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Matina then Matigwana,

two large islands that have formed over time geologically emerged parts of the southern arc of the eastern Caribbean.

by

Marcel BOURGADE

november 2020

Our demonstration from 2013 of the peculiarities of the endemic herpetofauna of the South East of Martinique, and particularly our study of Sphaerodactyls, and of the first molecular biology data relating to species of endemic herpetofauna of the Eastern Caribbean, led us by logical deduction to fundamentally reconsider the geological history of our region.

Thus in 2019, we published a summary of our analysis and interpretation of the observed facts relating to this endemic herpetofauna of Martinique, under the title:

"What the phylogeny of the herpetofauna of Martinique tells us"

Subtitle: "Reptiles and amphibians endemic to Martinique and geological history of the Eastern Caribbean".

Today following a study which has just appeared in the American journal "Plos one", a study still in progress, carried out in part thanks to a mission by the ship Atalante, departing from Guadeloupe, in 2017, and co- directed by a researcher from the University of the Antilles, Melody Philippon, lecturer in Geoscience (Guadeloupe pole), specialist in plate tectonics; study which has already resulted in the demonstration of the ancient existence of an island, "Granola"; thus baptized as a large island in the north of the eastern Caribbean, comparable in size to that of the present-day Greater Antilles (western Caribbean). "An island now submerged, but which, tens of millions of years ago, would have served as a land bridge between Puerto Rico, Saba, and the northern islands. A continental bridge crossing the Caribbean Sea from north to south about 35 million years ago. A large island that has disappeared, because now at the bottom of the Caribbean Sea. ";

<https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0241000#sec001>

and <http://www.univ-ag.fr/actualites/granola-une-grande-ile-des-antilles-aujourd'hui-disparue?width=800&height=auto&inline=true>

we consider that we have to confirm our deductions as to the existence identically and at the same period as the so-called "Granola" island, as an extension to its south, of another large island that we also baptized, "Matina": I island existing between 55 Ma and 35 Ma ago, which included the present-day Grenada, Grenadines Islands, Saint-Vincent, Saint-Lucia and Martinique. These two large and long islands of the eastern Caribbean arc, Matina and Granola, dating from the Eocene, positioned at the extreme east of the Caribbean plate,

constituting a first bridge or central American isthmus, conducive to dispersal by land of animal and plant species originating from the proto Orinoco basin. **(Fig. 1)**

Our interpretation of the molecular biology data of the micro herpetofauna of the eastern Caribbean, leads us to deduce that the strait north of Martinique, “Canal de la Dominique”, was formed much earlier than that between proto Martinique and proto Saint-Lucia. The genetic divergence between the Anolis of the *Dactyloa* and *Ctenonatus* groups attests to the very ancient existence of the geographical barrier formed by this channel from Dominica to the north of Martinique. Indeed, the still current range of *Dactyloa* corresponds almost to the position and extent of the old island of Matina; and that of the *Ctenonatus* corresponds to the position and extent of the ancient island of Granola. The *Dactyloa* diverged from the Anolis of the Orinoco Basin 37 Ma ago; and the *Ctenonatus* diverged from the *Dactyloa* 50 Ma ago. That is to say that the Anolis of the *Ctenonatus* group today present in Dominica are very distinct from those *Dactyloa* present a few kilometers in Martinique.

The common ancestors of Anolis *Dactyloa* and *Ctenonatus* 50 Ma ago would have separated from the coast of the Orinoco basin, some *Dactyloa* crossing the eastern Caribbean bridge, spreading over the island of Matina, and the others spread over the long island of Aves constituting a second bridge leading to the proto Puerto Rico and on the island of Granola.

Thus, speciation processes took place for a number of species constituting a very ancient endemism of the Eastern Caribbean, dating from the time of the existence of the islands of Matina and Granola. Knowing that these large islands were submerged and gradually disintegrated; and that as of 25 Ma ago, from Granola, only a few island banks remained to the north, east of Puerto Rico; and that of Matina, there remained only banks of islands mainly of proto Martinique. **(Fig. 2)**

Among these genera and species of herpetofauna, the ancestors of the Anolis, isolated for a time on Granola and Matina respectively, but also the ancestors of the Hylodes amphibians of the genus *Eleutherodactylus*, *E. johnstonei* (Barbour, 1914), *E. martinicensis* (Tschudi, 1838), ...

