DEMOCRATIC REPUBLIC of the CONGO
(DRC)

DEVELOPMENT OF A SOIL AND TERRAIN MAP/DATABASE

Technical Report No.

by

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for

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ABBREVIATIONS and CONVERSIONS

a.s.l.	altitude in metres above sea level
AWC	available water holding capacity
CEC	cation exchange capacity
EC	electrical conductivity
Ex. Ac.	Exchangeable acidity
FAO	Food and Agriculture Organization
INEAC	National Institute for Agronomic Studies in the Congo
SOTER	World SOils and TERrain Digital Data Base
WCG	Western Congo Group (rocks)

SUMMARY

The "development of a soil, terrain unit map, and database for the Democratic Republic of the Congo (DRC)" presents a revised soil map and a terrain unit map (to a scale of 1/5,000,000).

The report (volume I) contains descriptions of terrain units, according to the principles of the SOTER manual; soil mapping units are classified in the FAO soil classification (1990).

Major constraint is that this study has been based only on existing literature and reports, with incomplete soil analyses. In view of the size of the DRC, the information on soils and terrain units, available at present, is still very limited. When using the database, it should not be forgotten.

Volume II includes adaptations and translations of typical, geo-referenced, soil profile descriptions.

The report provides FAO with valuable basic data on the Congo's natural resources, fundamental data needed for multi-layered GIS-supported information systems and essential for land use planning decisions.

RECOMMENDATIONS

1. Recommendations for the Democratic Republic of the Congo (DRC)

There is no up-to-date soil map of the DRC. Sufficient and appropriate information on soils and soil properties is lacking and makes it difficult to assess the land use potentials for specific areas.

The fragile nature of soils and vegetation increases the risks of environmental degradation, due to population pressure and/or mismanagement of natural resources, such as overgrazing, deforestation for fuelwood production and land clearing.

Land resources inventarisation, as initiated by this project, is urgently needed. It should be based on systematic collection of all physical data, which influence land use.

The information presented in this report is very fragmental. More detailed, recent information is needed on major land regions, land units, soil types, climatic data (risk factors), land suitability potentials, farming systems, importance of soil erosion and soil conservation measures.

It is important to identify (map/describe) and stop land degradation: soil, soil water and soil fertility losses. Effective measures are needed, such as management of soil and water conservation and soil fertility restoration, crucial to reduce land degradation and increase productivity.

Climatic data need incorporation into agro-ecological zones. Studies of socio-economic factors should also be included.

The matching of all collected data should lead to formulation of sound advises for National Land Use Planning, on a scientific basis.

Databases need to be supplied with reliable, recent field observations and laboratory analyses. Land evaluation is needed to formulate recommendations of appropriate types of land use and soil conservation.

- It is recommended to refine the national terrain unit and soil map. It is evident there is a demand for recent field observations.

- The first objective would be to finalize an updated soil map to a scale of 1:2.5 Million, for incorporation in a digital soil map. At that level, terrain units could be subdivided into clearly defined terrain components. Field work, satellite image and aerial photograph interpretation would be essential at that stage. During reconnaissance soil surveys, combined with training courses, representative soils could be mapped and sampled for each terrain unit.

- In a second phase, more detailed soil and land unit mapping could be foreseen for critical agriculture, pasture or conservation areas.

2. Recommendations for digitalisation and database construction

The SOTER programme is a useful tool to handle terrain and soil data. The user of the programme should, however, be advised that the stored information is simplified and very restricted. It could give a false impression, that enough field data are available for any kind of land use planning.

- At the terrain unit level, the programme permits ONE entry only for each topic; e.g. lithology of an area is often complex and composed of several contrasting rocks, such as layers of quartzites and schists. The SOTER programme will accept ONE entry only. This over-simplification may lead to erratic decisions. The same problem exists at the terrain component level. More detailed information than available in SOTER, can be found in the written text of this report.

- SOTER permits a description of quantity and size of gravels, but not of gravel composition; e.g. a soil with weathered schist gravels will store water and provide nutrients to the plants, which is not the case for ironstone or inert quartz gravels.

- There is no entry available for ironstone pans or crusts, which cause important temporary water stagnation problems and damage to coffee and other crops.

- SOTER permits to describe soil structure, but there is no entry to describe the large and deep cracks, as in case of Vertisols.

- There is no entry for mottling, important to define drainage problems.

It must be repeated that, no matter how impressive GIS and computerized systems might be, outputs will be of inferior quality, as long as basic data (field observations) supplied to these system are of poor quality.

