Geomorphological Features of the Manengouba Volcano (Cameroon Line): Assets for Geotourism and Other Anthropogenic Activities

Caractéristiques géomorphologiques du volcan Manengouba (ligne du Cameroun): Atout pour le géotourisme et autres activités anthropiques

الخصائص الجيومورفولوجية لبركان مانينكوبا (خط الكاميرون): رصيد للجيوسياحة وأنشطة بشرية أخرى

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Abstract

Mount Manengouba, a volcanic complex emplaced between 1.5 and 0 Myr, occurs in the Cameroon Line, about 120 km NE of Mount Cameroon, Cameroon. Mount Manengouba culminates at 2,411 m and is characterized by important geomorphological features (geomorphosites), namely, two nested sub-circular calderas (Elengoum and Eboga), broken cones, crater lakes (Female, Male and Beme), and domes and basin (Djeu-Seh). These geomorphosites constitute an asset for geotourism and other anthropogenic activities. The scientific values (rareness, representativeness, integrity…) and additional values (aestheitic, ecological, economic…) Mount Manengouba geomorphosites constitute an enterprise for geotourism. The fertility of the soil favours farming in the downslope areas of the volcano, with the main products being coffee, maize, bananas, fruit and tubers. Hunting and fishing are practiced by craftsmen throughout the year in the forests and Female Lake, respectively. Vegetation cover fosters the practice of animal breeding (beef and sheep) in both calderas and their vicinities. The presence of pyroclastic cones are utilised for quarrying in the region. Pozzolana is the main product that is used as road aggregates, and in the manufacture of concrete, bond-stones and cement. Excursions and research programs are carried out by universities for educating the public about the geological and geomorphological heritage of

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Mount Manengouba. Currently, in the Mount Manengouba region, tourism is not well developed, but it is recommended that, roads be improved to facilitate the accessibility to the geomorphosites, and interpretative panels, guide books and postcards be produced to inform tourists about the geology of the region.

Résumé

Le Mont Manengouba est un complexe volcanique qui s'est mis en place entre 1,5 et 0 Ma, le long de la Ligne du Cameroun, à environ 120 km au NE du Mont Cameroun (Cameroun). Le Mont Manengouba culmine à 2,411 m et se caractérise par d'importants géomorphosites, à savoir, deux caldeiras sub-circulaires emboitées (Elengoum et Eboga), des cônes égueulés, des lacs de cratère (Femme, Homme et Beme), et des dômes et bassin (Djeu - Seh). Ces géomorphosites constituent un atout pour le géotourisme et d'autres activités anthropiques. Leurs valeurs scientifiques (rareté, représentativité, intégrité…) et additionnelles (esthétique, écologique, économique…), confèrent au Mont Manengouba une entreprise pour le géotourisme. La fertilité du sol favorise l'agriculture au piedmont du volcan dont les produits principaux sont le café, le maïs, la banane, les fruits et les tubercules. La chasse et la pêche sont pratiquées toute l'année par les paysans; respectivement dans les forêts et le lac de la Femme. Le couvert végétal favorise la pratique de l'élevage dans les deux caldeiras et leurs environs. La présence de nombreux cônes pyroclastiques donne lieu à l'ouverture de carrières dans la région. Les pouzzolanes, produits principaux, sont utilisés dans les revêtements routiers et dans la fabrication du mortier, des parpaings et du ciment. Les excursions et les programmes de recherche sont exécutés par les universités dans l'optique d'éduquer le public sur le patrimoine géologique et géomorphologique du mont Manengouba. Comme le tourisme n'est pas bien développé dans le Mont Manengouba, il est recommandé d'améliorer les infrastructures routières pour une bonne accessibilité aux géomorphosites, de produire les panneaux interprétatifs, des documents et des cartes postales pour informer les touristes sur la géologie de la région.

ملخص

جبل مانينكوبا هو مجمع بركاني تكون ما بين مليون ونصف سنة إلى الوقت الحالي، على طول خط الكاميرون، وعلى بعد حوالي 120 كلم شمال شرق جبل الكاميرون (الكاميرون). يبلغ علو جبل مانينكوبا 2411 مترا، ويتميز بخصائص جيومورفولوجية هامة، وهي اثنتين من الكالديرا شبه دائرية ومتداخلة، مخاريط مكسورة، بحيرات فوهة البركان، القباب والحوض (دجو – سه). تشكل هذه المواقع الجيومورفولوجية رصيدا للجيوسياحة وأنشطة بشرية أخرى. فجودتها العلمية والجمالية وطابعها الاستثنائي يجعل من جبل مانينكوبا مُنْشَأَةٌ للجيوسياحة. تشجع خصوبة التربة الزراعة بسفوح البركان، ومن منتجاتها الرئيسية هناك القهوة، والذرة، والموز، والفواكه والدرنات. ويُمَارَسُ القنص وصيد الأسماك على مدار السنة من قِبَلِ الفلاحين، على التوالي بالغابات وببحيرة المرأة. الغطاء النباتي يشجع على ممارسة تربية المواشي بالكالديرتين والمناطق المحيطة بها. إن وجود العديد من مخاريط بيروكلاستية يؤدي إلى فتح مقالع بالمنطقة. ويستخدم البوزولانا، المنتوج الرئيسي، في الطرقات وتصنيع الكتل الخرسانية والاسمنت. يتم تنظيم الرحلات وبرامج البحث من قِبَلِ الجامعات بهدف تثقيف الجمهور حول التراث الجيولوجي والجيومورفولوجي لجبل مانينكوبا. وبما أن السياحة ليست متطورة بجبل مانينكوبا، فإنه ينصح بتحسين البنية التحتية للوصول بشكل أفضل إلى المواقع الجيومورفولوجية، وانتاج لوحات تفسيرية ووثائق وبطاقات بريدية لإرشاد السياح حول جيولوجية الموقع.

