- PN-AAV-065

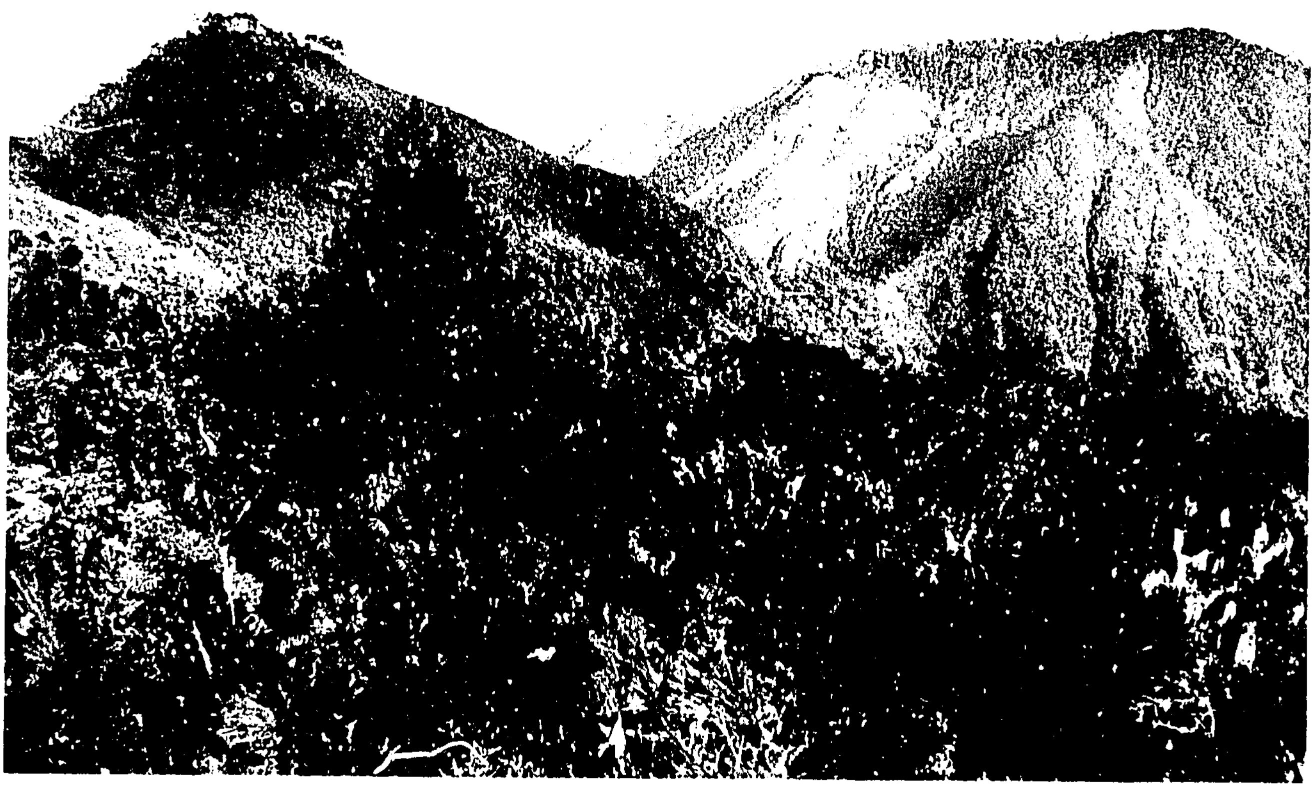
Geology

of

The National Parks of Haiti

by

Bruce MacFadden



GEOLOGICAL SETTING OF

MACAYA AND LA VISITE NATIONAL PARKS

SOUTHERN PENINSULA

OF

HAITI

by

Bruce J. MacFadden, PhD

Florida State Museum

University of Florida

Gainesville, Florida 32611

January 1986

Prepared for USAID/Haiti under

Contract #521-0169-C-00-3083-00

TABLE OF CONTENTS

INTRODUCTION

Hispaniola lies on the northern edge of the Caribbean Basin. This island is bounded to the north by the Atlantic Ocean, to the east by the Mona Passage and Muertos Trough, to the south by the Caribbean Sea, including the Venezuelan Basin, Beata Ridge, and Colombian Basin, and to the west by the Nicaraguan Rise, Cayman Trough, and Windward passage (Figure 1). Geophysical and oceanographic evidence indicates that the Caribbean Plate has undergone an exceeding complex geological history for at least the last 85 million years since the early late Cretaceous. This complex history must extend farther back in time; however, no older rocks are preserved on land or in adjacent ocean basins. A coherent and comprehensive synthesis of the Caribbean plate remains as a major area of geological research. Therefore, in addition to oceanographic and geophysical surveys, land-based geological investigations on the Caribbean islands enhance progress towards a needed synthesis of this region.

In subsurface exposures in Haiti, which comprise the western one third of Hispaniola, volcanic and marine sedimentary rocks predominate and range in age, so far as is known, from early late Cretaceous (Conaician to Campanian) to Recent. The structurally complex mountainous areas trending east-west in the Southern Peninsula and the extensive central massif in the northern part of the country attest to numerous phases of tectonic activity. Haiti is characterized by extensive development of karst topography as a result of the extensive uplifted carbonates and the very humid tropical climate. In the

Southern Peninsula mean annual temperatures are ca. 25° C and rainfall ranges from ca. 1200-2000 cm/year (Woodring et al., 1924; Van den Berghe, 1983). This geomorphological regime of processes and landforms influences the modern biota and, in numerous instances, provides natural traps for the very diverse Pleistocene fauna, many species of which are extinct today.

The purpose of this report is: (1) to present the results of reconnaissance geology of the Macaya and La Visite national parks; (2) to place the geology of these into a regional framework; and (3) to identify important research projects for future investigations. The fieldwork was done in January-February 1984 and January 1985. During these excursions, two trips were made to Macaya National Park and one was made to La Visite National Park.