INTRODUCTION

1. ACKNOWLEDGEMENTS

First of all, I am grateful to Dr. F. Nachtergaele and Dr. P. Koohafkan at FAO HQ/Rome for their support and for the opportunity to undertake this study.

In Belgium, I would like to thank Prof. Dr. Jan Feyen and Prof. Dr. J. Deckers of the University of Leuven (B) for their confidence.

2. TERMS OF REFERENCE

Preparation of a technical report, containing a brief description of the major terrain and soil units in the Republic of the Congo (separate report) and the Democratic Republic of the Congo (DRC).

The database will contain the following:

1. A physiographic layer with terrain information at an equivalent scale of 1:5 or 1:2.5 million, according to the principles used in the SOTER manual.

2. A soil map at the same scale giving information on the soil unit composition in each unit, surface conditions and the soil phase if required.

3. A selection of geo-referenced typical soil profiles characterizing the major SOTER units in the country, classified in the FAO revised Legend (1990).

Language: English

3. BACKGROUND

In June 1995, FAO, UNEP and ISRIC launched the idea of a significant update of the soil map of the world, using the SOTER methodology. Two volumes (South America and north-eastern Africa) have been released by FAO in digital format. It is the intention to complete the southern and central African region. For this purpose, AGL has collected in cooperation with the national soil institutes concerned, the soil and terrain information for the Republic of the Congo and the Democratic Republic of the Congo. However, much material and soil information is dispersed in other libraries and universities. Systematic terrain information has only recently become available. It is the intention that this material be compiled and put in a relational database system compatible with earlier material collected using the SOTER methodology.

All information could be build into an easily accessible, multi-layered GIS-supported information base, suitable for national and sub-national level agro-ecological zoning, improving irrigation capability interpretation and environmental impact studies, with a view to support the land use planning facilities of the countries concerned.

Agriculture plays a large role in the economy of those countries. It is by far the greatest source of employment for the majority of the population. There is a need to increase the productivity of agriculture, to improve the live of the rural poor.

Development planning depends heavily on sufficient data inputs. Land use planning in the Congo’s, is up to now, rarely based on natural resources information. There is a growing awareness that a sound perspective of the agricultural potential is needed. Essential is the preparation of a systematic inventory of natural factors determining the agricultural potential, e.g. landforms and soils.

The objectives of this study are to collect basic data of the natural resources, for procession of those data by computer and to release conclusions on the optimal use of land to decision makers

The ultimate goal is to provide essential information for land use planning to decision makers, in order to improve the living conditions of rural communities and to establish systems for sustainable management and protection of both the renewable natural resources and the physical environment.

4. IMPLEMENTATION AND WORKING METHOD

4.1. Literature study

The consultant gathered information from the libraries of the University of Ghent (Belgium) and from the INEAC in Brussels. Valuable data were collected on geology and soils. Detailed information on soils, vegetation, land use and landscapes could be extracted.

4.2. Soil map

Not many soil studies have been done in the DRC. The main source for this work has been the soil map of Congo, to a scale of 1/5,000,000 (1962). This map had been used already to prepare the soil map of the world in 1974. During this study the original map has been reviewed and adapted to the revised FAO soil classification of 1990. Many soil profile descriptions of Sys (1972) have been translated, classified and adapted.

4.3. Terrain unit map

The terrain unit map has been based on geology and the step-like plateau nature of the country. Terrain units were subdivided according to geology of the substratum, soils, geomorphology and vegetation. A comparison with the available soil information was useful to understand the physiography of the country.

4.4. Database for the DRC

The reader is referred to part II: database. According to the terms of reference, each terrain unit has been coded and described, taking into account the objective of informatisation.

MAIN FINDINGS AND CONCLUSIONS

PART I NATURAL RESOURCES OF THE DRC

1. Area and population

The Democratic Republic of the Congo (RDC) is a vast, relatively scarcely populated country. It is located in central Africa, between the parallels of 5°N to 13°S and the meridians of 12° to 32°E. The country has a surface of 2,345,410 km^2. The RDC is bordered (clockwise) by Cabinda (Angola), the Republic of the Congo (Brazzaville), the Central African Republic, Sudan, Uganda, Rwanda, Burundi, Tanzania, Zambia, Angola, and by the Atlantic Ocean in the west.

There is an extreme diversity of landscapes. Relief is dominated by step-like plateaux around the Central Congo Basin. The mountains of the eastern highlands are the western uplifted block of the Rift Valley. The high plateaux of Katanga are uplifted and dissected blocks. A coastal, dissected highland (Mayombe), almost locks the Congo Basin. A narrow coastal plateau and plain occur along the ocean.

