conference papers, editorials, commentaries, and book chapters. These three databases were chosen to guarantee the quality of the literature selected. The keywords used for the search were (ALL = ("Inventory" OR "Geosites" OR "Geomorphosite" OR "Geoheritage assessment" OR "Geosite assessment" OR "Geoconservation" OR "Geotourism" OR "Geoeducation")), examining the title, abstract, and keywords of each. The literature identified was then fed into the second phase of the study, in which we extracted information on the inventory and assessment of Moroccan geoheritage sites.

Results

We identified 84 relevant documents published since 2008 (Table 1). In these, different authors have tried to inventory and present geosites and areas with geological heritage, where 50 papers (59.5%) focus on geosites, 18 (21.5%) on geomorphosites, and 16 (19%) on both (Fig. 4).

In the papers, different approaches are used to identify geosites and evaluate them: 55 (65.5%) used the descriptive method, 16 (19%) used the Reynard *et al.* (2016) method, 6 (7.5%) used the Brilha (2016) method, and 7 (8%) proposed new approaches (Fig.5). These results suggest that the literature in general is insufficient as most use only the descriptive method.

In further detail, 24 (28.5%) of the papers focused on inventory, 29 (34.5%) on presentation of a geosite or an area containing geological and/or geomorphological heritage, 28 (33.4%) on inventory

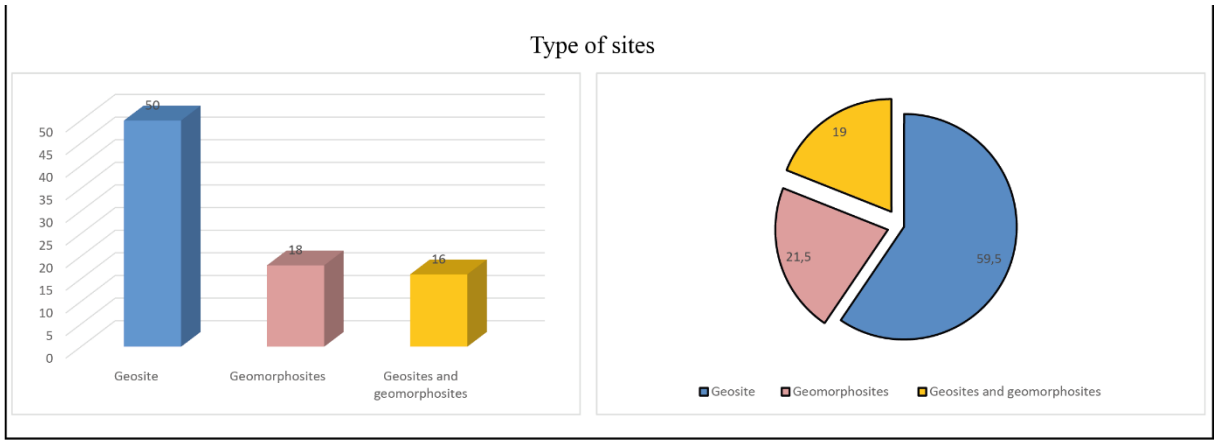

Figure 4. Type of sites.

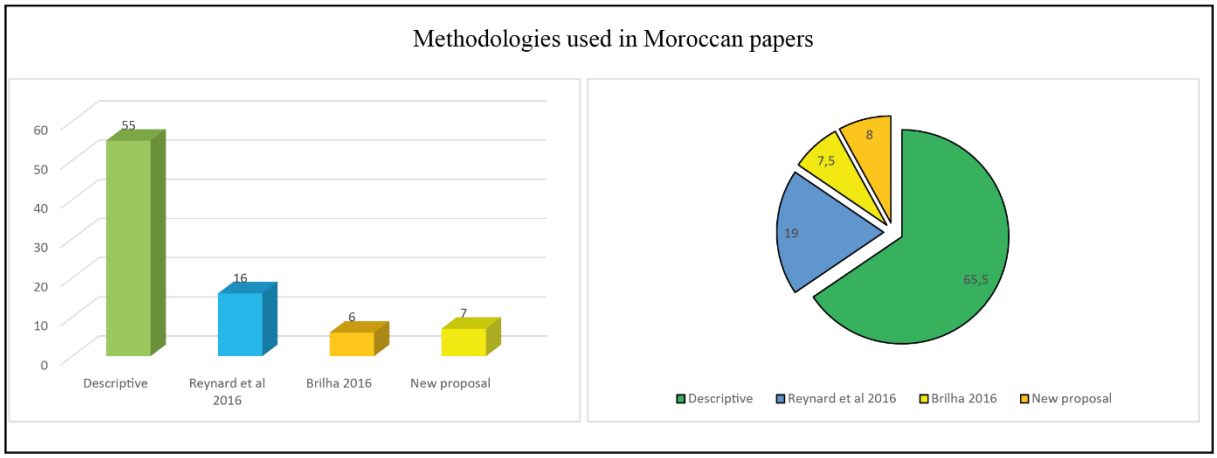

Figure 5. Methodologies used in Moroccan papers.

and quantitative assessment, and only 3 (3.6%) presented a geosite with a quantitative assessment (Fig. 6).

We identify two distinct periods in the study of Moroccan geoheritage: the introductory phases (2008–2015) and the growth phase (2016–2022) (Fig. 7).

• During the introductory phases, there was limited growth in publications focusing on Morocco's geological heritage. The authors relied mainly on descriptive methods to describe aspects of the geological inventory and the presentation of specific regions of the country.

• In contrast, the growth phase saw a remarkable increase in scientific output, indicating growing interest and commitment within the Moroccan scientific community. Researchers employed a range of methodological approaches to quantify,

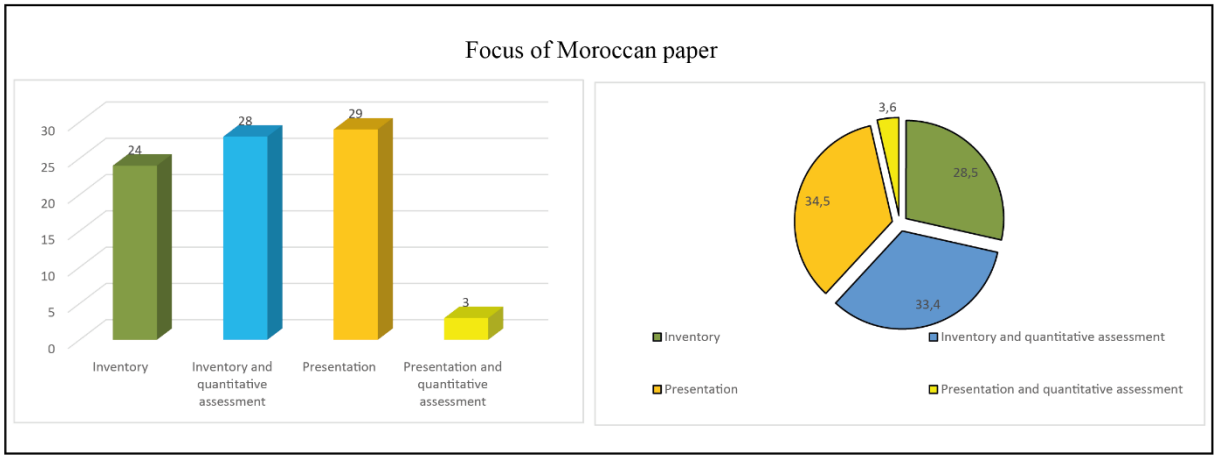

Figure 6. The focus of Moroccan paper.