ACKNOWLEDGEMENTS

I extend my thanks to Dr. Charles A. Woods who invited me to participate on this project. I appreciate the assistance of Mr. Raymond Cleeland, of Oak Park, Illinois, during the 1984 season. Much of the geological interpretations presented here were influenced to a great degree by the work and knowledge of Dr. Florentin J.-M. R. Maurrasse of Florida International University, Miami, and Dr. Gaston Georges, Director of Geological Studies at the Ministry of Mines and Energy Resources, Port-au-Prince. I thank Dr. Michael R. Perfit for helpful discussions on igneous petrology relevant to the geology of the Southern Peninsula. I am especially appreciative of Rhoda J. Bryant, who edited the manuscript.

SYNOPSIS OF PREVIOUS STUDIES

Working as representatives of the U.S. Geological Survey, Woodring and field associates spent 6 1/2 months in 1920 and 1921 doing mapping and reconnaissance geology by automobile, horseback, and on foot. During that time the group accomplished an extraordinary amount of work resulting in a comprehensive geological map and an exhaustive report that still stands as the classic reference today (Woodring et al., 1924). Of archival importance, many of their paleontological collections are presently housed in the Department of Paleobiology at the U.S. National Museum of Natural History, Washington, D.C. Of relevance to the present report, the region of Macaya National Park in the Massif de la Hotte was not studied by Woodring et al. (1924), and consequently the geology was not interpreted on their geological map.

Butterlin (e.g., 1954, 1960, 1977) has provided comprehensive studies of the geology of the Caribbean basin. Much of this field work was done on Haiti. Butterlin has increased our knowledge of Haiti over that presented by Woodring et al. (1924) by describing new formations, detailed structural settings, and placing Hispaniola in a circum-Caribbean context. Butterlin's work on the geology of Haiti has subsequently been enhanced by his French colleagues. Of particular relevance to the present report, the national park regions are covered in two doctoral theses, i.e., Calmus (1983) for Macaya and Van den Berghe (1983) for La Visite.

During the last two decades Dr. Florentine J.-M. R. Maurrasse has carried out extensive field-based geological research in Haiti, as well as studying marine geophysical, micropaleontological and stratigraphic data from adjacent parts of the Caribbean Basin and Atlantic Ocean. His publications on Haitian geology are far too numerous to mention here; however, Maurrasse (1982, 1983) provides current syntheses of the state of our knowledge on this subject.

There have been numerous recent publications on the general evolution of the Caribbean basin; these are integral to an understanding of the broad-scale geological context of Haiti (e.g., Malfait and Dinklemann, 1972; Jordan, 1975; Ladd, 1976; Burke and Fox, 1977; Burke et al., 1978; Perfit and Heezen, 1978; Mattson, 1979; Sykes et al., 1982). As mentioned above, the surficial carbonate exposures, high rainfall, and high temperature have resulted in widespread development of tropical karst geomorphology and hydrology in the circum-Caribbean region. Whereas karst has been studied in areas such as Florida, Jamaica, Puerto Rico, and the Yucatan (e.g., Jennings, 1971; Sweeting 1973), surprisingly little has been published on this subject from Hispaniola.

MACAYA NATIONAL PARK

Macaya National Park is located at latitude 18°21' N and longitude 74°01' W in the Department de Sud, Arrondissement de Jeremie (Figure 1). It is part of the Massif de La Hotte; two prominent physiographic features within this park include Pic Macaya (elevation 2347 m) and the headwaters of the Grand Ravine du Sud.

Field reconnaissance was done during a total of about 2 1/2 weeks in 1984 and 1985. At that time, the northern and northeastern parts of the park were inaccessible. Therefore the results presented here are based on numerous traverses made in the southern and western park areas. As is characteristic of reconnaissance in heavily vegetated tropical regions, for certain traverses, particularly in the areas of higher elevation (above the line of deforestation), the geology had to be interpreted from widely scattered and discontinuous outcrops. Table 1 lists topographic and air photo coverage for the national parks and relevant adjacent areas.

Stratigraphy

So far as can be determined, two named formations are represented in the surficial exposures of Macaya National Park.

Macaya Formation.-- Virtually the entire park and adjacent areas consist of outcrops of limestones referred here to the Macaya Formation. Butterlin (1954) named this unit from exposures to the east of this region with the type locality (Maurrasse , 1983, p. 24) as the: "Road between Les Cayes and Jeremie, in the valley of Riviere Glace, at 100 meters northeast of the point where the river crosses the road." Maurrasse (1983) previously described the Macaya Formation as predominantly a massive limestone with abundant calcite veins. It can vary in color from white, yellowish gray to purplish or chocolate brown. Butterlin (1954) estimates that the Macaya is at least 2000 m thick. Based on planktonic foraminifera, the age of the Macaya

Formation is certainly late Cretaceous and probably ranges from the Santonian to Maastrichtian. Calmus (1983b) provides a very detailed description and analysis of the Macaya Formation in this and adjacent regions.

In the Park, the Macaya Formation is very similar to previous descriptions above; it is five-grained and characteristically very light gray (5yR 8) but other colors (e.g., grayish brown, 5YR 3/2) are also encountered. In the Grand Ravine du Sud at an elevation of 1050 m, the calcite veins within the Macaya Formation are broken, pulled apart, ("boudinage") and folded (Figure 2). These small-scale features indicate post-depositional local deformation. This may be related to a contact metamorphic zone observed by Calmus (1983) for the Macaya Formation in Ravine de Cahon. No macroinvertebrate fossils were found during the reconnaissance. Cordier (1984, pers. comm.) stated that, although exceeding rare, some macrofossils (probably mollusks) were observed in the walls of caves in the park, which probably consist of the Macaya Formation.