The Central Congo Basin is covered by equatorial forest, where the Congo and its affluents flow in (swampy) wide valleys. Those rivers descend from the stepped plateaux in many rapids and waterfalls, with enormous hydro-electrical potentials.

Population is about 40,000,000 inhabitants (1991), or 16 per square kilometre. Population growth is 3.3 %. Population doubles every 21 years. The main towns are Kinshasa (2,654,000 inh.), Lubumbashi (543,000 inh.), Mbuji-Mayo (423,000 inh.), Kananga (291,000 inh.)... (PC Globe, 1992).

2. Climate

The RDC has a number of climatic zones in accordance with the large vegetation formations.

The climate of much of the Congo Basin is equatorial and is hot, moist and fairly cloudy throughout the year. Seasonal changes of temperature are very small; there is no dry season on the equator. A definite, short dry season appears N and S of the 3° latitude in wintertime and there is a decrease of the amount of rain, for a few weeks, about the middle of the wet season. S of 9° S the climate is tropical, with a drier and cooler season in winter. In the E and S, the climate is modified by altitude.

Precipitation is highest in the Central Congo Basin and on the western slopes of the eastern highlands (at > 2,200 m). The length of the dry season increases towards the N and S (4 months on the northern border and 7 months in southern Katanga).

2.1. Central Congo Basin

The NW and W part of the Central Congo Basin has a humid (annual precipitation of 1,600 to > 2,200 mm) and hot equatorial climate, with two rainfall maxima. There is no dry season around the equator, but there are two dry seasons at higher latitudes (dry season of 0-2 months). The average temperature is around 25°C and the daily ranges increase with distance from the equator (11 to 20°C). Köppen climatic classification is Af and Am.

2.2. Surrounding stepped plateaux

The higher SE plateaux have a climate with cooler nights. It becomes cooler and more humid with altitude. Köppen climatic classification is Aw.

2.3. Northern plateaux or Sudano-Guinean strip

A W-E strip on the northern border with the Central African Republic and Sudan has a hot tropical climate, with a dry season of 4 to 5 months and a rainy season of 5 to 7 months. Köppen climatic classification is Aw.

2.4. High plateaux of Katanga

As altitude often exceeds 1,000 m, average temperatures are lower. Winter seasons (May-September) are long and dry. Köppen climatic classification is Aw and Cw.

2.5. Eastern highlands and Rift Valley

Köppen climatic classification is Cf and Cw. A subdivision can be made according to altitude.

a. Rift Valley floor (< 1,200 m a.s.l.)

There is a small range of temperatures. Winds from the Indian Ocean become hot and dry when descending from the Rwanda highlands.

b. Mountain areas (1,200-3,900 m a.s.l.),

This area is cooler and has a higher rainfall. Total annual rainfall ranges from 1,250 mm at 1,650 m a.s.l. to a maximum of 2,500 mm at 2,400 m a.s.l. Humidity increases, with altitude, to saturation point. Clouds and mist reduce insolation to a minimum.

c. Alpine areas (> 3,900 m a.s.l.).

The Ruwenzori massif and the Virunga chain receive less rainfall, but it is more continuous. Air humidity is high. The mountain tops are often concealed by clouds or mist. Perpetual snow is found at 4,500-5,000 m.

2.6. Coastal belt

Climate is equatorial, but cooled and dried by the Benguela current. A dry season exists from June to October, corresponding to a drop in the mean temperature from July to November.

