QUATERNARY STRATIGRAPHY OF SURINAME

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Abstract

In this paper the Quaternary sediments of the Coastal Plain of Suriname are highlighted since they were recently subjected to a stratigraphical revision.

The Pleistocene Coropina Formation, constituting the Old Coastal Plain, has now formally been subdivided into the Para and Lelydorp Members. The sedimentary history of these units has been well-documented in the past, relating high sea levels to inter-glacials and regressions to glacials. In the light of modern Quaternary stratigraphical considerations and the results of recent Brazilian investigations, the hitherto assumed Late Pleistocene age for the entire Coropina Formation has become questionable.

Traditionally, all Holocene sediments in the Young Coastal Plain were grouped into the Demerara Formation. It is now realized that the Demerara Formation comprises widely differing lithologies which should not be grouped in one formation. Moreover, the name Demerara Formation has been associated too closely with the geomorphological unit Young Coastal Plain and with its Holocene age. Therefore it has been proposed to abandon the name Demerara and to attribute the status of formation to two of its most distinct lithologies (Mara and Coronie). Within the Coronie Formation three morphostratigraphic units (Wanica, Moleson and Comowine) represent oscillations of the sea. Part of these oscillations seems to correlate with Brazilian events but additional research is needed.

Résumé

Le Quaternaire du Surinam a fait récemment l'objet d'une révision stratigraphique.La Formation COROPINA (Pléistocène) - qui constitue le soubassement de la plaine côtière "ancienne"- est subdivisée en deux membres : PARA (faciès argileux, à la base) et LELYDORP (faciès sableux, au sommet), dont évolution a été interprétée comme liée à des oscillations du niveau marin. La Formation Coropina a été entièrement attribuée au Pléistocène Supérieur mais des études récentes au Surinam et au Brésil permettent de reconsidérer cette datation.

Les sédiments de la plaine côtière "récente" ont été abusivement liées à une seule unité stratigraphique, la Formation Demerara, d'âge holocène. En réalité, il s'agit des différentes lithologies, avec des évolutions spécifiques. C'est pourquoi nous proposons d'abandonner le nom Demerara et de faire la distinction entre deux unités lithologiques, MARA et CORONIE. Cette dernière rassemble trois unités morphostratigraphiques (Wanica, Moleson et Comowine) qui sont en relation avec des oscillations marines. Il est possible qu'une partie de ces oscillations puisse être être correlée avec des événements identifiés au Brésil, mais d'autres études sont nécessaires pour mieux cerner ce problème.

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Key-words : Quaternary stratigraphy, Late Pleistocene, Holocene, Surinam, Guianas coastal plain.

Mots-clés : Stratigraphie du Quaternaire. Pléistocène Supérieur. Holocène. Surinam. Plaine côtière des Guyanes.

1 INTRODUCTION

Recently (Wong, 1989), the stratigraphy of the Coastal Plain of Suriname has been revised. The main reason for this revision was that the existing lithostratigraphic nomenclature was not conform modern stratigraphic principles. Moreover, the majority of the existing lithostratigraphic units was lacking reference sections and detailed descriptions. Quaternary sediments were also included in this revision. This, and the increased kwowledge of both general and regional Quaternary stratigraphy justify a review of this particular section.

2 GEOLOGICAL SETTING

The Coastal Plain of Suriname, French Guiana and Guyana, forms the marginal part of the large Guiana Basin (Fig.1) in which subsidence and sea level movements have greatly influenced sedimentation. The basin originated in the Late Jurassic-Early Cretaceous with the opening of the Atlantic Ocean. After an initial rifting phase, the history of the Guiana Basin has been controlled by the gradual subsidence of a passive or trailing continental margin which underwent little tectonic activity and numerous periods of erosion.

Progressively younger sediments onlap the Precambrian basement in southern direction. The age of the sediments in the Coastal Plain of Suriname range from Senonian (Late Cretaceous) to Holocene. They have been grouped in the Corantijn Group (Fig.2), consisting of a monoclinally dipping (ca. 1°) section of mainly clastic sediments. In the entire Group, several sea level movements, as well as major periods of non-deposition, can be recognized. It proved to be difficult to correlate them to similar "global" events because we are dealing here with incomplete sections while adequate biostratigraphic control is also lacking. Hence, the proposed "global" events may, in fact, be limited to regional events.

The Coastal Plain traditionally has been divided into two geomorphological units: the Young Coastal Plain (in the north) with Holocene sediments and the Old Coastal Plain (in the south). The latter is a dissected surface with predominantly Pleistocene sediments.

Towards the south the coastal plain is bounded on the Savannah Belt which comprises mainly Pliocene continental sediments and minor residual weathering deposits from the Precambrian basement.

3 QUATERNARY SEDIMENTS

3.1. Pleistocene

3.1.1. Coropina Formation

3.1.1.1. Lithostratigraphy

Ever since its establishment by Schols & Cohen (1951, 1953), this formation was characterized by a twofold division: a sandy upper part ("Lelydorp Sands") and a clayey lower part ("Para Clays"). Wong (1989) assigned the formal lithostratigraphical designation of Member to these units, incorporating various reference sections (Fig.3). On the geological map (Fig.4) it is evident that the Coropina Formation forms a strongly dissected surface.

The Para Member in its type area consists of heavy, finely laminated, stiff grey and brown clays with films of fine sand and with lenses of coarse poorly sorted sand, mainly near the base; the top is characterized by a purple, red and brownish mottling. The Member may attain thicknesses up to ten meters. mainly outcropping near the northern limit of the Savannah Belt and extending into Guyana and French Guiana. The Member unconformably overlies both the Zanderij Formation and weathered basement rocks. To the north it is covered by sediments of the Lelydorp Member and the Mara Formation (the latter in erosional gullies).

The Lelydorp Member is characterized by fine sorted sands, silts, silty clays and sandy clays. The sandy facies can be recognized as lenticular sand bodies, while the clayey facies consists of red-mottled, stiff clays. Brinkman & Pons (1968) and Veen (1970) described two different facies within the Lelydorp clays: 1) Onoribo facies (in the south); a dark grey, very carbonaceous, pyritic clay with reddish mottles, and 2) Santigron facies (in the north); a yellowish red and brown mottled clay with only traces of pyrite. Krook (1979) found these two facies on top of each other NE of Heidoti, along the Coppename River.

