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Museal Activity to Promote Geotourism and Geosite Protection: The Case of the National Ceramics Museum, Safi, Morocco.

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Original Research Abstract

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Museums, as significant actors in their respective areas, face the challenge of evolving beyond being mere repositories of heritage. They are increasingly expected to serve as instrumental contributors to balanced human development and overall societal well-being. This includes actively participating in cultural tourism and geotourism initiatives, which are essential components of broader efforts to enhance collective welfare. This study explores the role of museums in promoting geotourism and preserving geological heritage, using the National Ceramics Museum in Safi, Morocco (NCMSM) as an example. Experts agreed on the potential of museums to promote geotourism and protect geosites through a variety of activities, including geosite visits, educational programs, interpretive panels, geotours, awareness campaigns, souvenir offers, and interactive applications. These initiatives can effectively raise awareness, foster appreciation, and support the conservation of geosites, while also contributing to the development of sustainable geotourism practices. Statistically, amongst the listed activities at NCMSM, the pottery workshops are the most recommended activity as they appeal to people of all ages and levels. The ceramic-rich heritage at NCMSM is encouraged to take a holistic approach, ensuring a wider impact on public understanding, engagement, and preservation efforts.

Keywords: Ceramics, Conservation, Geoheritage, Geotourism, Museum, Morocco, Safi

Introduction

The concept of natural diversity encompasses both geodiversity and biodiversity (Brilha 2016). Geodiversity is defined as the evolution of land surface features, the geomorphological landscape, and the processes involved in shaping these features (Gray *et al.* 2013). It also encompasses the different elements of geological nature that host biogenic activities (Nieto 2001).

The conservation and promotion of such geological features are key elements of geoheritage and geotourism, which represent emerging disciplines within the Earth sciences (Carcavilla *et al.* 2007).

Geoheritage is an integral component of natural heritage, encompassing unique sites with profound historical significance (geosites) (Brilha 2016). Geosites may be broadly categorized into several types, including volcanoes, geological structures, distinctive geomorphic landscapes, and geo-anthropogenic sites (Brilha 2018; Yaseen *et al.* 2019). Geotourism is the primary activity associated with geodiversity and geoheritage, defined as a form of tourism in natural areas that centers on geology and landscapes. It encourages visits to geosites, the conservation of geodiversity, and the understanding of Earth sciences through appreciation and educational experiences.

Museums with a geological theme play a pivotal role in geotourism activities, serving as vital repositories for information about the primary geological attractions in an area. Such institutions provide visitors with valuable insights and knowledge about the geological features and landscapes that make the region unique. Some studies have demonstrated that the geological museum can be assimilated into a geosite and is a potential stimulator of geotourism from both a paleontological (e.g., Herrera-Franco *et al.* 2021; Prachita *et al.* 2023) or mineralogical (e.g., Turner-Carrión 2021) perspective. There are several methods for evaluating a geosite (Grandgirard 1995; Panizza 2001; Pralong 2005; Pereira *et al.* 2007; Reynard

et al. 2007; Pereira and Pereira 2010; Fassoulas *et al.* 2012; Brilha, 2016; Reynard *et al.* 2016; Brilha 2018; El Hamidy *et al.* 2024b), but there is currently no generally accepted methodology for geoheritage research.

Morocco boasts areas of significant scientific, cultural, tourist, and educational value (El Hamidy *et al.* 2024a; El Hamidy *et al.* 2024c; El hamidy *et al.* 2024d; Errami *et al.* 2024). The country is also home to several museums and collections with a geological focus, some of which represent specific regions, such as the M'Goun Geopark Museum in Azilal and the Archaeological Museum in Tetouan (Fig. 1), while others house impressive collections



Figure 1. Examples of museums in Morocco: A) the Archaeological Museum in Tetouan , B) the M'Goun Geopark Museum in Azilal , and C) the NCMSM .

curated by major higher education institutions, such as the University Museum of Meteorites at Ibn Zohr University in Agadir, the University Museum of Archaeology and Heritage, the High

School of Technology in Nador, and the Science Museum of Sidi Mohamed Ben Abdellah University in Fes (Fig. 2).



