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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).

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Abstract: ***This article presents the results which were taken first inan inventory of geomorpho-sites. The latter was carried out in the rural communes of Anergui and Tillouguite in the Central High Atlas of Morocco. Its objective is to highlight the richness of the natural heritage (i.e. geological, geomorphological) and the landscape heritage of these territories in order to make them known for the general public as geological heritage.It also aims to reinforce the terms of protection, valorization and good management of these geo-morphosites to be integratedin sustainable development, thus offering new incentives and opportunities for sustainable tourism to become a pioneering front of geo-tourism.***

Keywords: Central high atlas - Geo-tourism - Geopark M'goun - Inventory IGUL –Geomorphosites

1. Introduction

In the province of Azilal, Anergui and Tillouguite, which are part of the Beni-Mellal-Khénifra region in central Morocco, do have great landscapes, environmental richness and geological interest marked by the diversity of geological and geo-morphological forms.

Being remote and ‘difficult to access' areas away from the well-known tourist sites (Cascades d'Ouzoude, Source Ain Asserdoune, Bin el-Ouidane lake, Ait Bouguemmaz happy valley ...), these areas are rich in geo-morphology, heritage, culture and natural features characterized by the overall value of geo-morphosites.

In terms of the natural potential of the sites in the area, these characteristics have encouraged the emergence of a certain tourist activity, which supported the creation of the first geological park in the country in 2004 (Géo-parc M'Goun): the first of its kind in Morocco and North Africa as a major tourism development project which held the 'GLOBAL GEOPARC' Label at the 6th session of UNESCO which was held in Canada between September 18thand 22nd2014.

The IGUL method, which is applied in this trial, was developed within the Institute of Geography of the University of Lausanne as a simple and systematic method which attempts to go beyond the distinction between broad and restricted concepts of the geotope concept, by considering a central scientific value and several additional values, all of which have the same weight as the first.

The notion of inventory of geo-morphosites in Morocco remains a cautious and an unsure attempt, which hinders any approach to conserve and enhance the natural heritage, especially in fragile environments.

2. Objectives

The main goal of the test is to bridge the gaps between the inventory of geo-morphosites and the natural landscapes in its territories which are rich in geo-biodiversity and typical architectural heritage. We will also verify both the relevance and the limits of the inventory’s success in protecting and valorizing the geo-morphosites. We will thus carry out an inventory of the geo-sites and geo-morphosites along the Assif Melloul river, which crosses the two rural communes of Anergui and Tillouguite to evacuate to the lake of Bin Elouidane and then to spawn new tourist circuits. These must be capable of incrementing the attractiveness of tourism in these remote areas and create new sustainable income-generating incentives and opportunities.

3. Methodology

So as to achieve the objectives outlined above, we will adopt the IGUL method, which was developed by Professor Reynard et al., 2007 at the Institute of Geography of the University of Lausanne. It is simple and systematic (compared to the FOEN and Pralong method) which attempts to go beyond the distinction between the broad and restricted meanings of the concept of geotope or geo-morphosite, considering the scientific value among others as a main basis, all of which together have the same weight as

the first.This of geotopes' evaluationmethod which is developed at the Institute of Geography of the University of Lausanne (Reynard et al., 2007) is based on the use of an inventory sheet divided into six parts (Reynard 2006) each with several sub-criteria:1. General information; 2. Descriptive data; 3. Scientific value; 4. Additional values; 5. Synthesis; 6 References.

Historical Concepts: Geo-morphosites; Geotopes; Geosites and landscapes.

On the occasion of the first International Symposium for the Protection of the Geological Heritage in 13 June 1991 in Digne-Les-Bains, France, the International Declaration of the Rights of the Memory of the Earth was born and it became a reference for the Scientific community to adopt the terms of the natural heritage, geotope, geo-site, geological sites ... The concept of geological monuments has evolved alongspace and time according to authors, schools and countries. Barca and Di Gregorio (1991) defined the geological monuments as landscape elements with a particular specification corresponding to significant characteristics of the genetic (lithologic, morphological, structural) type or possessing peculiarities. This gives them a scientific and a cultural value with obvious aesthetics. The geo-morphosites are spatially delimited portions of the geo-sphere of particular geological, geo-morphological or geo-ecological importance. They are important witnesses of the history of the Earth and give an overview of the evolution of the landscape and the climate."A working Group for the Protection of Geotopes in Switzerland" (STRASSER et al, 1995).

According to Strasser et al. (1995), a geotope is a portion of land with value for earth sciences while Wimbledon et al. 1996 extend the concept of geo-sites, as a local zone or territory where geological or geo-morphological interest can be defined.

In 2003, Panizza and Piacente determined the geotopic term for any geological or geo-morphological object of any scientific, historical, cultural, aesthetic or socio-economic value, due to the human perception of the geological, geo-morphological, historical and social, hence the subjectivity of the object. Reynard(2004) sees the word geotope as a synonym of geo-site and defines a geo-morphosite as a portion of the earth's relief, seen, perceived (and sometimes exploited) by man.

Thus, we notice the definitions are numerous which depend onthe research environments and the linguistic variations. (Two large schools are interested in and committed to the conservation of the geological heritage, namely the German school which adopts the term Geotope, the Scandinavian-English school which adopts the term Geosite). But the most interesting is that the definitions are the combination of the scientific value of geo-morphosites as the objects which reconstruct the history of the Earth and the climate and the additional values which are subjective depending on the perceptual filters (culture, training, social level ...)

The concept of Eco-Geotourism:

More precisely, Blamey (1997, 2001) argues that analyzing the definitions definitely leads us to consider three dimensions that constitute the true meaning of the Eco-Geotourism concept: a nature-based tourism; an educational component and a need for sustainability. The geo-tourism, which is part of Eco-tourism, is a concept developed by the National Geographic Society to promote tourism which preserves and enhances the geographical character of a place: its environment, heritage, aesthetics, beauty, culture and the well-being of its residents because at the interface between human geography and physical geography, geo-tourism can also be defined as a form of tourism whose purpose is to consciously and voluntarily promote the objects of study of Earth Sciences, from a geo-morphological and geological perspective.

