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**Archaeological investigations between Cayenne Island and the Maroni river : a cultural sequence of western coastal French Guiana from 5000 BP to present**

Bel, M.M. van den

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**Author:** Bel, Martijn Marijn van den

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## The landscapes of the eastern Guianas

### 2.1 The geographical setting

The Guianas are situated in northeastern Lowland South America and consist of five regions, from west to east: the eastern and southeastern part of Venezuela (formerly Spanish Guayana), Guyana (formerly British Guiana), Suriname (formerly Dutch Guiana), French Guiana or *La Guyane* (Department 973 of France) and a large part of northern Brazil, located to the north of the Amazon and east of the Rio Negro Rivers.<sup>34</sup> The latter rivers flow through the vault between the Guiana and Brazilian Shield, i.e. the southern limits of the Guiana Shield (Fr., *Bouclier des Guyanes*). The Orinoco River roughly presents the western limit of the geologic Guianas whereas the Atlantic Ocean represents the northern limits, combining in order to constitute an independent geological formation, better known as the Precambrian Guiana Shield of which 80% consists of crystalline basement rocks (Gibbs and Baron 1993; de Vletter et al. 1998). This shield features two mountainous regions: (a) the Roraima Highlands in the west and (b) the Tumuk Humak in the east. These are divided by the Essequibo and Rio Branco Rivers (Fig. 1.1).

Between the Atlantic Ocean and the Precambrian core, a Tertiary and Quaternary belt stretch parallel to the coast: 10 km in width near Kourou in the east and 120 km wide at the Courantyne River in the west (Delor et al. 2004:211). In French Guiana, the Quaternary deposits correspond to the littoral or lowlands (Fr., *terres basses*) representing *c.*6% of its surface. The Precambrian and Tertiary deposits represent the remaining part, i.e. the upland interior (Fr., *terres hautes*).

French Guiana is situated between 2 and 5° N latitude and 52 and 54° W longitude implying it lies within the equatorial zone of the northern hemisphere. Its tropical humid climate comes with an annual mean of 80% rainfall and four seasons of unequal length, mainly characterized by variations in the volume of rainfall. The Intertropical Convergence Zone (ITCZ) often sweeps French Guiana between November and February and again between April and July, corresponding with the rainy or winter seasons. However, we see significant differences between various years as to shifting seasons or extreme droughts or heavy rainfalls. In general, however, the western coast of French Guiana is drier than the eastern part. Trade winds are predominantly east-north-easterly and the mean temperature is 27° C.

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34 Lowland South America designates almost the entire South American continent excluding the Andes, Pacific Coast, and its southernmost part. Amazonia usually refers to the Amazon and Orinoco drainages (Fausto 2007:498, note 1) or to merely the Amazon River and its tributaries (Erickson 2008:158). The Guiana Rivers that drain into the Amazon River are thus part of Amazonia whereas the northern watershed, draining into the Atlantic Ocean is merely part of Greater Amazonia. See also Fig. 1 in Eva and Huber (2005 ii) for Amazonia including the 'Atlantic Guianas' (*sensu latissimo*) and without (*sensu stricto*).

According to the classification presented by Köppen, the littoral has an equatorial climate (Af) whereas the interior of the country has a monsoon climate (Am).

The Maroni River is the most important drainage (65,000 km<sup>2</sup>) located between Cayenne and Paramaribo. It springs in the Tumuk Humak region at a distance of c.520 km from the coast. Important affluents join the Oyapock and Maroni drainages in the east and the west. When ascending the Tapanahoni River one can not only reach the Courantyne River by means of the converging headwaters of the Sipaliwini Savannah on foot but also the East and West Paru Rivers. Moreover, when ascending the Ouaqui River one can reach the Oyapock River by descending the Tamouri and Camopi Rivers after a hike of between four to five days, which to the present-day is known today as the “Trail of the Émerillons” (Fr., *Sentier des Émerillons*).<sup>35</sup> When travelling along the Marouini River, one reaches the Upper Jari River and eventually the Amazon River. In this manner the interior of French Guiana is accessible to other regions of the Guiana Shield by means of rivers and trails. Here the Tumuk Humak serves as a pivot for the eastern Guianas. Following the planation principle of the Guiana shield, another set of rivers (e.g. the Mana, Sinnamary and Approuague Rivers) is also interconnected at their headwaters which rise at the *Central Massif* near the modern village of Saül. Yet again, these drainages are also connected to the affluents of the larger rivers and thus linked to the entire network of rivers. A third group of rivers (e.g. the Organabo, Iracoubo, Kourou and Cayenne Rivers) originate from the septentrional mountain range. Their sources are also connected to the affluents of the previous set of rivers, providing another link from the Atlantic coast to the Amazon River.

All rivers have tidal estuaries with a mean difference of 2 to 3 m between high and low tide. In general, the tidal influence of each river is discontinued at the first important rapids of which the Hermina Falls in the Maroni and the Maripa Falls in the Oyapock Rivers are perhaps the best known. The Lower Oyapock, Approuague and Maroni Rivers feature several stretched islands, of which the Arouba Islands and Portal Island in the Maroni River are suitable for human habitation. The latter delta also includes numerous winding creeks, such as the Coswine and Wane Creeks. The latter is a lateral creek, i.e. a natural canal, which joins the Coermontibo River. It is in turn a tributary of the Cottica River and finally falls into the mouth of the Suriname River. The former two rivers share an east-west direction. Another similar bifurcation is also found between the Coppename and Courantyne Rivers: the Wayombo Creek. This riverine phenomenon is probably caused by the larger coastal plains of Suriname and is absent in French Guiana. Another interesting feature –rivers flowing from east to west– is the fact that the Oyapock, Maroni and Suriname Rivers are joined in their mouth by another river: the Urucaú, Mana and Nickerie (Marataka) Rivers, respectively.

## 2.2 The geological setting

Geological research in the Guianas started during the 19<sup>th</sup> century but has been hampered by the application of dissimilar terminologies as to each Guiana. The founding of the National Mining Companies in both Suriname and French

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35 See the travels of Jean-Baptiste Leblond (Hurault 1965) or Raymond Maufrais (2014).