For small amphibians the dispersion is even older than for reptiles and confirms the existence of an isthmus more than 40 Ma ago, ranging to 100 Ma. Thus for hylodes of the genus *Eleutherodactylus martinicensis* and *E. johnstonei* from the eastern Caribbean. This group of species diverged very early from the Hylodes of the Greater Antilles (between -46 and -36 Ma; Hedges *et al.*, 2015).

But also a process of speciation of terrestrial mammals now extinct, such as the Pilory Rat or Musk Rat, an extinct endemic species of Saint Lucia and Martinique, having also extinct cousin on the bank of Puerto Rican islands, where its fossils.

Almost only 25 Ma ago, proto Martinique, made up of a bank of islands from the proto Caravelle peninsula and the larger one of Sainte-Anne, remained emerged. The island banks of the proto Saint Lucia found themselves at this period almost submerged, as well as those further east of the proto Barbados.

Also, we baptize Matigwana, the island having existed between approximately 35 Ma and 29 Ma ago, of which Saint Lucia and Martinique were part.

(Fig. 3)

The *Sphaerodactylus microlepis* of Saint Lucia, close to the *Sphaerodactylus* of the current South East of Martinique, is still an indication of the ancient existence of one and the same island; the nearby proto Barbados constituting a much larger surface area, at the same period of existence of Granola; and same period of existence as the long island of Aves, constituting the second bridge between proto basin of the Orinoco and proto Puerto Rico.

The mammal Rat Pilori, an extinct species endemic to Saint Lucia and Martinique, having also extinct cousin on the Puerto Rican islands, is then another clue that corroborates our analysis relating to genera and species of herpetofauna. Indeed, as already mentioned, if we add to these species of herpetofauna strictly endemic to proto Martinique, the data of the rare or even unique presence for the eastern Caribbean of an endemic species of terrestrial mammal (non-flying) , the Pilori Rat or Martinique Muskrat *Megalomys desmarestii* (J. Fischer, 1829), which suffered greatly from the introduction of the rat (*Rattus rattus*) and the small Indian mongoose (*Herpestes edwardsi*), and which was observed alive in Martinique until 1897, 1902, which died out with eruption of Mount Pelée (on whose sides were the last specimens); species on proto Martinique which also would have dispersed towards proto Saint Lucia to generate *Megalomys luciae* (Forsyth Major), also extinct in 1881, one of the last specimens of which died in a zoo in London in 1852, we can then find convinced of the past existence of land bridges between the Orinoco basin and the Greater Antilles, with large and long islands (Aves, Granola, Matina, etc.) which have disappeared and which have been left as their only refuge (concerning Matina) for this terrestrial mammal, first the island of Matigwana, then the proto Martinique. Species close to this large Pilori Rat from Martinique of the same family of Cricetidae, also extinct in the island of Puerto Rico (Greater Antilles north of Granola) have certainly taken the land bridges of Aves and the Eastern Caribbean to find their way, disperse from their center of origin of the Orinoco basin. And this, knowing that it is much more complicated for a land mammal than for reptiles and amphibians to migrate over very long distances at sea on a plant raft.

(Fig. 4)

(Fig. 5)

Hylodes *Eleutherodactylus coqui* from the Puerto Rico Bank (Granola), with endemism of the same age as *Eleutherodactylus johnstonei*, *E. martinicensis*, ... from the eastern Caribbean and Martinique (Matina):

Beyond the non-respect of the precautionary principle in the event of real scientific uncertainties, relative to decisions of the French Ministry of the Environment of classification or not of taxa, in the rank and status of invasive alien species for Martinique, central island and exceptional of the Eastern Caribbean by its geological history; if we admit the evidence of the existence since the Eocene of very old and large islands of Granola north of the Dominica channel, Matina, then Matigwana (which included Saint Lucia and Martinique) , it becomes logical to consider the problem of "an uncertainty as to the location of precise places of speciation", as to the choice therefore between the current islands of Saint Lucia, and Martinique, and secondarily Barbados, for species whose molecular biology attests to the certainty of an endemism in the Eastern Caribbean, as being an almost false debate; this is particularly the case for the ancestors of *Eleutherodactylus*, *E. johnstonei*, *E. martinicensis*, etc. who started the process of speciations very long ago on the large island of Matina, then on the one and the same island of Matigwana, understanding and integrating the positions geographical areas of the current islands of Martinique and Saint Lucia.