Figure 2. Examples of university museums: **A)** University Museum of Meteorites, University Ibn Zohr Agadir , and **B)** University Museum of Archaeology and Heritage, Higher School of Technology, Nador .

The NCMSM was established in 1990 and became part of the National Museums Foundation in 2018. It has since emerged as one of Morocco's premier museums from the richness and diversity of its collection of Moroccan pottery and ceramics. With over 600 objects preserved, studied, and predominantly showcased to the public, the museum stands as a testament to Safi's longstanding tradition of pottery craftsmanship. Historical sources and archaeological evidence demonstrate that Safi has a longstanding historical significance as a center for pottery production. Since its inception, the town's residents have integrated maritime resources with the production of utilitarian pottery items, leveraging the abundance of high-quality raw materials found in the surrounding deposits (Guerraoui *et al.* 2009; Boualla and Mehdi 2011; Wright and Fraser 2020; Bouchra and Jaber 2023). The discovery of extensive archaeological ceramics at the Lalla Hniya Hamriya site in 1994 provides compelling scientific evidence of Safi's involvement in the ceramics industry dating back to at least the Almoravid period in the 11th century (Arharbi and Lenoir 2011; Touri 2022). This activity lasted throughout the Middle Ages, before

being suspended during Portuguese colonization (1508–1541).

The mission of a museum dedicated to geological and archaeological themes is to adopt a comprehensive approach to exploring and presenting the evolutionary history of our planet. In terms of geology, the museum is dedicated to conserving, displaying, and elucidating the diversity of geological formations, minerals, rocks, and natural phenomena. It illuminates Earth's history, depicting changes across geological epochs and underscoring the impact of these processes on shaping today's landscapes. From an archaeological perspective, the museum endeavors to safeguard and exhibit remnants of human history through artifacts, tools, structures, and even entire archaeological sites. The museum's archaeological mission is to educate the public about ancient cultures, their lifestyles, technologies, and accomplishments while stressing the significance of preserving archaeological heritage.

The museum's mission is underpinned by a commitment to education, with a focus on interactive exhibits, educational workshops, and school pro-

grams designed to enhance public awareness of both geology and archaeology. These educational endeavors aim to spark intellectual curiosity and foster a deeper comprehension of our geological and human history. Further, a museum that integrates these two themes can also embrace a research dimension, conducting thorough geological and archaeological studies to contribute to the advancement of knowledge in these respective fields.

The NCMSM is notable for its focus on exhibiting its collection. While this is of the utmost importance in preserving and sharing the museum's rich ceramic heritage, the absence of other equally crucial activities represents a gap in the museum's mission. The integration of educational programs, innovative research projects, or interactive activities could not only enhance the public's comprehension of ceramics but also extend the museum's impact beyond the scope of a traditional exhibition, thereby reinforcing its reputation as a dynamic and inclusive cultural institution. The objective of this study is to propose activities that are suitable for the NCMSM and that will promote geotourism and protect geosites in the region.

Literature Review

The definition of a museum has evolved and may vary slightly depending on context and organization. However, a widely accepted definition has been formulated by the International Council of Museums (ICOM), an international non-governmental organization that sets standards for museums worldwide. According to ICOM, the official definition of a museum is: "A museum is a permanent, non-profit institution at the service of society that researches, collects, preserves, interprets and exhibits tangible and intangible heritage. Open to the public, accessible, and inclusive, museums promote diversity and sustainability. They operate and communicate ethically, professionally, and with community participation, offering diverse

experiences for education, enjoyment, reflection, and knowledge sharing" (ICOM 2022). The UNESCO (United Nations Educational, Scientific and Cultural Organization) definition also presents the fundamental idea of the role of museums in the preservation and transmission of cultural heritage: "a permanent, non-profit institution at the service of society and its development, open to the public, which acquires, conserves, studies, exhibits, and transmits the tangible and intangible heritage of humanity for study, education, and enjoyment."

The role of museums in the promotion of geotourism and the protection of geosites and geoheritage is a promising area of research that aims to explore the crucial role played by museum institutions in the awareness, education, and preservation of geological sites. The literature on this subject highlights several key aspects.