Emmanuel Reynard, a professor at the University of Lausanne, Lausanne Institute of Geography has defined geo-tourism as a form of tourism based on a primary supply of quality and landscapes with high quality of geological features, which aims to enhance the geological heritage of a region.

In the same vein, and in order to have a consensus definition of the concept of geotourism, David Newsome and Ross Dowling defined geotourism as a form of sustainable tourism focused on geology, nature, environmental education that focuses primarily on geotourism. on the geosystem and favoring the benefits of the local community ... The goal of geotourism is to promote tourism development opportunities while ensuring the conservation and / or protection of the attributes of the geological heritage ... Participants in the geo- Tours are usually interested in interacting with local communities and observing landforms and other geological objects. This occurs when they interact with local people by viewing geo-actions or participating in related activities. Local guides are often particularly popular with geo-tourists as they can provide a better understanding of the surrounding abiotic, biotic and cultural environment (Mao, Robinson, &Dowling,2009).

The geotourism promotes tourism in geosites and the conservation of geodiversity and understanding of earth sciences through appreciation and learning. This is achieved through geological feature visits, use of geo-trails and viewpoints, guided tours, geological activities, and sponsorship of geosite visitor centers (Dowling & Newsome, 2006; Newsome & Dowling,2010).

At the International Geotourism Congress, celebrated under the auspices of UNESCO, in Geopark Arouca (Portugal), from 9 November to 13 November 2011, "Geotourism in Action - Arouca 2011". the Organizing Committee, in line with the definitions established by the "Center for Sustainable Destinations - National Geographic Society", presents the "Arouca Declaration" which recommended to define the geoutourism as a tourism that supports and improves the identity of a territory, taking into account its geology, its environment, its culture, its aesthetic values, its heritage and the well-being of its residents ... and on the basis that geological tourism is one of the various components of geotourism it presents a fundamental tool for the conservation, the understanding, and the valorization of the past of Earth and Life, of its dynamics and its mechanisms, this in order to allow the visitor to apprehend a

past of 4.600 million years to analyze the present with another perspective and to project scenarios of possible futures common to Earth and to Man. Arouca (Arouca Geopark, Portugal), November 12, 2011.

Study Area: (Fig.1)

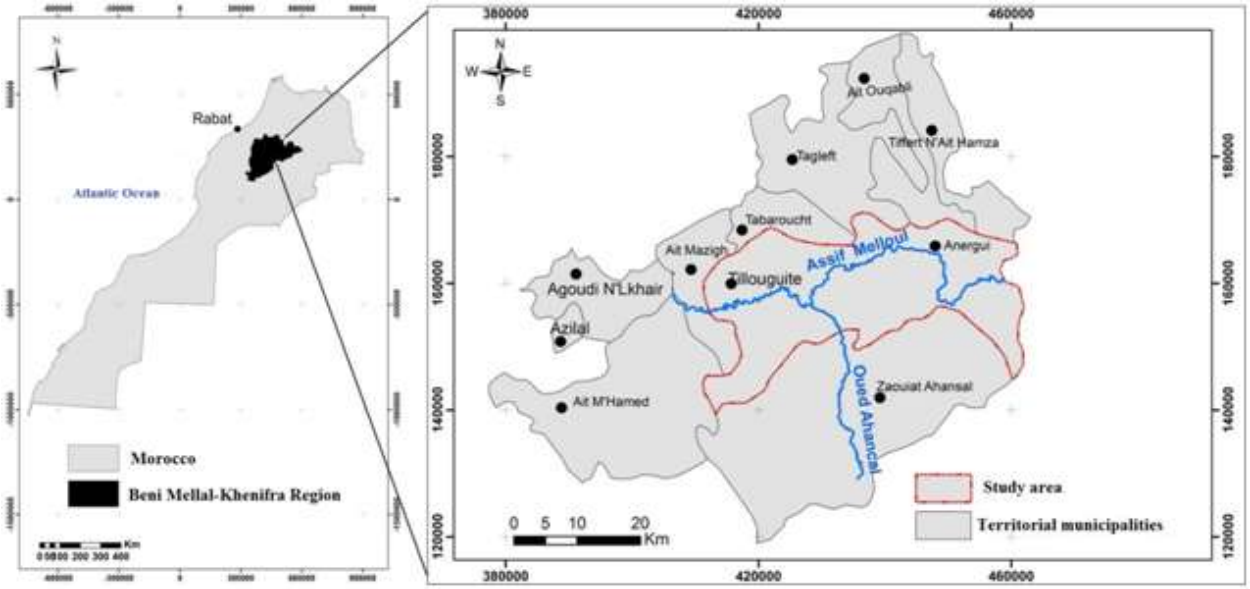

Figure 1: Location map of the studied area

The Anergui site is located about 34 km from the village of Tamga and 80 km from Azilal. It is accessible by paved road until the village of Tiloguite. From the point of view of tourism potential, the site is famous for its natural landscapes and immense amphitheatres of cliffs where several beautiful panoramic views of forests, rivers, ksours, caves, caves and gorges are. The site is a crossing point for hikers towards Imilchil and an access point (by 4x4 vehicle) of tourists from Midelte to Azilal.

The site of Tamga is located about 41 km (trail) of Zaouitet Ahansal and 85 km of the town of Azilal via the village of Ouaouizerth (on one of the shores of Lake Bin Elouidane). Like the site of Anergui, it is very rich in natural and cultural potentialities and distinguished by an imposing geological formation in the form of a Cathedral. It was selected by the Administration of Water and Forestry known as SIBE(Sites of Biological and Ecological Interests). It is currently the subject of a project to manage the protected areas in Morocco.