There is therefore indisputable existence of evidence from Martinique of dispersal for 50 Ma (millions of years) of non-aquatic, refugee fauna that have remained isolated and have evolved on islands in proto Martinique since 35 -33 Ma:

(Fig. 6)

(Fig. 7)

Fig. 6 & Fig. 7 based on published maps of the work and studies by Philippon M et al. (2020). Eocene intra-plate shortening responsible for the rise of a faunal pathway in the northeastern Caribbean realm.

(Fig. 8) Rat Pilory from Martinique *Megalomys desmarestii* (J. Fischer, 1829), extinct species. Naturalized specimen exhibited in the Grande Galerie de l'Evolution at the National Museum of Natural History, in Paris. *Megalomys luciae* (Forsyth Major), also extinct in 1881, was also present in Saint Lucia.

(Fig. 9) The Agouti (*Dasyprocta antillensis*) is a species of rodent, which was first described in 1758 by the Swedish naturalist Carl Von Linné (1707-1778). The taxon retained for the Agouti species destroyed in the 18th century in Martinique, but which still exists in Guadeloupe, is: *Dasyprocta leporina*. Currently grouped together in this species *Dasyprocta aguti* (Virgin Islands): *D. albida* (Grenada, Saint-Vincent), *D. antillensis* (Saint-Lucia), *D. noblei* (Dominica, Guadeloupe, Montserrat, Saint-Christophe-et-Niévès), which formerly referred to agoutis from the eastern Caribbean.

(Fig. 10 & Fig. 11) Hylodes of Martinique

Remarkable diversity observed in Martinique of patterns and shades both of the hylode *Eleutherodactylus martinicensis* (Tschudi, 1838) (Fig. 11), and for *Eleutherodactylus johnstonei* (Barbour, 1914) (Fig. 10) :

(Fig. 12) *Tetracheilostoma*, very probably 2 to 3 species are sheltered by Martinique, and only one species identified for Saint Lucia; as well as a single species present in Barbados.

(Fig. 13) *Sphaerodactylus*, idem, very probably 2 to 3 species existing in Martinique, and only one in Saint Lucia. Dispersions attested from lineages from Martinique to Saint Lucia, Saint Vincent, Grenadines, and Dominica.

(Fig. 14) *Dactyloa roquet* (Bonnaterre, 1789), strictly endemic to Martinique, dispersal to Barbados and Saint Lucia.

(Fig. 15) *Leiocephalus herminieri* (Dumeril & Bibron, 1837), extinct species strictly endemic to Martinique.

(Fig. 16) *Mabuya mabouya* (Bonnaterre, 1789) and *Capitellum metallicum* (Plée, 1820) two species of two genera endemic to Martinique which have been extinct for more than a century. (Photographs and text taken from the Atlas of Amphibians and Reptiles of Martinique, Maël DEWYNTER)

(Fig. 17) *Iguana delicatissima* (Laurenti, 1768), endemic to the eastern Caribbean, here very present in the Morne Jacob massif in the north of Martinique. Old endemism not yet estimated according to current knowledge (?).

(Fig. 18) *Thecadactylus rapicauda* (Houttuyn, 1782), endemic to the eastern Caribbean, widely represented in Martinique. Old endemism not yet estimated according to current knowledge (?).

(Fig. 19) *Gymnophthalmus pleii* (Bocourt, 1881), an almost endangered species endemic to Martinique and Saint Lucia. Old endemism estimated at the state of current knowledge probably since 10 Ma (?).

(Fig. 20) *Allobate chalcopis* (Kaiser, Coloma & Gray, 1994), a threatened species strictly endemic to Martinique. Old endemism estimated at the state of current knowledge probably since 10 Ma (?). (Photographs and text taken from the Atlas of Amphibians and Reptiles of Martinique, Maël DEWYNTER).