Museums are frequently regarded as privileged intermediaries for disseminating geological concepts to the general public. In this context, the work of Newsome and Dowling (2010) demonstrates the efficacy of museum exhibitions and educational programs in facilitating the accessibility and interest of geology. The Natural History Museum in London employs interactive exhibits to facilitate the comprehension of geological concepts by the general public. The earthquake simulators at the museum provide an immersive experience, enabling visitors to experience the tremors of earthquakes. The National Geological Museum of Romania also offers several educational programs in which participating students learn basic information about fossils and minerals, as well as the meaning of the terms geological heritage, paleontological site, reserve, national park, geopark, geotope, and natural monument. The workshop lessons were adapted to the level of the students and were supported by course sheets, handouts, posters, rock, fossil and mineral kits, binocular magnifier, and microscope.

Further, the integration of museums into geotourism strategies is addressed by authors such as Brilha (2016), who emphasize the importance of creating interactive and educational experiences for visitors, while also highlighting the specific geological features of the regions. The case study of the Museum of Earth Sciences of the Geological Survey of Pakistan (MESGSP) by Ghani *et al.* (2022) illustrates that the museum has the potential to serve as a geotourism attraction. The Water Museum in Lisbon offers guided tours that focus on the interrelationship between water, local geology, and regional development.

Such museums, as educational and cultural organizations, can make a significant contribution to the preservation of geosites and geoheritage by raising public awareness of their importance through awareness-raising campaigns, themed scientific events, or theme days in collaboration with schools, research centers, and universities. The National Geological Museum of Romania provides a noteworthy example, having organized themed days such as “World Geologists’ Day” and “World Heritage Day” (Macovei 2023). Another example is the Kandilli Earthquake Museum in Istanbul, which organizes educational programs

in collaboration with local schools that involve students in initiatives to preserve geological sites. These examples serve to illustrate the growing importance of museums in promoting a sustainable appreciation of geology and geological landscapes.

Materials and Methods

The objective of this study is to present museum strategies and activities as a tool for the promotion of geotourism and the protection of geosites within the Safi Geopark project in Morocco. To achieve these objectives, two main research questions were formulated:

- Q1-1: Can the museum be an establishment for promoting geotourism and protecting geosites?
- Q1-2: What activities and strategies can museums employ to promote geotourism and protect geosites?
- Q2-1: In the case of the NCMSM, what activities can be implemented to promote geotourism and protect geosites in the region?

The research methodology comprises three steps (Fig. 3): the first step involves a definition of the museum and a literature review of its introduction

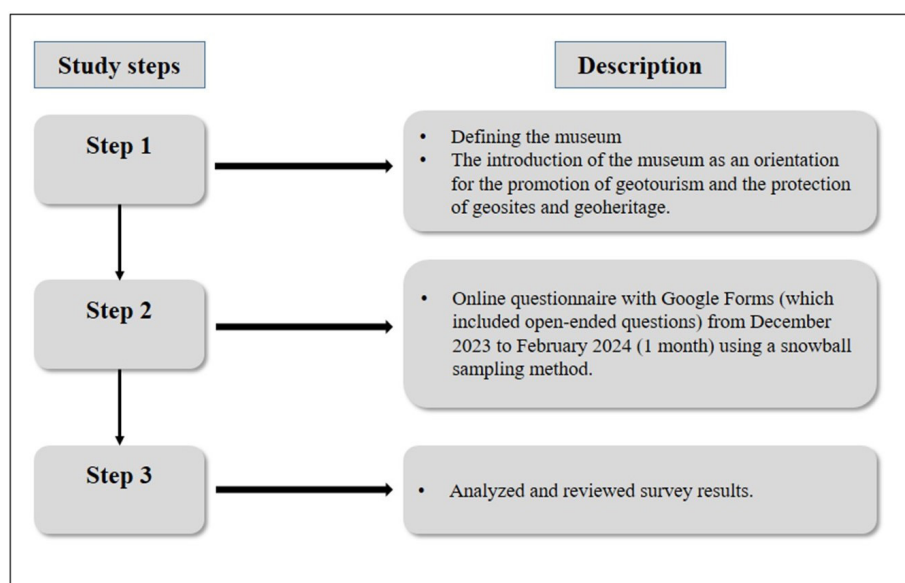


Figure 3. Methodology adopted for the study.