Keywords

Geomorphosites • Anthropogenic activities • Calderas • Mount Manengouba • Cameroon

Mots-clés

Géomorphosites • Activités anthropiques • Caldeiras • Mont Manengouba • Cameroun

الكلمات الرئيسية

مواقع جيومورفولوجية • أنشطة بشرية • كالديرا • جبل مانينكوبا • الكاميرون

1 Introduction

Cameroon is crossed by a structure called Cameroon Line (CL), which is an oceano-continental axis, comprised of volcanic and plutonic rocks (Fig. 1). It is oriented N30°E and stretches from Gulf of Guinea to Lake Chad (Tchoua 1974). Although there is sporadic occurrence of natural phenomena (Kling et al. 1987; Sigurdsson et al. 1987; Nana 1991; Evans et al. 1993; Tanyileke 1994; Wandji et al. 1994, 1998, 2001; Tchoua et al. 1998, 2001; Njilah et al. 1999; Bardintzeff et al. 2001; Ghogomu et al. 2001; Kagou Dongmo et al. 2005; Zangmo Tefogoum et al. 2009, 2011a, 2012a; Nechia Wantim et al. 2012), these structures represent numerous assets for educational and cost-effective activities. Thus, multi-ethnic populations migrated there; moreover, it is an attraction for national and international researchers, and visitors. In spite of the economic potential of the volcanoes, serious geoheritage studies have not yet been carried out along the CL. Among these volcanoes, Mount Manengouba has been selected for this study. It is characterized by an equatorial climate of the Guinean type, dominated by about 7 months of precipitation in June–October (with an average of 2,742 mm/year) and a dry season of 5 months' duration, with temperatures ranging from 21 to 24 °C (Olivry 1986). Mt Manengouba constitutes a geological heritage dominated by numerous geomorphological features.

The objective of this paper is to identify and study the potential geomorphosites of the Mt Manengouba, this will give an overview on: (1) the touristic potential of the studied area; and (2) impacts of the geomorphosites on farming, breeding, hunting (main income sources for local inhabitants), and educational activities. This will be an important