"Demisseau Formation."-- Maurasse et al. (1979) named this formation for a deep-water deposit consisting principally of basaltic composition volcanics, turbidites, limestones, cherts, and siliceous sandstones as exposed near Kenskoff. In the area adjacent to Macaya National Park, in situ basalts crop out at an elevation of 1150 m in the stream course of the Grand Ravine du Sud (Figure 2). This consists of fine-grained basalt which weathers to a very rotten rust-colored exposure. There are other scattered and isolated exposures of basalt observed along the southern slope of the park at an elevation of about 1400-1600 m. However, these may be allochthonous.

Maurrasse (1979) named the Demisseau Formation for exposures in the region of Massif de La Selle. With regard to the superpositional relations of this formation in the Massif de La Hotte, Maurrasse (1982, fig. 11, p. 24) indicates that the Demisseau Formation underlies (and hence is older than) the Macaya Formation. However, if indeed the basalts that crop out in the Grand Ravine de Sud and adjacent areas can be considered the Demisseau, then it is possible (as is also asserted by Calmus, 1983b) that this unit is younger than the Macaya Formation. The evidence for this alternate interpretation is that, in the few areas where the "Demisseau" basalts and the Macaya limestones are seen in contact, the latter formation is either deformed or exhibits local contact metamorphism (Calmus 1983b; this report).

Structure

As mentioned above, the interpretation of the structural geology of the Park and adjacent region is hampered by extensive weathering of outcrops and, particularly in the higher elevation forested areas, the dense vegetative cover. In areas where dips could be observed, these were shallow (usually 10° or less to the south in the southern part of the Park). Second-order warping results in undulating dips between north and south. Numerous medium-scale faults were observed in the extensive exposures in the Grand Ravine du Sud at elevations of about

950-1150m. These faults could be traced for hundreds of meters along the roughly E-W trending ravine. Throughout the park region, extensive parallel fracture systems trending ca. N-S were observed in the Macaya Formation.

In the southern half of the Park, a N-S traverse from Les Plantons to the Grand Ravine passes through structural features characteristic of the region. The heavily karstified Les Plantons is formed by shallow folded and/or dipping Paleogene and Cretaceous (Macaya Fm.) outcrops. The steep slopes to the north of Les Plantons, extending up to principal E-W trending ridge crest (including Pic Formon), are probably formed by a major fault zone (see further discussion below). The top of the ridge crest (above about 1800 m elevation) consists of karstified Macaya limestone. The north slope of the southern E-W trending ridge (with Pic Formon), extending down to the Grand Ravine du Sud, consists of the principal axis of the main transcurrent fault zone, which is extensively developed on the Southern Peninsula of Haiti. Based on outcrops in the faulted zones just north of Les Plantons, the lower elevation saddle connecting Pic Formon and Pic Macaya probably consists of structurally deformed, brecciated country rock (principally the Macaya Formation), which, because of its fracturing, is more prone to groundwater solution and weathering.

Because of the vegetative cover, there are several possible interpretations for the regional structure. Butterlin (1954) interpreted the area of the present park as an E-W trending anticline that was breeched by erosion to form the Grand Ravine. He interpreted the bedrock of the southern and western portions of the Pic Macaya, Pic Formon, and adjacent slopes down to Les Plantons to be Cretaceous. He also suggested a fault in the region of Morne Cavalier-Les Plantons that brings a wedge of early Tertiary limestones in contact with the Cretaceous unit. Calmus (1983) interprets the principal E-W trending structure, which resulted in the Grand Ravine, as a major left-lateral fault. As mentioned above, this is part of the extensive E-W trending fault system that is developed throughout the western portion of the Southern Peninsula of Haiti. In other areas (e.g., in and around Port-au-Prince) outcrops of this fault zone are characterized by brecciated fragments of the surrounding country rock (Maurrasse and Pierre-Louis, 1983). I am indebted to Dr. Gaston Georges, who interpreted numerous exposures of breccias along the southern margin of the Park as evidence of this fault zone (Figure 3). Within this zone, medium size breccia clasts (on the order of 10^2 mm in diameter) of limestone predominate, although locally, highly weathered basaltic composition clasts are found. In addition, it is possible that large (on the order of 10^5 mm) megabreccia limestone blocks, which at first glance seem *in situ*, may be incorporated within this zone. Together with lateral motion along the E-W trending fault system, very steep, youthful slopes suggest active vertical uplift in this region (Figure 4).

Geomorphology

Among the most spectacular geological features of the Macaya National Park area is the extensive development of karst topography.

This regime is best developed in areas of low relief such as Les Plantons south of the Park (Figure 5) and east of Morne Cavalier and along the ridges between about 1800 m and 2000 m elevation east of Pic Formon and between Pic Formon and Pic Macaya. In these areas of karst development the topographic highs represent residual cones ca. 25-50 m in diameter, with shallow slopes usually of 10^{o} or less (Figure 5). The topographic lows are principally doline collapses or sinkholes. Frequently, dry valleys are formed by successive, linear collapse structures. Steep-sided solution pipes are also frequently encountered. Along with sink holes, these structures form natural animal traps. Some of the richest collecting (and least disturbed by human intervention) for vertebrate fossils in Haiti come from these natural traps. As with many karst areas, at higher elevations, few streams are actively flowing throughout the year. Much of the atmospheric water quickly enters the subsurface hydrologic cycle via the extensive joint system and larger scale solution features (flowing into caverns). This water resurfaces at lower elevations as natural springs. Adjacent to the park, numerous springs exiting the subsurface hydrologic cycle at elevations between ca. 1100 m and 1500 m provide a constant water source for the Grand Ravine du Sud.

On a small scale (10^2-10^3 mm order of magnitude) there is extensive sculpturing of the Macaya Formation resulting in pinnacles, ridges (flutes), and troughs (bevels). The residual soils are characteristically highly oxidized, reddish laterites that are common in humid tropical environments.