[The study of protected areas of Morocco has allowed the development of a network that includes 09 national parks and 160 SIBE representative bioecologically of areas with remarkable ecosystems, with a high concentration of rare endemic plant and / or animal species or threatened, or with a high biodiversity index. The total area of these SIBE is 1,080,000 hectares.

The natural resources available to Morocco are certainly of high quality, but remain fragile and, above all, insufficiently protected. The conservation of natural environments has become a decisive issue. From 1942 to 1991, Morocco experienced the creation of four national parks namely Toubkal (1942), Tazekka (1950), Souss Massa (1991) and iriki (1994). The Protected Areas Master Plan, drawn up in 1996, identified 154 Sites of Biological and Ecological Interest (SIBE), representing almost all of the country's natural ecosystems, proposing the classification into national parks of about ten of them. The implementation of this plan strengthened the national network of protected areas by creating, in 2004, four other national parks namely: AI Hoceima (Province of AI Hoceima), Talassemtane (Province of Chefchaouen), Ifrane (Ifrane Province), Eastern High Atlas (Provinces of Errachidia and Khénifra)]

This test area is a geological site which illustrates the spectacular tectonic, sedimentary and karst geological structures that bear witness to the history of the Atlas chain. The sports activities available in these two sites of Anergui and Tamga are fishing for trout, hunting, kayaking, hiking in all its forms, and mountain climbing.

4. Inventory and Discussion of Geological and Landscape Field Studied:

1. Inventory of geomorphosites

The Geoparc m'Goun: (Fig.2)

The M'Goun Geopark is located at the heart of the Central High Atlas Mountains andit is bounded on the north-west by the R.P. 24 linking Beni Mellal and El Kelâa de Sraghna, on the west by the Bzou-Demnate road and Tessaout, and on the south by the reliefs of Ighil M'Goun. The territory of the M'goun Geopark covers an area of medium to High Mountain with mainly geological formations of Triassic, Jurassic and Cretaceous. It is a coherent whole with much accentuated reliefs with morphology and contrasts of distinct landscapes.

The territory of the M'Goun Geopark extends over a total area of 12791 km2 (contains 58 Territorial Communes).

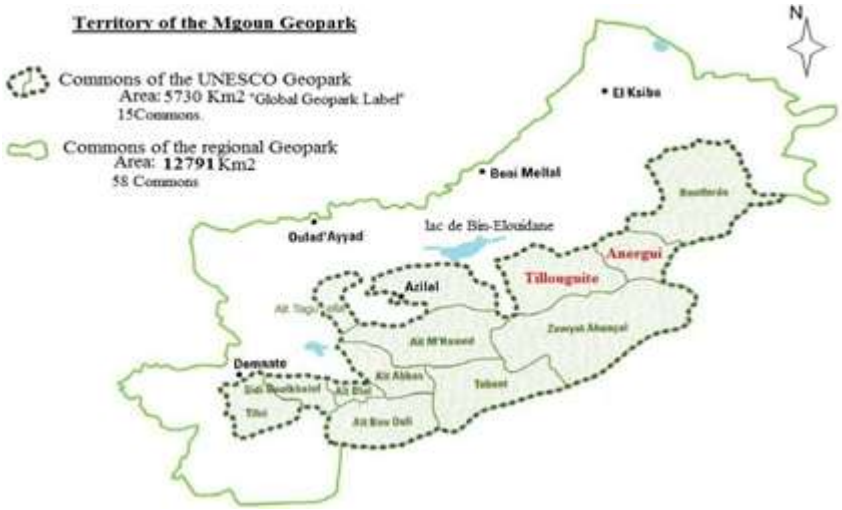

Figure 2: Map of the territory of the Mgoun Geoparc

The World Geoparks Network Office at UNESCO, at its 6th World Geoparks Conference, held the "Global Geopark" Label at a part of the Geopark from September 8 to 22, 2014 at Stonehammer Geoparc in Canada, M'goun is 5730 km² Label UNESCO (contains 15 territorial communities: Azilal, Demnate, Tilouguite, Anergui, Zaouit Ahensal, Tabant, Ait M'Hamed, Ait Taguella, Agoudi N'Lkheir, Ait Abbas, Ait Boulli, Ait Blal, Sidi Boulkhelf, Tifni and Boutferda), keeping the rest of the territory as a perimeter of study. Following this recognition by UNESCO, Morocco became the first Arab and African country to integrate this global network of Geoparks.

The geopark M'Goun contains a geological and architectural heritage of great value,hence their protection and valorisation constitute a vector of geotouristic development with a direct socio-economic impact on the life of the local population, who are generally poor. Like all the geoparks, the geopark of M'goun is not only a physical territory with geological richness but also an active structure whose missions can be grouped together in the protection and the enhancement of the geological heritage, the development of geo-tourism and the promotion of sustainable development.

Geology

The Geopark of M'Goun is a continuity of reliefs at often elevated altitudes whose main massifs are Ighil M'Goun which dominates the totality of the geopark (4,068 m) and Azourki (3,690 m).

The geological history of the territory of the M'Goun geopark is integrated into the geological evolution of the Central High Atlas, which dates back to the Triassic era with 250 million years ago, but the main phases took place during the Jurassic period, of about 180 million years ago. At the beginning of this last period, a warm, shallow sea occupied the present location of the Geopark and its neighboring regions, while the Tadla plain functioned as a mountainous border area.

Subsequently, tectonic fragmentations produced wrinkles and grooves or even accumulated thick calcareous and marl-limestone sedimentary formations of the lower Jurassic.

The red detrital deposits at the end of the Middle Jurassic period (170-160 million years) mark the withdrawal of the sea and the gradual emersion of the atlas.

In the Cretaceous, this lagoon-continental history was temporarily interrupted by two abrupt marine incursions, with one in the Aptian and the other in the Cenomano-Turonian. This left two limestone or limestone bars white to yellow in the landscape before the withdrawal part of the sea from these high-atlasic regions at the end of the Cretaceous. However, the sea remains both on the northern edge and on the southern edge on both sides of the Upper Altas until the end of the Middle Eocene.