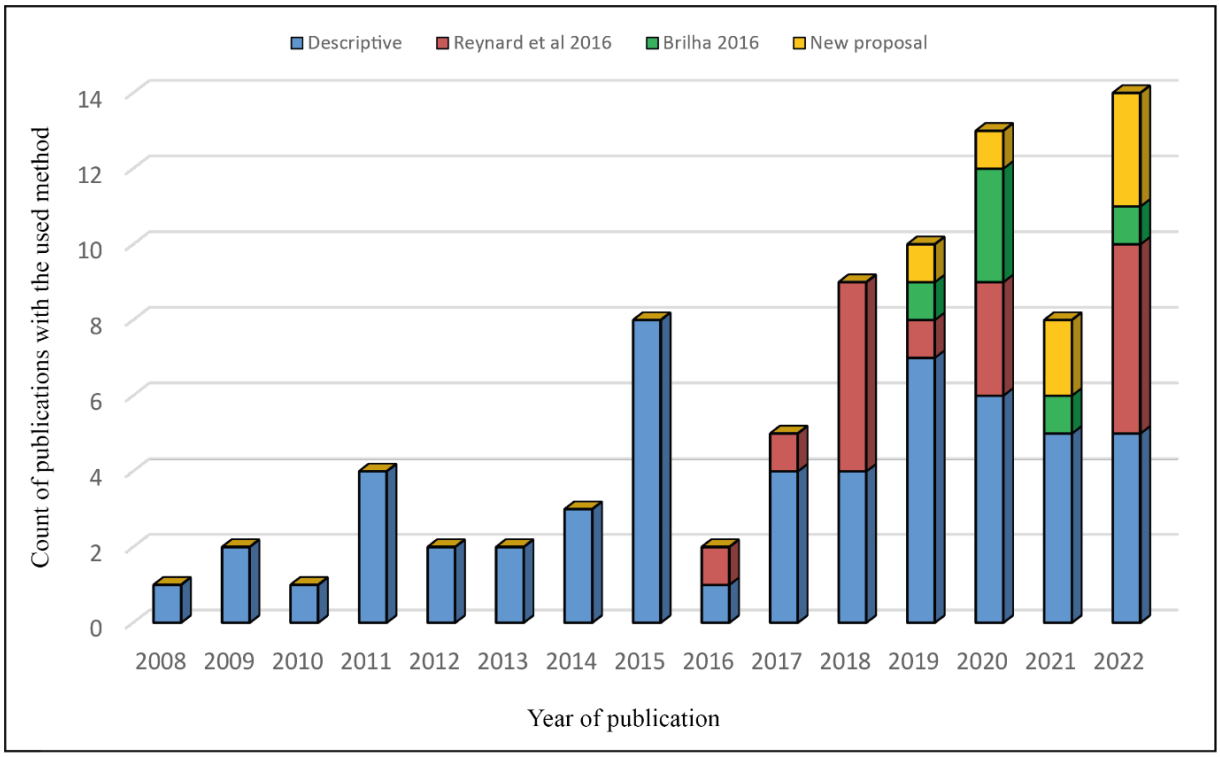

Figure 7. Trends in the assessment method used in publications from 2008 to 2022.

assess, and manage geosites and geomorphosites, including those of Reynard *et al.* (2016) and Brilha (2016). In addition, some new methods adapted to the inventory and assessment of Moroccan geosites and geomorphosites were proposed (Ait Omar *et al.* 2019: Baadi *et al.* 2020; Ech-charay *et al.* 2022).

Discussion

Geoheritage assessments based on qualitative methods in Morocco range from very general studies, such as the inventory of geosites in a given area, to detailed studies, such as the presentation of a single geosite or geomorphosite. In Morocco, two quantitative methodologies are commonly employed:

• Brilha (2016): the method evaluates geoheritage according to four criteria: scientific value, educational value, tourist value, and risk of degradation. Each criterion is divided into sub-indices (from 5 to 13), and the scores are then added together. The maximum possible score is 400 points.

• Reynard *et al.* (2016): the procedure includes four steps. First, a comprehensive description of the site under consideration is provided, detailing its geological and geomorphological features. Second, the assessment examines the intrinsic value of the site, considering its scientific significance alongside additional values such as cultural, ecological, and aesthetic attributes. Third is documentation of the current use and management status of the site, including evaluation of the site's protection measures, ownership, existing damage, and potential threats. Fourth is synthesis of the collected data and observations to provide a comprehensive overview of the site's characteristics and suitability for various purposes, such as conservation, tourism, and education.

The methodologies proposed by Ait Omar *et al.* (2019), Baadi *et al.* (2020), and Ech-charay *et al.* (2022) are built upon previously established evaluation criteria, combined to enable their application to various types of sites to provide a comprehensive assessment of all aspects of a geomorphosite or geosite's value in Morocco.

For the geoheritage inventory of a large area with many geosites, the presentation of the results of the assessment (tables, graphs, thematic map...) is an important step in securing and supporting the next steps in the geoconservation strategy, as it helps managers to prioritize protection and management. It is recommended that sites with a high potential for a particular type of use and a high risk of degradation be given higher priority in management and planning. However, it should be noted that such a presentation is not necessary for the assessment of a single geosite.

The results of the quantitative assessment of geoheritage sites constitute an invaluable tool for the effective management of these sites, which is a fundamental aspect of any action plan for geoconservation (Prosser *et al.* 2018) and geotourism development (Newsome and Dowling 2018).

In general, inventories are based on the researcher's perspective, retaining only those geosites that the researcher is aware of or has previously visited, while other geosites that have scientific value are ignored, which means they will also be ignored during the legal protection process. The inventory must be systematic and include all geosites within the region.

It is essential to recognise the lack of clarity surrounding the application of geoconservation strategies, particularly in the context of geosite evaluation methodologies. This lack of clarity could potentially lead to the unintentional exclusion of important sites or the inclusion of less significant sites. Awareness-raising and training can help to address this issue and ensure more effective conservation efforts.

Conclusion

Morocco is home to a multitude of areas that are of significant scientific, cultural, touristic, and educational value. However, the development of these sites has been constrained by the lack of adequate identification and documentation. Consequently, a significant proportion of the population is unaware of the aesthetic, cultural, geological, and economic importance of these sites. Recognizing and understanding the diversity of these sites is crucial. Comprehensive studies aimed at identifying and documenting these sites in Morocco are essential to provide detailed insights into the significance of geoheritage sites, thereby empowering local communities and government officials at both the state and central levels to manage them effectively and responsibly. By gaining insights into the value and potential uses of these sites, stakeholders can make informed decisions regarding conservation, tourism development, and educational initiatives. Ultimately, effective management and promotion of these sites will not only preserve Morocco's rich heritage but also contribute to local economies and promote cultural appreciation and awareness.