as an orientation for the promotion of geotourism and the protection of geosites and geoheritage. In the second step, data were collected using an online questionnaire with Google Forms (which included open-ended questions) from December 2023 to February 2024 (1 month). As the methodology for this part of the survey was qualitative and the population included experts with knowledge of geology, geomorphology, traditional art, geoheritage, and the tourist area, and as the researchers were unfamiliar with this population, data were collect-

ed using a snowball sampling method. In a qualitative method, sample sizes may be too small to claim to have achieved informational redundancy or theoretical saturation (Sandelowski 1995). In this research, sample collection continued until saturation was reached (and included questionnaires completed by 31 experts). The participants included professionals with expertise in geology, geoheritage, geomorphology, traditional art, and the tourism sector (Fig. 4).

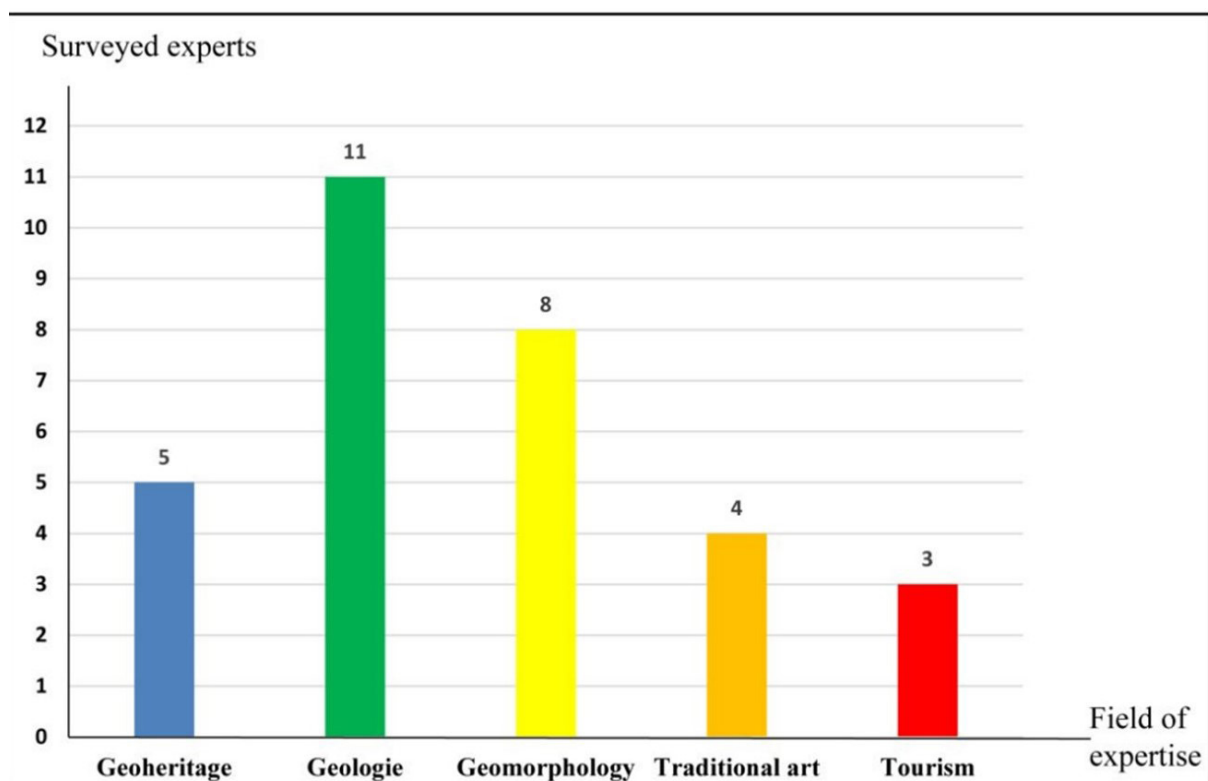


Figure 4. Distribution of surveyed experts by field of Expertise.