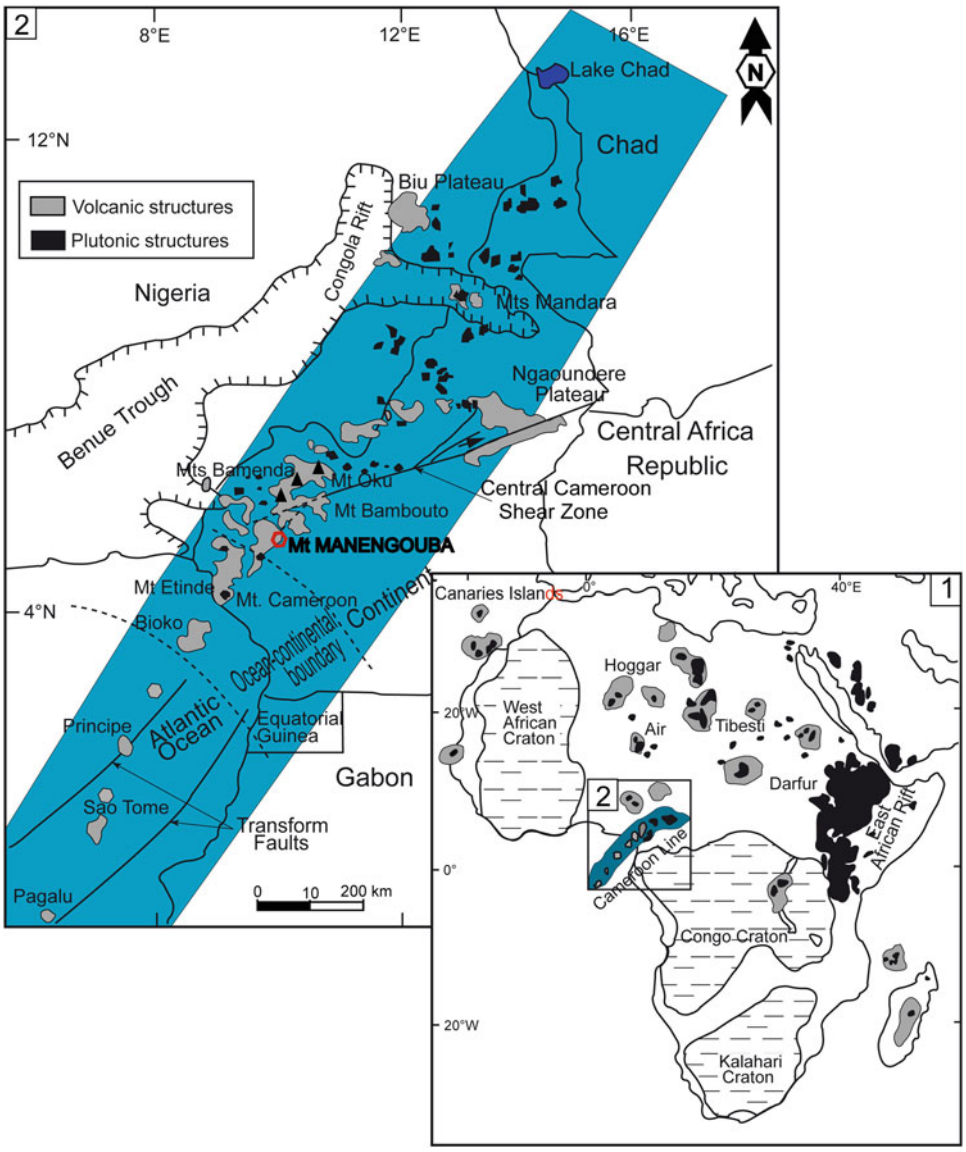

Fig. 1 Cameroon Line (CL) in Africa (*1*); location of Mt Manengouba in the CL (*2*) (from Nkouathio et al. 2008, modified)

contribution in increasing the awareness of the local population about their geoheritage and the necessity for its management for local sustainable development.

According to Grandgirard (1997), Reynard (2005), a geomorphosite is any part of the Earth's surface that is important for the knowledge of Earth, climate and life history. Panizza and Piacente (1993, 2003) and Quaranta (1993), defined geomorphological sites as geomorphological landforms and processes that have acquired a scenic/aesthetic, scientific, cultural/historical and/or a social/economic value due to human perception of geological, geomorphological, historical and social factors.

2 Geological Context

Mt Manengouba was developed by successive emplacement, from 1.55 to 0 Myr, on a 800 m uplifted granite-gneiss substratum of two volcanoes, Elengoum and Eboga, and is situated at about 120 km NE of Mount Cameroon. Mt Manengouba covers an area of 500 km^2 and occurs between the Tombel and Mbo grabens, precisely between longitude 09°42′ and 10°10′ East and, latitude 04°49′ and 05°15′ North (Kagou Dongmo et al. 2005). The maximum height of the whole volcano is 2,411 m and it is located at the south-eastern external slopes of the Eboga caldera.

Mt Manengouba is surrounded by plutono-tectonic units expressed geomorphologically as the Ekomane cliffs to the north (1,685 m), Mount Bakossi to the west (1,678 m), Mount Koupé to the south-west (2,064 m) and Mount Nlonako to the south-east (1,825 m).

Mt Manengouba was characterized by adventive fissural volcanism that gave rise to more than 70 strombolian cones; some of them were initiated by phreato-magmatic explosive events (Kagou Dongmo et al. 1998). Numerous rocks occur at Mt Manengouba such as basalts, hawaiites, mugearites, benmoreites trachytes, dolerites and pyroclastic ejecta (scoria) (Figs. 2 and 3). The outcrop expression of these rocks results in several geomorphological units that comprise the uneven topography of Mt Manengouba.

2.1 The Geomorphological Features of Mt Manengouba

The high geodiversity (lithological diversity) and the tectonics in this area have been the main influence in developing its distinctive geomorphological features (Meireles et al. 2002; Pereira et al. 2004a, b). In Mt Manengouba, as well as in other volcanoes along the CVL, tectonic events have been underlined by eruptive events (Tchoua 1972; Marzoli et al. 2000; Zangmo et al. 2011b; Gountie et al. 2011). These events created four major volcanic landforms, namely, cones, domes, cliffs and lava plateau (Wandji 1995; Kagou Dongmo et al. 2010), as in the volcanic terrains in the Park of Fogo Island, Cape Verde (Costa 2011). To assess the Mt Manengouba landforms, we undertook a review of the criteria to determine intrinsic values (scientific) and additional values (ecological, aesthetic, economic and cultural) used by Gray (2004), Pereira et al.(2006, 2007), Reynard et al. (2007), Reynard (2008), Ilies and Josan (2009), Pereira and Pereira (2010), Maillard and Reynard (2011) and Reynard and Coratza (2013). The geomorphosites that characterize Mt Manengouba are calderas, broken cones, crater lakes, domes, plug, and basin.