Wong (1989) did not include these lithological variations into a formal subdivision of the Lelydorp. Brinkman & Pons (1968) stated that the Lelydorp sand ridges are more extensive and coarser grained towards the east, comparable to the sand ridges of the young Holocene deposits. According to the same authors the Member, which in Suriname occurs north of the Para Member in the area east of Coronie, also outcrops from Cayenne to Organabo in French Guiana.

Mainly based on the Pleistocene age, Brinkman & Pons (1968) also included various river deposits in the former Coropina Formation. These deposits, consisting of clays, sands and gravels, are found in terraces at elevations between 4 and 30m above the mean local river level. The terraces occur along the Marowijne and Suriname Rivers and, especially those of eastern Suriname, have been described in detail by De Boer (1972). On the geological map of Suriname (Bosma et al., 1984) these deposits are mapped as a separate unit under (8): Sand, clayey sand and gravel. From a lithostratigraphic point of view, Wong (1989) emphasized that these deposits should not be part of the Coropina formation. He rather grouped them into an informal unit called "older alluvium".

3.1.1.2. Sedimentary history

Various authors (e.g. Brinkman & Pons; 1968, Veen; 1970) have documented the sedimentary history of the Coropina Formation, stressing that it was governed by various global sea level changes during Pleistocene glaciations in the northern hemisphere. In this context, deposition took place during high sea levels corresponding to inter-glacial periods whereas regressions coincided with glacial periods.

It has always been assumed that the Para Member has been deposited during a transgression corresponding to the Mindel-Riss or the Early Riss-Würm interglacials. The only known radiocarbon age dating of the Para Member stems from similar clays in Guyana (Veen, 1970) and yielded a result of 48,000 years. Deposition of the basal sands of the Member took place on the abraded surfaces of the Zanderij and Onverdacht Formations, and on top of the basement. These sands represent various backbars, probably formed by beachdrifting. The predominant clayey facies however, is indicative of an extensive mudflat. After this period, the sea level was lowered and erosion and weathering occurred in the penultimate glacial period or perhaps during a temporarily lower sea level in the last interglacial period.

During a next sea level rise, possibly during part of the last interglacial period the sediments of the Lelydorp Member were deposited. In many places the top soils of the Para were removed by abrasion. During this transgression the dark, carbonaceous (mainly Rhizophora) and pyritic clays of the Onoribo phase were deposited under brackish conditions. A sample from these clays was dated at more than 48,000 years by Brinkman & Pons. Next, sedimentation of the Santigron phase took place under relatively deep, marine conditions. The paleogeographic configuration of this period shows cheniers near the coast and extensive mudflats at the landward side. The conditions were very similar to the present situation in which mud is beiing supplied by the Amazon River and Guiana Current, while the sands are generally transported by beachdrifting. A great part of the fine sands underwent only little beachdrifting. They were concentrated out of the mud by wave action (Pers.comm. Krook). Finally in the last glacial period the sea level fell drastically (about 90 m, according to Nota; 1969) and the sediments of the Lelydorp Member were exposed to erosion and weathering. In this period, the pronounced dissection of the area by numerous gullies took place.

The various river terraces also reflect the Pleistocene climatological changes. In specific phases of the glacials semi arid conditions prevailed, erosion was eminent and much eroded material was transported by braided rivers. Locally, alluvial fans were formed (Krook, 1970).

3.1.1.3. Discussion

Ever since the fundamental work of Brinkman & Pons (1968), Veen (1970) and Krook (1979) little research has been done on the sediments of the Coropina Formation. It is still not clear how this formation continues laterally under the Young Coastal Plain, and if the pronounced unconformity between the Lelydorp and Para Members still is apparent over there. Another uncertain aspect is the age of the Coropina Formation. It is evident that little value should be attached to the radiocarbon age datings of 48,000 years and more. Already Veen (1970) stressed this point, since he could not relate this age to the global climatological record.

Recent investigations along the eastern Brazilian coast (e.g. Martin et al., 1988; Suguio et al., 1988) revealed that the age of the transgression during the last interglacial is 123,000 years BP. These authors called this high marine level Barrier III which is known as the Cananéia Transgression along the Sao Paulo coastline, and as the Penultimate Transgression in Bahia, Sergipe and Alagoas (Fig.5). In Suriname, the correlative rock unit is likely to be the Lelydorp Member. The Brazilian record shows the presence of yet two older Pleistocene high sea level phases of which the exact age is not known at present. The corresponding deposits which are found in terraces about 20-25m and at least 13m above present MSL are known as the Barrier I and Barrier II respectively. It is not clear if one of these deposits can be correlated with the Para Member in Suriname. Certainly, the intensively weathered and incised surface of the latter suggests a large hiatus, implying the absence of a significant section, but it goes to far to correlate the Para Member with the Barrier I deposits. Similarly, the correlation of Wong (1986) of the two Coropina sea level rises with major Pleistocene "global" cycles Q1 and Q2 of Vail et al. (1977), invoking an Early Pleistocene age for the Para Member, remains highly speculative. It is highly recommended to carry out a modern age dating of the Coropina Formation and to perform a detailed study on its northern continuation in the Young Coastal Plain.

3.2. Holocene

3.2.1. Mara Formation

3.2.1.1. Lithostratigraphy

This is a new formation name introduced by Wong (1989) covering the basal marine deposits of the former Demerara Formation. This author argued that since the introduction of the name Demerara (Kugler et al., 1944) for the Holocene sediments of Guyana, it has become a "garbage can" in which widely differing lithologies have been grouped. Moreover, the name Demerara has been associated too closely with the geomorpholgical unit Young Coastal Plain and with its Holocene age. For these reasons it was proposed to abandon the name Demerara and to attribute the formational status to two of its most distinct lithologies (Mara and Coronie). This subdivision was already introduced, albeit not on formation-level, by Brinkman & Pons (1968). Based on radiocarbon age dating these authors determined an age of more than 6000 y. B.P., an age which was later confirmed by Roeleveld (1969) and Roeleveld & Van Loon (1979).