The study of geoheritage is an important field of geographical and geological research in environmental protection. Preserving the natural creations of the past is the key to preserving the present for the future. Researchers are currently at the scientific research stage, as no general methodology for evaluating geoheritage sites has yet developed.

The diversity of methods for evaluating geoheritage sites is due to the particularities of their structure and conditions of formation in different parts of the world. There are three groups of assessment methods for geoheritage sites: qualitative, quantitative, and quantitative-qualitative. Qualitative evaluation methods consist of a general scientific description and justification of the objects in terms of their conformity with the criteria for belonging to the geological heritage. These methods are not precise, as they rely mainly on the subjective opinion of the researcher. Quantitative assessment involves defining clear criteria, classifying them, and assigning them a corresponding weight. These methods are more reasonable, but they do not exclude the subjective evaluation factor.

Conflict of Interest

The authors declare that they have no competing interest

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Conflict of interest statement

The authors declare that there are no conflicts of interest associated with this study.

References

Abioui M (2014) Short communication funerary monuments of Oued Chbeika (Tan–Tan Province, Western Morocco): A threatened cultural heritage. International Journal of Global Science Research. 4: 614–616. DOI: 10.26540/ijgsr.v4.i2.2017.84

Abioui M, M'Barki L, Benssaou M, Ezaidi A, El Kamali N (2019) Rock art conservation and geotourism: a practical example from Foum Chenna engravings site, Morocco. Geoconservation Research. 2: 1–11. DOI: 10.30486/gcr.2019.664488

Achkir H (2018) The geological heritage of central High Atlas: an asset for integrated geotourism (case of Assif Melloul crossing (common territorial of Anergui and Tillouguite) in the province of Azilal; Béni Mellal-Khénifra-region/Morocco). International Journal of Science and Research. 7: 1541–1552. DOI: 10.21275/ART20192190

Albab S, Ezaidi A, Benssaou M, Kabbachi B (2013) Le patrimoine naturel-géologique et oasien-au service du développement géotouristique dans la province de Sidi Ifni et son arrière-pays oasien (Maroc). Cahiers de Géographie. 14: 117–130. https://www.persee.fr/doc/edyte_1762-4304_2013_num_14_1_1229

Amine F, Berrahma M H, Aarab A (2018) Inventory and management of dinosaurs traces: a case study of Azilal region, Morocco. International Journal of Global Science Research. 5: 793–814. DOI: 10.26540/ijgsr.v5.i2.2018.106

Amine F, Berrahma M H, Aarab A (2020) Dinosaurs footprints of the High Atlas Morocco by using geological heritage information system. International Journal of Advanced Research in Engineering and Technology. 11: 982–993. DOI: 10.34218/IJARET.11.12.2020.098

Aoulad Sidi Mhend A, Maaté A, Amri I, Hlila R, Chakiri S, Maaté S, Martín-Martín M (2019). The geological heritage of the Talassemtane national park and the Ghomara coast natural area (NW of Morocco). Geoheritage. 11: 1005–1025. https://doi.org/10.1007/s12371-019-00347-4

Aoulad Sidi Mhend A, Maaté A, Hlila R, Martín-Martín M, Chakiri S, Maaté S (2022). A quantitative approach to geosites assessment of the Talassemtane national park (NW of Morocco). Estudios Geológicos. 76: e123. https://doi.org/10.3989/egeol.43448.520.

Alilou MR,Salhi A (2018) Le patrimoine naturel dans la zone du Rif, région Tanger-Tétouan El Hoceima (province de Chechaouen): géo-tourisme et géo-patrimoine. Revue Internationale de Management, Entrepreneuriat et Communication. 2: 27–55. https://doi.org/10.59285/rimec.317

Aichi A, Ezaidi S, Abioui M, Ezaidi A (2022a) Cultural heritage in Imghranes massif (Drâa-Tafilalet Region, Morocco): An optimist's contribution and opportunity for the local people and sustainable tourism. International Journal of Innovation and Applied Studies. 37: 387–391. https://ijias.issr-journals.org/abstract.php?article=IJIAS-22-192-12

Aichi A, Ezaidi A, Abioui M, En–nasiry M (2022b). From geoheritage to geoeducation and geotourism: the Imghranes Massif, Drâa-Tafilalet region, Morocco. International Symposium "Geodiversity and Geoheritage - Status and Perspectives" Oct 7–9, 30.

Ait Barka A, Rais J, Barakat A, Louz E, Nadem S (2022a). The geosite of travertine waterfall of El Ksiba (Morocco): A heritage to enhance and preserve. Proceedings. 87: 16. https://doi.org/10.3390/IECG2022-13865

Ait Barka A, Rais J, Barakat A, Louz E, Nadem S (2022b). The karst landscapes of Beni Mellal Atlas (Central Morocco): Identification for promoting geoconservation and tourism. Quaestiones Geographicae. 41: 87–109. DOI: https://doi.org/10.2478/quageo-2022-0027

Ait Omar T A, Taïbi A N, El Hannani M, El Khalki Y (2019) Nouvelle méthodologie d'inventaire et d'évaluation des géomorphosites dans le contexte du géoparc M'goun (Maroc). Geo–Eco–Trop. 43: 569–580. https://geoecotrop.be/uploads/publications/pub_434_08.pdf

Ait Omar T A, El Khalki Y, Taïbi A N, El Hannani M (2021). Les géopatrimoines de la partie nord-est du géoparc régional du M'Goun (Maroc): représentations sociales et valorisation géotouristique. Géo-Regards: Revue Neuchâteloise de Géographie. 14: 157–173. https://libreo.ch/view/507452/3161705/Geo-regards_14_157.pdf

Ait Omar T A, El Khalki Y, Taibi A N, El Hannani M, Achkir H (2022a). A quantitative method for inventory and assessment of geoheritage in the Beni Mellal Atlas Mountains, Morocco. Cinq Continents. 12(26): 174–196. https://cinqcontinents.geo.unibuc.ro/12/12_26_Omar.pdf

Ait Omar T A, El Khalki Y, Ackhir H (2022b) Contribution of social perception for identifying geomorphological potential and touristic practices in the North-Eastern part of the M'goun regional geopark, Morocco. African Scientific Journal. 3: 307–307. https://doi.org/10.5281/zenodo.7104179

Alexandrowicz Z, Kozlowski S (1999) From selected geosites to geodiversity conservation-Polish example of modern framework. Towards the balanced management and conservation of the geological heritage in the new millennium. Sociedad Geológica de España, Madrid, 52–54. DOI: 10.13140/2.1.4950.2728

Arrad T Y, Errami E, Ennih N, Ouajhain B, Bouaouda MS (2020a) From geoheritage inventory to geoeducation and geotourism implications: insight from Jbel Amsittene (Essaouira province, Morocco). Journal of African Earth Sciences. 161: 103656. https://doi.org/10.1016/j.jafrearsci.2019.103656