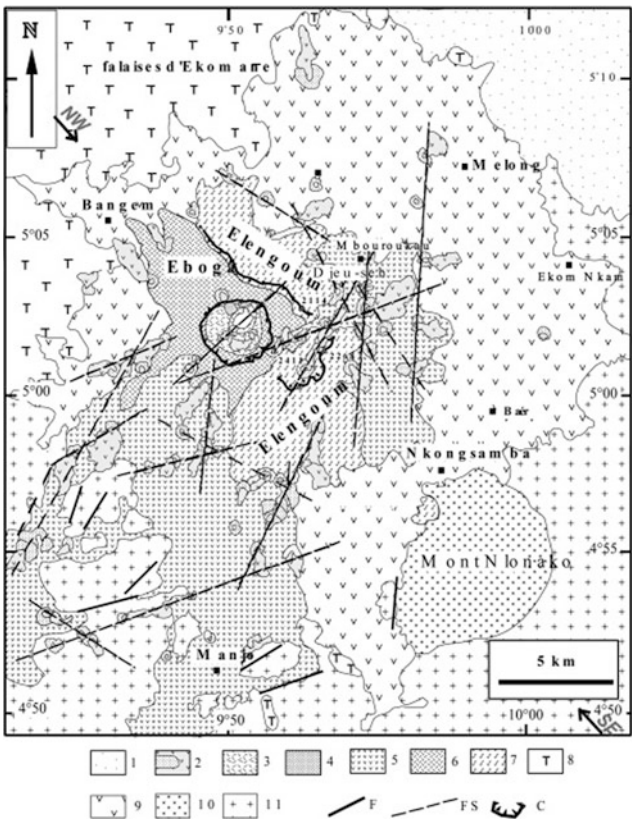

Fig. 2 Geological map of Mt Manengouba. *1* alluvium; *2* recent adventive strombolian volcanoes, with cones and basaltic flows; *3* diatremes-related hyaloclastites in the Eboga caldeira and at Djeu-seh; *4* mugearite extrusions in the Eboga caldeira; *5* piles of basalt and hawaiite flows of the Eboga middle and lower flanks; *6* mafic to intermediate lavas and tephras of the Eboga central edifice; *7* intermediate to acidic (trachytes) lavas of the Elengoum volcano emplaced before the Eboga; *8* old trachytic outpourings, mainly ignimbritic; *9* relative substratum made of Mio-pliocene basaltic plateau flows; *10* pre-volcanic Cenozoic intrusion of syenite; *11* Precambrian granito-gneissic shield; F, fault; FS, fissural system; C, caldera scarp. (From Kagou Dongmo et al. 2005)

2.1.1 Calderas

Mt Manengouba stands as an example of a Hawaiian shield. At the summit, there are two sub-circular nested calderas: Elengoum and Eboga (Fig. 4). The larger one is the Elengoum caldera, some 6–7 km in diameter, but its margins appear diffuse. The floor of Elengoum is occupied by the

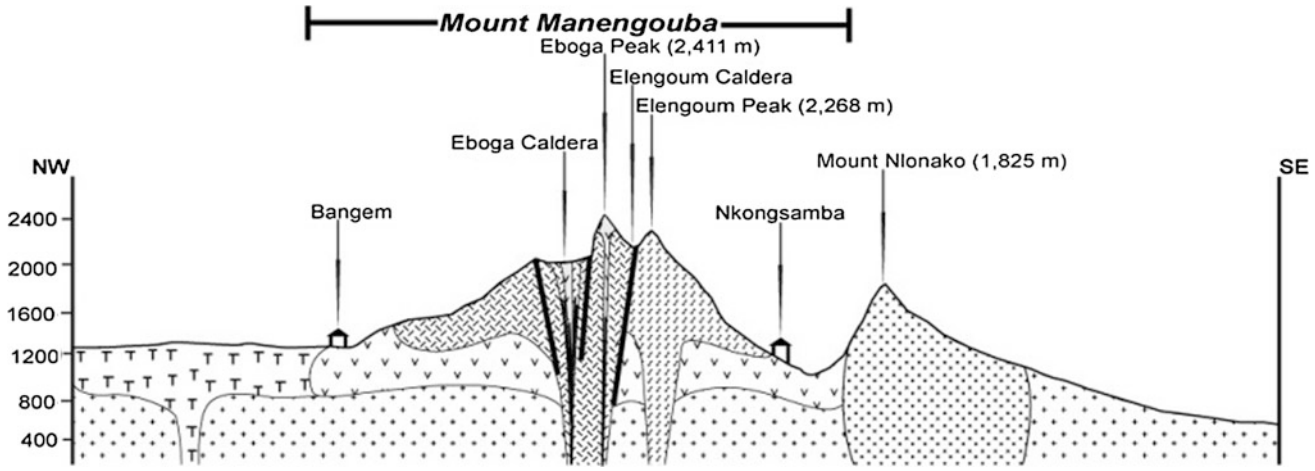

Fig. 3 Geological cross section of the Mt Manengouba (symbols are same as in Fig. 2)