Guiana during the latter half of the 20<sup>th</sup> century has increased scientific research concerning natural sources (e.g. water, bauxite, gold, oil). As mentioned above, the eastern Guiana Shield possesses a vast Precambrian crystalline rock core with an altitude of between 50 and 900 m. At its foot, a succession of Tertiary and Quaternary deposits represents a changing littoral zone generally situated below 50 m in altitude. Three geological formations are distinguished in a north-south cross-section of the Tertiary and Quaternary belt: (a) the Pliocene White Sand Formations, (b) the Pleistocene Plain and (c) the Holocene Plain (Wong et al. 1998:77, Fig. 1). This classification is adopted here because it is suitable for an archaeological perspective (e.g. different habitats, exploitation areas). However, Cayenne Island and, to a lesser extent, the coastal plain near Kourou are exceptional features in this littoral setting. These important Precambrian outcrops represent table mountains which stand alone in the Atlantic Ocean and also include Pleistocene and Holocene deposits.

### 2.2.1 *The Precambrian Shield*

When ascending the Guiana rivers, an important rapid frequently marks the transition between the interior and the lowlands. However, as mentioned above, this does not apply to the Island of Cayenne or Kourou which are home to impressive table mountains (e.g. Mont Mahury, Cabassou, Montabo, Mont Grand-Matoury, Montagne des Pères and the Devil Islands respectively). In general, the geomorphology of the Precambrian Shield is dominated by means of a series of step-like planation surfaces which can be followed over large distances (Krook and Zonneveld 1998). These surfaces are laterite-capped and constituted once vast peneplains. The presence and individuality of each planation surface can be established by means of the following criteria: (a) they normally consist of peneplains which bevel various geological formations and rock types, (b) they have a fairly constant altitude, albeit they may display a slope of several promilles and (c) a pronounced escarpment often separates each peneplain from the next younger one.

The Precambrian crystalline core consists of rock formations, of which the Granitoid Formation represents the solid foundation of the Shield. The Paramaca Formation borders the coastal zone. The latter formation is of particular interest as it consists predominantly of chloritic green tuffs (Choubert 1974:27–34), often referred to as the “greenstone belt.” The prehistoric Amerindian population often extracted it as raw material for axes, hatchets and chisels. This Paramaca Formation is part of the northern belt (Fr., *chaîne septentrionale*) and forms the youngest Precambrian formation. It consists of superimposed volcanic and sedimentary layers (metapelits and metagrauwakes) which have been vaulted through tectonic movements and subjected to metamorphisation. As to the majority of massive greenstone rock in the Guianas, a ferralitic soil developed in the uppermost part of these formations. The weathering of this rock has created a kaolin clay coating which is rich in iron oxides and aluminium as well as pegmatite veins. At the highest parts, the clay coating has been washed away allowing the unaltered bedrock, or duricrust, to submerge from which the tabular shaped mountains and inselbergs originated. The sites of Crique Sparouine and Cimetière paysager Poncel are located at the summit of small tabular shaped mountains.

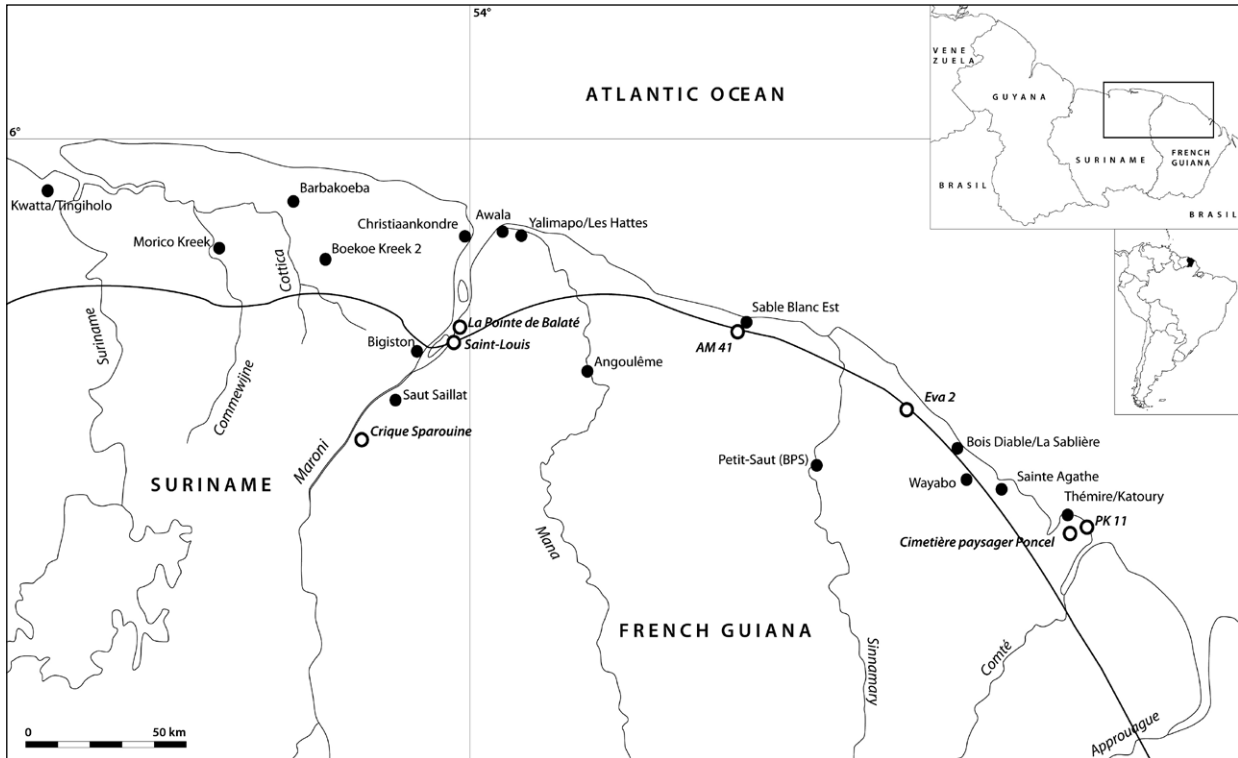


Figure 2.1. A schematic map of the area located between Paramaribo and Cayenne, including the archaeological sites discussed in the present publication. The black line indicates the approximate limit of the coastal zone between the Atlantic Ocean and the Precambrian Shield.

