



Research Paper

Global Sustainable tourism development and geomorphology: Agouliz Oasis, Morocco

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Abstract: The development of sustainable tourism in Morocco has not benefited much for the pre-Saharan oases of Tata, southeastern Morocco. The sustainable tourism has become an undeniable economic and social for many countries. Currently, Morocco is taking a number of strategies and programs to the involvement of the local population are needed for projects to achieve sustainability (e.g. Strategy of the sector of tourism: Vision 2020). Furthermore, beside its habitual tourism products, Morocco is necessary to increase new products in order to develop the tourism industry, for example geo-tourism and eco-tourism in oasis's areas. In fact, Agouliz is an attractive oasis that is endowed with cultural heritage and rich natural. However, data collected from the field were used to characterize the geomorphology, biodiversity and heritage in the Agouliz oasis, a qualitative approach is carried out to evaluate the geo-sites of the

Agouliz oasis and to highlight its potentialities for the development of this alternative tourism. The purpose of this study was to emphasize the present tourism resources in the Agouliz oasis and the problems that hold back its development.

Keywords: geo-morphology, geo-eco-tourism, sustainable development, Agouliz Oasis, South-eastern Morocco.

INTRODUCTION

To understand a relief (Demangeot, 2009), it is necessary to analyze its lithology (materials), its structure (architecture), its tectonic (set-up) and its erosion (wear). The importance of the oasis studied lies, in addition to the quality of its patterns, in the presence of a promising valley in terms of the explanation of the layout and the evolution of the natural environment. The main role of floods in the morphogenic

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shaping of the wadis is confirmed for Agouliz valley, knowing that the functioning of the valley is linked to the rare moments of flood movement; the effects are, however, evolving forms of erosion and accumulation. The geomorphology of Agouliz is characterized by morphostructures and morphosculptures (Bertrand, 1972; Meščerjakov, 1968) which are interesting to study and valorized. The first group, in the background of the valley, the patterns of relief capped by the Adoudounian lands. The second concerns the intra-montane karstic geomorphosite, the valley crossing the locality, the agrarian system, the general climate and the local microclimate, water activity, transport and deposition of blocks and pebbles, and finally vegetation cover.

Geomorphology, a discipline that describes and explains the genesis and evolution of terrestrial reliefs, presents elements that help to understand the endogenous and exogenous phenomena that have shaped the present landscape.

Like the oases of the Tata region (M'Barki and Benssaou, 2016), the geological and geomorphological richness of the Agouliz valley, by its biodiversity and its anthropogenic activity, an incentive for research in these geo-eco-touristic potentials. The relief, geo-sites and geomorphosites of the authors Reynard (2005, 2009), Sellier (2009) and Gray (2013), in their different forms and dimensions, can be conceived as a heritage in the same way as other elements of the natural environment.