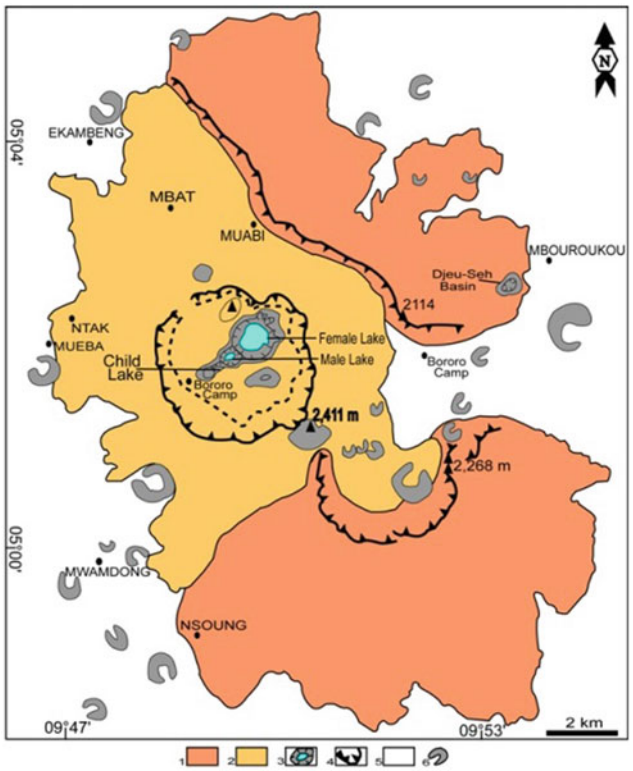

Fig. 4 The Mt Manengouba summit. *1* Elengoum volcano and its caldera; *2* Eboga volcano and its caldera; *3* Crater lakes; *4* Caldera boundaries; *5* Adventive phase flows; *6* Broken cones

smaller Eboga caldera, which is well shaped and 4–5 km in diameter. The floor of the Eboga caldera is slightly flat and approximately 1,900 m in relative relief.

2.1.2 Cones

Volcanic cones result from the accumulation of bombs, ashes and lavas, ejected from the vents of a pre-existing scoria cone (Costa 2011). Mt Manengouba has around 70 cones (Kagou Dongmo et al. 1998) three-quarters of which are broken (Figs. 5 and 6). Broken cones result from lavas that have erupted downslope of the pre-existing cones composed of volcanic ejecta (bombs, cinders, scoria etc.). The slope of a cone will slide under the influence of the loose state of the volcanic ejecta (Kagou Dongmo 1998).

2.1.3 Crater Lakes

The Eboga caldera is characterized by two major crater lakes (Female Lake and Male Lake). Female Lake (Fig. 7) is the larger one of the two, some 22 ha in area and 168 m deep. Male Lake (Fig. 8) is 2 ha in area and 92 m deep (Kling 1988). The temperature of the waters lakes varies from 19.2 to 20.6 °C and from 16.8 to 21 °C, respectively (Tanyileke 1994).

Beside both lakes, in a SW–NE direction lays Child Lake (Fig. 9). This lake is shallow and seasonal. It is recharged during the rainy season. During the dry season, the lake floor is inhabited by natural herbage. Child Lake is not closed like Female Lake and Male Lake, and its outlet is visible in the NW side of Fig. 9.

In the Beme village (NW of Mt Manengouba), there is an important circular crater lake (Fig. 10). This lake is the largest in the region, some 60 ha in area and 14.5 m deep (Kling 1988). It is characterized by steep rims that make accessibility difficult.

2.1.4 Dome and Basin

Mt Manengouba slopes are characterized by several extrusive domes (Kagou Dongmo 2006) that have uneven topography. The most scenic is the mugearite dome called Mboriko (2,067 m altitude), situated in the Eboga caldera (Fig. 11). There is also a spectacular basin called Djeu-Seh (approximately 300 m in diameter and 70 m deep), located on the eastern external slopes of the Elengoum caldera. While this basin is not a lake, its bottom is swampy (Fig. 12).

Fig. 5 Two cones located in the south-western bottom of the Eboga caldera

Fig. 6 Ekambeng broken cone; situate on the north-western flank of Mt Manengouba

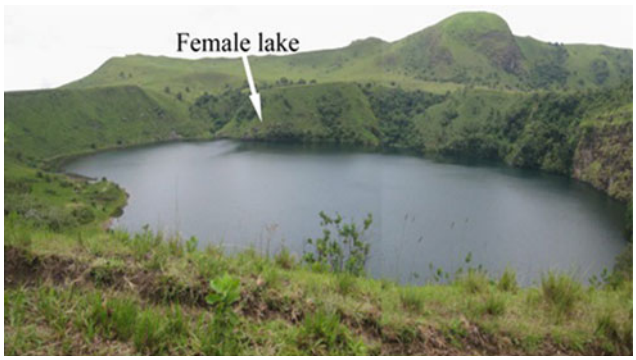

Fig. 7 The female lake in the Eboga caldera

Fig. 8 The male lake in the Eboga caldera

2.2 The Influence of Geomorphology on Anthropogenic Activities

The geomophosites of Mt Manengouba give rise to numerous sustainable anthropogenic activities such as geotourism, agriculture, breeding, animal building, fishing, hunting and education.