### 2.2.2 The White Sand Formation

The white sand savannah belt coincides with the outcrops of the Zanderij Formation and represents a rather flat, slightly undulating landscape, also known as the Cover Landscape.<sup>36</sup> The latter landscape comes with specific ombrophilic vegetation which has very frequently changed into a secondary forest because of (recent) human occupation. Its deposits consist of white bleached and brown loamy non-bleached angular quartz sands. These are encountered on flat hilltops, or plateaus (and alluvial fans), that vary between *c.*15 and 45 m in height (D., *Coesewijne Series*; Fr., *Serie détritique de base*; E., *White Sand Series*). These so-called giant podzols are dated to the Pliocene in Suriname and to the Pleistocene in French Guiana, indicating that the origins of this formation are still uncertain (Boyé 1963; Blancaneaux et al. 1973; Palvadeau 1999; Wong et al. 1998).

In French Guiana, two white sand belts are currently hypothesized: (a) a younger belt (~133 ka) situated between Saint-Laurent du Maroni, Mana, Organabo and Iracoubo, measuring between 15 and 25 m in height and (b) a much earlier belt (330 ka) is located to the south of the former belt. It measures from 35 up to 45 m in height and is positioned roughly between the Lower Kourou River and the Plateau des Mines at the Maroni River. According to Palvadeau (1999:136, 141), these white sand deposits could once have been coastal dune formation as we can observe today in Céara, Brazil: ‘Il est donc envisageable que le long des côtes guyanaises se soit développées en période de haut niveau marin des dunes éoliennes littorales, peut-être dans des conditions climatiques sensiblement plus sèches.’

36 ‘A landscape is an area, which as a result of its specific geological origin, morphologically forms a unit, characterized by a special rock formation and a variation in soil conditions and vegetation typical of this area’ (van Eyk [1957] in de Boer 1972:12).

Today, the known Archaic sites in French Guiana are located on these white sand belts. The Eva 2 site is situated on the lower younger belt and the Plateau des Mines site on the older inner belt, based on their mean sea level heights (MSL). When observing the impressive escarpments, still visible along the national highway (RN 1), we may conclude that between Iracoubo and Organabo, and to the east of Mana, the younger white sand belt has been subjected to significant (marine) erosion.

### 2.2.3 The Coastal Plains

The landscape of the Coastal Plains, both Old and Young Coastal Plains, includes four principle geomorphological elements (Brinkman and Pons 1968:6; Wong et al. 1998:84, Table 2):

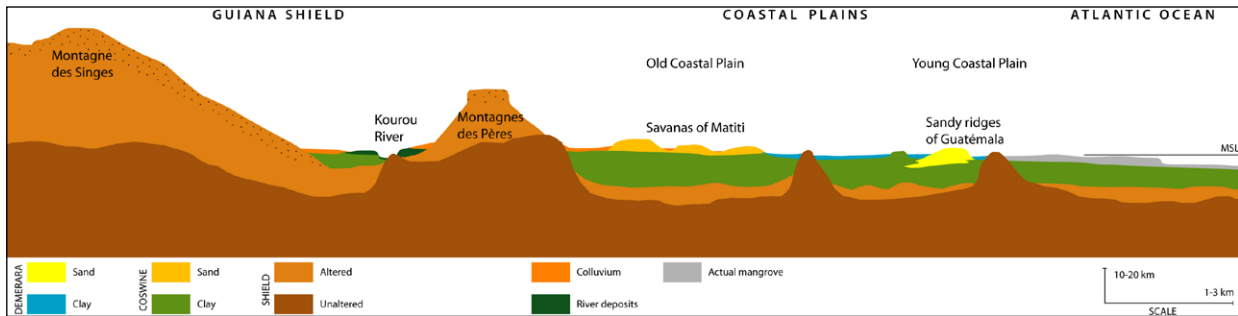
- a. *Beach ridges*. Narrow elongated ridges of sand or shells are formed along deep parts of the coast. Their tops reach to highest wave level, i.e. between 2 and 4 m above MSL. When the coast eroded during their formation only one or two ridges occurred on the edge of the clay flat. Under accretive conditions, broad bundles of deep-rooted ridges are formed. Their maximum height measures 3.5 m. In French Guiana, abandoned sand ridges are referred to as *cheniers* and in Suriname as *ritsen*.<sup>37</sup>
- b. *Marine tidal clay flats and marshes*. During accretion, they develop from uncovered mudbanks positioned in front of the coast into brackish and salt *Rhizophora* and *Avicennia* marshes. Once cut off from sea water and subsequent desalinization, they evolve into clay marshes with fresh water forests or grass swamps covered with a thin *pegasse* or peaty layer.
- c. The *natural levees* of the rivers and estuaries as found as broad to narrow bands parallel to the rivers with mainly silty clay textures. They are silted up to above mean high tide level and carry an evergreen seasonal forest.
- d. *Peat swamps*. Eustatic peat is formed in back swamps on top of tidal clay flats under the conditions that prevail during a relative rise of the sea level. Very poor drainage conditions in large areas lead to the formation of ombrogenous peats with swamp vegetation.

A complete geomorphologic landscape thus includes each of the elements described above. Due to incomplete development or partial erosion, merely poorly developed elements or remnants may be found as is the case in French Guiana (Palvadeau 1999). The coastal plain of the three Guianas consists of a series of such geomorphologic landscapes, sometimes incomplete.

