SURVEY OF THE GEOLOGY OF HAITI

GUIDE TO THE FIELD EXCURSIONS IN HAITI

OF THE

MIAMI GEOLOGICAL SOCIETY

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By

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The tenth physiographic unit of Hispaniola lies west of the Jacmel-Fauché depression. It is referred to broadly as the Massif de la Hotte (Figures 2,4). This unit is physiographically more complex than suggests the single name attached to it. In fact two distinct orographic sub-zones can be recognized north and south of the Trans-Xaragua fault which transects the area diagonally (Figure 3). This fault system includes from east to west, the low-land area of the Etang de Miragoâne, the Vallée de Fond des Nègres, Vallée de l'Azile, and the valley of Rivière des Anglais and Riviere de Tiburon.

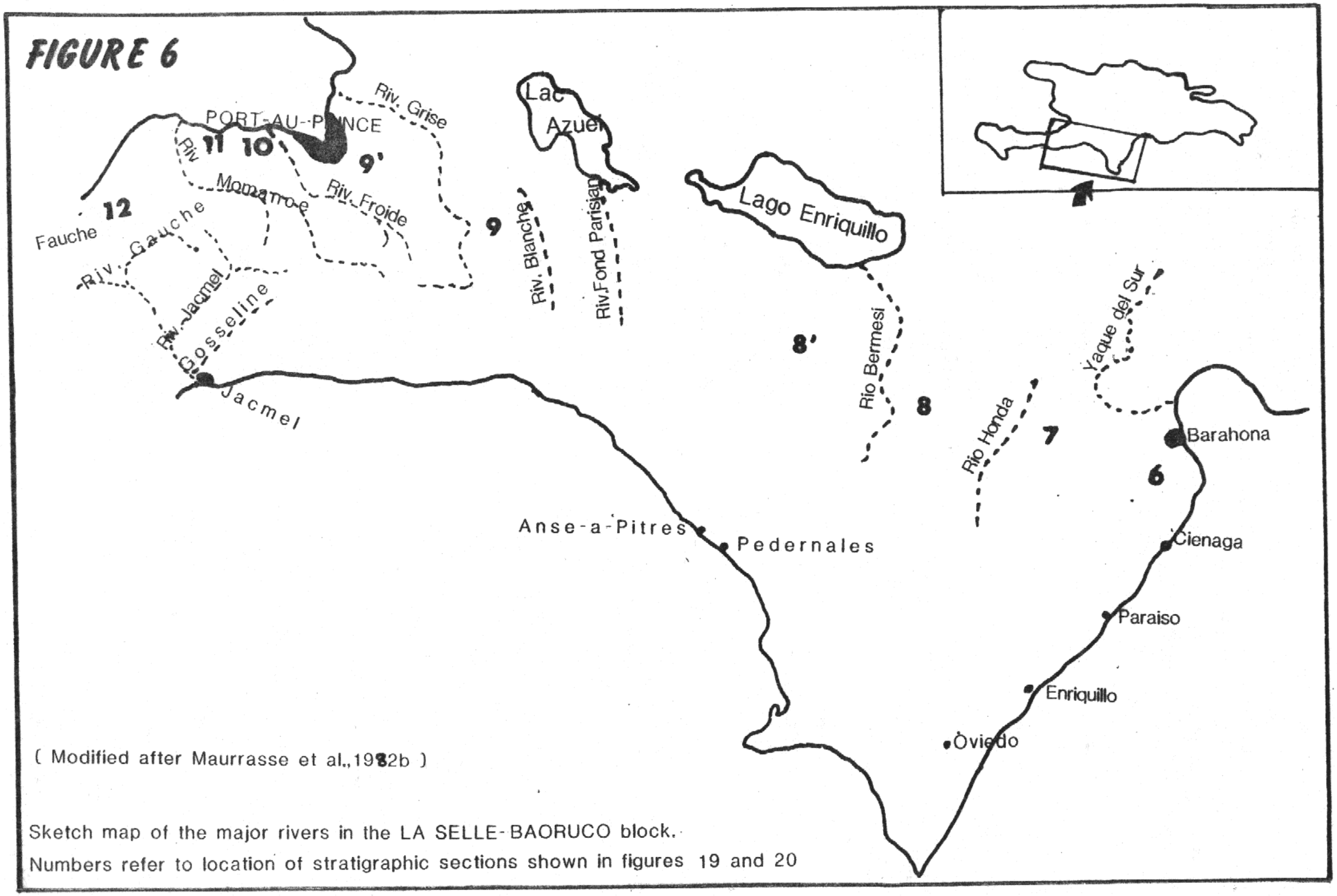
North of the fault system, and in a similar direction, the mountains of Bonnet Carré, Plateau de Rochelois and Macaya Massif form a series of reliefs controlled by secondary fault systems. The highest elevation of the La Hotte Physiographic unit, Peak Macaya (2347 meters) is one of these uplifted blocks bounded by multidirectional or orthogonal fault systems. The Monts Cartaches at the extreme northwest end of the Peninsula is also a fault-controlled subunit, (Figures 3,4).