The Mara Formation consists of soft, grey, unmottled to hardly mottled peaty clays and clayey peats with generally, high contents of pyrite. The unit also contains oyster fragments and high percentages of Rhizophora pollen grains. In Suriname, the Formation is less extended than in Guyana. The majority of the Mara deposits in Suriname occurs in erosion gullies in the Coropina Formation (Fig.4).

3.2.1.2. Sedimentary history:

The Mara Formation has been deposited during the first transgression in the Holocene, under conditions of a rapid rising sea level. This transgression lasted until ca. 6000 years B.P., when the sea level reached it present position. The muds accumulated in extensive coastal swamps with a dominant mangrove (*Rhizophora*) vegetation. Reducing conditions prevailed in these swamps, favouring the formation and preservation of pyrite and carbonaceous material respectively. In this period, the development of the coastal area was generally vertical with a constant to receding shore line.

3.2.2. Coronie Formation

3.2.2.1. Lithostratigraphy:

As discussed earlier, this is the second unit derived from the former Demerara Formation. The Coronie Formation consists of clays with small amounts of pyrite and organic matter, and numerous coarse and fine sand bodies (ridges) which may contain varying amounts of shells. In general the sands east of the Suriname River are fine to medium grained and poorly sorted, whereas those west of this river are very fine grained and well sorted. Usually, the individual sands have coalesced and form wide sand flats.

Brinkman & Pons (1968) described three depositional phases which they called: Wanica phase (6000/5500-3500/3000 B.P.), Moleson phase (2500-1300 B.P.) and Comowine phase (ca. 1000 B.P.-Present). The deposits which were formed during these phases are separated from each other, and locally also from the Mara Formation, by erosion coastlines, mostly with sand or shell ridges (Fig.6). The criteria to define these deposits are essentially based on geomorphological and pedological criteria. Based on these characteristics these units proved to be well recognizable and mappable in the field. Wong (1989) preferred not to introduce a formal lithostratigraphic status for these units since they are rather to be considered morphostratigraphic than pure lithostratigraphic. Hence, it was suggested to maintain the original nomenclature of Brinkman & Pons (1968).

The clays of the Wanica deposit have low pyrite and carbonaceous contents. These clay soils are characterized by a rather low, locally medium, base saturation. They are desalinized to at least 2.5m, showing initial soil formation (firm consistence, yellowish or/with yellowish red mottling) to depths of 1-1.5m. The sands are very fine to silty, becoming rather coarse toward the east, with scarce shells or shell fragments. Individual sand ridges are 4m thick. Together they form E-W oriented, broad bundles in the Young Coastal Plain. The ridges of the Wanica deposit are more weathered than the younger ridges; in the heavy mineral association, garnet has disappeared (Krook, 1979). For the distribution of this deposit see Fig.4 and Brinkman & Pons (1968).

The Moleson deposit constitutes relatively soft clays and locally sand ridges. The clays diplay olive, olive brown and sometimes yellowish brown mottles. The basal part of the clay is very soft and unmottled. The clays are situated ca. 1m above sea level and desalinization reached a maximum of 1 to 1.5m. The lenticular sand bodies (ridges) appear single or in bundles within the clay. They were described in detail by Geijskes (1952). The sand is medium to very fine grained and is frequently mixed with mollusc fragments. Locally the entire ridge may consist of shells, which occasionally are cemented by calcite and in this way form shell breccias. In Suriname, the deposit is situated between the Wanica deposit in the south and the Comowine deposit in the north (see Fig.4).

The Comowine deposit consists of brown mottled clays and grey clays which have vague or no mottles, depending on the degree of desalinization. Within the clay there are sand ridges which may contain shells and shell fragments. The sediments of this unit form a narrow strip (10-20 km wide) along the entire Guiana coast. At present, formation of this deposit is still in progress. Because of its unique character of being one of the worlds largest mud-accretion coasts, it received much attention from various scientists (e.g. Ginsburg & Missimer, 1976; Wells, 1977; Augustinus, 1978, 1980, 1983, 1987; Krook, 1979; Wells & Coleman, 1981a + b; Rine, 1980; Rine & Ginsburg, 1985).

The remaining two lithologies which traditionally have been grouped in the Demerara Formation are designated (1) Alluvial clay and sand and (2) Peat on the geological map of Suriname (Bosma et al., 1984). Wong (1989) proposed a separate lithostratigraphic status for these units (see Fig.4). For the alluvial deposits he suggested the name "younger alluvium". They represent natural levees and backswamp deposits, reaching thicknesses of maximum 6m. For the four ombrogenous peat occurrences the name "Peat" was maintained. They represent fresh-water swamps with poor drainage. Their morpholgy is dome-shaped with a characteristic radial drainage pattern. The Nanni swamp in the district of Nickerie is reported to have a maximum thickness of 7m.

3.2.2.2. Sedimentary history

The sea level reached its present position about 6000 years B.P. and lateral accretion of the Young Coastal Plain, alternating with some erosional phases, started. Large amounts of terrigenous material from the Amazon River were deposited under relatively constant sea level conditions. The sediments of the Wanica deposit accumulated from 6000 to 3000 years B.P. when the sea level possibly was slightly above its present position. The sand ridges (cheniers) represent numerous beach sands deposited by longshore currents. The large supply of terrigenous material forced the smaller rivers draining the Guiana Shield to deflect to the west and flow parallel to the coast.

In the period between 2500 to 2000-1300 years B.P. the sediments of the Moleson deposit were formed under the same marine conditions as those of the Wanica deposits. The shell ridges represent old shell beaches that have been cut off from the sea by mud accumulations.

Deposition of the Comowine deposit started ca. 2000-1300 years B.P. and is still continuing. The majority of these sediments were deposited at or near the mean sea level in intertidal, subtidal and occasionally supratidal environments (Ginsburg & Missimer, 1976) The intertidal areas near the coast are presently mangrove swamps with *Avicennia* predominating in the outer zone and *Rhizophora* as the dominant floral element in the inner zone. The shoreline and nearshore subtidal areas undergo rapid changes because contemporary deposition along the Guiana coast is cyclic, with the cycles averaging 30 years. They represent alternating periods of intense erosion and periods of rapid deposition forming wide intertidal mudflats. Under influence of the Guiana Current and wind generated waves and currents, the mudbanks and the erosional areas migrate gradually westward. Since the volume of sediment accumulating during the depositional phases is generally greater than the volume removed during an erosional phase, the net result is a progradation of the shoreline.