2.2.1 Geotourism

Geotourism focuses on the geological and geomorphological heritage of an area (Gavrila et al. 2011). In Mt Manengouba geotourism sites were selected according to five criteria used by Pereira et al. (2009) in the Portugal National Park. These

Fig. 9 The child lake in the Eboga caldera. There is the outset of water accumulation in the beginning of the rainy season

Fig. 10 The Beme Lake

Fig. 11 The Mboriko dome in the Eboga caldera

criteria are: value, vulnerability, accessibility, visibility and spatial distribution. The scientific quality, the aesthetic appeal and the uniqueness of Mt Manengouba geomorphosites such as calderas, crater lakes, broken cones, domes and basin (Zangmo Tefogoum et al. 2012b), constitute an enterprise for geotourism that can be led by foreign and local tourists (Figs. 13 and 14).

In Mt Manengouba, there are several locations that enable tourists to have a panoramic view of the landscape. Geomorphosites of Mt Manengouba have a local, national and international relevance, and this annually attracts more than 600 local and foreign tourists. The local tourists include mainly researchers from the universities, and students from the colleges in Manengouba neighborhood towns and other

Fig. 12 The swampy Djeu-Seh basin

Fig. 13 Tourists (*1*, *2*) in the Eboga caldera

Fig. 14 The excursion of secondary school students in the Eboga caldera

regions of Cameroon. Every year, the tourism activities in Mt Manengouba occur from December to April, and are focused on the Eboga caldera that presents the most interesting features with well-defined rims that exhibits the Mboriko dome, and has three broken cones covered by natural lawn. Female Lake for instance, has a swimming facility, and plays a leading role in craftsmen fishing and traditional ritual issues (Fig. 15).

To facilitate tourism activity in the region and limit the variations of the routes of visitors, Kagou Dongmo et al. (1999), have proposed the following trails:

1. tourists with off-road vehicles can pass through Bangem (NW of Mt Manengouba) to obtain direct access to the caldera;
2. tourists on foot pass through Mbouroukou, and, after 3 h walking on the NE flank of the caldera, they arrive at a

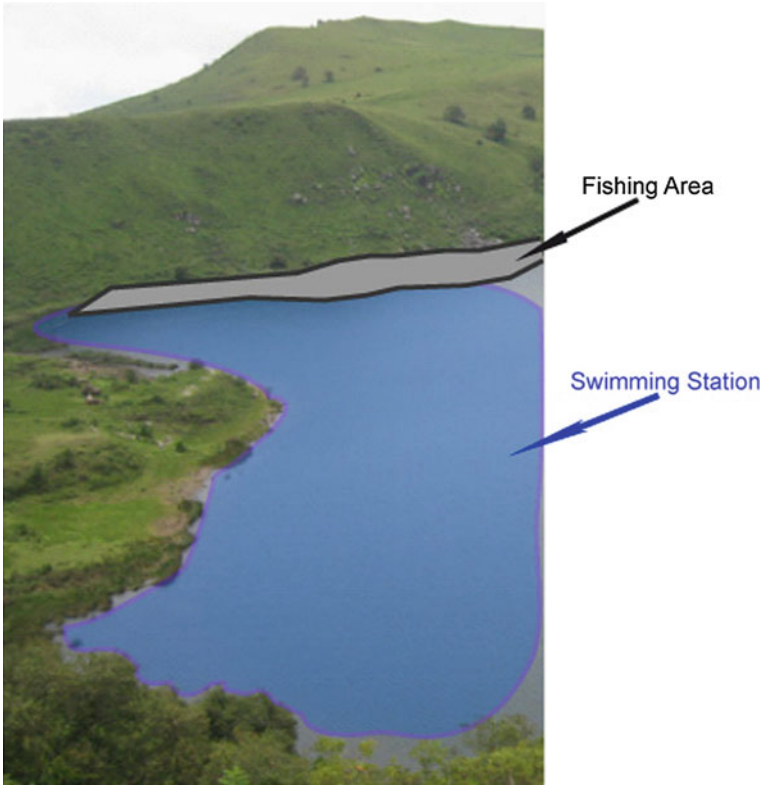

Fig. 15 Swimming and fishing area in the female lake

location where they have a panoramic view of the whole caldera;
3. the third trail for tourists on foot passes through Mouanguel, when, after one and half hour's walking, they arrive on the eastern flank of the caldera;
4. the fourth trail for tourists on foot passes through Nsoung, and, after two and a half hours' walking on the uneven track, arrive on the southern flank of the caldera.

According to Reynard et al. (2003), Pralong (2006), geosites should possess original (or primary) and derived (secondary) tourist attractions. In this region, the original attraction is the geology (rocks, crater lakes, volcanoes, domes, etc.) and the derived attraction is the set of infrastructures, goods and services that are offered to tourists to facilitate their visit. As presented above, the Mt Manengouba geomorphosites are the primary attraction in the region. The secondary attractions are not well developed, nevertheless there are infrastructures such as accommodation in the closest village to the calderas (Zangmo Tefogoum et al. 2012b), and two degraded shelters in the Eboga caldera. One of the limits of the derived tourist attractions is the lack of guide books and interpretative panels.

2.2.2 Farming, Breeding and Hunting

In several cases geomorphosites provide the basis for human occupation and biodiversity (Ferreira et al. 2001; 2003; Alves et al. 2004). However, while biodiversity encourages human activities, it can be threatened by them. The geological and biological diversity of Mt Manengouba has attracted a multi-ethnic active population (Mbo, Bakossi, Bamileke, Bamenda and Bororo) who settled there to undertake agriculture, animal breeding and hunting.