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Figures :

Fig. 1

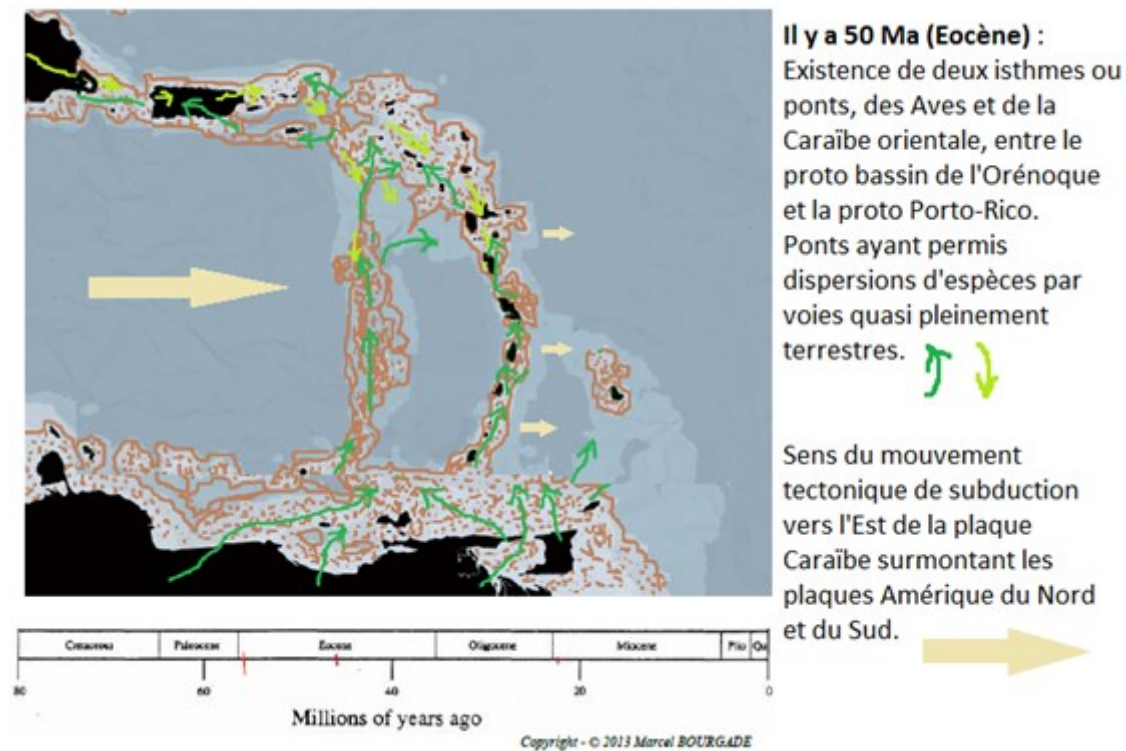
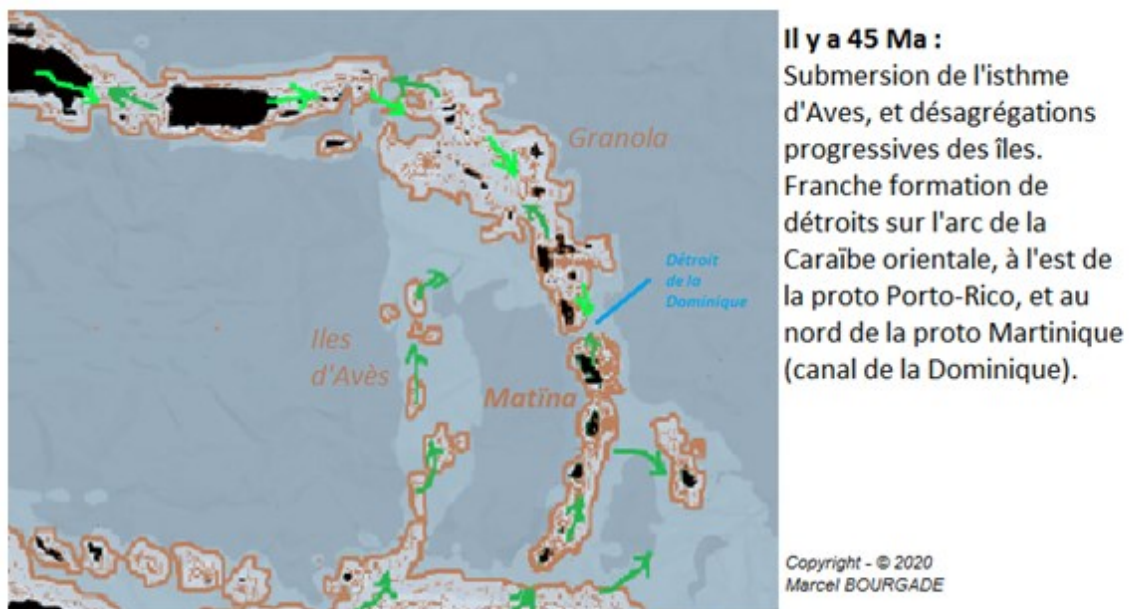