The flora : (Fig.3)

The Central High Atlas is known by its flora which is composed mainly of shrubs and herbs of the diversified ecological and climatic conditions, varieties of forest trees (*Quercus ilex*, *tetraclinis-articulata*, *Pinus halepensis*). The forest cover shows a staggering stage where one succeeds according to the altitude:

- 300 to 900 m: *Ziziphus jujuba* (steppe with jujubier) and Ficus elastic (gommier) in the plain of Tadla.
- 400 to 500 m: imposing endemic *Euphorbia resinifera* (euphorbia) mantle mixed with the *Chamaerops humilis* (*doum)* surmounted by the first stands of *Pinus halepensis(*Aleppo pine) and *Quercus ilex (*green oak).
- 500 to 900 m: *tetraclinis-articulata* (cedar) and *Juniperus phoenicea (*red juniper*)* often accompanied by *Pinus halepensis* (Aleppo pine) and *Juniperus oxycedrus*
- juniperoxycèdre with a few species in the localized stations such as *Quercus canariensis(Zen oak), Taxus baccata* (yew), *Acer monspessulanum* (Montpellier maple), *Fraxinus(* ash), etc ...
- 1500 to 2200 m: field of the *Quercus ilex (*green oak) developed especially in the pure settlement in the region between Taguelft, Tillouguite and Anergui.
- -2200 to 2500 m: *Juniperus thurifera* (juniperthuriferous), noble and majestic tree of the foothills of the Atlas. It is the valuable tree that is the victim of the degradation that gives rise to dead forests, which are found in *Kousser*, Plateau des Ait Adbi, and between jbel Azurki and the happy plain of Aït Bou Guemmez.

The lithological (calcareous) and structural conditions are associated with the prevailing arid to semi-arid climatic conditions and the presence of vegetation cover condition the formation of spectacular and surprising superficial and underground karstic landscapes and the appearance of a typical Karstic morphology : Dolines, stalagmites, stalactites, resurgences, *lapiez, avens*, ruiniform landscapes ...

Figure 3: *Juniperus thurifera* forest in the Kousser plateau - Anergui

Lapiez: (Fig.4,5)
Various types of lapiez of the naked Karsts are observed on large scales and on large (Kilometric) surfaces, with forms depending on the lithology of the limestones, the dissolution channels (sometimes in two families) more or less parallel, dug by water (runoff) on limestone slabs and make them shredded, serrated, with sometimes sharp rough edges, holes, crevices, grooves to give very beautiful lapiez.

Figure 4: Lapiez in pothole (decimeter)

Figure 5: Teeth-shaped lapies

The majority of the microforms on the plateau of the Ait Abdi testify to the dominance of a high altitude Karst whose speed of evolution is slowed down by the aridity of the climate. At extreme stages of the corrosion process, often associated with the action of frost, is the complete dislocation of limestone beds in the shape of a hutch, stone fields or mixing lapies and gellings (QUINIF1976).

Dolines:(Fig.6)
Causing the subsoil to collapse, a chemical alteration (dissolution) has created more or less rounded depressions called dolines; these depression surfaces are very fertile and cultivable. The coalescence of several dolines gives birth to the ouvalas. Sometimes, and following the intensity of the alteration, the bottoms of these sinkholes continue to widen and give geomorphological formations in gulf form.

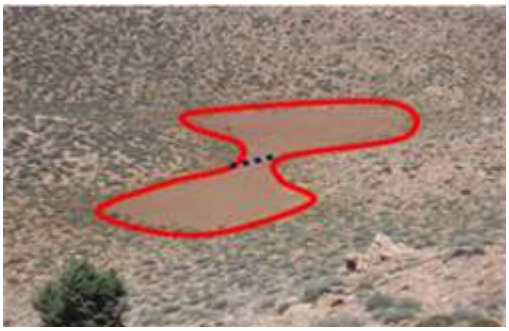

Figure 6: The Ovalas

The avens:
Typical and characteristic chasms of karstic systems. They are often formed by the collapse of the vault of an underground cavity during the dissolution of limestone. These avens generally communicate with subterranean caves and an entire network of galleries.

The caves: (Fig.7)
Caves are the most well-known forms of the karst phenomenon due to their chemical alteration of carbonate dissolution and to specific temperature conditions (increase of water temperature and CO2 exhaust) and super-saturation of calcite waters (CaCo3), deposit and form concretions. The dripping of the water then creates, over time, fantastic structures called stalactites, and stalagmites; As these caves can be the result of a ductile - folding- (anticlinal) tectonics.

Figure 7: A cave in the heart of an anticline in Akhachane(river AssifMelloul)

The ruin form landscapes (Fig.8,9)
Other landscapes which are typical of the karstic regions, the results of a heterogeneity of the lithology of formations in the region and the succession of hard and resistant levels (limestone beds or sandstone) and fragile levels (clay, marl, gypsum) inequality of erosion by allowing the most resistant rocks to form reliefs while the least resistant rocks will disappear and form hollow the parts. These landscapedaspects in ruins are of great repetitivity (like the ruiniform landscapes of Anergui and that of Messafrane 'Cathedral' at the SIBE of Tamga.

Figure 8: Part of the Messefrane rock

Figure 9: A ruiniform landscape in the center of Anergui

The waters follow the cracks of the soil in clayey soil, gradually widening them into parallel channels which merge by collapse of the crests that separate them. At the same time, the heads of the channels retreat towards the upstream (regressive erosion). This process is responsible for the formation of "badlands".**(Fig.10)**

Figure 10: Badlands formation by erosion in a slope

The fluvial process is very active in the mountainous part of the region. The forms 'receiving basin - flow channel - cone of dejection' are very frequent by regressive erosion, the waters borrow from the clay soils, fissures of the soil, widen them progressively into parallel channels which merge by collapse of the crests that separate them. At the same time, the heads of the channels retreat upstream (regressive erosion) to form the "badlands". These streams also shape and sculpt beautiful gorges and cluses.