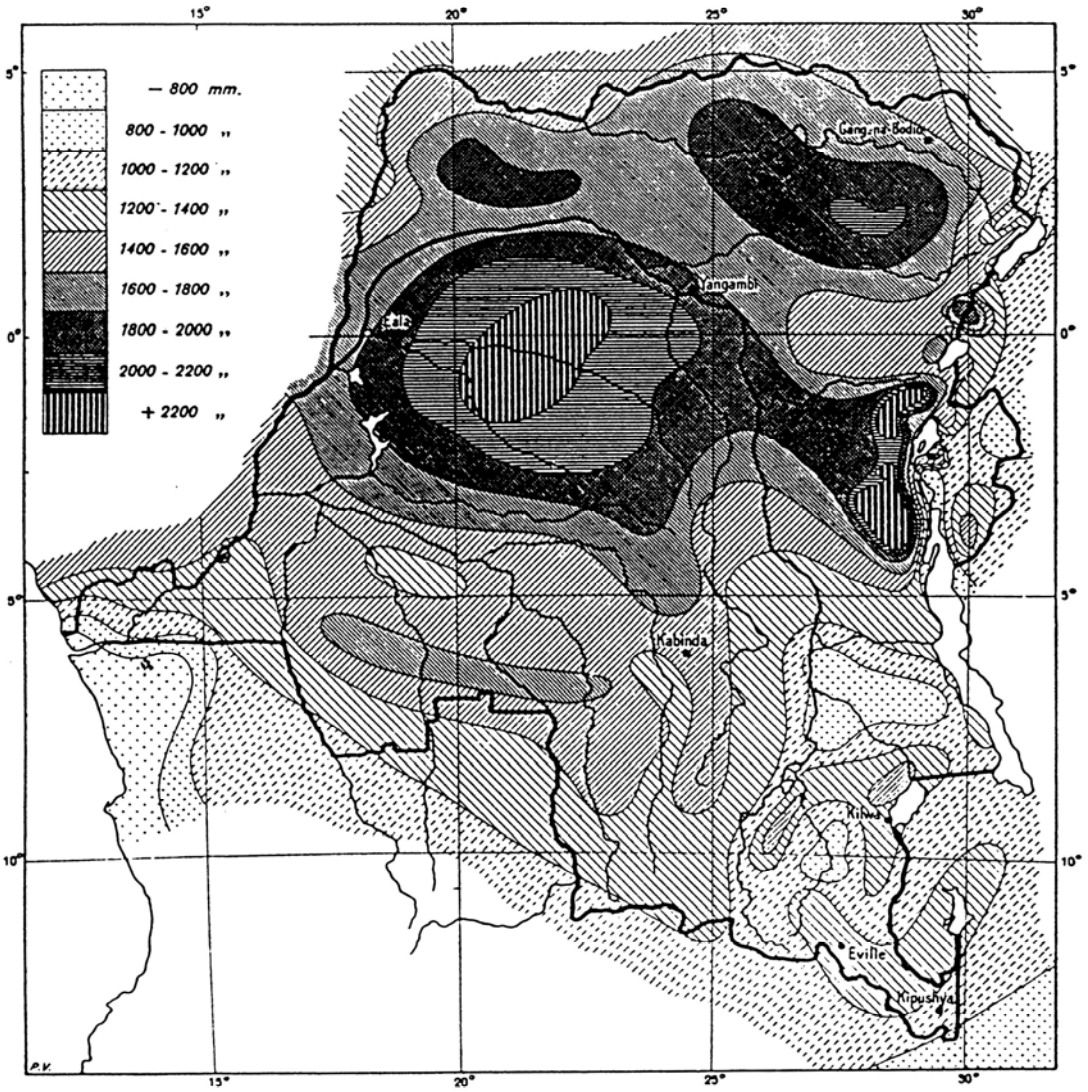


Planche pluviométrique du Congo (période 1930-1939)

Fig. 1. Annual precipitation (mm) in the DRC (Robert, 1946).