In the third step, we employed a quantitative content analysis approach to systematically categorize and quantify the specific attributes or elements within the collected data. By analyzing the frequency of responses, we identified the most commonly suggested strategies and activities by experts, which informed our proposal for effective measures in promoting geotourism and protecting geosites.

Results

Based on the results of the qualitative analysis, all experts (100%) agreed that the museum could be an establishment for the promotion of geotourism and the protection of geosites (Table 1). The respondents identified several key activities and strategies for promoting geotourism and geosite protection, including visits to geological sites (93.5%), provision of guides (87%), and educational programs and workshops (80.6%). Other

Table 1. Can the museum be an establishment for promoting geotourism and protecting geosites? (results derived from qualitative analysis of open-ended questions)

Q1	Code	Frequency	Frequency %
Can the museum be an establishment for promoting geotourism and protecting geosites?	A Yes	31	100%
	B No	00	00%

notable activities included interpretation panels, geotours, awareness campaigns, and souvenirs. These findings provide a clear direction for museums and cultural institutions to develop effective geotourism and geosite protection initiatives (Fig. 5; Table 2).

In the case of the NCMSM (Fig. 6; Table 3), analysis of the data confirms that the most effective activity for promoting geotourism and geoeducation within the museum is the provision of work-

shops for all skill levels and ages, which share the different techniques of modeling, sculpting, and throwing with the potter’s wheel, and painting on ceramics. This was confirmed by 100% of respondents. The results also include visits to the region’s geosites, in particular those where the clay layers used in pottery can be observed, such as the Sidi Abderrahmane clay quarry, the Sidi Bouzid Escarpment, and the Lalla Fatna Escarpment (96.7% of responses). Other activities included in the results are the organisation of thematic geotours (87%), the provision of guides (80%), the installation of interpretation panels on geosites (77.5%), and the organization of awareness campaigns in collaboration with schools, research centers, and universities (71%).

Table 2. What activities and strategies can museums employ to promote geotourism and protect geosites?

Q1	Code	Frequency	Frequency %
What activities and strategies can museums employ to promote geotourism and protect geosites?	A visit to the region's geological sites	29	93.5%
	B the provision of guides	27	87%
	C organization of educational programs and workshop-type courses	25	80.6%
	D Installation of interpretation panels on geosites	24	77.4%
	E Organizing geotours	20	64.5%
	F organizing awareness campaigns in collaboration with schools, research centers and universities	17	54.8%
	G supply of souvenirs and other items	12	38.7%
	H Online or hybrid conferences	11	35.4%
	I Virtual exhibition presentations	10	32%
	J Fun interactive applications involving key permanent exhibition exhibits	08	25.8%
	K Mobile programs with moving collections or workshops accompanied by specialist staff.	06	19.3%