The soils of the Young Coastal Plains and Old Coastal Plains are formed on Demerara and Coropina (Coswine in French Guiana) sediments dating from the Holocene and Pleistocene eras, respectively. The Old Coastal Plain soils of the Coropina Formation are described as deeply developed, sticky and intensely red-mottled clays (Fr., *arigles bariolées*). In French Guiana, the Pleistocene is divided into *Coswine supérieur* and *Coswine inférieur*, coinciding with the division of the Coropina Series in Suriname into the (higher) Lelydorp and the (lower) Para landscapes (Boyé 1963). The former sand deposits represent early coastal barriers

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37 According to Marie-Thérèse Prost (1992:398), the term *chenier* is derived from the French Creole population in Louisiana (USA), where the sandy ridges of the Mississippi were covered with oak trees (Fr., *chênes*).



(Fr., *barres pré-littorales*). During the Wisconsin glacial these barriers were eroded by means of small rivers and creeks forming the characteristic dissected landscape that was partly filled up afterwards (Wong et al. 1998). They measure between 5 and 15 m high above MSL and generally overlook the surrounding younger swamps filled with Holocene sediments. Any transgressions in these fine sand deposits, indicating its age, partially eroded the Old Coastal Plain.

The Young Coastal Plain soils of the Demerara Formation are shallow and consist of physically hardly ripened clays (marine and estuarine) with reduced, soft subsoils which have been deposited during the Holocene sea level rise. In French Guiana, these deposits have been divided into recent (Coronie) and the earlier Demerara (Mara) deposits; the former comprise the saline soils whereas the latter comprise the desalinized older soils which display soil formation. The presence of *cheniers*, arranged in bundles, and apparently closely related to the river mouths represent old beaches and highly characterize the Young Coastal Plain (Wong et al. 1998). These beaches have transformed into *cheniers* because of a renewed accretion of the mudflats at large. The ocean current transports this mud, with its Amazonian origin, in steadily westward moving mud-shoals, as can still be observed today (Prost 1989, 1992).<sup>38</sup>

In Suriname, subsequent phases within the evolution of the Recent Demerara deposits were detected by means of pedological methods and named Wanica, Moleson and Comowine (Brinkman and Pons 1968:31–36). The Mara deposits consisting of clay and peat that developed during the start of the Holocene era preceded these Coronie deposits. In western Suriname, the first appearance of shell ridges and clays attributed to the Wanica phase and has been dated to between *c.*6000 and 3000 BP. The following Moleson deposits, dated in the vicinity of the Herttenrits archaeological site, were deposited between 2500 and 1300 BP. The beginning of the Comowine transgression is dated just before 1000 BP and continues to the present day (Versteeg 1992). Versteeg also pointed out that the end of the Moleson sedimentation was not synchronous along the Surinamese coast (Versteeg 1985:737). He describes a shift from east to west that ends at 2000 BP near the Burnside habitation mound and at 1300 BP near the Herttenrits site, revealing an east-west sedimentation pattern. It is very probable that similar shifts did exist in French Guiana; geological research near the Sinnamary and Kourou Rivers confirms the existence of the Moleson transgression, dated between 2700 and 500 BP (Palvadeau 1999:89).<sup>39</sup>

Figure 2.2. A schematic cross-section of the Coastal Zone and Guiana Shield representing the geologic formations near Kourou (after Cautru 1994). A similar cross-section as to Suriname can be found in Wong et al. (1998:86).

38 Roeleveld and van Loon (1979), Augustinus (1980) and Rine and Ginsburg (1985) have studied the coastal dynamics of Suriname.

39 The uplift of the Guiana Shield in French Guiana of 0.01 mm per year has changed the height of the geological formations when compared to MSL as well as to similar deposits in Suriname (Palvadeau 1999).

#### 2.2.4 The River Terraces

The Maroni and Sinnamary Rivers have either river terraces or old alluvial plains consisting of Tertiary and Quaternary deposits. The Maroni River—which has been subjected to more scientific research than the Sinnamary River on this matter—features terraces along the entire river trajectory: between Pilima Pata upon the Upper Lawa until the village of Saint-Laurent du Maroni. The alluvial sediments have been deposited during glacial periods when erosion and sedimentation are more active. The rivers transport such a quantity of sediment that they also deposit it along their trajectories. In the course of the interglacial periods, the river erodes or cuts into the earlier deposited sediments, thereby forming its terraces.

De Boer (1972:23–28) and Palvadeau (1999:166–174) distinguished four terraces with regard to the Maroni River (T1–T4), based on their relative height during the midst of the dry season:

- a. The *High Terrace* rises at 20 to 30 m above the riverbed. It consists of coarse grained gravel covered with sandy clay (4 m above MSL);
- b. The *Medium Terrace* is situated between 5 and 14 m above the actual Maroni level. It also consists of gravel and is covered with sandy clay (6 m above MSL);
- c. The *Intermediate Terrace* is found within the Medium Terrace deposits and measures 14 m in relative height. This not very thick alluvial formation is composed mainly of clayey sand. T1, T2 and T3 date from the Pleistocene age;
- d. The *Low Terraces* date from the Holocene era (between 10,000 and 8000 BP). They are found at *c.*5 m in relative height above river level and consist mainly of sandy clay.

Below the terraces, the streambed develops (alluvial) flats composed of silty clays. These are often flooded during the rainy season and thus form levees (riverbanks) and alluvial fans. Despite the fact that these flats are fairly recent, they already show a clear pedogenesis whenever its soils have not been eroded by sedimentation. The sites of Chemin Saint-Louis and La Pointe de Balaté are located on the Low Terraces, overlooking such a flat. At present, a large number of Lokono and Kali'na villages (e.g. Bigiston, Balaté, Village Pierre), are located on the terraces of the Lower Maroni River (Kambel and de Jong 2006; Armanville 2010) as is the village of Saint-Laurent du Maroni itself.