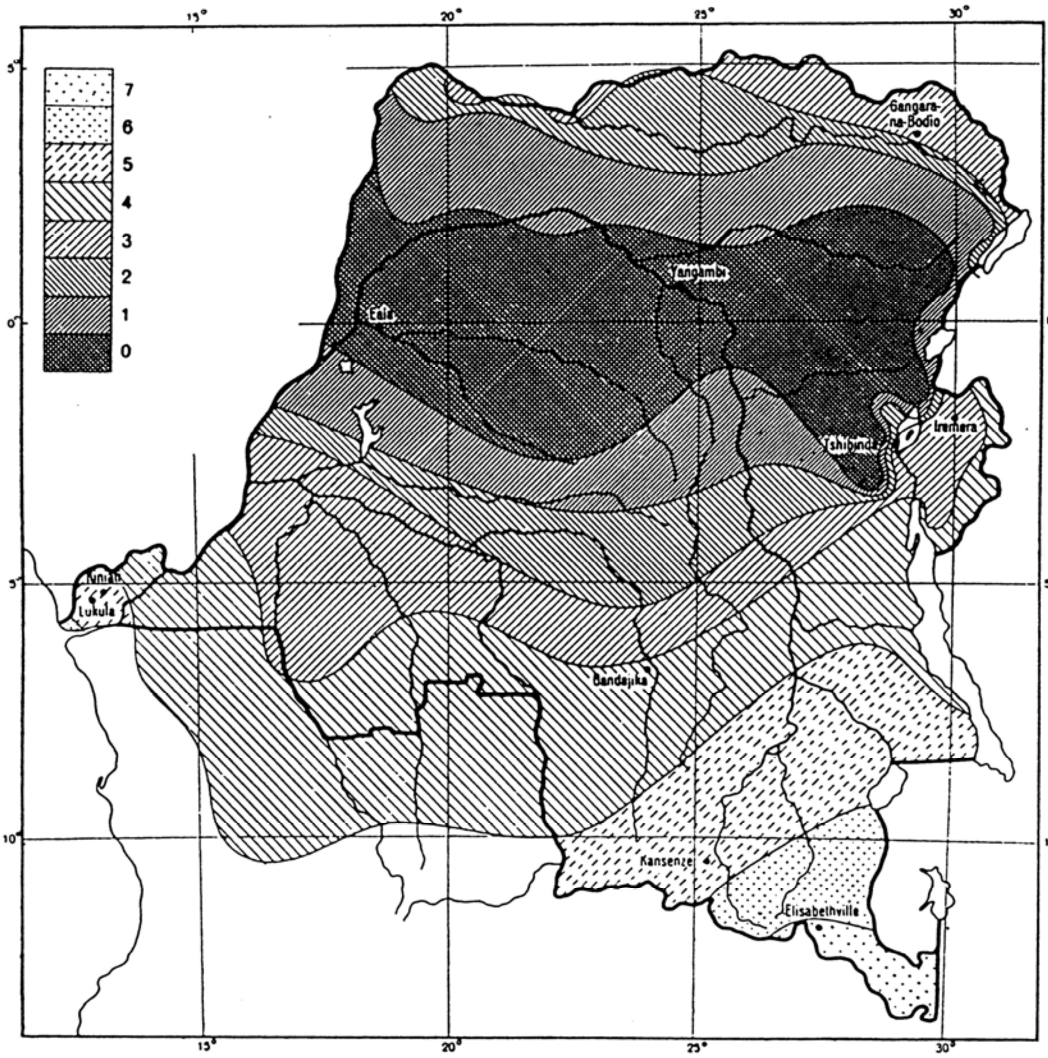


Fig. 2. Length of the dry season (months) in the DRC (Robert, 1946)

3. Land use

About 40-45 % of the country is covered by tropical rain forest and another 10 % by dry forests in Katanga and riparian forests along the rivers.

In the rain forest area, cassava (manioc) is the staple crop. Cattle cannot pasture here because of the tsetse fly. On the tsetse-free highlands of the NE, people possess cattle and grow maize or millets.

Roughly in between forest and highland, on the upper reaches of the great rivers, bananas and rice are grown. Shifting cultivation is common.

Cassava is the staple food of more than half of the population, but it quickly exhausts soils. The Kwango and Kivu provinces are major cassava growing areas.

Rice grows well along the banks of the Lualaba and Lomami rivers, near Kisangani.

Maize is cultivated in quantities in the highlands.

Millets and sorghum thrive in the drier open savannah and their cultivation is usually associated with cattle-owing people.

Bananas and plantains are mainly grown around Kisangani and in the Kivu.

Sweet potatoes and beans are more grown in the east.

Concerning export crops:

Cotton is grown N and S of the rainforest.

Oil palm and rubber are grown in the Central Congo Basin (rainforest); oil palm (*Elaies guineensis*) grows between the latitudes of 3°N and 6°S.

Coffee grows on the Kivu and Lower Congo highlands. Cocoa is found on the Mayombe highlands, in the Lower Congo.

Near Lubumbashi (Katanga), apples, peaches, plums and other temperate fruits are produced. In nearby Kasenga, oranges and strawberries have been grown. Tea is cultivated in the Kivu highlands.

Rubber can be cultivated in the Congo Basin.

Table 1. Agriculture production of the DRC in 1989
(PC Globe, 1992)

crop	Metric tons
coffee	98,000
maize	790,000
cotton	26,000
rubber	18,000
potatoes	32,000
rice	315,000
sugar	75,000
soybeans	17,000
tea	6,000
tobacco	8,000
wheat	35,000

4. Physiography

The RDC belongs to the "African Interior Plateau". Its central part is depressed and forms the Congo Basin. It is bordered on all sides by uplands and in the east by the high mountains of the African Rift Valley.

Incision of valleys started during the Cretaceous and further deepening took place following the Miocene tectonical upheaval.

One of the most characterizing elements of African geomorphology are the different planation surfaces. These pediplains, nowadays plateaux, represent the final stage of individual cycles of erosion and are separated from each other by escarpments.

- The middle Tertiary pediplain (Miocene) is found on the high plateaux of southern Katanga and in some parts of eastern and north eastern Congo (at > 1,000 m). This planation forms much of the present higher plateau surfaces in south Katanga, on the watershed of the Congo and the Zambeze. It also occurs in the south of the Kasai basin. The surface is overlain by the “polymorphic sandstone” (Kalahari duricrust), by Kalahari sands and by ferralitic ironstone crusts.