Regional Geological Interpretation

Regardless of the superpositional relations of the Macaya and Demisseau formations, they both imply similar deep ocean origins within the ancient Caribbean. In this region paleontological data indicate a late Cretaceous age for the Macaya Formation, possibly extending between the latest Santonian-Conaician through Maastrichtian stages, or about 80 to 70 mya. Several authors (e.g., Mattson, 1979; Maurrasse 1983) suggest that during this time the western portion of what is now the peninsula of Haiti was a eugeosynclinal back-arc basin complex south of an E-W trending subduction zone, and it was probably detached (to the west) from northern Haiti.

Early Tertiary carbonates surrounding the Macaya Formation outside the survey area indicate uplift and shallowing of the western portion of the Southern Peninsula. During the middle to late Tertiary (Miocene) a major tectonic feature developed in the left-lateral fault complex, which is found throughout much of the Southern Peninsula. In this region the Tertiary has also been characterized by continued uplift. These lateral and vertical tectonic features have continued into the Holocene (Mattson, 1979; Calmus, 1983a, 1983b; Maurrasse 1983). The results of active vertical tectonics seem particularly striking in the Grand Ravine du Sud where there are high-angle slopes (Figure 4), talus deposits, and frequent occurrences of large-scale mass wasting (landslides). The late Tertiary and Quaternary has been characterized by the formation of karst landforms and lateritic soils.

Potential Research Projects

The work of Maurrasse (summarized in 1983) and Calmus (1983a,b) provide an excellent body of base-line information that can be drawn upon in other studies. The following are merely a few examples of potential studies in Macaya National Park:

1) Petrography and Isotope Dating of the "Demisseau" Formation. This could provide a better understanding of the superposition of the Macaya and "Demisseau" formations as well as the origin of "Demisseau."

2) Paleomagnetism of the Macaya Formation. This may result in a determination of a late Cretaceous pole position (and hence paleolatitude) for the Macaya Formation that would be of fundamental importance in understanding the early origins of the Southern Peninsula.

3) Macropaleontology of the Macaya Formation. During his field work Cordier (pers. comm.) located several probable fossil molluscs in the Macaya Formation. If an intensive collection of these were made, they may provide additional biochronological data along with what is already known from micropaleontology (e.g., Calmus 1983b).

4) Karst Topography. Despite the significant knowledge of the processes and land forms associated with karstification elsewhere in the Caribbean (e.g., Sweeting, 1973), those developed on Haiti are poorly known. There is much room for a study of this nature in Macaya National Park.

5) **Hydrology.** The region in and around Macaya National Park is at or near the drainage headwaters for much of the western portion of the Southern Peninsula. It is therefore of critical importance to understand the regional hydrologic parameters as well as the impact that continued deforestation and increased erosion will have on the ground-water cycle.

LA VISITE NATIONAL PARK

La Visite National Park is located at latitude 18°20'30" N and longitude 72°20' W in the Department de l'Ouest, Arrondisement de Jacmel (Figure 1). It lies within the principal E-W trending elongated high elevation ridge and peak system in the east portion of the Southern Peninsula, Massif de La Selle. This physiographic region extends into the adjacent Dominican Republic where it is called Sierra de Baoruco (Figure 1). Within La Visite, elevations range from the park boundary at ca. 1600-1200 m to the highest point of 2282 m along the La Selle escarpment between Morne La Visite and Morne Bois Pin (Figure 8). The main surface drainage within the park is from the Riviere Blanche, which flows to the south and west. During January 1985, 1 1/2 weeks were spent doing the reconnaissance geology of La Visite National Park. In contrast to the limited accessibility at Macaya, all quadrants were traversed during the work of La Visite. Relevant topographic and air photo coverage is presented in Table 1.

Stratigraphy

So far as could be determined, two rock units crop out in and around La Visite National Park. Virtually the entire park consists of limestone. Depending upon the exact park boundaries along the north face of the La Selle Escarpment (Figure 6), the older igneous rocks of the Demisseau Formation, which variously crop out between ca. 1500 m and 1600 m, are either just within or just outside La Visite National Park. Nevertheless, a description of this rock unit is included here because of its significance for regional geological interpretations.

Demisseau Formation.-- The prominent central valley that lies between Kenscoff and the Massif de La Selle (Figure 6) consists of this rock unit. Maurrasse (1979) described this formation from near the hamlet of Demisseau, just to the northeast of La Visite National Park. The Demisseau Formation is an interbedded sequence of Predominantly olivine tholeiite basaltic composition rocks, as well as deep-water limestones, and some clastic deposits (including turbidites). Within the region just north of the park, there are extensive outcrops of pillow lavas (basalts), indicating an extrusive, submarine igneous origin for portions of the Demisseau Formation (Figure 7). The Demisseau Formation, particularly for the igneous component, weathers to a rotten, iron-stained outcrop which is characteristic of ultramatic rocks in tropical regions. Van den Berghe (1983) obtained a date of 85 $\pm$ 5 myr for the Demisseau, which would indicate a probable Conaician-Campanian age (early late Cretaceous).

Neiba Formation.-- Middle to late Eocene limestones have been known in the region of Massif de la Selle since Woodring et al. (1924); however, few authors have referred these rocks to a named formation. In a comprehensive study of the Massif de La Selle region, Van den Berghe (1983) refers these same middle-late Eocene limestones to the Neiba Formation, which takes its name from rocks exposed in the Sierra de Baoruco in the Dominican Republic.

In La Visite National Park the Neida Formation is principally a massive biomicrite. Based on the present field work, its predominant lithology is very pale orange (10YR 8/2), although other local variations can occur; weathering can make it a very light (N7) to medium (N5) gray. Micropaleontological investigations indicate large foraminifera (many of which have close affinities to those of the late Eocene Crystal River Formation of Florida, see Woodring et al., 1924; Van den Berghe, 1983). Nannofossils indicate an age of zone NP17, or Bartonian stage, ca. 40-42 my (time scale of LaBrecque, Hsu, et al., 1983); the paleoenvironment of the Neida Formation was probably an external platform (Van den Berghe, 1983). In the uppermost part of the limestone sequence, at about 2000 m elevation (along the E-W crest between Morne La Visite and the Pic Cabaio regions), a rich, shelly marine fauna was encountered during our work, including corals, pelecypods, and gastropods.