Arrad T Y, Errami E, Ennih N, Ouajhain B, Ettachfini E M, Bouaouda MS, (2020b). Inventory, evaluation and promotion of the Essaouira Province geoheritage (Morocco): Toward a local and socio-economic sustainable development. EGU General Assembly Conference Abstracts May. DOI:10.5194/egusphere-egu2020-806

Arrad Y, Presenter T (2020c). Moroccan caves and their implications in the scientific, geoeducational, and geotouristic programs through speleological Activities. Conservation of Fragile Karst Resources Proceedings, Aug 18, 10. https://digitalcommons.wku.edu/con_karst_res_proc/con_karst_pro_2020/day_one/10

Baadi K, Sabaoui A, Tekiout B (2020). Methodological proposal for assessment geosites: its application in Bou-Iblane Region (Middle Atlas, Morocco). Geoheritage. 12: 1–16. https://doi.org/10.1007/s12371-020-00476-1

Baadi K, Lebreton B, Sabaoui A, Atrops F (2021a). The karst of the northern middle Atlas (Morocco): An Invaluable Heritage to Inventory. Geoheritage. 13: 1–15. https://doi.org/10.1007/s12371-021-00559-7

Baadi K, Amine A, Tefogoum G Z, Sabaoui A, Tekiout B (2021b). Volcanic geosites assessment in the Plio-Quaternary Azrou-Timahdite plateau (Middle Atlas, Morocco). Journal of African Earth Sciences. 184: 104352. https://doi.org/10.1016/j.jafrearsci.2021.104352

Bâca I, Schuster E (2011). Listing, evaluation and touristic utilisation of geosites containing archaeological artefacts. Case study: Ciceu ridge (Bistrita-Nasaud County Romania). Revista Geografica Academica. 5(1): 5-20. https://

biblat.unam.mx/hevila/Revistageograficaacademica/2011/vol5/no1/1.pdf

Belkhattab H (2012). Propositions pour la protection et la valorisation du patrimoine: les sites archéologiques de Casablanca, une chance pour le développement durable de la région. 15(15): 215–241. DOI: 10.21608/cguaa.2012.37358

Belkhattab H, Zahour G, Mohib A, Geraads D, Raynal J P (2014). Les sites d'interets prehistoriques et bio-ecologiques de casablanca. caracterisation et valorisation. European Scientific Journal. 10(35): 284–304. https://eujournal.org/index.php/esj/article/view/4877

Beraaouz M, Masrour M, Atrops F, Bouchaou L (2010). Les géosites des provinces de Ouarzazate et Zagora (Maroc): interprétation et valorisation dans le cadre du géotourisme. Geomaghreb. 6: 121–131.

Beraaouz M, Macadam J, Bouchaou L, Ikenne M, Ernst R, Tagma T, Masrour M (2019). An inventory of geoheritage sites in the Draa Valley (Morocco): a contribution to promotion of geotourism and sustainable development. Geoheritage. 11: 241–255. https://doi.org/10.1007/s12371-017-0256-x

Berred S, Fadli D, Berred K (2019a). Aerial interference of Hercynian folds and their morphological peculiarities in the Bani geopark of southern Morocco. Arabian Journal of Geosciences. 12: 1–10. https://doi.org/10.1007/s12517-019-4537-3

Berred S, Fadli D, El Wartiti M, Zahraoui M, Berred K, Sadki R (2019b). Geomorphosites of the semi–arid Tata region: valorization of an unknown geoheritage for geotourism sustainable development (Anti-Atlas, South Morocco). Geoheritage. 11: 1989–2004. https://doi.org/10.1007/s12371-019-00414-w

Berred S, Fadli D, Di Gregorio F, Berred K (2020). Geological and landscape particularities of Issafen-style chevron pattern in Tata region (Anti-Atlas, South Morocco). Arabian Journal of Geosciences. 13: 1–17. https://doi.org/10.1007/s12517-020-05713-z

Berred S, Berred K, Fadli D (2022). Geodiversity of kingdom of Morocco: Tata province geomorphosites inventory for creating a geopark project (Anti-Atlas). International Journal of Geoheritage and Parks. 10: 367–382. https://doi.org/10.1016/j.ijgeop.2022.07.001

Bétard F, Peulvast JP, Magalhães ADO, Carvalho Neta M DL, de Freitas FI (2018). Araripe Basin: a major geodiversity hotspot in Brazil. Geoheritage. 10: 543–558. https://doi.org/10.1007/s12371-017-0232-5

Bollati I, Pelfini M, Pellegrini L (2012). A geomorphosites selection method for educational purposes: a case study in Trebbia Valley (Emilia Romagna, Italy). Geografia Fisica e Dinamica Quaternaria. 35: 23–35. https://doi.org/10.4461/GFDQ.2012.35.3

Bollati I, Smiraglia C, Pelfini M (2013). Assessment and selection of geomorphosites and trails in the Miage Glacier Area (Western Italian Alps). Environmental Management. 51: 951–967. https://doi.org/10.1007/s00267-012-9995-2

Bollati I, Fossati M, Zanoletti E, Zucali M, Magagna A, Pelfini M (2016). A methodological proposal for the assessment of cliffs equipped for climbing as a component of geoheritage and tools for Earth Science education: the case of the Verbano-Cusio-Ossola (Western Italian Alps). Journal of the Virtual Explorer. 49: 1. https://virtualexplorer.com.au/system/files/papers/8681/assets/assessment-cliffs-equipped-climbing.pdf

Bouari A, Lazreq N, Soulaimani A, Tahiri A, Aboulfaraj A (2021). The heritage interest of the Koudiat Ferjane outcrops of Jebel Ardouz in the M'zoudia region and their protection. Geoheritage. 13: 1–8. https://doi.org/10.1007/s12371-021-00541-3

Bourchich N, Adarab H, Ezaidi A (2015). Geotourism in Ida Outananes Moroccan western high atlas: state of valuation and opportunity of improvement. Journal of Geography and Geology. 7(3): 35–48. DOI:10.5539/jgg.v7n3p35

Bouzekraoui H, Barakat A, Touhami F, Mouaddine A, El Youssi M (2018a). Inventory and assessment of geomorphosites for geotourism development: A case study of Aït Bou Oulli valley (Central High-Atlas, Morocco). Area. 50(3): 331–343. https://doi.org/10.1111/area.12380

Bouzekraoui H, Barakat A, Mouaddine A, El Youssi M, Touhami F, Hafid A (2018b). Mapping geoheritage for geotourism management, a case study of Aït Bou Oulli valley in Central High-Atlas (Morocco). Environmental Earth Sciences. 77: 1–15. https://doi.org/10.1007/s12665-018-7589-x

Bouzekraoui H, Barakat A, El Youssi M, Touhami F, Mouaddine A, Hafid A, Zwoliński Z, (2018c). Mapping geosites as gateways to the geotourism management in central High-Atlas (Morocco). Quaestiones Geographicae. 37(1): 87–102. https://doi.org/10.2478/quageo-2018-0007