3.2.3. Discussion

Fortunately, the Holocene sediments in the Young Coastal Plain are well documented. The various age datings are rather consistent and can be calibrated with other regional data. A further sharpening of the ages of the transitions between the Wanica and Moleson and between the Moleson and Comowine deposits is needed, however.

The major sea level rise during the Holocene has also been recorded in Brazil, where it is known as Santos transgression (cf. Martin et al., 1988; Suguio et al., 1988). The sediments formed during this transgression are named Barrier IV deposits (Fig.5). It is striking that during the further Holocene development there were also two sea level lowerings in Brazil. The Wanica/Moleson regression seems to fit well with the 2700 y. B.P. regression in Brazil (Fig.7). It is evident that detailed, systematic, research is needed to complete the regional Holocene picture.

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TEXT OF FIGURES BELONGING TO TH.E.WONG

Figure.1
Outline of the Guiana Basin showing the coastal plains of Suriname, Guyana and French Guiana.

Figure.2
Stratigraphical framework of the Coastal Plain of Suriname, also showing various sea level movements. Modified after Wong, 1986.

Figure.3
Reference section Coropina Formation, showing lower clayey part (Para Member) and upper sandy part (Lelydorp member). After Wong, 1989.

Figure.4
Geographical distribution of the Pliocene, Pleistocene and Holocene sediments in the Coastal Plain of Suriname. After Wong, 1989.

Figure.5
Quaternary stratigraphy of Suriname in comparison with that of East Brazil. After Wong, 1989. Brazilian data after Martin et al., 1988 and Suguio et al., 1988.

Figure.6
Lateral section Coronie Formation. After Wong, 1989.

Figure.7
Holocene sealevel curve of Suriname in comparison with that of East Brazil; A: correlates well, B: probably correlatable, C: not in Suriname, D: seems to correlate, E: not in Brazil.

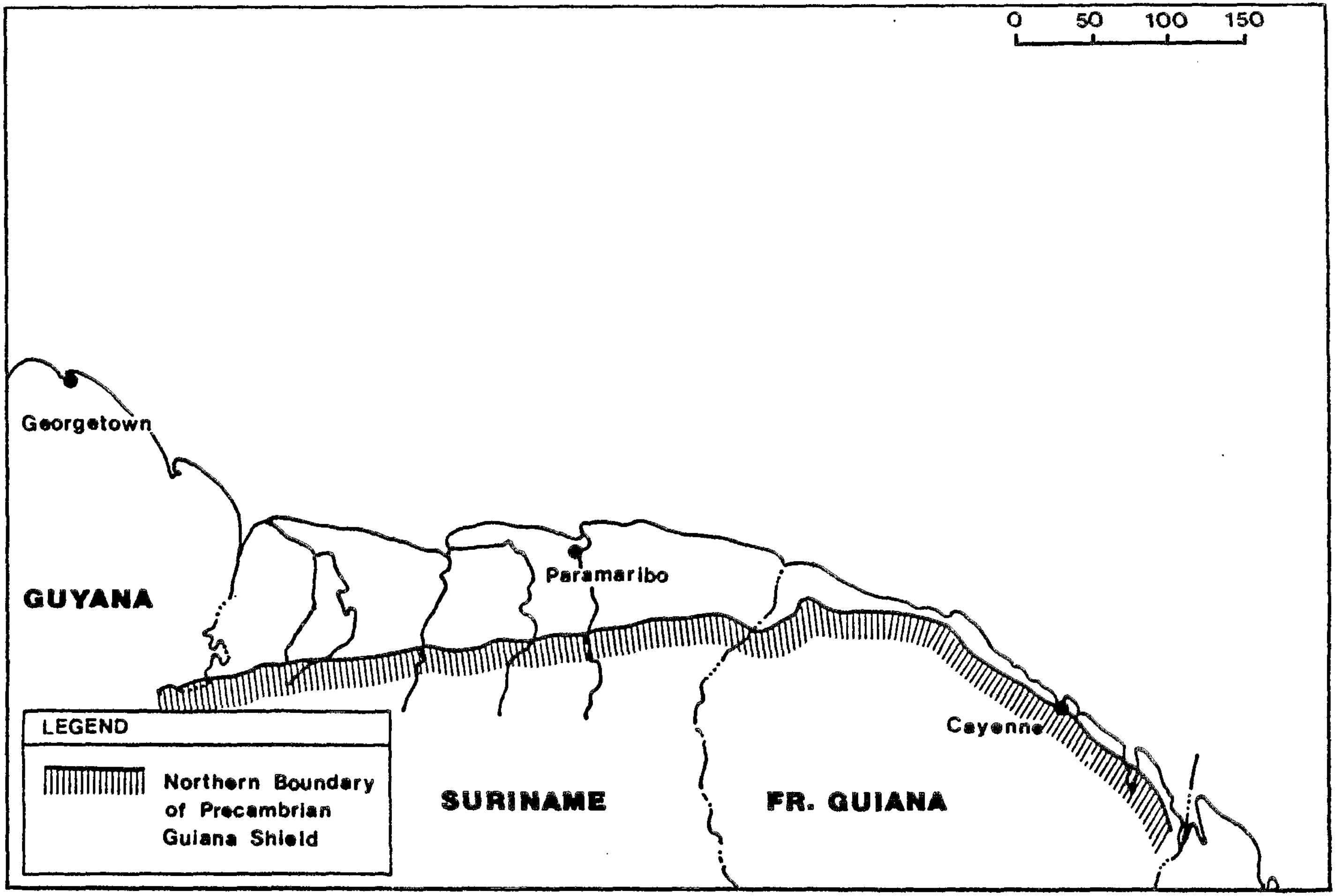
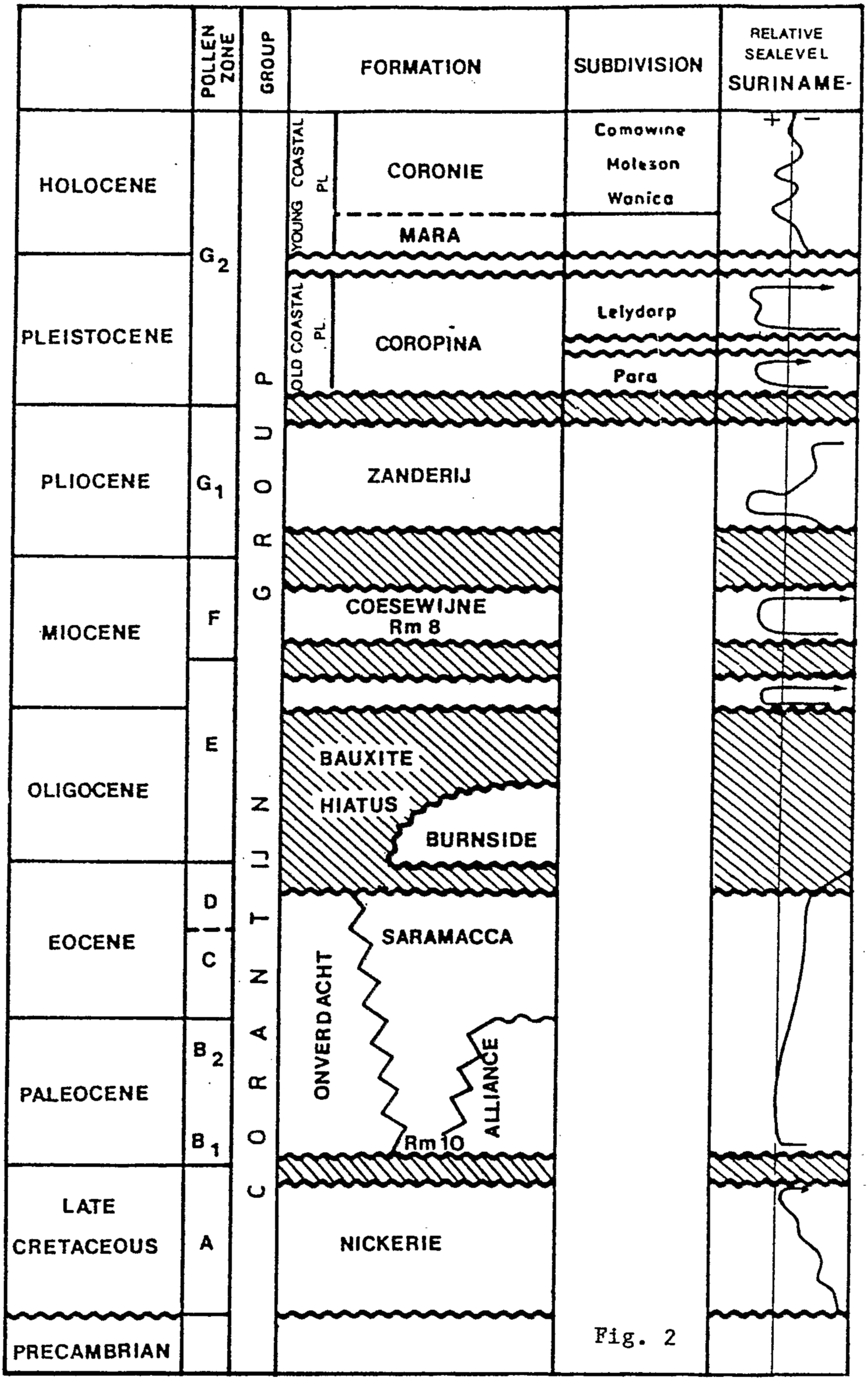