Structure

To the south of the La Selle Escarpment, the Eocene limestones form a dip slope, or cuesta, that controls the topography (lower elevations from N to S). This dip slope does not appear to be significantly deformed, although some faults were observed during field reconnaissance. In the southern part of La Visite, the Neiba Formation crops out down to the park boundary at about 1600 m. In the northern part of the park, it forms the very steep slopes on the northern side of the escarpment. In this area the Demisseau Formation crops out at elevations between 1500 m and 1600 m and lower, forming the highly eroded central valley between Massif de La Selle and Kenscoff. Butterlin (1954, 1977) indicated that, beneath the late Eocene limestones, the La Selle escarpment is formed by folded Paleocene or Eocene sediments which overlie the Cretaceous volcanic rocks of the Demisseau Formation (Figure 6). My field work around Morne La Visite did not reveal any folded/overturned carbonate rocks along the north slope of the Massif de La Selle. However, a large fault was encountered in this same region trending along the axis of the escarpment (Figure 8). Faults of similar magnitude are probably represented between Morne La Visite and Pic Cabaio. These observations seem to confirm that the escarpment is formed by a major structural feature, the La Selle fault (see Maurrasse, 1983), rather than merely an eroded valley and more resistant cuesta.

Geomorphology

Within and on the limestone substrate, extensive karst topography has developed. The solution features include many dolines, sinks, and vertical-walled pipes (Figure 9). The residual cones form low hills with shallow slopes (ca 10-20^{o} or less). A complex system of underground caverns is developed, some of which extend for at least 5 km (Paryski, pers. comm.). The caverns have solution features, such as stalagtites and stalagmites, formed of dripstone. There are many examples of dry valley collapses. On a smaller scale, the surficial limestone outcrops weather to form small, rounded residual rocks. These can be extensively pitted or small troughs, and crests can form (Figure 10). As is characteristic of karst regions, much of the atmospheric water enters the hydrologic cycle by vertical movement into the subsurface through joints and solution features. However, the headwaters and tributaries of the Riviere Blanche also significantly drain this area.

Regional Geological Interpretation

The Demisseau Formation includes the oldest-known rocks in the eastern portion of the Southern Peninsula of Haiti. Van den Berghe (1983) published a radiometric date of 85 $\pm$ 5 my which correlates to Conaician or possible Campanian age. The combination of utramafic, tholeiitic basalts, cherts, and radiolarian limestones suggests an ophiolitic ocean-floor complex. Maurrasse (1979, 1982, 1983) indicates that the lithologies of the clastic and carbonate sediments are very similar to those recovered during DSDP drilling in the eastern Caribbean Sea. Kent and Maurrasse (1980) investigated the paleomagnetism of the basalts of the Demisseau Formation in this part of the Southern Peninsula. Although it was unfortunate that no primary natural remanence was detected, the magnetic properties of these rocks are similar to crustal basalts recovered during the DSDP cruises in the Caribbean basin. It therefore seems plausible that the Demisseau Formation represents late Cretaceous sea floor. The reconstructions by Mattson (1979) and Maurrasse (1982) indicate a plate boundary running roughly E-W across present-day northern Hispaniola with the North American plate being subducted. Therefore the uplift of Demisseau sea floor could have resulted from obduction of the Caribbean plate. It also should be noted that these and other (e.g., Sykes et al., 1982) paleogeographic reconstructions place the Southern Peninsula separate and to the rest of present-day Hispaniola.

During the early Tertiary, the central highlands of Hispaniola had become emergent (e.g., paleogeographic reconstructions of Khdoley and Meyerhoff, 1971; Maurrasse, 1983).

Based on the paleontology and sedimentology, the Neida Formation was deposited in a shelf environment (Van den Berghe, 1983). The intraformational changes from predominately macrofossils below to shelly faunas above may suggest a shoaling during the middle to late Eocene. In the Massif de La Selle region, several depositional hiatuses in the Oligocene and Miocene could suggest subsequent emergence coupled with eustatic changes (Van den Berghe, 1983). The late Neogene is characterized by further emergence as well as the latest possible timing of development of the principal E-W trending fault systems (e.g., the La Selle Fault) during the suturing of the Northern and Southern peninsulas and formation of the horst and grabens of the central valley. The Quaternary has been a time of continued uplift and lateral movement along active faults as well as solution weathering, subaerial erosion, and extensive development of karst landforms (Maurrasse and Peirre Louis, 1982; Maurrasse 1983).

Potential Research Projects

1) **Late Eocene Paleontology.** Despite the extensive amount of work on the micropaleontology of Haiti (see references in Maurrasse, 1983) little has been done with macro-invertebrate fossils. The shell bed at ca. 2000 m on the crest of Massif de La Selle would be a valuable project to interpret the exact biostratigraphy and paleoecology of the Neiba Formation.

2) **Karst Topography.** Because of its relatively flat terrain on the southern dip slope of the park, there are many examples of karst features developed. A systematic study of the processes and genesis of these features would lead to a better understanding of tropical karst as developed in Haiti.

3). **Hydrology.** The southern dip slope of the park provides a large watershed for both the Riviere Blanche and subsurface drainage. This drainage, much of which starts in the park, impacts a large amount of area and population extending to the south coast. As with much of Haiti, the pace of human deforestation continues, which undoubtedly results in increased rates of erosion. Given the extreme importance of the hydrological cycle, a detailed study of this subject in La Visite National Park should be assigned a very high priority.

SUMMARY

Rocks exposed in the Macaya and La Visite national parks span some 85 million years from the late Cretaceous to the Recent. The older rocks consist of deep-ocean basalts and limestones deposited in a probable back-arc basin (also eugeosynclinal) setting to the south of an active subduction zone. Uplift of these rocks probably occurred via obduction at the Caribbean-North American plate boundaries.