South of the Trans-Xaragua fault, other fault-controlled reliefs form the remainder of the La Hotte physiographic unit. They include Morne Saurel and Fond des Negres. Geologically the La Hotte physiographic unit is more complex than its eastern counterpart in the Southern Penninsula. It is more intensely deformed and its Lithofacies more diversified than those found in the La Selle-Baoruco block. Its basement is composed of intensely deformed rocks of the Dumisseau formation. In certain areas extreme multiphase deformations led to extreme dislocation of originally continuous lithologic unit giving rise to a tectonic melange, as can be seen on the road Carrefour Dufort - Jacmel (Figure 9).

GENERAL STRUCTURAL SETTING

Given its medial position relative to the major structural features of the Caribbean (Figures 1, 10), the island of Hispaniola may be considered the structural hub of the region. As can be seen in figure 1, Hispaniola lies at the intersection of the main tectonic features of the present Caribbean plate, and most of its major structures can be related to wrench-fault tectonism between the eastward moving Caribbean plate and the westward moving North American plate. Added complexity developed because of differential motions between the sub-blocks, and also changes in stress field during differential rotations between the major adjacent continental plates (Ladd, 1976). Consequently, a complex orthogonal fabric of dislocation has developed throughout the island, and in the adjacent Caribbean Sea as well (Case and Holcombe, 1980). Most of the major fault systems indicated earlier have been activated several times and diachronically, the latest cycle of activity was Late Pleistocene (Maurrasse, 1982). These fault systems have apparently played a major, if not the most important role, in the distribution of sedimentary environments throughout the geologic evolution of Hispaniola. Their differential motions through time led to the development of series of troughs and banks, sometimes individual islands. These early features heralded the present structural setting of the island, as defined by the major physiographic units discussed herein above.

FIGURE 6



(Modified after Maurrasse et al., 1982b)

Sketch map of the major rivers in the LA SELLE-BAORUCO block.
Numbers refer to location of stratigraphic sections shown in figures 19 and 20

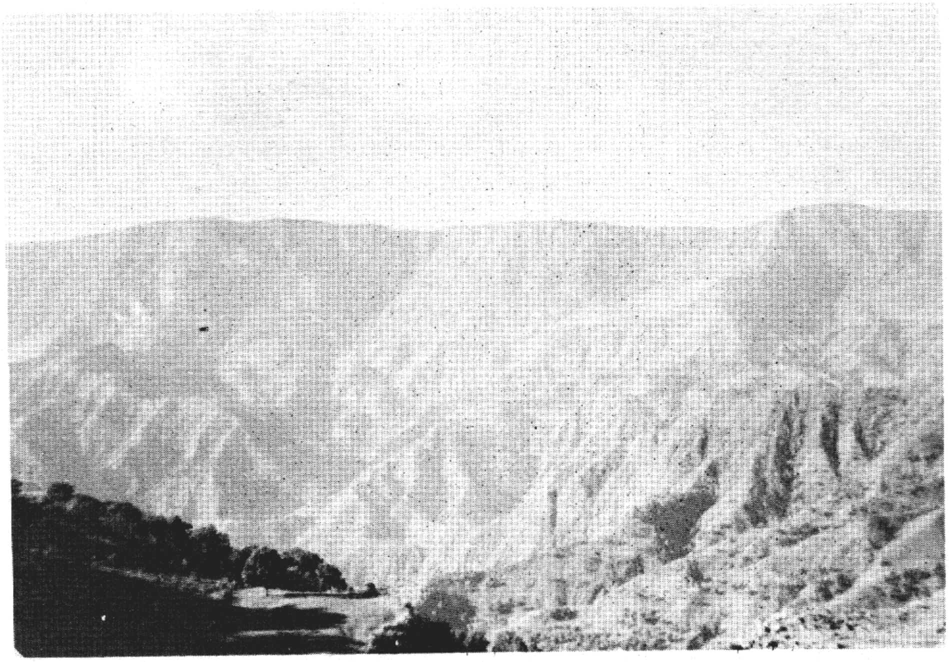
1920). Most of the clastic supplies appear to have derived from alluviums carried by Riviere Grise and the Rio Yaque del Sur at least throughout the Neogene (Maurrasse et al., 1980 b; 1982b). Other smaller rivers shown in figure 6 have also played limited roles in providing clastic sediments to the basin. The youngest rocks exposed in this physiographic unit consist of pleistocene coral reefs, which are exceptionally well preserved and occur along the edges of the central region.