The gorges of Akhachane or Aqqa Noukhachane extended between the Cathedral Messafrane and the center of Anergui for a length of 34Km, is in the rock substrates generally of limestone nature with a succession of steep cliffs with sometimes troglodyte dwellings. True "fortress" of imposing *ighrem* reminds that food is, in these valleys of the Atlas, a precious commodity that it was long to protect from the plunderers.

Before the year 2000 these gorges were the only channels of communication for Anergui and the irreplaceable intermediary between the people of the valley and the outside world. They are still today in winter, when the paved road linking Anergui and Ouaouizerth or Beni Mellal is interrupted by snow.

The valley of Anergui is a valley dug by the bed of Oued Assif Melloul during its progression from its sources in the area of Imlchil towards 100Km in the East of Anergui, until its confluence with Oued Ahanasal at the foot of the Tamga Rock (site of biological and ecological interest).

Uupstream and thanks to the very resistant lithological nature and the steep slopes, the valley takes the appearance of a deep groove-shaped canyon by the speed of the current in the hard rock of the basaltic intrusion.

But downstream an alluvial valley or alluvial plain appears as a result of the gentle dip and loose soil formed by alluvium. the river widens by forming several fertile arms and mines exploited by the farmers.

Far from the noise and the tourist surge of the imperial cities and seaside towns, the valley of Anergui perched between 1400 and 1800m of altitude in the heart of the Atlas, shelters a permanent stream called Assif Melloul. A splendid mountainous landscape, terraces are carefully maintained.

The adobe houses blend into the landscape of the magnificent granary fortresses in adobe and raw bricks, were used in the past to protect the spillards' harvests and precious goods. A granary can contain the values of up to 40 families.

Agro-pastoral activity based on the cereal farming of barley, oats and maize is dominant in the valley of Anergui as in all the valleys of the High Atlas while plowing is still done by donkeys or cows. Goat and sheep farming takes place in the *Kousser* plateaux at tribal / Agdal tribal pastures. But in recent years there have been tourist activities which have a positive impact on the standard of living of the population.

Structural:**(Fig.11)**

Figure 11: Isoclinal Folds

The zone obeys the major structural features from a structural point of view. They are sketched for the Central High Atlas characterized by the presence of tectonic accidents oriented SW-NE corresponding to that of the atlas chain. The uplift of the intrusive mound of *Addendoun* and

another NE in the vicinity of the village of Anergui, which extends over more than 40 km in the direction of the east (towards Imilchil) have set up a series of folds and Fold-faults along Oued Assif Melloul and Oued Ahanasal near the Agred-N-tazoulte mine and the Cathedral Messafrane.

Cliff: the formation of Ait Abdi (massive banks of oolitic and micritic limestones / Aalenian-Bajocian).

Slope Foot: Formation of Agred-N-Tazoulte (an alternation of limestones, sandstones and marl / Taorço-Aalénien)**(Fig.12)**

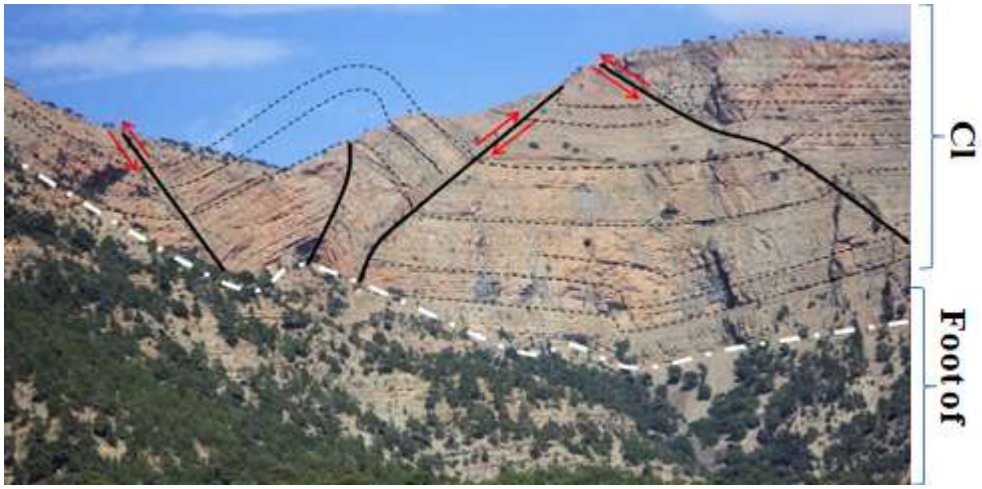

Figure 12: Fold-weakness of AitAbdi

The Aguerd-n-Tazoulte mine:
The Aguerd-n-Tazoulte mine is 30 km south of the rock of Messafrane and on the road leading to Zaouite Ahansal in which mining began in 1953 and remained artisanal until 1982. Zinc is the main element exploited in the form of smithsonite (scale) as well as lead in the form of galena and cerusite. The Ore with a red to yellow color takes form in veins and megafente crossing the dolomitic limestones of the Upper Sinemurian-Domérien.

Contact Metamorphism: (Fig.13)

Figure 13: Shimmering rocks by a contact metamorphism to the valley of Anergui

The intrusive massifs formed by Gabbro and Syenite of Bathonian age at the first folding of the Atlas appear at the cores of the ejective anticlines in this orogeny and also within the carbonate formations of Lias and Dogger MONBARON1980).

Following contact metamorphism (aureole), pink and whitish clays in contact with altered Gabbros-type intrusive rocks of Jurassic age. This assembly of rock gives a magnificent aspect to the landscape on the two banks of the Assif Melloul, along the valley of Anergui.