#### 2.2.5 The pedogenesis

This section on pedogenesis includes a short introduction to the terminology applied in the following chapters in order to describe soil processes on the excavated sites. Although multiple elements generate pedogenesis according to de Boer (1972), its most important factors in eastern Suriname are the following:

- a. *Bioturbation*: the mixing of soil components by animals very active in well-drained soils.
- b. *Appauvrissement*: the removal of clay from the A-horizon without any correlative accumulation in the B-horizon; nearly all soils show an increase in clay content from surface to subsoil. In general, it can be stated that

Coastal Plain Suriname			Age (years BP)	Plaine côtière guyanaise		Age (years BP)	
<b>DEMERARA</b>	Coronie	Comowine	Recent	<b>DEMERARA</b>		Holocène	
		Moleson	2500 - 1300 years BP (Versteeg 1985)				
		Wanica	6000 - 5500 yrs BP and 3500 - 3000 yrs BP Brinkman & Pons 1968)				
	Mara	Holocène (older than 6000 years BP; Brinkman & Pons 1968 )					
<b>COROPINA</b>	Lelydorp	Lelydorp Sand	Eemien 120,000 years BP (Brinkman & Pons 1968; Veen 1970)	<b>COROPINA-COSWINE</b>		Supérieure (cordons sableux)	Eémien sup. (Boyé 1963)
		Clayey Santigrón					
		Clayey Onoribo					
	Para	Holsteinien 300 - 350,000 years BP or 48,000 years BP (Brinkman & Pons 1968 )	Inférieure (argiles à lentilles de sable)			Eémien inf. (Boyé 1963)	
<b>DE ZANDERIJ SANDS</b>			Pliocène (2 to 5 Ma) (Wijmstra 1971)	<b>SERIE DETRIQUE DE BASE</b>		Série des sables à faciès Zanderij	Pléistocène moyen 300-120,000 yrs BP (Boyé 1963)
						Série des sables micacés	Pléistocène inférieur 1,8 Ma – 700 ka BP (Boyé 1963)

Figure 2.3. A schematic overview of the stratigraphy of the Holocene Series in the Coastal Plains of Suriname and French Guiana (after Palvadeau 1999:32).

superficial erosion has contributed to the coarser texture of the A-horizons. A surface wash, however, that deprives the soil of its finer constituents affects only the immediate surface.

- c. *Lessivage*: the process of migration and deposition of unaltered clay-sized particles in the soil profile. This process is often related to a climate in which the soils become either thoroughly or partially dried during a certain season. It refers to an important pedogenesis during a drier period such as a Late Glacial Period as witnessed on the Old Coastal Plain (Veen et al. 1971).
- d. *Ferrallization*: a complex process, principally composed of hydration, hydrolysis and oxidation of primary minerals, followed by leaching of the liberated bases and silica. Here the neosynthesis of goethite, kaolinite or gibbsite is a characteristic phenomenon.

- e. The *podzolization* results in the formation of podzols or spodosols. A distinction can be made between humus podzols and iron podzols but both podzols occur under hydromorphic conditions. In the very common first type humus has accumulated, but iron is almost absent. An (illuvial) accumulation of iron characterizes the second type, while humus accumulation is not detectable.
- f. The *anthropogenic soils* (dark earths or *terra preta*) are characterized by means of its black surface layer which often contains archaeological material. They occur on well-drained and imperfectly drained soils, such as river terraces. This black colour is the result of (intentional) soil enrichment by means of household garbage, dung as well as the refuse of hunting and fishing, as suggested by the *terra preta* pioneer Wim Sombroek (1966) with regard to Lowland Amazonia. De Boer was the first to pay attention to this phenomenon in Suriname and analysed two *terra preta* profiles both yielding ceramic material just below the surface. During the last two decades, *terra preta* studies in Greater Amazonia have focussed principally on its origin and chemical components (Lehman et al. 2003; Glaser and Woods 2004; Woods et al. 2009).<sup>40</sup> A more extensive introduction to *terra preta* as well as the results of the chemical analysis performed on dark earths from the site of Chemin Saint-Louis will be presented in Section 5.2.2.

### 2.3 The coastal vegetation

The vegetation of the Guiana coast follows a systematic sequence dictated by means of various geological formations. We will describe here the types of vegetation as presented by Jean-Jacques de Granville (1992) with regard to French Guiana with an adopted classification as proposed by Jan Lindeman (1955) regarding Suriname.<sup>41</sup> From the sea towards the interior, one finds:

- a. *The vegetation of the Young Coastal Plain.* The sandy beaches are colonized by rampant herbs, mainly *Ipomoea pescaprae* and *Canavalia maritime*, or sea beans. *Avicennia germinans*, or black mangrove, grows on the mud banks along the coast, dominating the coastal mangrove. Cypéracées (*Eleocharis mutata*, *Cyperus articulatus*, *C. giganteus*) and ferns (*Acrostichum aureum*, *Blechnum indicum*) dominate the vast coastal swamps, or “wet savannahs.” In certain swamps we can observe isolated bushes consisting of trees such as fat pork (*Chrysobalanus icaco*) and corkwood (*Pterocarpus officinalis*). The *Virola surinamensis* and *Symphonia globifera* dominate the inundated forests or wooded marshes. The manicole palm, or açai (*Euterpe oleracea*),

40 In French Guiana, a dissimilar pedogenetical terminology and criteria for subdivisions are applied. In short, De Boer (1972) focussed especially on the soils displaying consistencies with eastern Suriname: the *sols podzolisés* are similar but have different diagnostic criteria dealing with the characteristics of the B-horizon; the *podzols à gley* are also found here. The *sols ferrallitiques* are related to oxisols and may include soils with an argillic or with a cambic horizon. The *sols ferrallitiques fortement désaturés* is a subdivision including all well drained soils. They are characterized by means of a number of exchangeable bases and are subdivided in groups, i.e. *typique*, *remaniée*, *appauvrie*, *rajeunie* and *lessivée*. The *sols hydromorphes* have no equivalent in Suriname since it affects the majority of soils and constitutes the essential aspect of pedogenesis. The *sols hydromorphes à gley* correspond to soils where the groundwater oscillates at a shallow depth.

41 Lindeman (1955) formulated four types of vegetation: (a) the marsh, or seasonal swamp, forest, (b) the savannah vegetation, (c) the rainforest and (d) the secondary forest.

can indeed form entire mono-forests (Fr., *pinotières*). These marshes as well as areas along the rivers also feature the renowned moca-moca (*Montrichardia arborescens*) and the majestic *Mauritia flexuosa*, or ité palm. Upon the sandy ridges of the Young Coastal Plain we find richer vegetation consisting of *Parinari campestris* and *Triplaris surinamensis*. The *Rhizophora racemosa*, or red mangrove, dominates the riverine estuaries. Higher up the river, however, we also find the ité palm and corkwood intermingling with the mangroves.