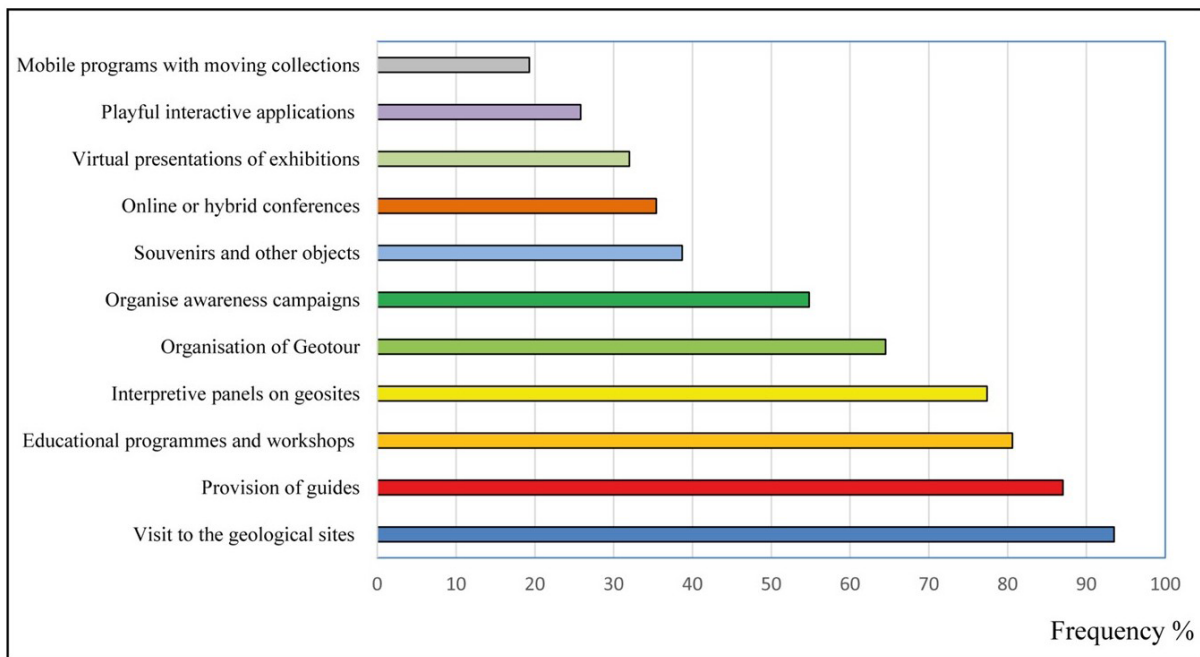


Figure 5. Activities and strategies can museums apply to promote geotourism and protect geosites.

Table 3. In the case of the NCMSM, what activities can be implemented to promote geotourism and protect geosites in the region? (results derived from qualitative analysis of open-ended questions)

Q2-2	Code	Frequency	Frequency %
In the case of the NCMSM, what activities can be implemented to promote geotourism and protect geosites in the region?	A Pottery and Ceramic Painting Workshop	31	100%
	B visit to the region's geological sites	30	96.7%
	C Organizing geotours	27	87%
	D the provision of guides	25	80%
	E Installation of interpretation panels on geosites	24	77.5%
	F organizing awareness campaigns in collaboration with schools, research centers, and universities	22	71%

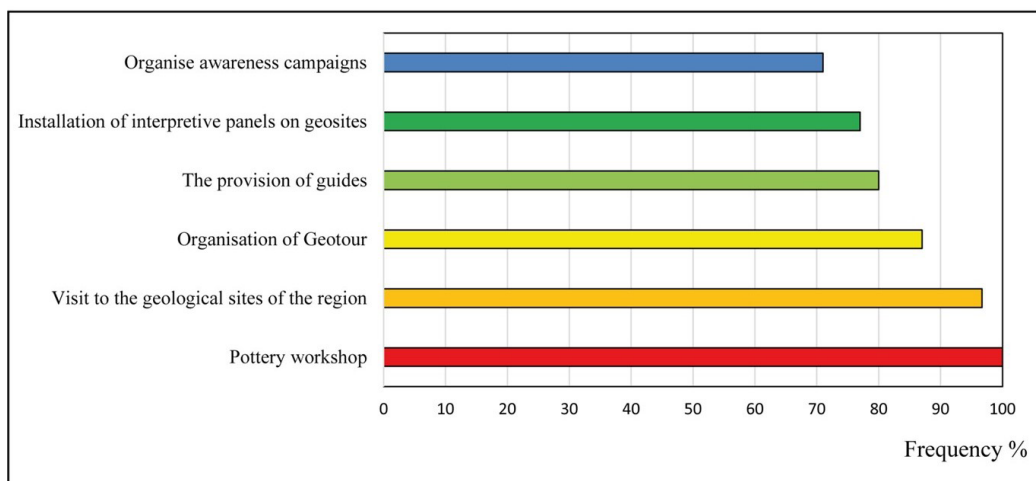


Figure 6. Activities and strategies can NCMSM apply to promote geotourism and protect geosites

Discussion

The findings of this qualitative analysis demonstrate that museums play a pivotal role as key institutions for the advancement of geotourism and the safeguarding of geosites. The recognition of the importance of museums in this respect suggests a significant potential for mobilizing the public around geology and contributing to the preservation of geological sites.