Fig.1

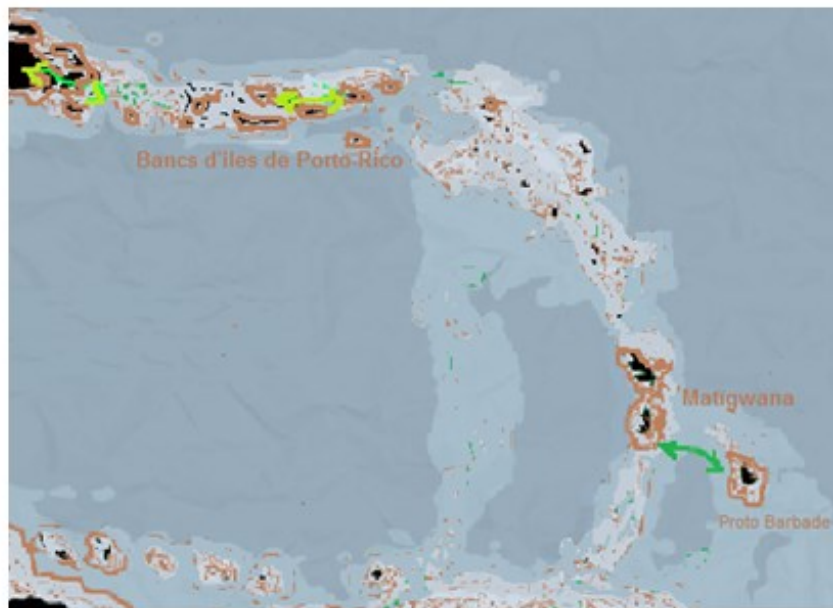
Fig. 2



Suite études menées depuis 2017 et toujours en cours par la chercheuse de l'Université des Antilles, Melody Philippon, maître de conférence en Géoscience à l'Université des Antilles (pôle Guadeloupe), spécialiste de la tectonique des plaques, ayant baptisé du nom de Granola, la grande île faisant l'objet de ses recherches sur l'étendue nord de la Guadeloupe ; nous avons pour notre part à partir de nos cartes établies en 2013, aussi dénommé "Matina" : l'île existant entre il y a 55 Ma et 35 Ma, dont faisaient partie les actuelles Grenade, îles Grenadines, Saint-Vincent, Sainte-Lucie et la Martinique. Puis dénommer aussi, Matigwana, l'île existant entre il y a environ 35 Ma et 29 Ma, dont faisaient partie Sainte-Lucie et la Martinique.

Fig.2

Fig. 3



Il y a 37 Ma jusqu'à 29 Ma :
Submersion de la grande île récemment nommée "Granola" (2017), et maintien de bancs d'îles constituant la proto Porto-Rico. Submersion d'une grande part du sud de notre "Matina"; maintien de bancs d'îles de la proto Barbade, et d'une île que nous nommons Matigwana, dont faisaient partie la proto Sainte-Lucie et la proto Martinique.