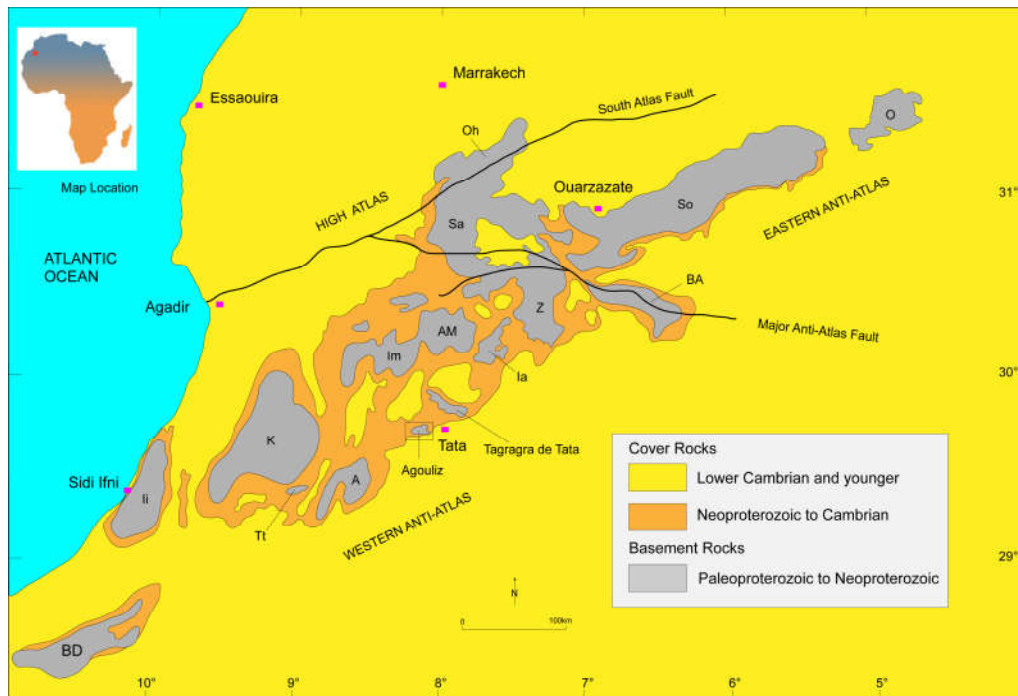


Figure 1: Simplified geologic map of the Anti-Atlas showing the location the Agouliz inlier, modified from the 1:1000000 Geologic Map of Morocco (Service Géologique du Maroc, 1985). Other Precambrian inliers labeled as follows: BD-Bas Drâa, li-Ifni, K-Kerdous, Tt-Tafeltast, A-Tagragra d' Akka, Im-Igherm, AM-Agadir Melloul, Ia-Iguerda, Z-Zenaga, Sa-Siroua, Oh-Ouzellarh, So-Saghro, BA-Bou Azzer, and O-Ougnat. General geological map of the Tagragra buttonhole showing the situation of the Agouliz buttonhole (modified from Walsh et al., 2002).

Study area:

The Agouliz is an intra-montane oasis in a fluvial environment in the heart of the reliefs of the Western Anti-Atlas in the South-east of Morocco. It is located near the Agouliz Precambrian buttonhole, to the west and southwest of the Tata city (Figure 1). It is located in the area affected by the Tata fault (Faik et al., 2001), considered as an important E-W Precambrian accident (ESE-WNW to E-W). This normal fault during the Upper Proterozoic (PIII) and the early Paleozoic (during the early Paleozoic Proterozoic rifting) becomes an inverse fault during Hercynian clenching (Hassenforder and Jeannette, 1974). It thus allowed the outcrop of the Precambrian basement in the small buttonholes of Agouliz, Aigou and Tanamrout.

Figure 2 shows the outcrop of the thick upper Neoproterozoic series. It begins with an alternation of conglomerates, sandstones and siltstones with volcanic material greater than 500 m (Benziane *et al.*, 2002). The volcanic sequence of the Paleoproterozoic basement is composed of three units (Yazidi *et al.*, 2002; Walsh *et al.*, 2002): micaschists and pelites, tuface schists and metasilites; then metamers and shales.

Unconformably, on this Neoproterozoic formation comes the Adolonian dolomitic base series. Faik *et al.* (2001) report that the deformation in this Adoudounian series was very intense at Agouliz. It is marked by metric to decametric folds of variable shapes. At the base / cover interface, the basic conglomerates or volcanodetritic series of the PIII deform by flattening the pebbles and a penetrative schistosity surrounding the pebbles or at the pelitic intercalations.

Methodology:

During site visits during the course of 2014 and 2015, observations were noted and information was gathered from indigenous

peoples. The samples and photographs collected, as well as the data from the literature, served as a basis for initiating this work focused on the evaluation of the natural potential of the Oasis of Agouliz.