Late Pleistocene compressions caused considerable deformation along the edges of the depression where there is limited thrust faulting, and significant uplift.

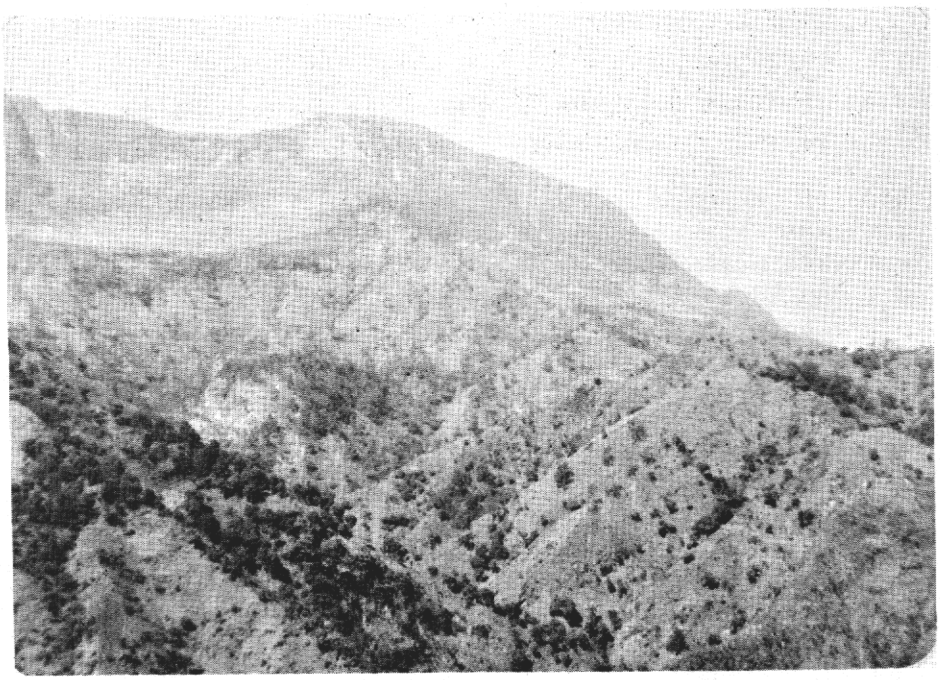
As pointed out earlier, the southern part of the island south of the Cul-de-Sac/Enriquillo graben is very distinct from the northern areas in their overall structural trend. The southern part can be further subdivided into two major physiographic units separated by the Jacmel/Fauche depression (figures 2,3).