Farming The Manengouba volcano is underlain by Ando soils developed on basic volcanic rocks (mainly basalts and pyroclastic ejecta) that contain fertilizing elements (Kagou Dongmo et al. 1999). This promoted the practice of farming that is well developed in the downslope areas of Mt Manengouba. More than ten types of crops are grown: coffee, cacao, plantains, bananas, melons, tubers (manioc, yam, and tarot), maize, potatoes, beans, fruit (avocado, sugar cane, pineapple) and pigments (Fig. 16). These products are marketed in some of the villages near the volcano.

Breeding and hunting Mt Manengouba geomorphosites are strewn by vegetation comprised mainly of forests and meadow as natural herbage (Fig. 17). The latter supports animal breeding at the summit of the volcano. Stock raising (cattle and sheep) is practiced in the calderas (Fig. 18). The annual income from this activity is about USD 290,000 (ZangmoTefogoum et al. 2011b).

There are two categories of forest: gallery forests located in the Eboga caldera, and forest reserves (Bakaka, Manehas, Mekombé and Eko) that are mainly distributed in the

Fig. 16 Crops harvested in Mt Manengouba. *1* Plantains and bananas; *2* pineapples; *3* sugar canes; *4* tarots; *5* maniocs; *6* gingers; *7* yams; *8* potatoes; *9* avocadoes; *10* palm oil; *11* cocoa; *12* coffee; *13* dry manioc for many purposes; *14* mangoes

Fig. 17 The Northern rim of the Eboga caldera that highlights a primary school enclosed by a natural marvelous lawn

Fig. 18 The breeding activity highlighted by sheeps flock (*1*) and cattle herd (*2*)

Fig. 19 The forest reserve in the Beme village

Elengoum caldera and on the external slopes of the whole volcano (Fig. 19). Both forest types, due to the richness of their fauna, support hunting; however, hunting is the less-developed activity in the region.

2.2.3 Civil Engineering Works

Mt Manengoubais is composed of several rocks types (Kagou Dongmo et al. 2005; Zangmo Tefogoum 2007; Zangmo Tefogoum et al. 2011a). The most widespread is pyroclastic ejecta that formed the numerous cones in the volcano, and consists mainly of pozzolana that reacts with lime to form the cement (Wandji and Tchoua 1988). As such, pozzolana is used for the local manufacture of cement and for civil engineering works which led to the opening of several quarries by local councils and residents on the flanks of Mt Manengouba (Fig. 20). Moreover, the friability of pozzolana renders it useful in manufacturing bond-stones and concretes, and in the surfacing of roads and terraces (Fig. 21). Blocks of volcanic rocks are also used for the building of foundations and the surfacing of walls and road embankments.

The greatest threat to the geodiversity in this region is probably the ignorance about the potential impacts and activity (Gray 2008). Quarrying is the main threat to the Mt Manengouba geomorphosites. More than three quarries are deserted, but they now represent an anthropogenic landscape that plays a scientific and educational role in geotourism (Gavrila et al. 2011).

2.2.4 Education

Mt Manengouba geomorphosites are important assets for research and science. Due to its geological history, petrographic variability, structure and geomorphology, many field studies are carried out by secondary schools and universities and other research institutions. Young scientists undertaking Masters and Ph.D. degrees are increasingly focusing their research in this region (Fig. 22).

There are several tens of streams and four thermo-mineral water springs in this region. The major streams are the collecting zone of smaller streams and are very useful for local purposes. The thermo-mineral water springs are found in Baré, Ngol, Nsoung and Bangem (Tchoua 1974; Kagou Dongmo et al. 1999). Thermo-mineral water springs (Figs. 23 and 24) are a post-volcanic product in Mt Manengouba. Thus, they are helpful in the training of scholars in the volcanic processes along the CL.

Fig. 20 Some opened quarries in Mt Manengouba surrounding villages: *1* Njombé, *2* Njom, *3* Ndom and *4* Ekoh

Fig. 21 Coating of road with the pouzzolana in the Njom Village

Fig. 22 Students fields work in Mt Manengouba

3 Discussion and Conclusions

Mt Manengouba is one of the most popular volcanoes along the CL. It constitutes a geomorphological heritage of a volcano emplaced between 1.5 and 0 Myr. It has some important assets that foster numerous cost-effective educational and economical activities. To that end, several active local populations (Mbo, Bakossi, Bamileke, Bamenda and Bororo) are still migrating and settling there.

Mt Manengouba geomorphosites are characterized by fertile soils and diversified vegetation. The fertile soils promote the farming of several crops that are marketed in the village near the Manengouba volcano. The meadow and

Fig. 23 The reddish thermo-mineral water spring in the Ndibse village. There is a colorless fresh water stream that is quite close to the hot spring

Fig. 24 The thermo-mineral water spring in the Baré village

forest vegetation of the region underpin animal breeding and hunting respectively. The competition for the green space gave rise to tribal conflicts that led to the settlement of animal breeders on the summit and crop farmers on the downslope areas of the volcano.