The early Tertiary of Haiti has been characterized by uplift and consequent deposition of relating shallow marine carbonates surrounding an emergent central land mass. This was also a time when the northern part of the island and the Southern Peninsula of Haiti were separated and moving towards one another as a result of plate tectonics (probable sea-flow spreading from the Cayman trough, *sensu* Sykes et al., 1982). These two land-masses became sutured by the late Miocene, ca. 7-10 mya. Since the Miocene, the Southern Peninsula has been characterized by the development of large-scale E-W trending left-lateral strike slip faults resulting in prominent physiographic features such as the Grand Ravine du Sud.

The Quaternary has been a time of continued uplift (e.g., Dodge et al., 1983), and the formation of Karst topography and lateritic soils. This geomorphological regime has created natural traps for animals and significantly influenced the resulting biota. The marked faunal differences between the northern and southern parts of Haiti (and Hispaniola in general) undoubtedly resulted from the historical paleogeographic reconstruction described above.

The Macaya and LaVisite parks are of extreme economic and cultural importance. They include the headwaters of several large drainage areas which impact on a sizeable population in surrounding areas. Conservation of the resident biotas (and most notably, the curtailment of deforestation) is critical to preservation of the natural hydrological cycle.

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Table 1. Topographic and Air Photo Coverage of the National Parks and Adjacent Areas of Importance, Republic of Haiti.[1]

Topographic Maps	Air Photos(1:40,000 Scale)
	Macaya National Park
(All 1:50,000 Scale)	
NW Portion, Pic Macaya, Sheet 5371 II	Northern Portion of Park and Environs:
NE Portion, Beaumont, Sheet 5471 III	Photos no. 1272, 1274, 1276, 1278, 1280
SE Portion, Camp Perrin, Sheet 5470 IV	Southern Portion of Park and Environs:
SW Portion, Les Coteaux, Sheet 5370 I	Photos no. 1262, 1264, 1266, 1057, 1059
	La Visite National Park
(All 1:25000 Scale)	
NW Portion, Pic Cabaio, Sheet 5771 III SE	Northern Portion of Park and Environs:
NE Portion, Inviter, Sheet 5771 II SW	Photos no. 479, 481
SE Portion, Sequin, Sheet 5770 I NW	Southern Portion of Park and Environs:
SW Portion, Macary, Sheet 5770 IV NE	Photos no. 471, 469, 467

[1] All maps and air photos can be purchased (subject to availability) at the Geodetic and Cartographic Institute, Rue J. Janvier, Port-au-Prince. Air photos require a 1-day processing period from the time they are ordered to the time they are ready.

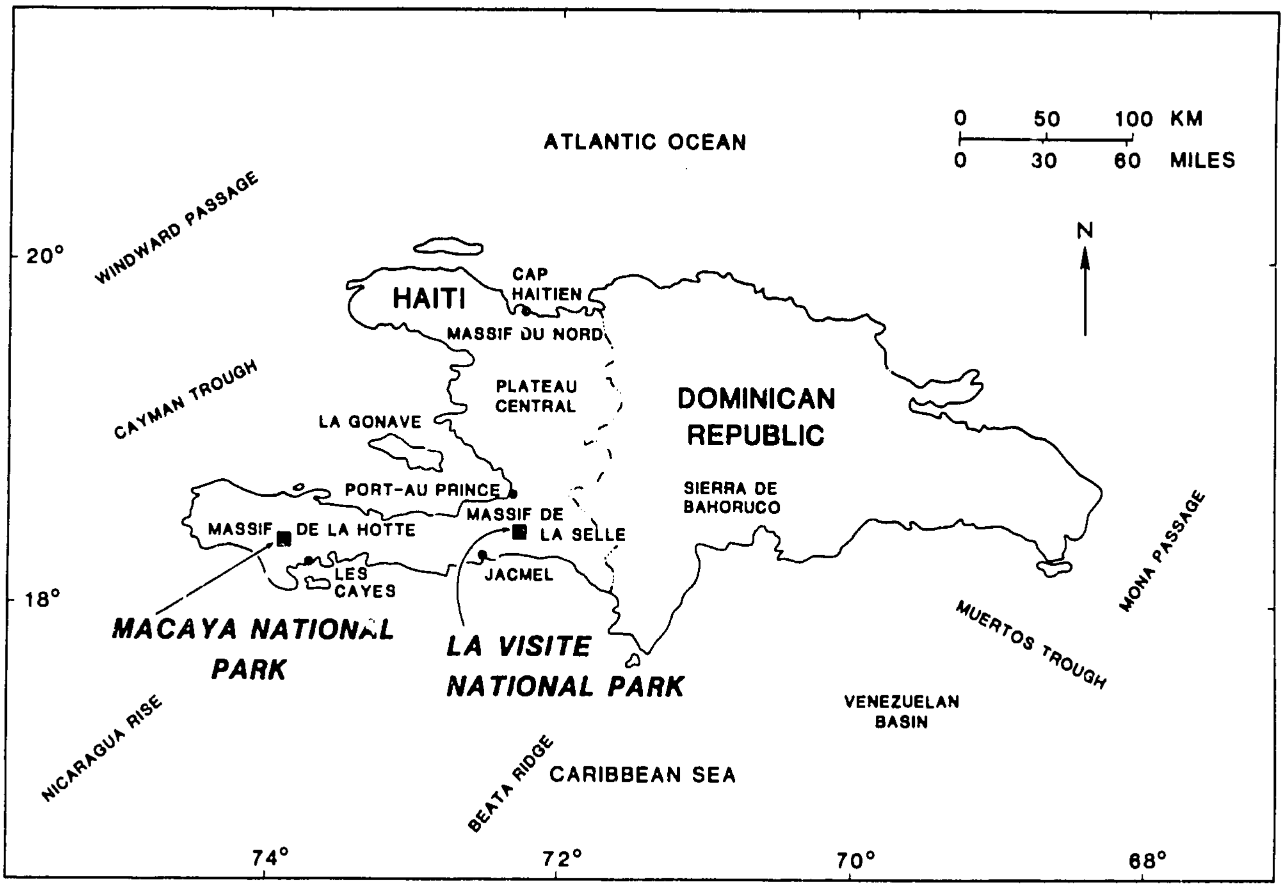

Figure 1. Geographic location of Hispaniola, Macaya and La Visite National Parks, and surrounding regions.