Brilha J (2016). Inventory and quantitative assessment of geosites and geodiversity sites: a review. Geoheritage. 8(2): 119-134. https://doi.org/10.1007/s12371-014-0139-3

Brilha J, Gray M, Pereira DI, Pereira P (2018). Geodiversity: An integrative review as a contribution to the sustainable management of the whole of nature. Environmental Science & Policy. 86: 19-28. https://doi.org/10.1016/j.envsci.2018.05.001

Bussard J, Martin S, Monbaron M, Reynard E, Khalki YE (2022a). Les paysages géomorphologiques du Haut Atlas central (Maroc): potentiel éducatif et éléments pour la médiation scientifique. Géomorphologie: Relief, Processus, Environnement. 28: 173–185. https://doi.org/10.4000/geomorphologie.17103

Bussard J (2022b). Heritage value and didactic potential of geomorphological landscapes: the case of eight sites in the Central High Atlas (Morocco). 10th International Conference on Geomorphology, Coimbra, Portugal, Sep 2022. https://doi.org/10.5194/icg2022-549

Bruschi VM, Cendrero A (2005). Geosite evaluation; can we measure intangible values?Alpine and Mediterranean Quaternary. 18(1): 293-306. https://distantreader.org/stacks/journals/amq/amq-499.pdf

Bruschi VM, Cendrero A (2009). Direct and parametric methods for the assessment of geosites and geomorphosites. Geomorphosites. 9: 73-88.

Bruschi VM, Cendrero A, Albertos JAC (2011). A statistical approach to the validation and optimisation of geoheritage assessment procedures. Geoheritage. 3: 131-149. https://doi.org/10.1007/s12371-011-0038-9

Camara M, Errami E, Ennih N, Guerraoui N, Zitoune I, Enniouar A, El Attari A (2011). Valorisation du géosite de la kasbah de Boulaouane (Province d'El Jadida, Maroc). First International Conference on African and Arabian Geoparks, El Jadida (Morocco), Nov 20-28.

Cayla N (2009). Le patrimoine géologique de l'arc alpin: De la médiation scientifique à la valorisation géotouristique (Doctoral dissertation, Université de Savoie). https://theses.hal.science/tel-00459658v1/file/Le_patrimoine_geologique_de_l_arc_alpin_-_These_N._CAYLA.pdf

Cendrero A, Dramis F (1996). The contribution of landslides to landscape evolution in Europe. Geomorphology.15(3-4): 191-211. https://doi.org/10.1016/0169-555X(95)00070-L

Coratza P, Giusti C (2005). Methodological proposal for the assessment of the scientific quality of geomorphosites. Alpine and Mediterranean Quaternary. 18(1): 307-313. https://amq.

aiqua.it/index.php/amq/article/view/500

De Waele J, Di Gregorio F, Melis MT, El Wartiti M (2009). Landscape units, geomorphosites and geodiversity of the Ifrane-Azrou region (Middle Atlas, Morocco). Mem. Descr. Carta Geol. D'It. 87:63–76. https://api.semanticscholar.org/CorpusID:209438397

De Wever P, Le Nechet Y, Cornée A (2006). Vade-mecum pour l'inventaire national du patrimoine géologique. Mémoire hors-série de la Société Géologique de France.

Doktor M, Miśkiewicz K, Welc EM, Mayer W (2015). Criteria of geotourism valorization specified for various recipients. Geotourism. 3-4(42-43): 25-38. http://dx.doi.org/10.7494/geotour.2015.42-43.25

Druguet E, Rahimi A, Carreras J, Castaño L M, Sánchez-Sorribes I (2015). The geoheritage of Kerdous inlier Western Anti-Atlas, Morocco: pages of earth history in an outstanding landscape. In Geoheritage to Geoparks: Case Studies from Africa and Beyond Springer Verlag (pp. 81–90). https://doi.org/10.1007/978-3-319-10708-0_5

Ech-charay K, Boumir K, Ouarhache D, Ouaskou M, Marzouki A (2022). The geoheritage of the South-Eastern frontal zone of the Middle Atlas (Morocco): First inventory and assessment. Geoheritage. 14(4):103. https://doi.org/10.1007/s12371-022-00736-2

Eddif A, Sadkaoui D, Tajd A, Aghbal A, Hamid A, Inspecteur SVT (2017). Les volcans eteints du Maroc: Patrimoine geologique encore peu connu" etude de cas. European Scientific Journal (ESJ). 13: 90–103. https://doi.org/10.19044/esj.2017.v13n33p90

Eddif A, Hamid MA, Ouazzani H, Boutsougame A (2018). Exemple de géosite à forte valeur patrimoniale méconnu du grand public: cas de la chaîne volcanique du Moyen Atlas (Maroc). digitAR-Revista Digital de Arqueologia, Arquitectura e Artes. (5): 69–81. https://doi.org/10.14195/2182-844X_5_4

El Hadi H, Tahiri A, Simancas JF, González-Lodeiro F, Azor A, Martínez-Poyatos D (2011). Geoheritage in Morocco: the Neoproterozoic ophiolite of Bou Azzer (Central Anti-Atlas). Geoheritage. 3: 89–96. https://doi.org/10.1007/s12371-011-0032-2

El Hadi H, Tahiri A, Cabrera J F S, Lodeiro F G, Pérez A A, Poyatos D J M, El Maidani A (2012). The Precambrian ophiolites of Bou Azzer (Anti Atlas): an example of geoheritage in Morocco. Geotemas (Madrid). 13: 1265–1268.

El Hadi H E, Tahiri A, Brilha J B, Maidani A E, Baghdad B, Zaidi A (2015). Geodiversity examples of Morocco: from inventory to regional geotourism development. Open Journal of Ecology. 5(09): 409–419. DOI: 10.4236/oje.2015.59034

El Hamidy M, Errami E, Elkaichi A (2024a). An overview of scientific research on geoheritage in Morocco. Proceedings of the Geologists' Association. https:// doi. org/ 10. 1016/j. pgeola. 2024. 01. 002

El Hamidy M, Errami E, Kabouri J.E, Naim M, Assouka A, Youssef, A A B, Bchari F (2024b). Jbel Irhoud Geosite, the Cradle of Humanity (Youssoufia Province, Marrakech-Safi region, Morocco): Evaluation and Valorization of the Geological Heritage for Geoeducation and Geotourism Purposes. Geoheritage, 16(1), 1-20. https://doi.org/10.1007/s12371-024-00927-z

El Hamidy M, Errami E, Orion N (2024c). Proposed geo-educational activities at the Sidi Bouzid geosite, Safi Province, Marrakech-Safi region, Morocco. International Journal of Geoheritage and Parks, 12(2), 209-222. https://doi.org/10.1016/j.ijgeop.2024.03.003

El Hassani A, Aboussalam S, Becker T, El Wartiti

M, El Hassani F (2017). Patrimoine géologique marocain et développement durable: l'exemple du Dévonien du Tafilalt, Anti–Atlas oriental le géoparc du jbel bani–tata. Revue officielle de la société géologique de france,géosciences appliquées.