0 50 100 150
Georgetown
GUYANA
Paramaribo
Cayenne
SURINAME
FR. GUIANA
LEGEND
Northern Boundary of Precambrian Guiana Shield

Fig. 1


POLLEN ZONE
GROUP
FORMATION
SUBDIVISION
RELATIVE SEALEVEL
SURINAME
HOLOCENE
PLEISTOCENE
PLIOCENE
MIOCENE
OLIGOCENE
EOCENE
PALEOCENE
LATE CRETACEOUS
PRECAMBRIAN
G2
G1
F
E
D
C
B2
B1
A
CORANTIJN GROUP
YOUNG COASTAL PL.
OLD COASTAL PL.
CORONIE
MARA
COROPINA
ZANDERIJ
COESEWIJNE
Rm 8
BAUXITE
HIATUS
BURNSIDE
SARAMACCA
ONVERDACHT
ALLIANCE
Rm 10
NICKERIE
Comowine
Moleson
Wanica
Lelydorp
Para
+
−
Fig. 2

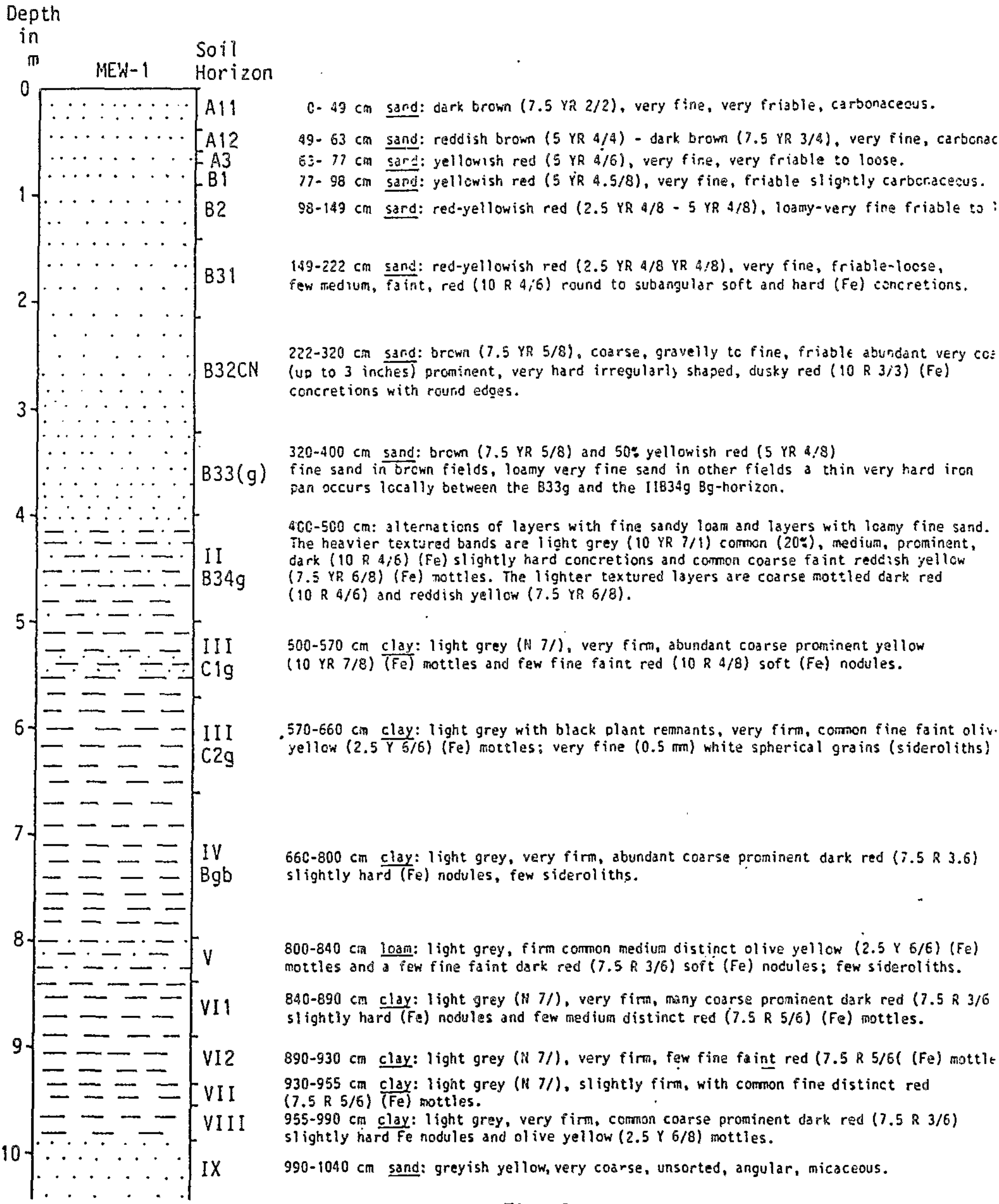
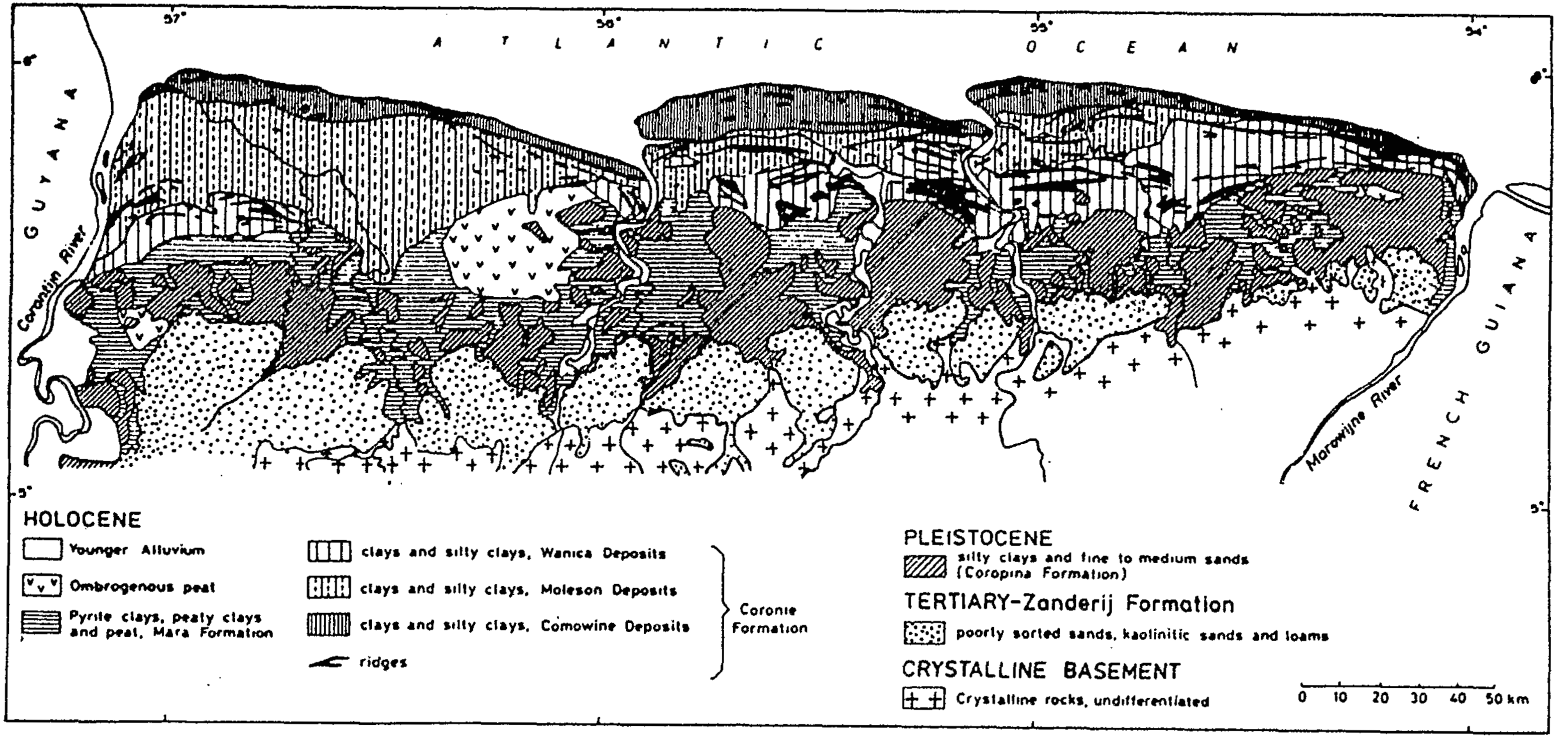