RESULTS

The locality of Agouliz, to a medium agglomeration, owes its existence to a permanent source of water to the NW of the Douar and to the flow of the valley crossing the karstic gorges. The altitude of the reliefs and the nesting of the locality on the left slope of the mountain gives it a microclimate tempered compared to the semi-arid climate of the zone of Tata. The main conclusions concerning the natural structuring of the Cantabrian area are as follows:

1) Geomorphological sketch of the Agouliz Valley

Four levels of spatial organization were individualized from top to bottom of the oasis of Agouliz:

- In the background, the powerful rocky volume was imposed which conceals the gorges of limestone composition. It is an ancient geological series formed of terraces of the Precambrian basement and the Palaeozoic cover (Figure 3 A). These reliefs, whose highest peak reaches about 1680m, dominate the valley.
- A fluvial sedimentary series with very variable granulometry ranging from sandy particles to giant erratic blocks.
- On the left slope of the valley, is Agouliz agglomeration. The constructions made of surrounding materials (Figure 3 C) continue to lose their authenticity with the introduction of artificial building materials;
- A level of terraces on the outskirts of the wadi located locally to receive a traditional agriculture limited to local

crops, grazing and poultry farming. It also contains vegetation mainly composed of the date palm (sp.) and some plant species characteristic of the

semi-arid climate (Figure 2). Most of these plants are used for nutritional and medical purposes.



Figure 2: In the foreground, the fluvial series of the valley of Agouliz. In the second plan, the vegetation, dominated by the date palm, which runs along the banks of the Oued. Stone dams are set up to protect the terraces from flooding. The background shows a geological series composed of Adoudounian limestones surmounted by a volcano-sedimentary series of schists and silites.

Bottom, a current river accumulation was formed of pebbles of different sizes, with the individualization of enormous erratic blocks in the heart of the valley.

2) Agriculture and the architectural heritage in distress

Invaded by numerous socio-cultural changes, as for all the rural environment of Morocco, the oasis of Agouliz preserves part of its ancient architectural identity (Figure 3 C). In fact, most buildings are built with authentic materials. Stones, sand, adobe and palm trunks beautify houses and corridors. However, this architectural beauty is facing a destruction accentuated by runoff, in addition to the introduction of artificial and

strange building materials to the environment.

Although the agro-pastoral system in this locality persists, its production capacity continues to decline. Almost all families make use of the financial support of their emigres to survive. Agricultural activities are carried out around crops on the outskirts of the wadi, grazing and beekeeping. Irrigation is based on the source behind the gorges. The waters, governed by the share, are transported by seguias to the plots (Figure 3 A, B) which continue to lose their areas by repeated invasion of floods. The plant cover is mainly composed of date palm (*Phoenix dactylifera*) associated with a few shrubs and herbaceous plants (Figure 4).



Figure 3: A - Cultivation occupies the outskirts of the Agouliz valley, which continue to be narrowed by the waters of the floods; B - The effect of the Oued current on arable land and vegetation; C - Stone constructions have fallen into ruin as a result of runoff.