El Wartiti M, Malaki A, Zahraoui M, El Ghannouchi A, Di Gregorio F (2008). Geosites inventory of the Northwestern tabular Middle Atlas of Morocco. Environmental Geology. 55: 415–422. https://doi.org/10.1007/s00254-007-0987-0

El Wartiti M, Malaki A, Zahraoui M, Di Gregorio F, De Waele J (2009). Geosites and touristic development of the Northwestern tabular Middle Atlas of Morocco. In Desertification and Risk Analysis Using High and Medium Resolution Satellite Data: Training Workshop on Mapping Desertification. Springer Netherlands. https://doi.org/10.1007/978-1-4020-8937-4_13

Enniouar A, Lagnaoui A, Habib A (2014). A Middle Jurassic sauropod tracksite in the Argana Basin, Western High Atlas, Morocco: an example of paleoichnological heritage for sustainable geotourism. Proceedings of the Geologists' Association. 125(1): 114–119. https://doi.org/10.1016/j.pgeola.2013.09.003

Enniouar A, Errami E, Lagnaoui A, Bouaala O (2015). Geoheritage of Doukkala-Abda region (Morocco): a tool for local socio-economical sustainable development. In Geoheritage to Geoparks: Case Studies from Africa and Beyond. From Geoheritage to Geoparks: Case Studies from Africa and Beyond (pp.109–124). https://doi.org/10.1007/978-3-319-10708-0_7

Erhartič B (2010). Geomorphosite assessment. Acta Geographica Slovenica. 50(2): 295-319. https://doi.org/10.3986/AGS50206

Errami E (2009). Pre-congress meeting of the fifth conference of the African association of women in geosciences entitled "Women and Geosciences for Peace". Episodes. 32(3): 210–211.

Errami E, Ennih N, Brocx M, Semeniuk V, Otmane K (2013). Geoheritage, geoconservation and aspiring geoparks in Morocco: the Zenaga inlier. Rendiconti Online Societa Geologica Italiana. 28: 49–53. https://api.semanticscholar.org/CorpusID:127497904

Errami E, Brocx M, Semeniuk V, Ennih N (2015a). Geosites, sites of special scientific interest, and potential geoparks in the Anti-Atlas (Morocco). From geoheritage to geoparks (pp. 57–79). https://doi.org/10.1007/978-3-319-10708-0_4

Errami E, Brocx M, Semeniuk V (2015b). From geoheritage to geoparks. Springer International Publishing Switzerland, Case Studies from Africa and Beyond. https://doi.org/10.1007/978-3-319-10708-0

Errami E, Sallam E.S, El-Ekhfifi S.S, Kamh S.Z, Muftah A.M, Ismail-Lattrache K.B, El Hamidy M, El Kabouri J, El Kaichi A, Chatir A, Bendaoud A (2024). Geoheritage, Geotourism, and Geoparks in North Africa: Current State. In The Geology of North Africa (pp. 631-660). Cham: Springer International Publishing. https://doi.org/10.1007/978-3-031-48299-1_21

Fassoulas C, Mouriki D, Dimitriou-Nikolakis P, Iliopoulos G (2012). Quantitative assessment of geotopes as an effective tool for geoheritage management. Geoheritage. 4:177-193. https://doi.org/10.1007/s12371-011-0046-9

Feuillet T, Sourp E (2011). Geomorphological heritage of the Pyrenees National Park (France): assessment, clustering, and promotion of geomorphosites. Geoheritage. 3(3): 151-162. https://doi.org/10.1007/s12371-010-0020-y

Fontana G (2008). Analyse et propositions de valorisation d'un paysage géomorphologique: Le cas de la Greina (Doctoral dissertation, Université de Lausanne). https://igd.unil.ch/memoires/uploads/memoire/memoire_pdf/253/

a3516807-6723-4f20-b59e-bb0b91c8d5d2.pdf

Fox N, Graham L J, Eigenbrod F, Bullock JM, Parks KE (2022). Geodiversity supports cultural ecosystem services: an assessment using social media. Geoheritage, 14(1), 27. https://doi.org/10.1007/s12371-022-00665-0

Fuertes-Gutiérrez I, Fernández-Martínez E (2010). Geosites inventory in the Leon Province (Northwestern Spain): a tool to introduce geoheritage into regional environmental management. Geoheritage. 2: 57-75. https://doi.org/10.1007/s12371-010-0012-y

García-Cortés A, Carcavilla L (2009) Documento metodológico para la elaboración del inventario español de lugares de interés geológico (IELIG). Madrid, Spain: Geological Survey of Spain (IGME). 61 p. Available at: http://www.igme.es/patrimonio/novedades/METODOLOGIA%20IELIG%20web.pdf

Grandgirard V (1995). Méthode pour la réalisation d'un inventaire de géotopes géomorphologiques. – In UKPIK Cahiers de l'Institut de Géographie de l'Université de Fribourg. 10: 121-137.

Grandgirard V (1996). Gestion du patrimoine naturel, l'inventaire des géotopes géomorphologiques du canton de Fribourg. Rapports de Recherches de l'Institut de Géographie de l'Université de Fribourg, Ukpik. 8 : 181–195

Grandgirard V (1997). Géomorphologie et gestion du patrimoine naturel: la mémoire de la Terre est notre mémoire. Geographica Helvetica. 52(2): 47-56.

Grandgirard V (1999). L'évaluation des géotopes. Geol Insubr. 4(1):59–66

Gray M, Gordan E J, Brown J E (2013). Geodiversity and the ecosystem approach: the contribution of geoscience in delivering integrated environmental management. Proceedings of the Geologists' Association. 124: 659–673. https://doi.org/10.1016/j.pgeola.2013.01.003

Hili A, El Khalki Y (2017). Les paysages karstiques du parc national de Tazekka (Moyen Atlas Nord Oriental, province de Taza, Maroc): inventaire, évaluation et valorisation pour un développement territorial durable et intégré. Karstologia. (70): 43–52.

Hobléa F, Cayla N, Giusti C, Peyrache-Gadeau V, Poiraud A, Reynard E (2017). Les géopatrimoines des Alpes occidentales: émergence d'une ressource territoriale. In Annales de géographie (No. 717, pp. 566-597). Cairn/Publilog. DOI10.3917/ag.717.0566

Iosif D (2014). La fiche d'évaluation des géosites : Un exemple exhaustif utilisé sur des sites Roumains, Cinq Continents. 4 (10):158-180. https://cinqcontinents.geo.unibuc.ro/4/4_10_Iosif.pdf

Kaid Rassou K, Razoki B, Yazidi M, Chakiri S, El Hadi H, Bejjaji Z, El Hmidi F, Allouza M (2019). The vulgarization for the patrimonialization of the kettara geodiversity (central jbilet) morocco. International Journal of Civil Engineering and Technology (IJCIET). 10 (06): 194-214. https://iaeme.com/Home/journal/IJCIET

Khoukhouchi M, Errami E, Hassou N, Irzan E (2018). The geomorphological heritage of the Oualidia and Sidi Moussa lagoons: assessment and promotion for a sustainable human and socio-economic development. Journal of Scientific Research and Studies. 5(4): 73–87.