- At a lower level (300-500 m) occurs the more extensive and stepped Late-Tertiary pediplain. It is covered by ironstone crusts.

- To Quaternary surfaces belong recent river valleys and alluvial terraces.

4.1. Central Congo Basin plain

The Congo Basin is a depression in the meteorological, as well as the topographical sense. This broad, flat basin constitutes a slight depression of the African continental platform. The Basin is almost completely sealed and the only outlet to the sea is a narrow valley across the Mayombe or Crystal Mountains. Its floor has an average altitude of 400 m and rises to the all-surrounding stepped plateaux.

The Congo Basin Plain traces out a rough ellipse, the major axis that runs SW-NE. Across this lower level - the Congo Plain and the area of dense forest - flows the Congo River, from Stanley Falls to close to Kinshasa (terrain unit 202).

In this plain the Congo is joined by great tributaries: Aruwimi, Lomani, Kasai, Ubangi and Sanga. All rivers flow wide and slow between banks. They are entrenched in thick beds of alluvium. There are many swamps (confluents of the Mongala, Lulonga and Ubangi rivers) and lakes (terrain unit 203).

Lake Mai Ndombe (Leopold II Lake), in N Bandundu, lies in one of the lowest parts of the plain. Around it exist extensive marshes and to its margins extends waterlogged forest.

The 500 m contour, which so plainly marks the Congo lowlands gives an exaggerated impression: the surfaces rise almost imperceptibly, over thousands of square kilometres, to between 900 and 1,500 m.

In the Basin, Precambrian rocks are covered by continental deposits, comprising Karroo beds (mainly Cretaceous), Tertiary and Quaternary sediments, which cover a 150,000 km^2 alluvial plain in the centre of the basin.

Lower Pleistocene sands cover large parts of the Central Basin.

Upstream the Congo River from Lukolela to Basoko a monotonous plain exists interrupted only at following places.

- N of Lukolela the dense forest begins and the Congo river is narrowed by a range of low conglomerate hills.
- At Lisala 60 m high hills appear on the N of the river.
- At Basoko hills appear on the west bank.

The central part of the Congo basin has a subhorizontal relief. Between the extensive marshes (60-70 % of the total surface) occur W-E strips of dry land.
A pediplain surface below the soils could be of Upper-Pleistocene age. It is located 10 m above the erosion basis of the large rivers and it is covered by 2-10 m of loose sediments.

Soils are yellowish Xanthic Ferralsols (strongly weathered). Usually they have a sandy clay texture and are suitable for rubber, oil palm and coffee. Sandy areas have magnesium deficiencies.

At Kisangani, the Stanley falls mark the transition to the stepped plateaux and also the dense forest ends.

Alluvial terraces exist between Kisangani and Basoko, at 7 m and at 12-13 m above the river.