The ninth physiographic unit of Hispaniola consists of the mountains east of the Jacmel/Fauche depression. They are known as the Massif de la Selle in Haiti, and the Sierra de Baoruco in the Dominican Republic. They form a unit recently described as the La Selle-Baoruco block (Maurrasse et al. 1980, 1982b) in which the geologic setting is much reminiscent of the adjacent Beata Ridge (figure 1). This mountain range shows extremely constasting reliefs as the areas of limestone terranes exhibit extensive Karst features whereas the igneous terranes develop smoother, but much steeper, reliefs. Dip-slopes along the flanks may be greater than 60^{o} angle (figure 7). The highest summits of the Southern Peninsula, namely the Peak La Selle (2674 meters) and Peak Loma del Toro (2367 meters) occur in this unit (Figure 3). The river valleys (Figures 6,8) in this region are mostly controlled by major and minor fault systems which transct the mountains. The most spectacular fault scarps of the islands are found in this physiographic unit where the most remarkable faults are those related to the Momance-Riviere Froide Fault (figure 8), the La-Selle Fault (Figure 8) and the Cienaga-Paraiso-Enriquillo Fault (Figure 3), respectively. Most of the topography of the La Selle-Baoruco block appears to be controlled by high-angle, partially tilted faults which gave rise to complex step-like plateaus with sharp drop-off edges asymmetrically distributed on either side of the main axis. These structural plateaus are best developed south of the axial region where the topography displays a series of spectacular steps which lead practically down to the adjacent Venezuela Basin in a sharp drop off (Maurrasse et al., 1979a), much in the same manner described by Roemer et al. 1976 for the northern portion of the Beata Ridge. A complex of igneous and sedimentary rocks (The Dumisseau Formation, Maurrasse et al., 1979a) constitutes the basement rocks which are overlain by limestones of various lithofacies. Many rock formations have been described from this area (cf. subsequent paragraphs in this field guide). Faster weathering of the igneous rocks in the central region of the Massif de la Selle has developed a relief reversal in the igneous rocks, which presumably stood higher than the limestone areas.

FIGURE 7



a: View looking south at the La Selle Escarpment. High cliff is of Eocene limestones - Sharp crested ridges below are igeous rocks of the Dumisseau Fm.



b: View looking south-southwest at the La Selle Escarpment. Mount Cabaio shows denuded fault scarp in center of picture.

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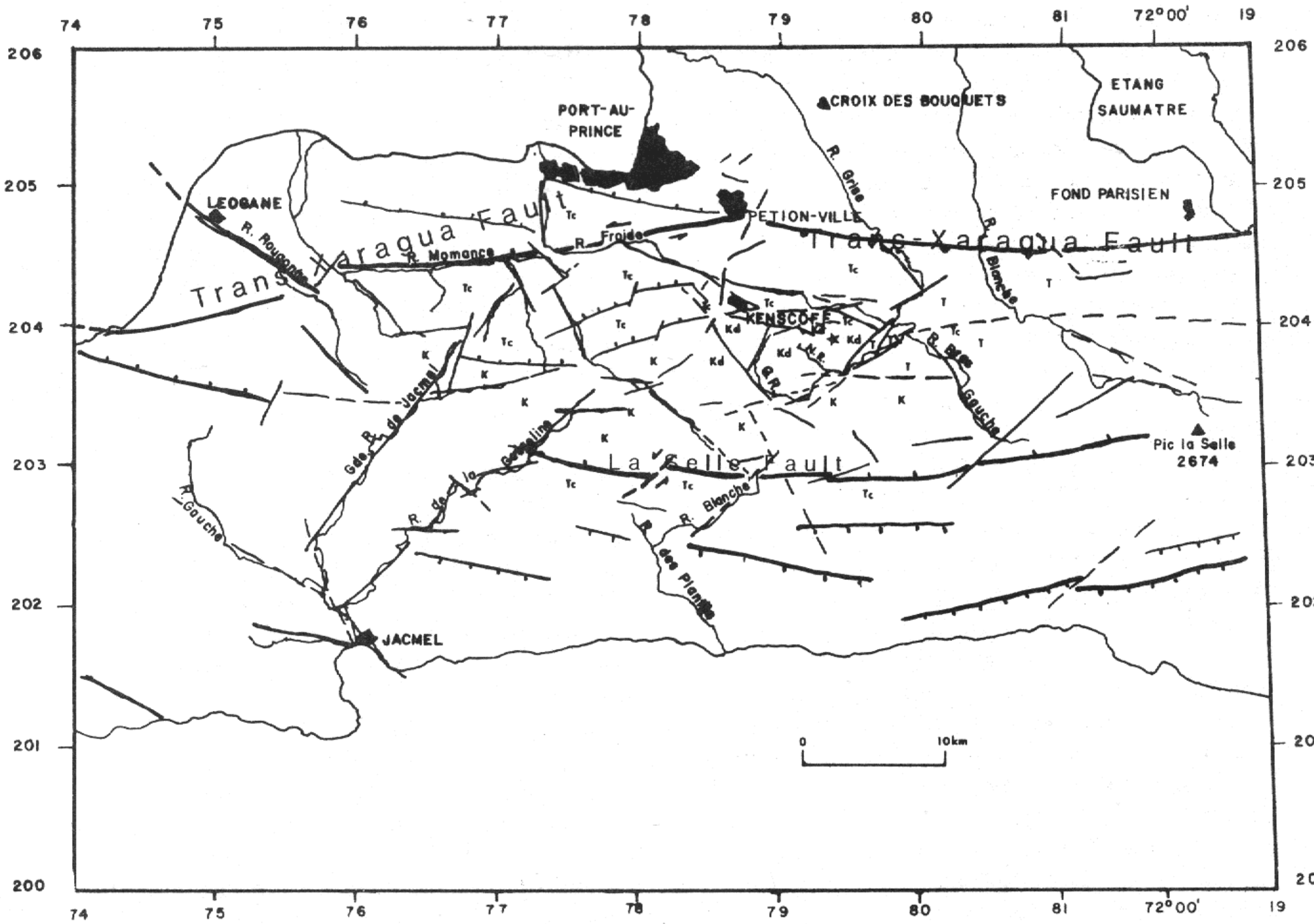
FIGURE 8