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Notre interprétation des données de biologie moléculaire de la micro herpétofaune de la Caraïbe orientale, nous conduit à déduire que le détroit au nord de la Martinique, Canal de la Dominique, s'est constitué bien plus anciennement que celui entre la proto Martinique et proto Sainte-Lucie. Et donc fût depuis l'Éocène jusqu'à - 37 Ma un canal, constituant "barrière écologique" entre la dite île de Granola et celle que nous nommons Matina. A compter de -37 Ma demeure émergée insulaire que nous nommons Matigwana, constituée de la proto Martinique et proto Sainte-Lucie.

Fig.3

Fig. 4



Il y a 25 Ma :
Submersion de l'île de Matigwana; la proto péninsule de Sainte-Anne et la proto péninsule de la Caravelle (bancs d'îles de la proto Martinique) demeurent émergées. Bancs d'îles de la proto Sainte-Lucie, Gros Ilet et Ilets Maria, quasiment submergées; ainsi que bancs d'îles de la proto Barbade.

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Fig.4

Fig. 5

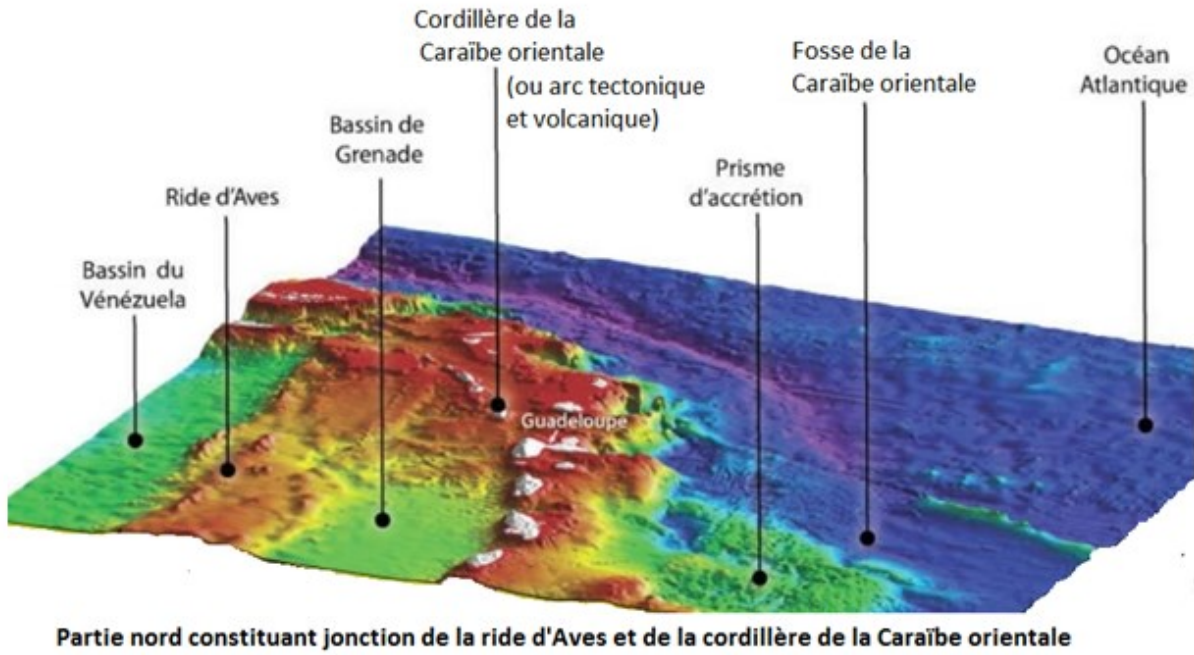