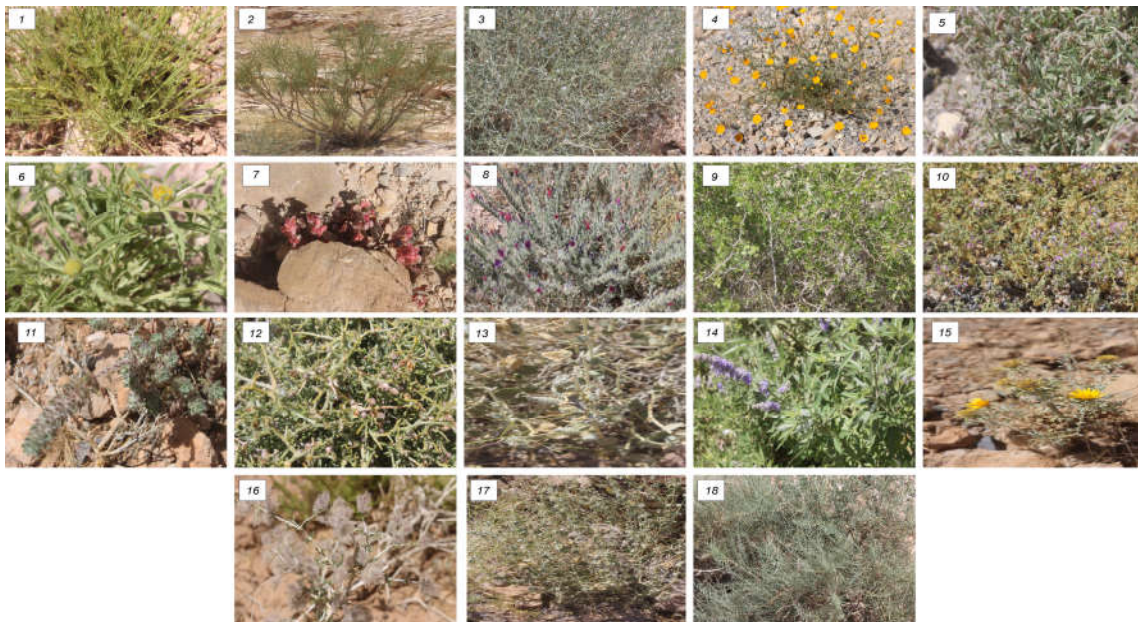


Figure 4: Plant procession of the valley of Agouliz. Some samples of the local flora:
 1 - *Lavandula caronopifolia*; 2 - *Retama* sp.; 3 - *Launaea arborescens*; 4 - *Pulicaria* sp.;
 5 - *Trichodesma calcaratum*; 6 - *Astericus imbricatus*; 7 - *Rumex vesicarius*; 8 - *Echium horidum*; 9 - *Ziziphus lotus*; 10 - *Fagonia longispina*; 11 - *Forskalea tenacissima*;
 12 - *Convolvulus trabutianus*; 13 - *Pergolaria tomentosa*; 14 - *Vitex agnus-castus*;
 15 - *Anvillea radiate*; 16 - *Gaillonia rebondiana*; 17 - *Reseda* sp.; 18 - *Hammada scoparia*.

3) Agouliz gorges, a geomorphosite to be valued

The gorges of Agouliz, in the heart of the wadi, are forms of rock canyons that have benefited from a tectonically active structural framework in this area and the favorable lithology of the geological terrains. These morphostructural conditions

associated with the bioclimatic conditions of the site favored intense karstification in the carbonate rocks. In addition to the lapiez at the top of the karst, the canyons cutting the rocks dig a depth of about ten meters (Figure 5 A), and ensure the circulation of water that is stored in giant pots (Figure 5 D).



Figure 5: The Karstic landscape of Agouliz. A - the gorges of Agouliz notched in calcareous soils; B - Water flow indicating the active aspect of this geomorphosite; C - Travertine fragment cemented to the material rocks dismantled from the neighboring relief; D - Front view of the main gorge canyon with a large Giant's kettle.

The role of rare floods in the morphogenesis process (Weisrock *et al.*, 2008) was evident at Agouliz level. The functioning of the wadi, although episodic, was expressed by evolutive forms of erosion and accumulation. But its effects on the whole valley, and especially on the karst landscape, were of a great capacity of destruction. Fragments were removed from the karstic

landscape and transported elsewhere or agglomerated with other blocks (Figure 5 B, C).

3) The erratic blocks, the history of a journey by the wadi

Sandstone bedrock undergoes dismantling releasing materials of all shapes. Diaclasses (Figure 6 A) was related to tectonic

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mechanisms in the region, rock lithology, and strong variations in climatic conditions. The materials resulting from this erosion was transported in the wadi where they were deposited. The discovery of enormous karst

erratic blocks of 2 to 3 meters in diameter (Figure 6 C) at 150m from the karstic landscape showed the strength of the current in the valley.