(From Maurrasse et al., 1979).

a: Simplified structural map of the eastern portion of the Southern Peninsula of Haiti. GR = Grande Riviere; RN = Riviere Nan Roseau; T = undifferentiated Tertiary (Miocene) rocks; Tc = Eocene limestones; K = Cretaceous: igneous and sedimentary complex of the lower member type; K_D = Cretaceous: igneous and sedimentary complex of the St. Dominique Member; ★ shows Dumisseau.

b: Sedimentary layers intercalated with basalts, Dumisseau Fm.

As can be seen from Figures 1, 10, Hispaniola is bounded and transected by major fault systems related to major structural dislocation along the northern edge of the Caribbean plate. These major fault zones also coincide with intense source of seimic activities on the island (Scherer 1912; Sykes and Ewing 1965; Molnar and Sykes 1969; and others). Nonetheless, an intense source of intermediate earthquake foci has also been reported beneath the eastern end of Hispaniola (Sykes and Ewing, 1965), although there is no known surface dislocation in the area. The hypocenters further show an apparent increase in depth dipping beneath the island. Bracey and Vogt (1970) suggested that such distribution pattern of the earthquake foci represent an actual underthrusting zone toward the southeast. They also indicated that the unnderthrusting plane could vary in dip from about 11° in the northeast to 60° in the southeast areas. The small underthrusting slab would have a hinge fault at its southeastern and northwestern ends, which would mark the juncture of the Puerto Rico and Cayman fault systems (Bracey and Vogt, 1970). Molnar and Sykes (1971) objected to this interpretation on the basis that there are no historically active volcanoes in eastern Hispaniola. Furthermore, they pointed out the fact that the seismic pattern scatters considerably over Hispaniola, and west to Jamaica. Thus, deformation inducive to seismic activities on the island is probably taking place over a broad fault zone or fault system, and a simple plate boundary between the Cayman Trough and the Puerto Rico Trench would not appear to exist (Molnar and Sykes, 1971). This view is compatible with the actual complexity of the fault systems of the island (figure 3), as previously mentioned. Nonetheless, Frankel (1982) reported that a composite focal mechanism for microearthquakes along the northeastern border of the Caribbean plate indicates that oblique underthrusting of the North American plate beneath the Caribbean plate occurs in the area farther east of Hispaniola. The oblique motion is accomodated along a thrust plane that dips at a relatively shallow angle beneath the Virgin Islands platform.

GEOLOGY

Taking account of the wealth of information that has become available on the geology of Hispaniola during the past ten years or so, it has also become clear that a revision of the geological history of the island is wanting. Nonetheless, it should be recognized that early works such as those by Tippenhauer, 1899, 1909; Jones, 1918; Vaughan et al., 1921; Woodring et al., 1924; Butterlin, 1954, have served worthy purpose and deserve commendation.

Recent summaries synthesizing the geologic history of the island based on most data gathered in the sixties and seventies have been given by Bowin (1975), and Lewis (1980). A model suggesting a possible scenario for the evolution of Hispaniola and the Caribbean as a whole has also been discussed by Maurrasse (1982c). In the present guide the writer will not attempt to reconstruct the detailed geologic history of the island, but will instead discuss some aspects of the paleogeography and tectonic of the island as can be deduced from the geologic record examined during the field trip.