Figure 2. Sketch of folding and "boudinage" of calcite views in Macaya Formation, elevation 1050 m, Grand Ravine du Sud.

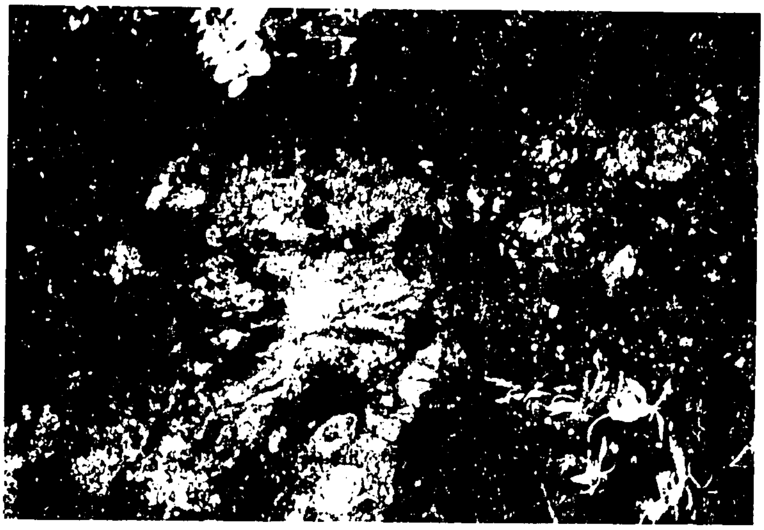

Figure 3. Outcrop of breccia just south of park boundary at ca. 1300-1400 m. This and similar outcrops may represent the broken and transported E-W trending fault zone that is extensively developed in the Southern Peninsula.

Figure 4. Relatively youthful, steep-sided slopes in Grand Ravine du Sud that suggest active uplift. View looking generally NE from ridge E of Pic Formon in Macaya National Park.

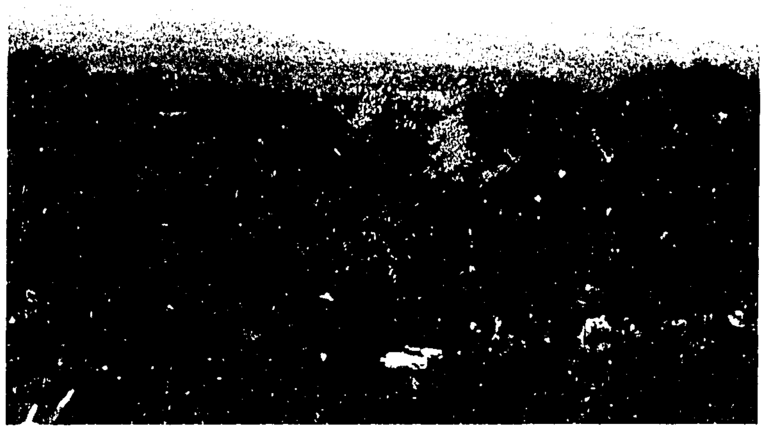

Figure 5. Residual weathering cones formed by Karst processes, on Les Plantons to the SE of Macaya National Park. Massif de la Hotte is in the background below cloud cover.

Figure 6. View of La Selle Escarpment looking roughly to the east. The cliffs are formed by the Neida Formation and the valley to the north by the Demisseau Formation.

Figure 7. Pillow structures in basaltic composition rocks of Demisseau Formation; located at ca. 1600 m on road to Kenscoff just at NW park boundary (to the W of Morne La Visite).

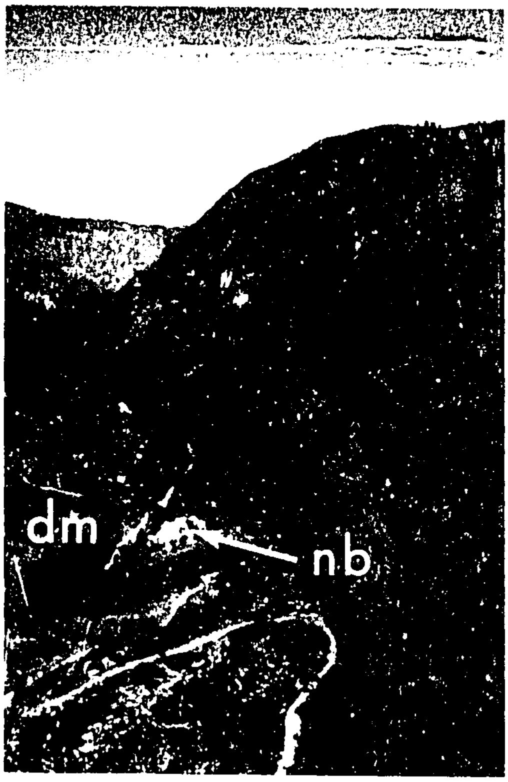

Figure 8. View of west side of Morne La Visite taken from the west. Note contact between Neiba (NB) and Demisseau (DM) Formations, which probably represents a fault plane or zone.