Depth in m
MEW-1
Soil Horizon
0
1
2
3
4
5
6
7
8
9
10
A11 0- 49 cm sand: dark brown (7.5 YR 2/2), very fine, very friable, carbonaceous.
A12 49- 63 cm sand: reddish brown (5 YR 4/4) - dark brown (7.5 YR 3/4), very fine, carbonac
A3 63- 77 cm sand: yellowish red (5 YR 4/6), very fine, very friable to loose.
B1 77- 98 cm sand: yellowish red (5 YR 4.5/8), very fine, friable slightly carbonaceous.
B2 98-149 cm sand: red-yellowish red (2.5 YR 4/8 - 5 YR 4/8), loamy-very fine friable to
B31 149-222 cm sand: red-yellowish red (2.5 YR 4/8 YR 4/8), very fine, friable-loose, few medium, faint, red (10 R 4/6) round to subangular soft and hard (Fe) concretions.
B32CN 222-320 cm sand: brown (7.5 YR 5/8), coarse, gravelly to fine, friable abundant very co (up to 3 inches) prominent, very hard irregularly shaped, dusky red (10 R 3/3) (Fe) concretions with round edges.
B33(g) 320-400 cm sand: brown (7.5 YR 5/8) and 50% yellowish red (5 YR 4/8) fine sand in brown fields, loamy very fine sand in other fields a thin very hard iron pan occurs locally between the B33g and the IIB34g Bg-horizon.
II B34g 400-500 cm: alternations of layers with fine sandy loam and layers with loamy fine sand. The heavier textured bands are light grey (10 YR 7/1) common (20%), medium, prominent, dark (10 R 4/6) (Fe) slightly hard concretions and common coarse faint reddish yellow (7.5 YR 6/8) (Fe) mottles. The lighter textured layers are coarse mottled dark red (10 R 4/6) and reddish yellow (7.5 YR 6/8).
III C1g 500-570 cm clay: light grey (N 7/), very firm, abundant coarse prominent yellow (10 YR 7/8) (Fe) mottles and few fine faint red (10 R 4/8) soft (Fe) nodules.
III C2g 570-660 cm clay: light grey with black plant remnants, very firm, common fine faint oliv yellow (2.5 Y 6/6) (Fe) mottles; very fine (0.5 mm) white spherical grains (sideroliths)
IV Bgb 660-800 cm clay: light grey, very firm, abundant coarse prominent dark red (7.5 R 3.6) slightly hard (Fe) nodules, few sideroliths.
V 800-840 cm loam: light grey, firm common medium distinct olive yellow (2.5 Y 6/6) (Fe) mottles and a few fine faint dark red (7.5 R 3/6) soft (Fe) nodules; few sideroliths.
VI1 840-890 cm clay: light grey (N 7/), very firm, many coarse prominent dark red (7.5 R 3/6 slightly hard (Fe) nodules and few medium distinct red (7.5 R 5/6) (Fe) mottles.
VI2 890-930 cm clay: light grey (N 7/), very firm, few fine faint red (7.5 R 5/6((Fe) mottle
VII 930-955 cm clay: light grey (N 7/), slightly firm, with common fine distinct red (7.5 R 5/6) (Fe) mottles.
VIII 955-990 cm clay: light grey, very firm, common coarse prominent dark red (7.5 R 3/6) slightly hard Fe nodules and olive yellow (2.5 Y 6/8) mottles.
IX 990-1040 cm sand: greyish yellow, very coarse, unsorted, angular, micaceous.

Fig. 3



ATLANTIC OCEAN
GUYANA
FRENCH GUIANA
Corantijn River
Marowijne River
57°
56°
55°
54°
6°
5°
HOLOCENE
Younger Alluvium
Ombrogenous peat
Pyrite clays, peaty clays and peat, Mara Formation
clays and silty clays, Wanica Deposits
clays and silty clays, Moleson Deposits
clays and silty clays, Comowine Deposits
ridges
Coronie Formation
PLEISTOCENE
silty clays and fine to medium sands (Coropina Formation)
TERTIARY-Zanderij Formation
poorly sorted sands, kaolinitic sands and loams
CRYSTALLINE BASEMENT
Crystalline rocks, undifferentiated
0 10 20 30 40 50 km

Fig. 4

	SURINAME		BRAZIL	
HOLOCENE	Coronie	Comowine (2000/1300 - Recent)	Barrier IV	2000 - Present *
		Moleson (2500 - 2000/1300)		3600 - 2800 *
	Mara	Wanica (6000/5500 - 3500/3000) (10.000 - 6000)	Santos transgression	5100 - 3900 *
PLEISTOCENE	Lelydorp	Santigron	Barrier III	123.000
		Onoribo	(Cananeia / Penultimate transgression) ?	
	Para		Barrier II	>123.000
			?	
			Barrier I	>123.000
PLIOCENE	Zanderij		Barreiras	