Kubalíková L (2013) Geomorphosite assessment for geotourism purposes. Czech Journal of Tourism. 2(2):80–104. https:// doi. org/ 10. 2478/cjot- 2013- 0005

Lahmidi S, Lagnaoui A, Bahaj T, El Adnani A, Fadli D (2020). First inventory and assessment of the geoheritage of Zagora province from the project Bani geopark (South-Eastern Morocco). Proceedings of the Geologists' Association. 131(5): 511–527. https://doi.org/10.1016/j.pgeola.2020.05.002

Lahmidi S, Lagnaoui A, Berrada I, El Adnani A, Saadi M, Bahaj T (2021). The Ordovician Foum Larjamme tunnel paleo–valleys from Bani geopark project–assessment of geological heritage for geo-education and geotourism purposes. Geoheritage. 13: 1–22. https://doi.org/10.1007/s12371-021-00630-3

Lahmidi S, Lagnaoui A, Adnani AE, Berrada I, Saadi M, Bahaj T (2022). Integrating geological and archaeological heritage for conservation and promotion of Foum Larjamme Geosite from Bani geopark Project South-Eastern Morocco. Geoheritage. 14(3): 81. https://doi.org/10.1007/s12371-022-00718-4

Lima F F, Brilha J, Salamuni E (2010). Inventorying geological heritage in large territories: a methodological proposal applied to Brazil. Geoheritage. 2: 91-99. https://doi.org/10.1007/s12371-010-0014-9

Lkebir N, Masrour M, Pascual-Arribas C, de Ducla M, Hernández-Medrano N, Pérez-Lorente F (2020). The Anza tracksite: Ichnological heritage and geoeducational significance of dinosaur and pterosaur tracks in coastal Morocco. Journal of African Earth Sciences. 171: 103949. https://doi.org/10.1016/j.jafrearsci.2020.103949

Louz E, Rais J, Barka A A, Nadem S, Barakat A (2022). Geological heritage of the Taguelft syncline (M'Goun Geopark): Inventory, assessment, and promotion for geotourism development (Central High Atlas, Morocco). International Journal of Geoheritage and Parks. 10(2): 218–239. https://doi.org/10.1016/j.ijgeop.2022.04.002

Martin S (2013). Valoriser le géopatrimoine par la médiation indirecte et la visualisation des objets géomorphologiques, Thèse de doctorat, Département de géographie, Université Lausanne, Suisse, Géovisions, n° 41, 305 P. https://igd.unil.ch/www/geovisions/41/Geovisions_41_small.pdf

Mehdioui S, El Hadi H, Tahiri A, Brilha J, El Haibi H, Tahiri M (2020). Inventory and quantitative assessment of geosites in Rabat-Tiflet Region (North Western Morocco): Preliminary study to evaluate the potential of the area to become a geopark. Geoheritage. 12: 1–17. https://doi.org/10.1007/s12371-020-00456-5

Mehdioui S, El Hadi H, Tahiri A, Haibi HE, Tahiri M, Zoraa N, Hamoud A (2022). The Geoheritage of Northwestern Central Morocco area: Inventory and quantitative assessment of geosites for geoconservation, geotourism, geopark purpose and the support of sustainable development. Geoheritage. 14(3): 86. https://doi.org/10.1007/s12371-022-00712-w

Milu V, Ikenne M, Seghedi A, Souhassou M, Içame N, Melinte-Dobrinescu M C, Lazăr I (2019). Geoheritage of The Anti-Atlas (Morocco): A Natural treasure in support of sustainable development. Geosciences in the 21 century (pp.126–130).

Mirari S, Aoulad-Sidi-Mhend A, Benmlih A (2020a). Geosites for geotourism, geoheritage, and geoconservation of the khnefiss national park, Southern Morocco. Sustainability. 12(17):7109. https://doi.org/10.3390/su12177109

Mirari S, Benmlih A (2020b). Promotion of geotourism and geoheritage at the oases of Oued Noun. Geo Journal of Tourism and Geosites. 32(4): 1433–1440. https://doi.org/10.30892/gtg.32435-591

Mountaj S, Remmal T, Makhoukhi S (2021). The volcanic province of the Middle Atlas: A volcanic geoheritage to highlight and promote (Middle Atlas, Morocco). In AGU Fall Meeting Abstracts. GC15J–0792. https://ui.adsabs.harvard.edu/abs/2021AGUFMGC15J0792M

Mounir S, Saoud N, Charroud M, Mounir K, Choukrad J (2019). The Middle Atlas geological karsts forms: towards geosites characterization. Oil & Gas Science and Technology–

Revue d'IFP Energies nouvelles. 74(17): 9. https://doi.org/10.2516/ogst/2018089

Mounir S, Saoud N, Mounir K, Choukrad J, Berbeche A, Charroud M (2021). The middle Atlas domain of Morocco: Geoheritage conservation allowing development in a sustainable manner. In 5th International Young Earth Scientists (YES) Congress "Rocking Earth's Future". German YES Chapter, GFZ German Research Centre for Geosciences, 24. https://gfzpublic.gfz-potsdam.de/rest/items/item_5007178_1/component/file_5007202/content

M'Barki L, Benssaou M (2016). Tectonic and geomorphological landscapes and their geodidactic and geotouristic involvement: Case study in Precambrian and Paleozoic reliefs of Tata–Morocco. International Journal of Innovation and Applied Studies. 18(3): 703–710. https://www.proquest.com/scholarly-journals/tectonic-geomorphological-landscapes-their/docview/1839705601/se-2

Newsome D, Dowling R (2018). Geoheritage and geotourism. In Geoheritage (pp. 305-321). Elsevier. https://doi.org/10.1016/B978-0-12-809531-7.00017-4

Noubhani A (2015). Late Cretaceous and lower Paleogene Moroccan phosphates: Geotourism opportunities. From geoheritage to geoparks (pp. 125–133). https://doi.org/10.1007/978-3-319-10708-0_8

Ollier C (2012). Problems of geotourism and geodiversity. Quaestiones Geographicae. 31(3): 57–61. DOI: 10.2478/v10117-012-0025-5

Oulmakki N, Lemjidi F, El Hamri M (2019). L'archéotourisme Dans Le Sud Marocain, vers une durabilité des sites rupestres. Antrope, Centro Transdisciplinar das Arqueologias, Instituto Politécnico de Tomar. https://hal.science/hal-02261296

Oukassou M, Boumir K, Benshili K, Ouarhache D, Lagnaoui A, Charrière A (2019). The Tichoukt massif: A geotouristic play in the folded Middle Atlas (Morocco). Geoheritage. 11: 371–379. https://doi.org/10.1007/s12371-018-0287-y

Panizza M (2001). Geomorphosites: concepts, methods and examples of geomorphological survey. Chinese Science Bulletin. 46: 4-5. https://doi.org/10.1007/BF03187227

Panizza M, Piacente S (2008). Geomorphosites and geotourism. Revista Geográfica Acadêmica. 2(1): 5-9. https://biblat.unam.mx/hevila/Revistageograficaacademica/2008/vol2/no1/1.pdf