Fig. 5

Fig. 6

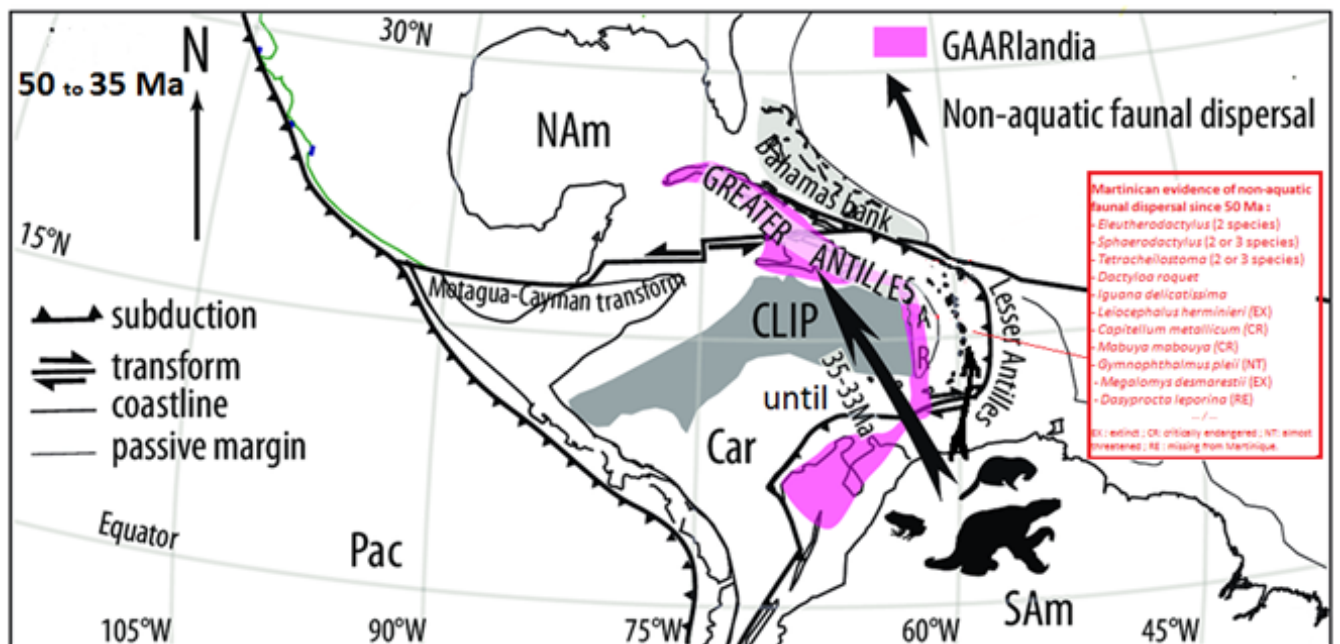


Fig. 6

Fig. 7

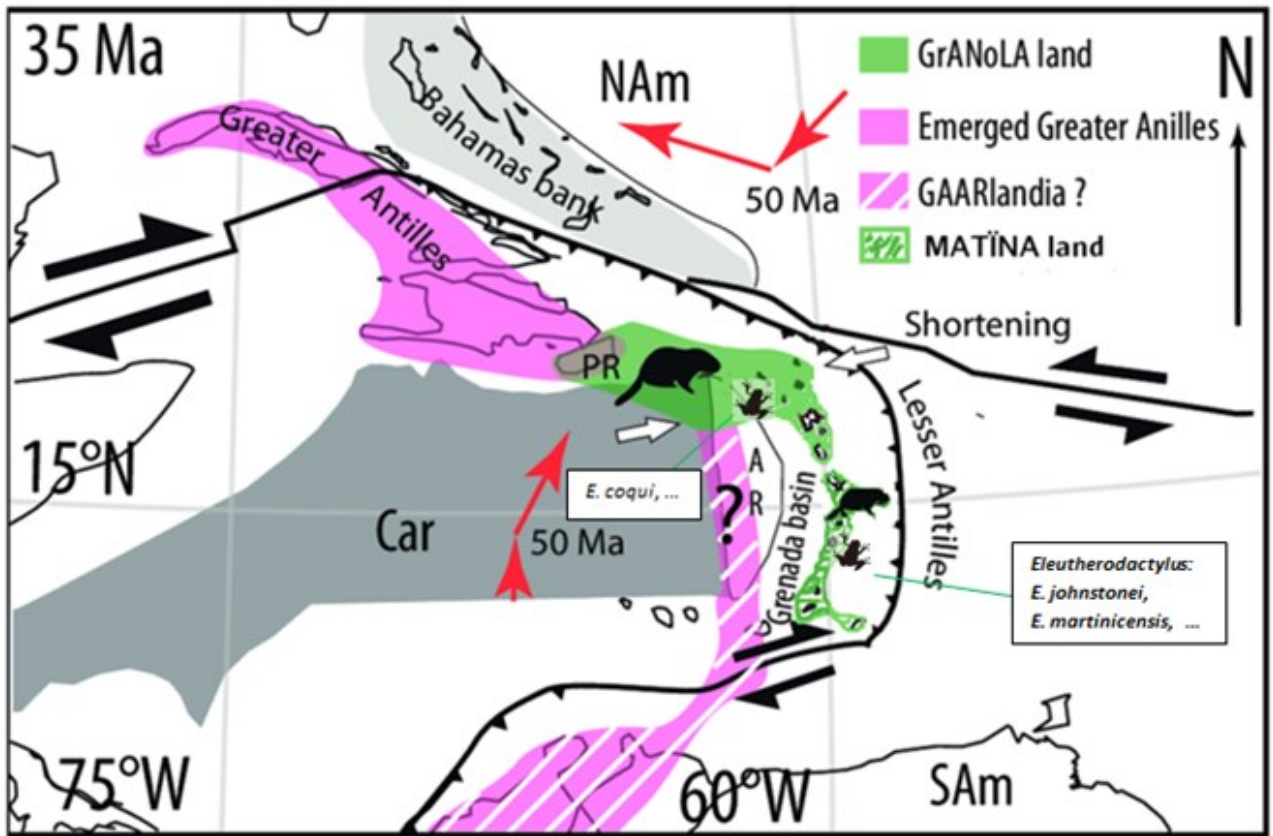


Fig. 7

Fig. 8



Fig. 8

Fig. 9



Fig. 9

Fig. 10

Quelques exemples de spécimens de l'espèce *Eleutherodactylus johnstonei* observés en Martinique:



1

2

3

4

5

1. *E. johnstonei*, spécimen observé sur péninsule du sud-ouest de la Martinique (Anses-d'Arlet)
2. *E. johnstonei*, spécimen observé sur péninsule du sud-ouest de la Martinique (Diamant)
3. *E. johnstonei*, spécimen observé au sud-est de la Martinique (Vauclin)
4. *E. johnstonei*, spécimen observé sur péninsule du sud-est de la Martinique (Sainte-Anne)
5. *E. johnstonei*, spécimen observé au nord-ouest, côte Caraïbe de la Martinique (Schoelcher)

Fig. 11

Quelques spécimens de l'hylode *Eleutherodactylus martinicensis* :



Fig. 12



Fig. 12

Fig. 13



Fig. 13

Fig. 14



Fig. 14

Fig. 15



Fig. 15

Fig. 16