The geomorphological features of Mt Manengouba consist of two nested sub-circular calderas, three permanent lakes, basin, domes and broken cones, and natural herbage (Fig. 25). The uniqueness of the geomorphological features and the thermo-mineral water springs in the region gives Mt Manengouba its local, national and international importance. Accordingly, every year, local and foreign tourists visit the area, though their number is still insignificant. The main threats to Mt Manengouba tourist assets are the opening of quarries on pyroclastic broken cones, the over-grazing of pastures, the deteriorating state of the roads and the lack of shelters in tourist sites. The geomorphosites of the summit of Mt Manengouba (calderas, lakes, cones and dome) are the main tourist attractions. In view of this, it is a necessity to:

1. amalgamate the stock breeders in a single location and create stock farms to avoid overpasturing;
2. control the balance between quarrying and promotion of geotourism;
3. improve and maintain the main itineraries to facilitate the accessibility to the geomorphosites;
4. create new tourism tracks in the Mt Manengouba area;
5. train local guides;
6. provide interpretative panels and adequate documentation to highlight the geological interest of the area;
7. foster cost-effective activities (handicrafts, shops, inns or hotels) to improve the local economy; and
8. establish a museum for the exhibition of rock samples, geological maps, tourist sites map, postcards etc.

Although the fact that most of geomorphosites of Mt Manengouba are well exposed and can attract mass tourism which can progressively influence their integrity in the region, there is no specific legal protection of the geosites. However, geomorphosites constitute the centre of interest of numerous research endeavours that could play an effective role in raising the awareness of the local population and

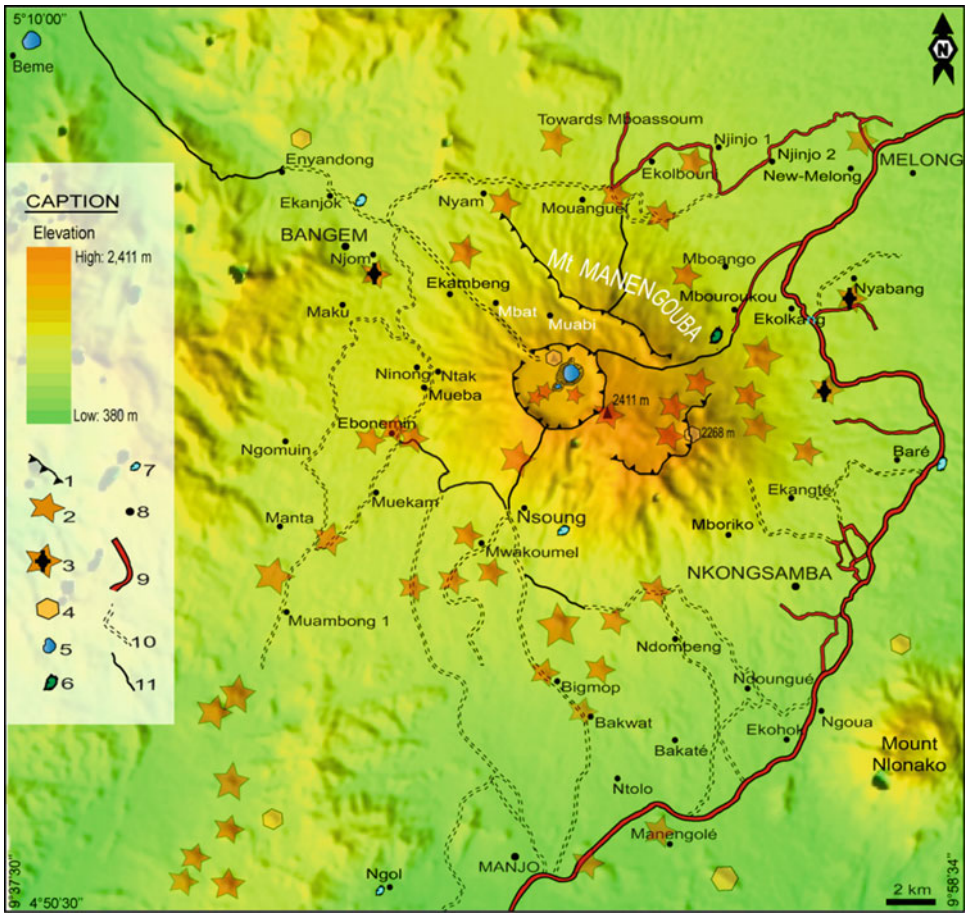

Fig. 25 Geomorphological features of Mt Manengouba of geoheritage significance. *1* Caldera boundaries; *2* cones; *3* quarries; *4* domes; *5* lakes; *6* basin; *7* thermo-mineral water springs; *8* settlements; *9* asphalted roads; *10* off-road vehicle tracks; *11* pedestrian tracks

visitors about the necessity for the protection and valorization of sites of geoheritage significance in the region. Thus, through the African and Arabian Geoparks Network which promotes geoparks in Africa and the Middle East, we hope to create the first geopark in Cameroon in the region of Mt Manengouba.

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