- b. *The vegetation of the Old Coastal Plain.* This plain with its higher location consists of: (1) old swamps and forest on well-drained higher, sandy ridges and (2) lower lying swampy soils on the flats representing both so-called “dry savannahs.” The higher savannahs consist of grasses and herbs dotted with small paper trees (*Curatella americana*) whereas the lower savannahs occur more frequently but come with poorer vegetation consisting of Cyperaceae shrubs (*Byrsonima verbascifolia* and *Byrsonima crassifolia*).
- c. *The vegetation of the White Sand Formations.* These old estuary deposits consist mainly of white quartz sand. They are principally populated by xerophilic forest, or “wallaba forest” (*Eperua falcate*), known as *wapa* (C.) in French Guiana. However, shrubs (*Clusia fockeana* and *Humiria balsamifera*) dominate the lower white sand deposits and even the high savannahs.
- d. *The vegetation of the Precambrian outcrops.* As stated above, the Precambrian hilltops reach the Atlantic Ocean on Cayenne Island and Kourou in central French Guiana. Nevertheless, the vegetation of the summit does not differ from that of the Precambrian Shield on ferralitic soils. Thus, the diversity of trees expected in the interior can also be encountered at these outcrops.
- e. *The secondary forest.* It is to be suspected that since their arrival in and appropriation of the coastal plain *lato sensu* more than at least 7000 years ago the prehistoric Amerindians did cut and burn down or modify the above-mentioned types of vegetation. Therefore, we must add here the concept of *kapoewerie* (Sr.), i.e. secondary vegetation, as Lindeman (1955) suggests.<sup>42</sup> Today, the secondary forest is often the result of shifting cultivation. Moreover, it is also frequented after abandonment as many fruits and other useful plants can still be gathered (P. Grenand 1981; Balée 1989, 1992; Rios et al. 2001). In its first stage, after abandonment, it frequently consists of a seedling crop of species that require much light in order to germinate. After several years a slender-stemmed forest develops, which very gradually regenerates into a rain forest, but seldom into a savannah. The period of land use spans between two and five years to the most. The fallow period may vary from between several decades to less than ten years.

These cultivated grounds or gardens (Fr., *abattis*) are usually situated on well-drained soils such as hilltop flanks or sandy elevations near the villages; as far as 5 km out of the village is not considered to far for Amerindian, Maroon and Creole populations. In French Guiana, the local population cultivates the land primarily

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<sup>42</sup> *Kapoewerie* is the Surinamese Dutch term for an abandoned garden claimed by the forest which still provides food. It is derived from the Portuguese *capoeira* that refers to the place of the “old garden”.

for their own needs but also to supply the local market. In 1978, approximately 5000 Hmong refugees from northern Laos and Vietnam settled in French Guiana. They soon controlled the local fruit and vegetable market (Géraud 2000).

## 2.4 The archaeological landscapes

This section provides a geological chronology of the coastal plain emphasising how and when prehistoric Amerindians might have experienced and utilised it. In addition, it allows us to present (a) a chronological description of the geomorphologic development and (b) the climatic changes that occurred in the coastal zone.

### The first peopling

Although scholars have much debated the arrival of mankind in the South American continent, the earliest radiocarbon dates go back as far as 40,000 years BP with regard to the Late Pleistocene.<sup>43</sup> The reconstruction of climatic changes in Greater Amazonia suggests that around this date the climate must have been warmer and more humid. The Last Glacial Maximum (LGM) dated between 20,000 and 18,000 BP evolves into the actual interglacial stage in *c.*12,000 BP (Hewitt 2000). It became much drier after the LGM between 17,000 and 14,000 BP (Ledru 1993:94). After 12,000 BP we observe a much more humid and cooler climate.<sup>44</sup> By this time, all archaeologists generally agree on the fact that the Paleo-Indians inhabited the Guianas (cf. Section 3.4).

This Paleo-Indian population is mainly found in the interior of the Guianas such as the Sipaliwini and Rupunini Savannahs. With regard to these upland areas, recent sedimentary studies indicate that a dry and cold climate was still present here in *c.*11,700 BP (Montoya et al. 2011) and that this did not change before 4300 BP (Nogué et al. 2009). However, these open spaces render a pedestrian survey more successful. This perhaps biases the fact that these early hunter-gatherers did not inhabit the humid forests or the coastal zone. Indeed the Old Coastal Plain had been deposited. The Precambrian outcrops were probably accessible to humans. Nonetheless, to the present-day, we find no artefactual evidence of Paleo-Indians in the coastal plain.

### The Early Holocene or the Meso-Indian way of life

The transition from the Late Glacial to the Early Holocene is marked by a relatively rapid warming trend. Beginning in 10,500 BP, it culminates between 7500 and 5200 BP (6300-4000 BC). It is eventually followed by a gradual cooling down period that continues to the present-day (Wijmstra and van der Hammen 1966; Roeleveld 1969; Bush et al. 1990, 2008; Tardy 1998; Ledru 2001). In the Early

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43 The survival of vegetation during the LGM is much debated too. On the one hand, the Refuge Theory suggests a separation of the Amazonian forest into multiple small, isolated forests by means of large open spaces which come together again during the Quaternary (Haffer 1969). On the other hand, too little geological data are available in order to support a contraction of the Amazonian forest linked to a drier LGM (Bush and Oliveira 2006). Modelling of the paleo-vegetation based on the climate and the concentrations of CO<sub>2</sub> suggest a humid dense forest during the LGM (Mayle 2004). See also note 64.

44 Between 11,000 and 10,000 BP, this cooler climate “disappeared”. This could be related to the Younger Dryas event (Ledru 1993).