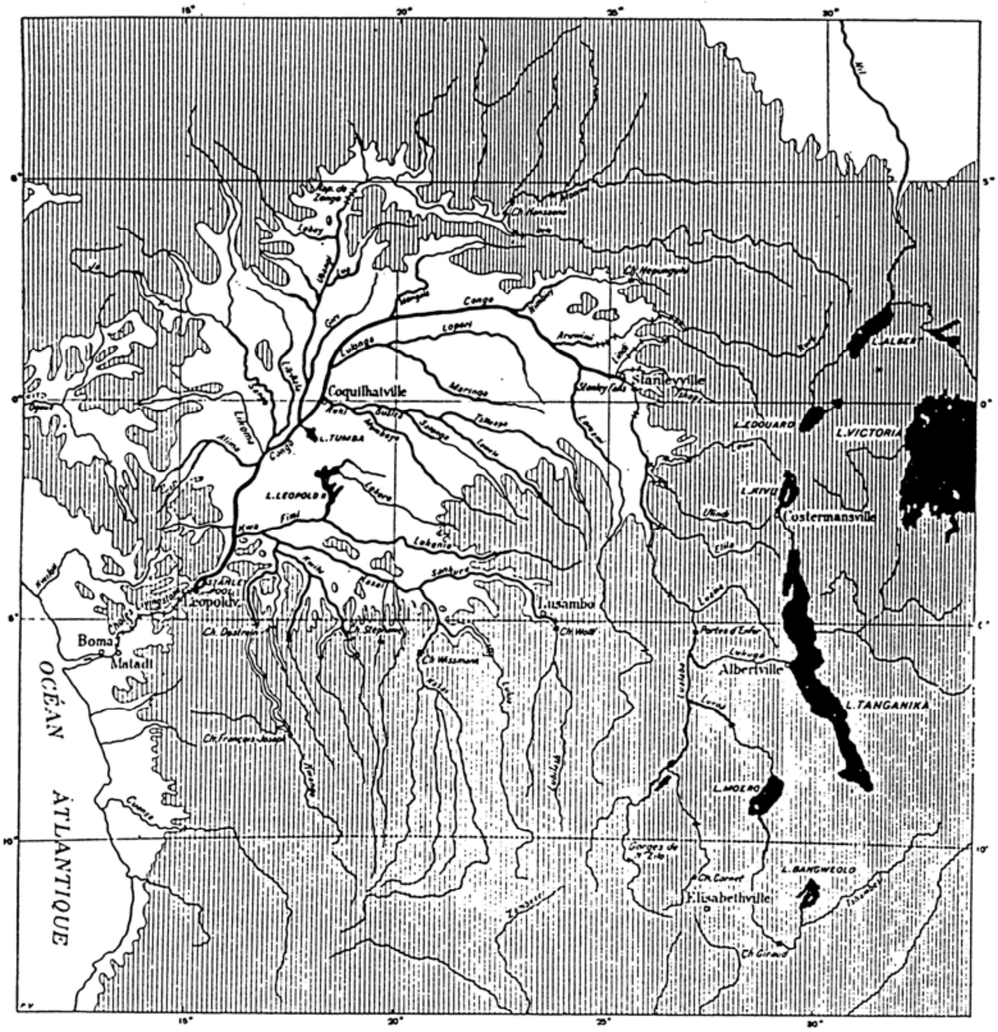
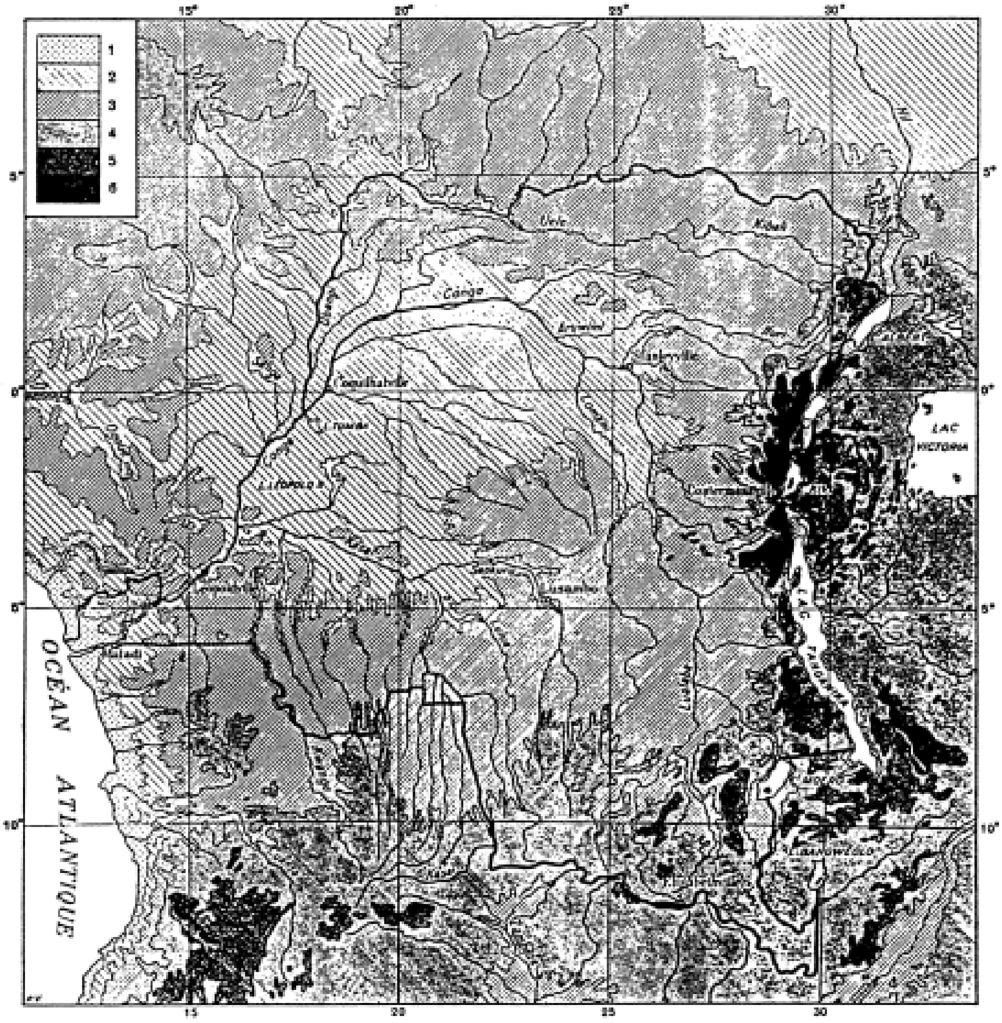