The Tamga SIBE:
The pine forest Of Tamga which is the unique and most beautiful pine forest of the region overlooks at 30km from the center of Anergui, going west, the confluence (-6.1561 / 32.0003) of Oued Ahansal and the Assif Melloul coming from the Imilchil region, where the rock of Messafrane (the cathedral).

The reserve of Tamga is one of the eight S.I.B.E which conceals the territory of the Geopark of M'Goun which is classified in category N ° 1 (well preserved). The TAMGA is an exceptional forest site for Morocco. It is a diverse environment that offers scenic landscapes and a remarkable natural diversity of biological and ecological interest (SIBE), and forms a typical ecosystem of Aleppo Pine / Tamga Pinus (Pinus halepensis), spread out over 8000 Ha (Equipped with a management and management plan) mixed with green oak, Berber cedar, and thuriferous junipers; Thyme, an aromatic sub-shrub woody plant dominates large areas of this reserve. According to the Tamga Forest District, SIBE has a particular biodiversity and harbors 33 species of mammals. The latter includes 11 species of national and global interest, 107 bird species, 19 reptile species and other interesting, endemic or rare species.

The rock of Messafrane / Cathedral (-6.0126 / 31.0987) culminates at nearly 600 meters above the Ahansal Assif with a vertical drop of 700 m. The vertical wall reaches nearly 300 meters constituted by the accumulation of ancient alluvium of age Paleo-Quaternary (2 to 5 million years); these deposits were then raised, at their present altitude by the atlasic orogenesis.

The huge megalith in the form of a cathedral of spectacular emblematic sign is made up of conglomerates of the Mio-pliocene (end of the tertiary era). It testifies the main phase of Atlasic folding which gave rise to the high mountain chain before being subjected to a strong and aggressive

erosion which appears to be fragile and less resistant though forming hollow parts between resistant layers which are in relief. The enormous quantity of the neighboring rivers deposits (large blocks) are deposited in sediment traps which are internal to the chain or in the foothills to the north and south of the Messafrane rock. Hence the area of Messafrane can be considered as a control of the internal basins which stack the detrital sediments transported by Oued Ahansal and Assif Melloul. The erosive mechanism continues to attack these massive deposits by shaping and carving the conglomeratic rock of Messafrane in its present form of a Cathedral.

5. Results and Discussion

This inventory concerns twenty geomorphosites, which are grouped into four Categories according to the dominant diagenesis and morphogenesis: Karst, Metamorphism, structural and fluvial.

The dominance of karstic forms in the study area is noted because the majority of geotopes and sedimentary figures are results of the dissolution that characterizes the karstic system that dominates the Moroccan Atlas (more than 80% of the formation is carbonate-limestone and/or dolomite) **(Fig.14)**

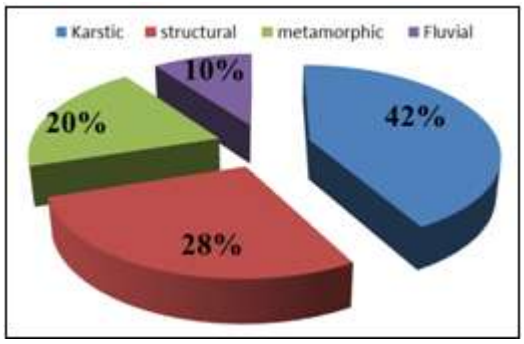

Figure 14: Percentage of different types of geomorphosites selected in the study area

Structural forms are also important, and are linked to the strong deformities that the region has in relation to the orogeny Atlas or with regional tectonics. These structural forms (ductile and brittle) make large parts of the high Central Atlas very rugged with large steep cliffs and very difficult access.

The rise of basaltic flows in valleys and eroded areas and the appearance of some doleritic dikes give rise to contact metamorphism and abnormal contact areas. Which gives a remarkable presence of the forms related to this phenomenon of metamorphism?

The river forms remain low to medium and present themselves by cone-dropping opening in the river of Assif Melloul and some small typical watersheds like the circular form of Aftis to Anergui**. (Fig.15)**

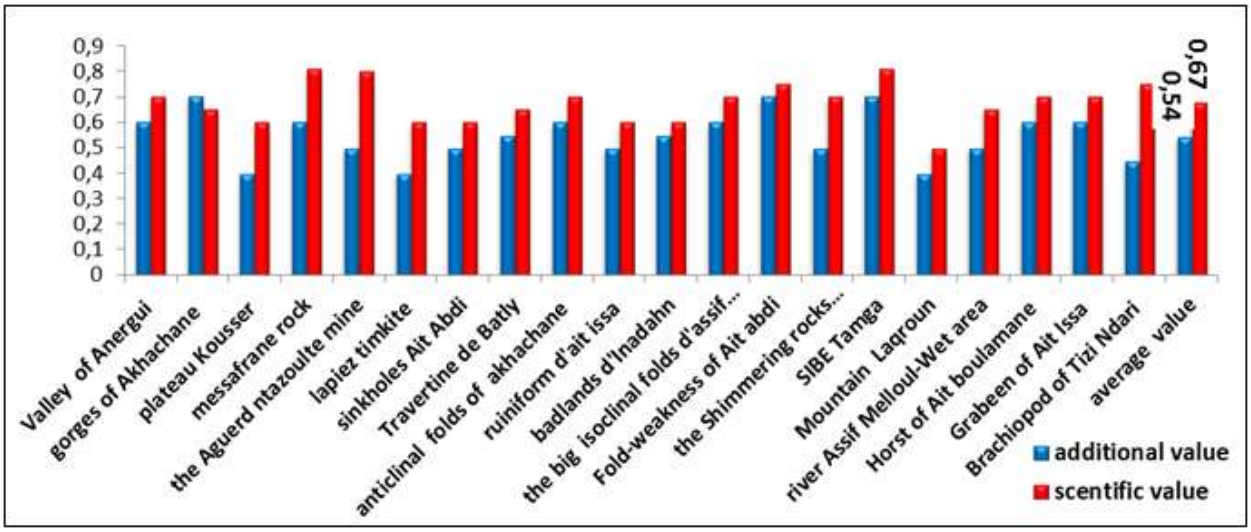

Figure 15: Diagrams of the values of different inventory geomorphosites:

a. Scientific value: (Fig.16)