Holocene, this trend resulted in a regular rise of the sea level, i.e. between 1 and 2 m per century, caused by an increased precipitation and steady melting of the ice caps as well as a consequent eustatic transgression (van der Hammen 1974). Various sea level curves have been presented, but it is generally accepted however that the sea rise flattened out in c.6200 BP (c.5100 BC) when the current level was reached (Roeleveld and van Loon 1979).

The deposition of Amazonian clays by the long-shore drift of the South Equatorial Current (SEC) was not important prior to the flattening of the sea level rise in 6200 BP. Therefore eustatic peat covered the Old Marine Clays, especially in Guyana and the Orinoco Delta. Throughout the Early Holocene, the littoral of the Guianas thus formed one, extended mangrove woodland to which the sea had easy access.<sup>45</sup> Soft humic (pyrite rich) clays were deposited under a growing vegetation consisting of red mangrove (*Rhizophora mangle*; Mara Formation) (Tissoti et al. 1988:135). Pre-Columbians could indeed have exploited this mangrove which most certainly at the time the sea rise had flattened out: just before 6200 BP. Archaeological sites now appear along the littoral of Guyana (Alaka Phase) revealing the exploitation of the mangroves by means of large shell middens (Evans and Meggers 1960; Williams 2003). Albeit situated more towards the interior upon the White Sand Formation, the Archaic sites of Eva 2 and Plateau des Mines in French Guiana reveal no tangible shell litter, only large amounts of quartz debitage, chopping tools, grinding tools and earth ovens. On the Pleistocene ridges, no artefacts have been found at all. However, radiocarbon dates from this era occur on LCA sites located at these ridges (e.g. the site of PK 11 on Cayenne Island) and may reveal an earlier human presence as yet not tangible (see also below).

### The Late Holocene or the Neo-Indian way of life

Once the sea had reached its present level, the Amazonian floodplain, or *várzea* (Br.), was formed. Now all the Amazonian riverine deposits reached the Atlantic Ocean to be subsequently transported by the SEC along the shore of the Guianas, i.e. the Coronie Formation. At the same time, negative but smooth oscillations of the sea level did occur at various dates (Brinkman and Pons 1968:8–9; Roeleveld and van Loon 1979). In Suriname three depositional phases were detected implying a rhythmic human occupation in the coastal plains: Wanica (6000–3000 BP), Moleson (2500–1300 BP) and Comowine (700 BP to the present-day) (Brinkman and Pons 1968; Versteeg 1985). The Moleson transgression filled up various river estuaries with sediment whereas the Comowine sediments have been deposited all along the coast (Brinkman and Pons 1968:25). Similar patterns are found to the east in French Guiana (Prost 1992; Palvadeau 1999) and to the west on Trinidad (van Andel 1967).

By now, the river terraces and the Old Coastal Plain had become permanently available for human activities but they were apparently left aside as to permanent installation –but perhaps a research bias is another plausible explanation. Today we find Early Ceramic Age sites upon the river terraces (e.g. Chemin Saint-Louis

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45 However, possible Early Holocene standstills or regressions of the sea level have been recorded in the Gulf of Paria about 9510 ± 400 BP (van Andel 1967) for at depth of 20 m below MSL. A similar event has been recorded at the mouth of the Maroni River at about the same depth (22 m). This implies a sandy delta with a possible reef (Nota 1971).

Phase 2) and lateritic outcrops in the coastal plain (e.g. Olga, Cimetière paysager Poncel). As mentioned before, Pleistocene sand ridges have not yet yielded ECA sites, but elements hereof have been found during surveys (van den Bel 2007b). The littoral is as yet heavily influenced by the sea, i.e. the Moleson transgression. After 900 AD, however, once the latter transgression has ended, the LCA population settles the Holocene plains of Suriname and French Guiana. Notably the pre-Columbian population of western Suriname had constructed artificial mounds on the Holocene plains to dwell on several centuries earlier, whereas similar constructions have not been found (yet?) in French Guiana. It is possible that these habitation mounds have existed here but have eroded away.<sup>46</sup>

Spaced cheniers and (wet) savannahs mark the Young Coastal Plain. Thousands of small heaps of soil, known as *champs surélévés* in French Guiana (Rostain 1991), mark these savannahs. Recent multidisciplinary research carried out by Rostain and McKey in similar wet savannahs near Kourou and Organabo has indicated that these savannah soils have been modified and that they represent raised fields in order to grow maize, squash, manioc, sugar cane and bananas (Rostain 2013:183).<sup>47</sup> However, it is also stated that: 'It also shows that studies of the resilience of pre-Columbian anthropogenic legacies need to consider the role of ecosystem engineers [ants] in the preservation of material signatures of past land use' (McKey et al. 2010:6). Hereby some doubt is cast on the anthropogenic origins of these heaps (cf. Section 12.2.2).

Palynological and anthracological research in French Guiana has demonstrated the existence of a series of wet and dry cycles during the Holocene. Several hereof have reduced precipitation phases that occurred on a supra-regional level. These drier periods are associated with the ubiquitous occurrence of charcoal in the forest soils, as has also been identified in French Guiana (Tardy 1998; Ledru 2001; Tardy et al. 2010:108). Extremely wet circumstances have been attested in southwest Amazonia between 1300 and 800 BP, i.e. between AD 750 and 1200 (Colinvaux et al. 1985; Iriarte et al. 2012). Moreover, we see reduced precipitation in southeast Brazil between 800 BC and AD 50 (Bigarella and Ferreira 1985; Ledru 2001:174; Moy et al. 2002; Sifeddine et al. 2001). Similar climatic circumstances/patterns have also been reported in archaeological excavations carried out in northwest Guyana (Williams 1982, 1985) and at various sites in the Lesser Antilles (Malaizé et al. 2011).