The concentration on visits to the region's geological sites serves to highlight the necessity of devising immersive experiences for visitors, to facilitate a direct and tangible comprehension of the local geology. The provision of guides, the organization of educational programs and workshops, and the installation of interpretive panels at geosites represent crucial strategies for effectively educating the public and stimulating their interest in geology. The results also indicate that collaboration with educational institutions, such as schools, research centers, and universities, is a strategic approach, underscoring the importance of integrating geology into broader educational programs. The provision of souvenirs and artifacts,

although less frequently mentioned, represents a further opportunity to enhance public engagement and financially support the museum's activities. Nevertheless, the advent of novel approaches, such as online or hybrid lectures and interactive applications, indicates that museums may benefit from exploring alternative avenues for reaching a broader audience, particularly in the contemporary digital context.

The analysis of the results relating to the NCMSM has yielded substantial conclusions regarding the most effective strategies for promoting geotourism and geo-education in this establishment. The provision of pottery workshops for all skill levels and ages emerges as an unquestionably popular approach, garnering unanimous support from respondents (100%). This innovative approach not only allows visitors to engage in the sharing of modelling, sculpting, and throwing techniques with the potter's wheel and ceramic painting, but also offers a hands-on, participatory experience, reinforcing visitors' engagement with geology and ceramics (Fig. 7).



Figure 7. Example of a pottery workshop to make and elaborate pottery objects.

At the same time, the results highlight the importance of visits to the region's geosites, particularly those that allow observation of the clay layers used in pottery. Sites such as the Sidi Abderrahmane Clay Quarry, the Sidi Bouzid Escarpment, and the Lalla Fatna Escarpment are attracting strong interest, illustrating visitors' desire to understand the origins of ceramic raw materials (Fig. 8A, B, C). The organization of themed geotours, incorporating these geosites as well as pottery-related sites such as the world's largest ceramic tagine and the "potters' souk". (Fig. 8D, E), is also strongly recommended (87%). The provision of guides to provide expert explanations during visits to the geosites (80%) confirms the importance of a thorough educational approach, while the installation of interpretation panels on the geosites (77.5%) reinforces the museum's commitment to provid-

ing educational information accessible on-site.

Finally, collaboration with educational institutions such as schools, research centers, and universities in Safi through the organization of awareness-raising campaigns and conferences (71%) testifies to the museum's wider awareness-raising strategy, underlining its educational role in the community.

Although our study offers valuable insights into effective strategies for promoting geotourism and geoeducation, it is acknowledged that the sample size of 31 experts may be considered small, potentially limiting the generalizability of our findings. This limitation is inherent to qualitative research, where depth and richness of data are prioritized over breadth. However, to enhance the robustness and applicability of our conclusions, future research should aim to include a larger sample size.