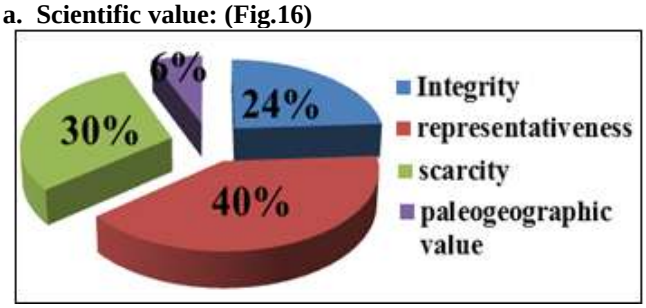

Figure 16: Percentage of scientific value

The majority of the geomorphosites presents scientific values of order 0, 70. That meant their scientific importance and interest because they reflect a critical period in the formation of the central high atlas to the Morocco and also provide important clues to the regional geology.

b. Additional values: (Fig.17)

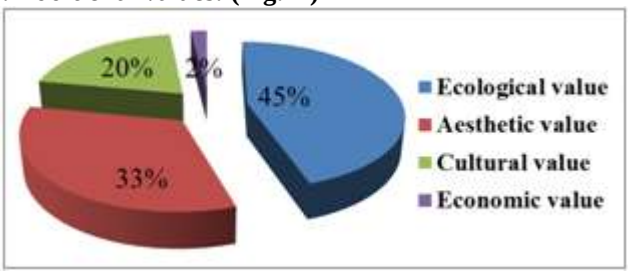

Figure 17: Percentage of additional value

The analysis of the data obtained shows that the scientific value is very important than the additional one. Because on the one hand, the geomorphosites detected present a scientific and educational importance and on the other hand the criteria determining the additional value (ecological, aesthetic, cultural and economic) are weak, thanks to the poor Relation of the general public (population) with its environment (natural landscapes). This is justified by the absence of territorial developments that value the geological and natural heritage.

Despite the weakness of the additional value, some of its components are important as the ecological one, which reached 45% following the presence of microclimates along the river Assif Melloul and in the pine Forest of Tait (wetlands), which gives Birth to local ecosystems with a typical biodiversity of the high Central Atlas.

As well as the aesthetic value comes in second position after the ecological and reaches 33%, which can be explained by the difficulty of access to the geomorphosites that are located in inaccessible places.

On the other hand, cultural and economic values remain substandard because geomorphosites are not valued and integrated into structural projects in the territory, capable of creating income-generating activities for the local population and Build a local solidarity economy based on eco-geotourism, (educational tourism, adventure and mountain Sports ...).

Despite the low difference noticed between the additional values and scientific values, the inventoried geomophosites are characterized by an average global geomorphological value of between 0.60.

Example of inventory record

Inventory sheet: Rock messafrane in the site of interest biological and ecological Tamga to Tillouguite / Province of Azilal in Morocco.

1. General information: (Fig. 18/19)

- CODE: TILL.TAM.MESF01
- Location: SIBE de Tamga (Geopark M'goun)
- Territorial Municipality: Tillouguite
- Douar: Tamga
- Name: Rock of Messafrane
- Coordinates: X: -6.0126; Y: 31.0987
- Main geomorphological process: River
- Type: punctual
- Difference in altitude: 700m
- Height: culminates at nearly 600 meters above
- the Ahansal Assif.
- Height of the rock wall: 300m
- Age: plio-quaternary (2 to 5 million years)

Figure 18: The location of the rock messafrane in the productions 1/100000 of Tillouguite map

Figure 19: Messafrane rock

2. Descriptive Data

Description:

The Tamga reserve is one of the eight SIBEs that holds the territory of the M'Goun Geopark, classified in category 1 (well preserved) which is a site of biological and ecological interest (SIBE) which forms a typical ecosystem of Alep Pine / Tamga Pine, spread over 8000 ha; SIBE harbors 33 species of mammals including 11 species of national and global interest, 107 species of birds, 19 species of reptiles and thus has a particular biodiversity. With a difference in height of 700 m, the rock of Messafrane / Cathedral culminates at nearly 600 meters above the Assif Ahansal. The vertical wall reaches nearly 300 meters constituted by the accumulation of ancient alluvium of age plio-Quaternary (2 to 5 million years); these deposits were then raised, at their present altitude by the atlasic orogenesis.

Morphogenesis:

The area of Messafrane can be considered as a control of the internal basins which stack the detrital sediments transported by Oued Ahansal and Assif Melloul. This enormous megalith composed of conglomerates of the Mio-pliocene (end of the tertiary era) and testifying the main phase of Atlasic folding which gave rise to a high mountain chain before subjecting to a strong and aggressive erosion which dismantled and disappears the fragile and the less resistant series to form hollow parts between the resistant layers in relief. The enormous quantity of deposits (large blocks) of neighboring rivers are deposited in sediment traps internal to the chain or in the foothills to the north and south of the

Messafrane rock. Hence The erosive mechanism continues and attacked these massive deposits and shaped and carved the conglomeratic rock of Messafrane in its present form of a Cathedral.