Pereira P, Pereira D, Caetano Alves MI (2007). Geomorphosite assessment in Montesinho natural park (Portugal). Geographica Helvetica. 62(3): 159-168. https://doi.org/10.5194/gh-62-159-2007

Pereira P, Pereira D (2010). Methodological guidelines for geomorphosite assessment. Géomorphologie: Relief, Processus, Environnement. 16(2): 215-222. https://doi.org/10.4000/geomorphologie.7942

Pereira P, Pereira D, Brilha J (2010). "Geoformas e depósitos glaciários e periglaciários", uma das categorias temáticas para a inventariação do património geológico português. https://hdl.handle.net/1822/45675

Poirier B, Daigneault RA (2011). La mise en valeur du patrimoine géologique du Sentier national du Québec dans les Laurentides. Le naturaliste canadien. 135(1): 45-55. https://mcours.net/cours/pdf/autres/patrimoine_geologique_fgw-dr.pdf

Pralong JP (2005). A method for assessing tourist potential and use of geomorphological sites. Géomorphologie: Relief, Processus, Environnement. 11(3): 189-196. https://doi.org/10.4000/geomorphologie.350

Pralong JP, Reynard E (2005). A proposal for a classification of geomorphological sites de-

pending on their tourist value. Il Quaternario. 18: 313-319. https://serval.unil.ch/resource/serval:BIB_36024.P001/REF.pdf

Prosser CD, Díaz-Martínez E, Larwood JG(2018). The conservation of geosites: principles and practice. In Geoheritage (pp. 193-212). Elsevier. https://doi.org/10.1016/B978-0-12-809531-7.00011-3

Rais J, Barakat A, Louz E, Barka AA (2021). Geological heritage in the M'Goun geopark: A proposal of geo-itineraries around the Bine El Ouidane dam (Central High Atlas, Morocco). International Journal of Geoheritage and Parks. 9(2): 242–263. https://doi.org/10.1016/j.ijgeop.2021.02.006

Reynard E, Panizza M (2005). Geomorphosites: definition, assessment and mapping. An introduction. Géomorphologie: Relief, Processus, Environnement. 11(3):177-180. https://doi.org/10.4000/geomorphologie.337

Reynard E, Fontana G, Kozlik L, Scapozza C (2007). A method for assessing" scientific" and" additional values" of geomorphosites. Geographica Helvetica. 62(3): 148-158. https://doi.org/10.5194/gh-62-148-2007

Reynard E, Lambiel C (2015). La cartographie géomorphologique au service de la lecture du paysage. Bulletin de la Murithienne. 132: 43-44. https://serval.unil.ch/resource/serval:BIB_5133117AA8F0.P001/REF.pdf

Reynard E, Perret A, Bussard J, Grangier L, Martin S (2016). Integrated approach for the inventory and management of geomorphological heritage at the regional scale. Geoheritage. 8: 43-60. https://doi.org/10.1007/s12371-015-0153-0

Ruban DA (2010). Quantification of geodiversity and its loss. Proceedings of the Geologists' Association. 121(3): 326-333. https://doi.org/10.1016/j.pgeola.2010.07.002

Saddiqi O, Rjimati E, Michard A, Soulaimani A, Ouanaimi H (2015). Recommended geoheritage trails in Southern Morocco: A 3 Ga record between the sahara desert and the atlantic ocean. From geoheritage to geoparks (pp. 91–108). https://doi.org/10.1007/978-3-319-10708-0_6

Sadki R, El Wartiti M, Azelmad R, Berred S (2016). Identification, valorization and protection of the geomorphosites for the developement of geo-eco-tourism integrated in the area of Errachidia (South–East) of Morocco. International Journal of Innovation and Applied Studies. 18(3): 784–793. https://ijias.issr-journals.org/abstract.php?article=IJIAS-16-200-13

Salhi A, Alilou M R, Benabdelouahab S, Vila-Subirós J, Sala P, Benabdelouahab T, Casas Ponsati A (2020). Assessment of geosites in Northern Morocco: diversity and richness with potential for socioeconomic development. Geoheritage. 12:1–21. https://doi.org/10.1007/s12371-020-00512-0

Sayad A, Essahlaoui A, Ben-Daoud M (2020). Dayet Aoua, a Threatened mountain geomorphosite for sustainable development. In Proceedings of the 4th Edition of International Conference on Geo–IT and Water Resources 2020, Geo–IT and Water Resources. 26: 1–5. https://doi.org/10.1145/3399205.3399234

Sellier D (2009). La vulgarisation du patrimoine géomorphologique: objets, moyens et perspectives.(Popularization of geomorphological heritage: objectives, means and prospects). Bulletin de l'Association de Géographes Français. 86(1): 67-81. https://www.persee.fr/doc/bagf_0004-5322_2009_num_86_1_2655

Sellier D (2016). A deductive method for the selection of geomorphosites: application to Mont Ventoux (Provence, France). Geoheritage. 8(1): 15-29. https://doi.org/10.1007/s12371-015-0144-1

Tahiri A, El Hassani A, El Hadi H (2011). Geological heritage of Morocco: The example of

Palaeozoic geodiversity in the Rabat Salé Zemmours Zaers area. Géologie de la France. 1: 79–88. http://geolfrance.brgm.fr/sites/default/files/upload/documents/revues_articles_gf11-1-2010.pdf

Tahouri J, Sadiki A, Mouhssine M, Mesrar H (2018). Inventory and evaluation of the geosites of Middle Ouergha (Central external Rif, Morocco). Conférence Internationale Technologie, Innovation et Systèmes d'Information, Mar 17–18. DOI: 10.13140/RG.2.2.22495.92328

Vujičić MD, Vasiljević DA, Marković SB, Hose TA, Lukić T, Hadžić O, Janićević S (2011). Preliminary geosite assessment model (GAM) and its application on Fruška Gora Mountain, potential geotourism destination of Serbia. Acta Geographica Slovenica. 51(2): 361-376. https://doi.org/10.3986/AGS51303

Wimbledon WAP (1995). The development of a methodology for the selection of British geological sites for conservation: Part 1. Modern geology. 20: 159-202.

Wimbledon WAP (1996). Geosites-a new conservation initiative. Episodes Journal of International Geoscience. 19(3): 87-88. https://doi.org/10.18814/epiiugs/1996/v19i3/009

Wimbledon WAP (2011). Geosites—a mechanism for protection, integrating national and international valuation of heritage sites. Geologia dell'Ambiente, supplement. (2): 13-25.

Zahra NF, Mohamed Z, Sanaa D (2011). Geomorphosite valorization a view to sustainable development: case of Ait Hajji, Oued Boulahmayel Valley, Central Morocco. Journal of Geographic Information System. 3(1): 12–17. DOI: 10.4236/jgis.2011.31002

Zouros N C (2007). Geomorphosite assessment and management in protected areas of Greece Case study of the Lesvos island–coastal geomorphosites. Geographica Helvetica. 62(3): 169-180. https://doi.org/10.5194/gh-62-169-2007