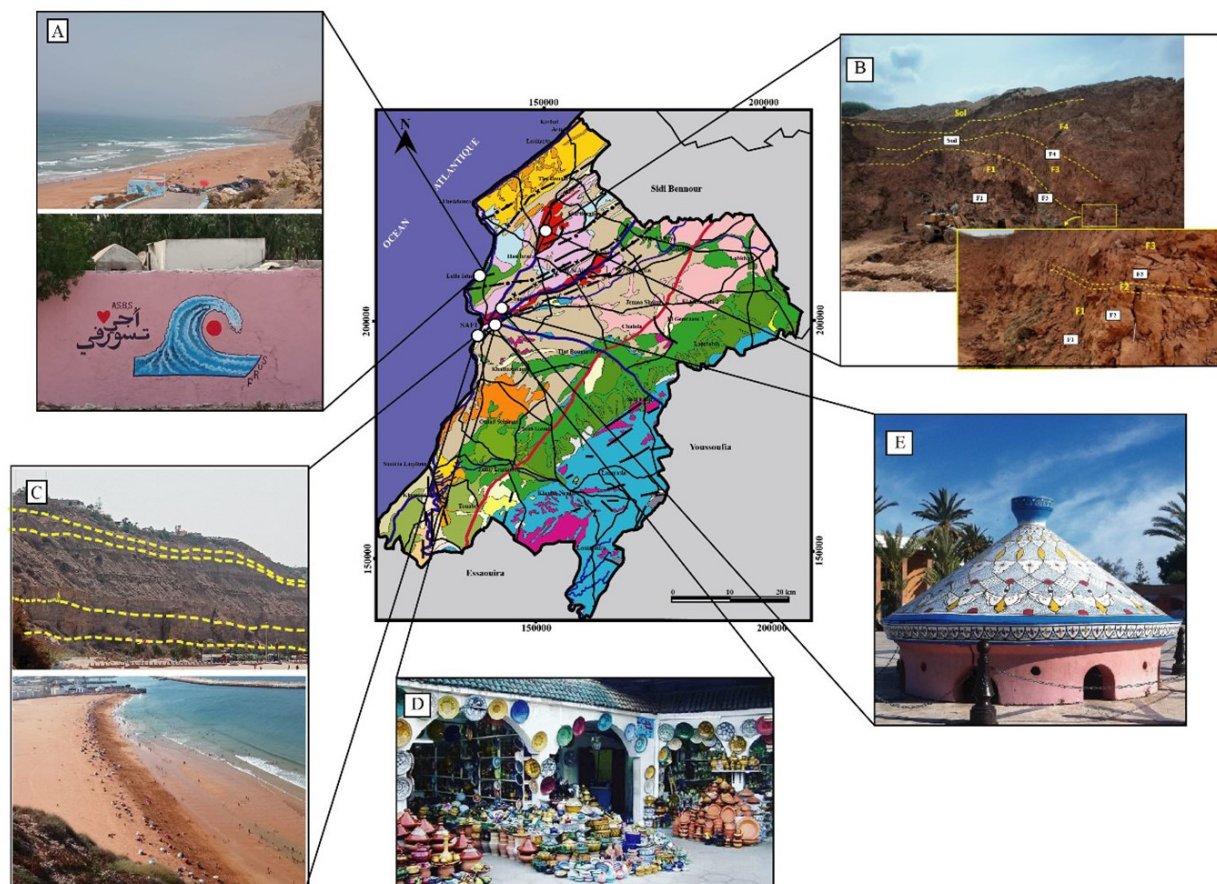


Figure 8. Examples of geosites in the Safi Province: **A)** the Lalla Fatna escarpment, **B)** the Sidi Abderrahmane clay quarry, **C)** the Sidi Bouzid escarpment, **D)** the world's largest ceramic tagine, and **E)** the "potters' souk".

Conclusion

Summarizing the activity of museums related to geotourism and the promotion of geological sites, we can list visits to geological sites in the region, the provision of guides, the organization of educational programs and workshops, the setting up of interpretive panels on geosites, the organization of geotours and awareness campaigns in collaboration with schools, research centers, and universities, the provision of souvenirs and other objects, online or hybrid conferences and the use of interactive applications involving key pieces of permanent exhibitions and the integration of technologies such as mobile applications, NFC tags, and augmented or virtual reality.

The NCMSM can become an engine for the promotion of geotourism and the protection of geosites. The results reveal the significant potential of museums to stimulate public interest in geology and actively contribute to the preservation of geological heritage. To maximize this positive impact, several recommendations emerge. First, it is suggested to create a pottery workshop at the side of the museum by adapting it to various skill levels and ages. This interactive approach proves to be a powerful way to connect ceramics and geology, thus engaging the public more broadly.

In parallel, the development of thematic geotours, including emblematic sites such as the largest ceramic tajine in the world, can enrich the visitor experience by highlighting the geological aspects related to pottery. In addition, improving educational materials, such as guides and interpretive panels, would effectively complement workshops and tours.

Expanding educational partnerships, by intensifying collaboration with schools and academic institutions in Safi (Polydisciplinary Faculty, School of Technology, and National School of Applied Sciences) strengthens the museum's educational role

within the community. Finally, exploring digital strategies, such as online conferences and interactive applications, opens opportunities to reach a wider audience, especially in today's digital age.

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Conflict of Interest

The authors declare that they have no competing interest

Author contribution:

Mustapha El Hamidy: Writing – original draft, Resources, Methodology, Conceptualization, Data curation.

Ezzoura Errami: Validation, Supervision, Resources. Writing – original draft.

Mukhtiar Ghani: Methodology, Writing – review & editing.

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