Figure 6: A - Large diacrosis in the sandstone rock forming the base of the left slope of the Agouliz Valley; B - Blocks and cobbles of various shapes and sizes in the middle of the oued; C - Large travertine block moved from the karstic landscape; D - Large erratic block torn away, blunted and moved into the valley.

The metric plurimetric size of the blocks (Figure 6 B, C, D) provided information on the water-borne erosion of the watercourse, but the angular to rounded shape of the rollers provided information on the degree of transport.

The lack of a consistent vegetation cover and the steep slope of the left slope accentuated the phenomenon of erosion; the vegetation implanted by man has failed to mitigate its disastrous effects.

DISCUSSION

1. Evaluation of the Agouliz oasis geo-sites

The site of Agouliz Gorge is of intrinsic value confirmed. By its location, its aesthetics and its functionality, it acquires the appearance of a geo-morphosite worthy of valorization and protection. It is one of the three main karst landscapes in the entire Tata region. Its educational value lies in the fact that it allows the different public

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(scientists, scientific mediators, students, tourists, indigenous people) the opportunity to discover shapes and understand open geological processes. The crossing of the valley from the upstream to the downstream, allows imagining the process of erosion, displacement and deposition in a fluvial environment. The erratic blocks scattered in the valley offer the elements necessary to reconstruct their history. In addition, access to the valley on the downstream side of the wadi allows observing the panorama drawn by the main geological formations of the area. The contrast of the colors of the geological layers and the size of their thickness makes the geological history of these terrains a great open book in nature and the space-time dyad an assimilable notion.

2. Tourism promotion of the Agouliz oasis

Geo-tourism emanates from the exploitation of the geo-diversity through the transformation of geo-sites into geo-heritage. It is therefore necessary to inscribe the educational attractions of these sites in a tourist project of territory. Besides this, the locality of Agouliz conceals other natural and cultural potentialities that can extend the tourist offer. The geological, geomorphological and local lifestyle framework is expanding to develop four segments of tourism: geo-tourism, eco-tourism, agro-tourism and oasis tourism. This research proposes a draft of the tourist valorization of the valley, through a didactic path that allows discovering the geo-bio-diversity and local heritage of the concerned area.

Proposal of a didactic trail in the locality of Agouliz oasis

The proposed educational trail will allow you to travel through the different typical environments of the locality of Agouliz. An

animated hike, lasting one and a half, will reveal ten themes covering geo-diversity, biodiversity, and lifestyle: 1. reading the geographical landscape; 2. stratification in relation to the concept of geological time and space; 3. the karstic landscape; 4. hydrological processes and movement of water across the valley; 5. rock behavior in the face of erosion and tectonics according to their lithology; 6. sedimentary processes: erosion, transport and deposition in a fluvial environment; 7. the agro-pastoral system in a mountain oasis; 8. local architectural heritage and its relation to local geology; 9. lifestyle in the rural environment: social organization, cultural heritage; 10. geo-hazards.

Conclusions: By means of a qualitative assessment of the natural and cultural potential available on the ground, this article shows that the geological heritage, inscribed in its local context, is capable of repositioning the enclosed and marginalized oasis and mountain areas. It will be a matter of reconverting the elements of abiotic nature into territorial resources that can contribute to sustainable development.

The education on the valorization of geo-heritage and cultural heritage must also take into account the environmental dimension imperatively.

The current state of the Agouliz oasis is worrying in terms of geo-hazards threatening the whole territory of Agouliz. Protection measures are urgently needed to protect arable land from flooding, threats against anthropogenic actions (rubbish, graffiti, etc.) and the architectural heritage in the face of permanent degradation.

It should be pointed out that the mobilization of actors (authorities, elected officials, scientists, associations, indigenous people, etc.) around such a territory project will make it possible to establish sustainable tourism with socio-economic spin-offs

Tangible. The tourism development strategy "2020 Vision" should benefit from this prospect of revitalization of the Oasis of Agouliz.

Future studies are in great demand to monitor the evolution of this territory and to evaluate the dynamics of participatory sustainable development in the light of the proposals put forward.

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