Fig. 5

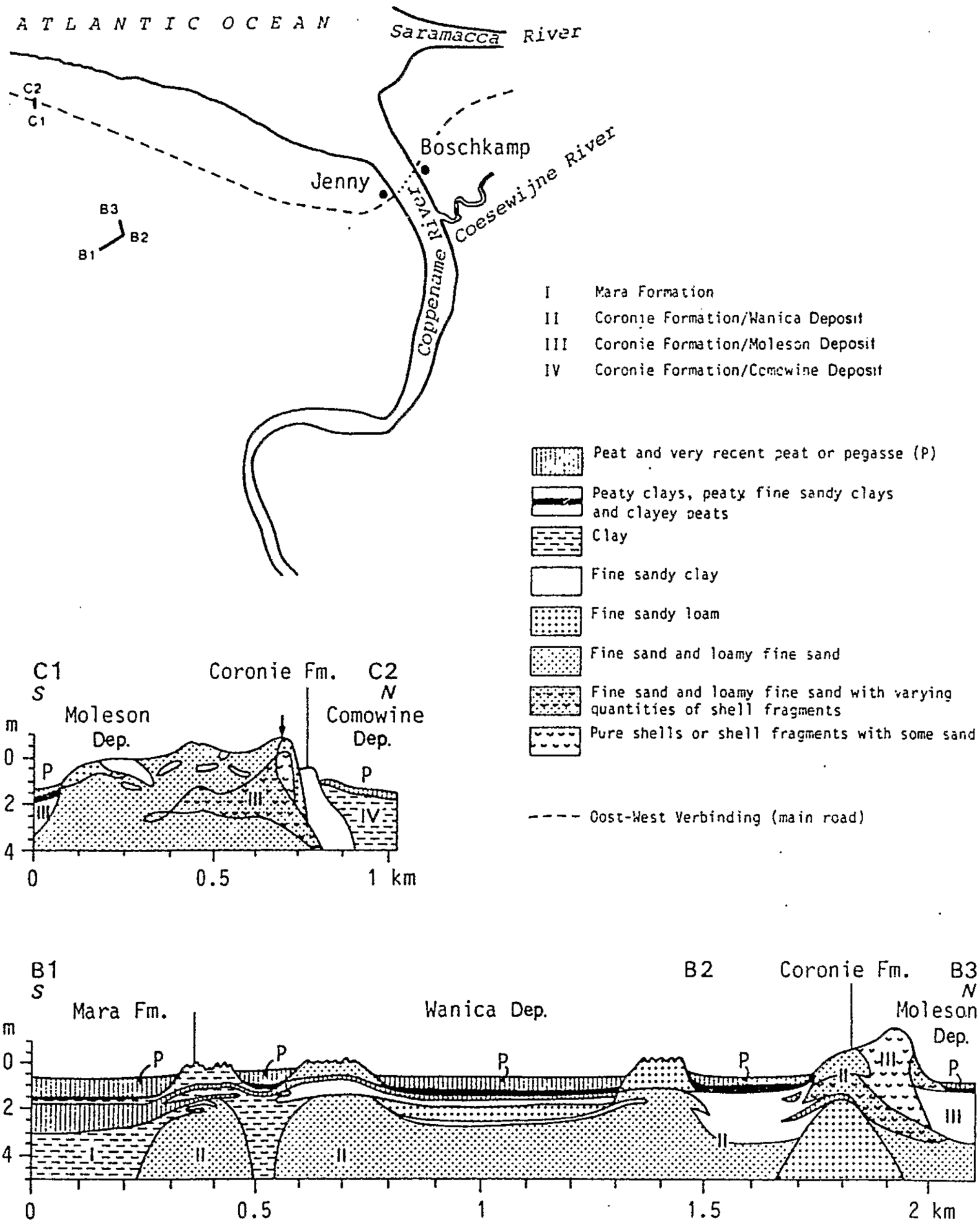

ATLANTIC OCEAN
Saramacca River
C2
C1
Boschkamp
Jenny
Coesewijne River
Coppename River
B3
B2
B1
I Mara Formation
II Coronie Formation/Wanica Deposit
III Coronie Formation/Moleson Deposit
IV Coronie Formation/Comowine Deposit
Peat and very recent peat or pegasse (P)
Peaty clays, peaty fine sandy clays and clayey peats
Clay
Fine sandy clay
Fine sandy loam
Fine sand and loamy fine sand
Fine sand and loamy fine sand with varying quantities of shell fragments
Pure shells or shell fragments with some sand
Oost-West Verbinding (main road)
C1
S
Coronie Fm.
C2
N
Moleson Dep.
Comowine Dep.
m
0
2
4
P
III
IV
0
0.5
1 km
B1
S
B2
Coronie Fm.
B3
N
Mara Fm.
Wanica Dep.
Moleson Dep.
P
I
II
III
0
0.5
1
1.5
2 km

Fig. 6

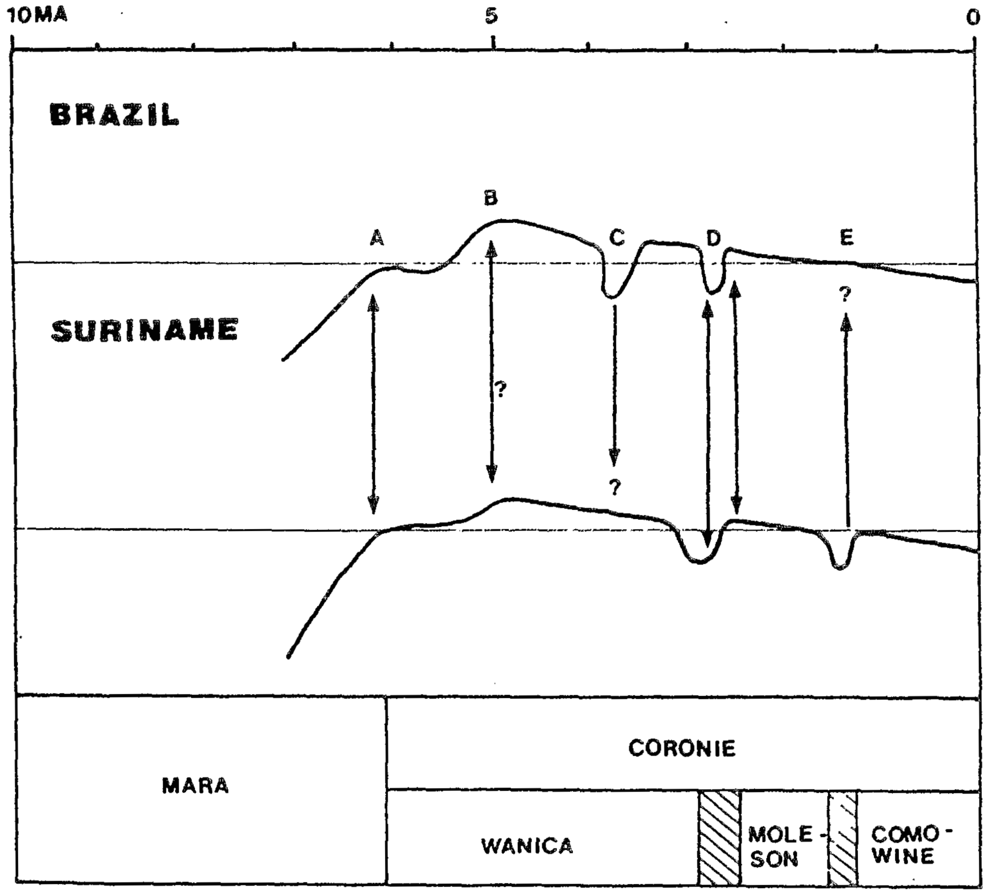

10MA
5
0
BRAZIL
SURINAME
A
B
C
D
E
?
CORONIE
MARA
WANICA
MOLE-SON
COMO-WINE

Fig. 7