Initialement décrites comme deux espèces différentes, puis longtemps considérées comme faisant partie de la même espèce, les deux scinques endémiques de la Martinique représentent bien deux espèces distinctes appartenant à deux genres (Hodges & Conn 2012). Ces deux espèces sont probablement éteintes depuis plus d'un siècle. En haut, Mabuya mabouia. Une dizaine de spécimens sont conservés dans plusieurs muséums. La planche représente les individus MNHN 5421 [a], BMNH 53.2.4.39 [b] et MCZ R-6048 [c]. En bas, Capriolium maculatum. L'unique spécimen connu de l'espèce est cette femelle de 7,4 cm de longueur du museau au cloaque. Capturée autour de 1820 par Auguste Pléé, elle est conservée au MNHN de Paris sous le numéro MNHN 5424. Modifié d'après Hodges & Conn (2012), <https://doi.org/10.1016/j.reev.2012.03.001>.

Fig. 16

Fig. 17



Fig. 17

Fig. 18



Fig. 18

Fig. 19



Fig. 19

Fig. 20



L'Allobate de la Martinique et l'Hyliode de la Martinique, deux espèces indigènes de l'île, qui présentent des niches écologiques bien différentes. L'Hyliode a une valence écologique bien plus large que celle d'Allobates chaquoyi : cela lui confère notamment une meilleure résistance face aux changements climatiques.

Fig. 20