In addition the eye catching table mountains, the Old and Young Coastal Plains are also marked by other Precambrian outcrops, such as dolerite dykes, which pre-Columbians now and again utilized as a support for rock engravings (e.g. the Carapa site near Kourou or Crique Pavé at Mont Mahury). The larger table mountains represent habitation and (ring) ditched sites occupied during the ECA and LCA (e.g. Montagne des Pères near Kourou and Mont Grand-Matoury, Mahury, Paramaná) on Cayenne Island. These mountains are excellent

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46 The coastal and estuary zones are still very dynamic and change continuously through erosion or accretion of the land mass. During the low tide shifting mud banks close to the coast fall dry and hamper coastal traffic and fishing. Modern Amerindian villages (e.g. Awala-Yalimapo, Christiaankondre, Langamankondre) are located on these ridges. Certain villages (e.g. Pasikondre, Point Isère), have been abandoned several decades ago due to erosion (Kloos 1971; Cornette 1987).

47 For some reason, the 2010 publication by McKey et al. does not feature bananas and sugar cane which were presented by Rostain of their research at the 22<sup>nd</sup> International Congress of Caribbean Archaeology held in Kingston (Jamaica) in 2007, but they reappear in *Islands of the Rainforest* (Rostain 2013).

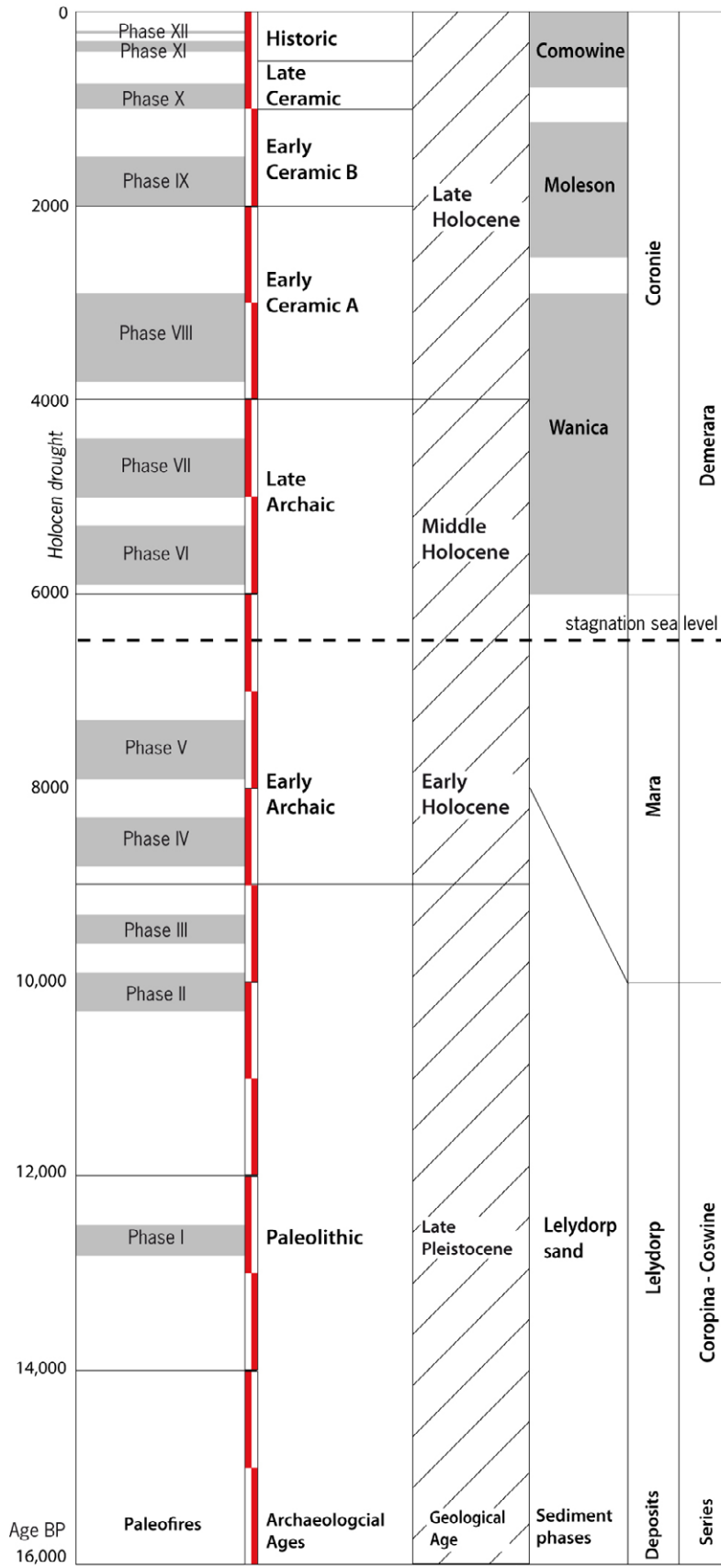


Figure 2.4. The Holocene period with paleofires and archaeological periods after Tardy (1998), Brinkman and Pons (1968:30) and Wong et al. (1998:85).

landmarkers for the pre-Columbian population and may have had various other functions through time. These higher “forest islands,” cheniers, dry and wet savannahs, tidal creeks and large rivers provide good quantities of fish, crabs, sea turtles (although protected nowadays) as well as large game (e.g. deer, agouti, peccaries, iguana, armadillo), found in marshes and creeks. Today, gardens located upon the sandy ridges produce manioc, sweet potato, bananas, maize, pepper along with many other edible and/or useful plants.<sup>48</sup>

In sum, the actual littoral is still changing whereas the former littoral has been (partially) eroded or fossilised. Since the Pliocene, not only the discharge of the rivers but also the changes in the sea level have provided an accretion of sediment at the foot of the Precambrian Shield which consists of various geological formations and landscapes each with a distinct vegetation. This entire littoral, fossilised and new, will serve here as the archaeological landscape of the coastal plains, including the Pliocene White Sand Formation, the Pleistocene and Holocene coastal plains, the river terraces and the Precambrian outcrops. Thus, when applying the term “coastal plain” or coastal zone we refer to these components as a whole and not only to the Pleistocene and/or Holocene coastal plains.

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48 In order to gain a better knowledge of modern Amerindian gardening and what for instance, the Wayāpi grow in their gardens, see P. Grenand (1979). However, it must be noted that Amerindian crops in Amazonia have changed in time and most certainly throughout the colonial period (Clement 1999).