6. Evaluation Scales

1. Evaluation of scientific value:

Criteria	Description	Scores
Integrity	The site retains its integrity and does not show signs of degradation, it is intact.	1
Representativeness	This form reflects the main phase of Atlasic folding and regional geomorphology and presents one of the main internal basins of the Central High Atlas	1
Rarity	It is unique in Morocco	1
Palaeogeographic	No paleogeographic value	0.25
V. global	Medium to large 0.75	0,81

2. Additional values assessment:

	Criteria	Description	Scores
Ecological Value	Ecological Impact	The site is a typical ecosystem with particulate biodiversity and contains 33 species of mammals, including 11 species of national and global interest, 107 bird species, 19 reptile species and other interesting, endemic or rare species.	0,60
	Protected site	This site located in the Geopark M'goun part of the "Global Geopark" is protected.	0.60
	The average value	Significant	0,60
Aesthetic. Value	Point of view	The views are good from the opposite side of this site, where the Douar Ait Oughral is located.	0,75
	Structure of The space	- The site is a crossroads of the "tracks" leading to Zaouite ahansal -Anergui-Tllouguite. - The site encompasses three phase Gites. - The bucket and drill services have developed pedestrian ways to climb to the top of the cathedral.	0.60
	The average value	Significant	0,67
Cultural. Value	Religious importance	Marabout de Tamga	0,50
	Historical importance	The region of Tamga is a Douar of the followers of Zaouite Tamga who have an intimate relationship with the chorafas of Zaouite Ahansal. An annual moussem was celebrated there.	0,50
	Literaryand artistic Importance	A typical architectural heritage - collective granaries A clean and typical folklore of Tamga	0,25
	Geo-historical significance	History of the main phase of Atlasic folding and the inner basin of the central atlas 0.75	0,60
	The average value	Significant	0,46
Economic value	Economic importance	Significant tourist activities (rock climbing ...)	0,25
	the value overall average	Significant	0,49

3. Synthesis: (Fig.20)

The SIBE of Tamga is a site of great scientific value since it presents a typical and unique ecosystem in the region and thus can be recognized as a remarkable heritage site due to its distinct cultural and architectural richness. This site has an interesting scientific educational value because it presents a true document which testifies the geological history of a part of the Central High Atlas. The site presents part of the M'goun Geopark recognized by UNESCO, That's why it is protected and far from any anthropogenic or natural threats.

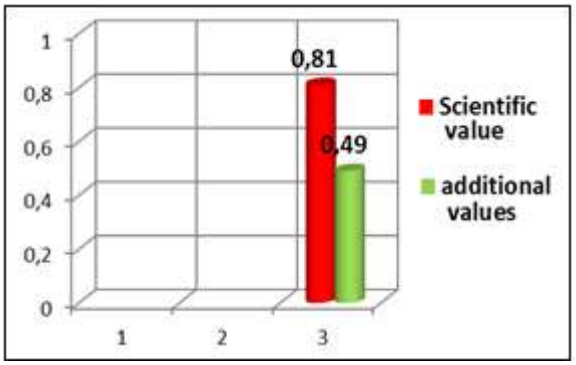

Figure 20: Scientific and additional values of the Tamga SIBE

The creation of certain geo-tourism activities and the development of mountain sports (Kayaking, climbing, fishing, hunting ...) in this area can improve the tourist attractiveness of this territory and then give birth to a solidarity economy and improve the living standard of the neighboring population.

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Example of a proposed geo-tourist circuit: (Fig.21)

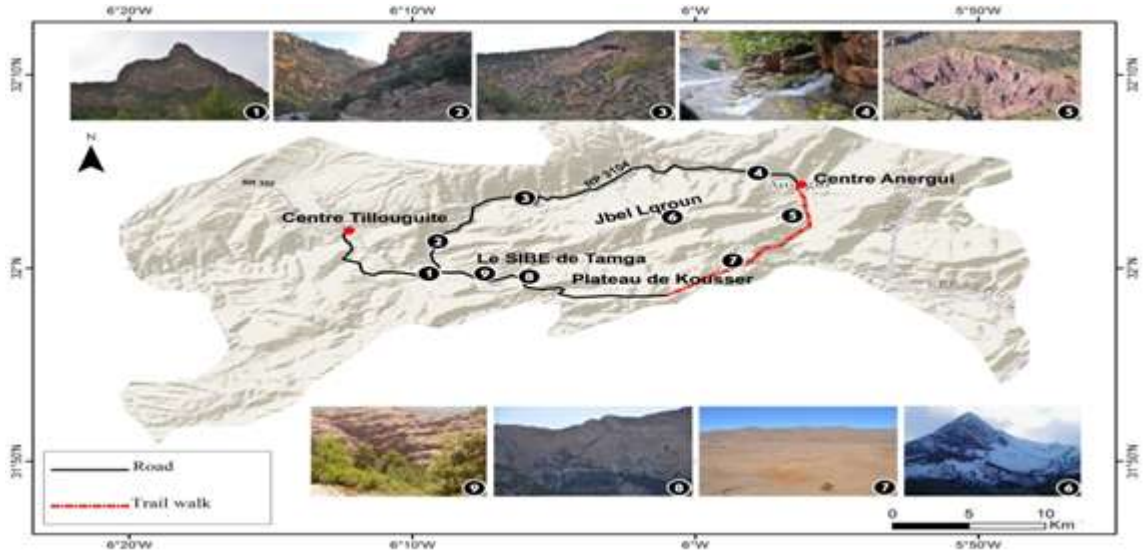

Figure 20: Example of a tourist circuit

7. Conclusion

The common land of Anergui and Tillouguite in the province of Azilal, who are in the territory of Geopark Mgoun, the unique in Africa, contain a large number of geological sites and spectacular natural landscapes, which deserve to be inventoried, protected and valued, because they are characterized by scientific value, ecological, aesthetic and educational important, and have a natural potential that can be a true lever of Geotourism able to offer new motives and opportunities for sustainable development.

The success of the development and development of the geo-touristic products in these small territories is possible and thus can become the pioneering fronts of geo-tourism in general that meet distinct economic, social and environmental objectives as well as to support scientific and educational research.

But, the problems of lack of access and the ignorance of the population and local stakeholders to the importance of these sites and their role in local development, are real obstacles that limit the effectiveness of any intervention, either of the Geopark Mgoun association or international organizations.

8. Acknowledgments

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