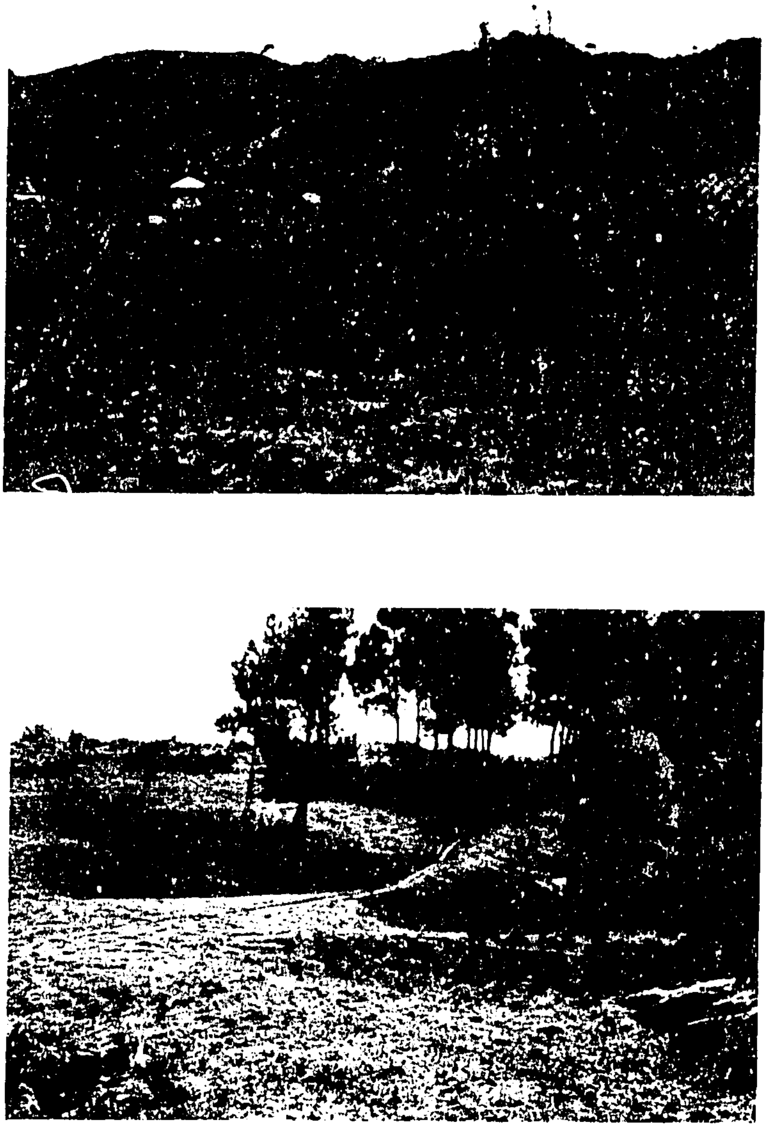

Figure 9. Residual cone and doline collapse features in La Visite National Park.

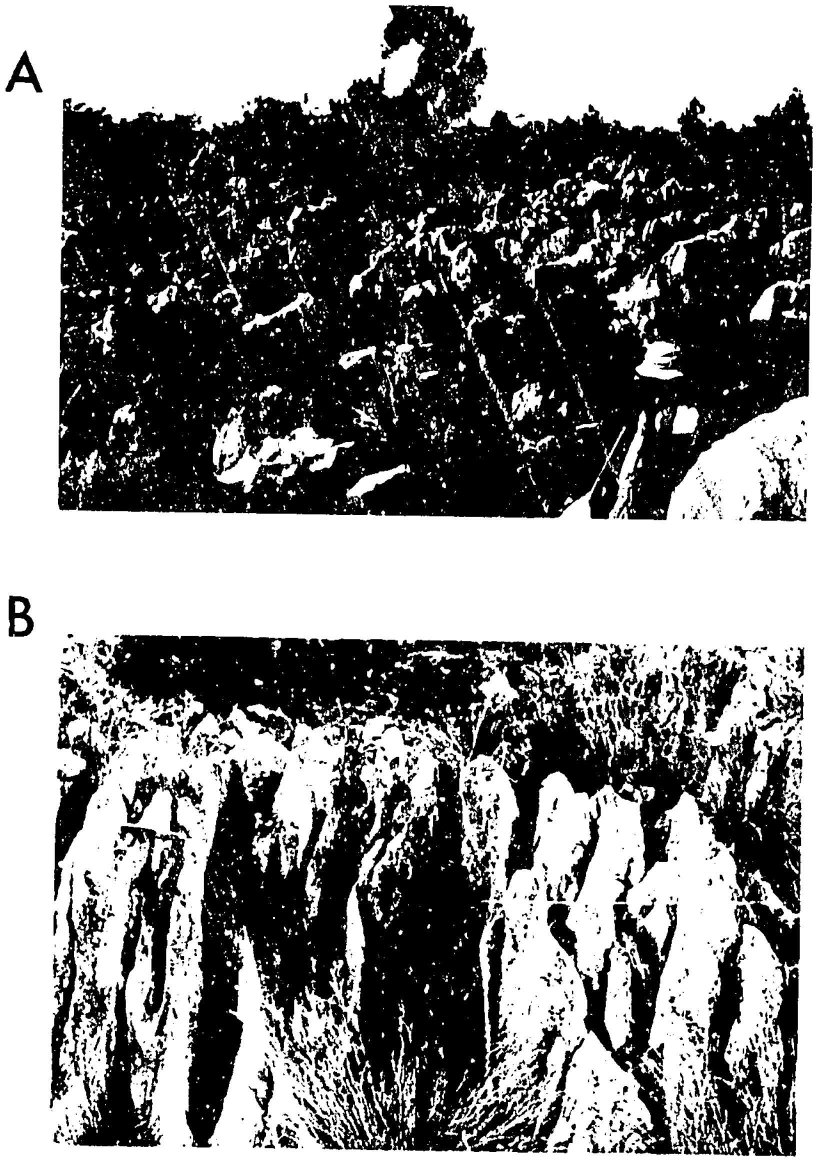

Figure 10. Small-scale weathering features of Neiba limestones, La Visite National Park. A. Residual outcrops. B. Troughs and crests.