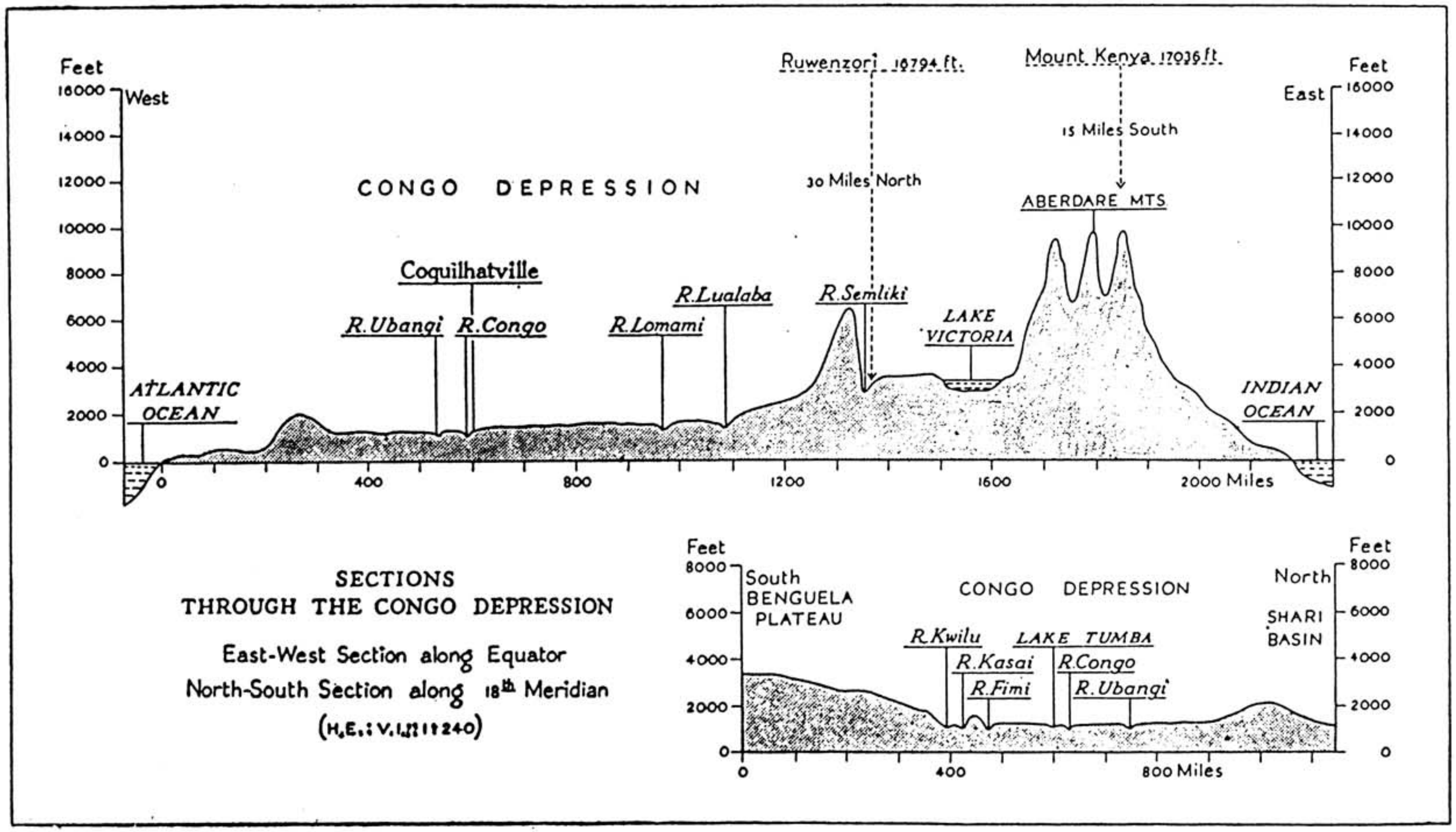
Fig. 3. The Central Congo Basin (striated area: > 500 m a.s.l.); darker rivers are navigable (Robert, 1946).

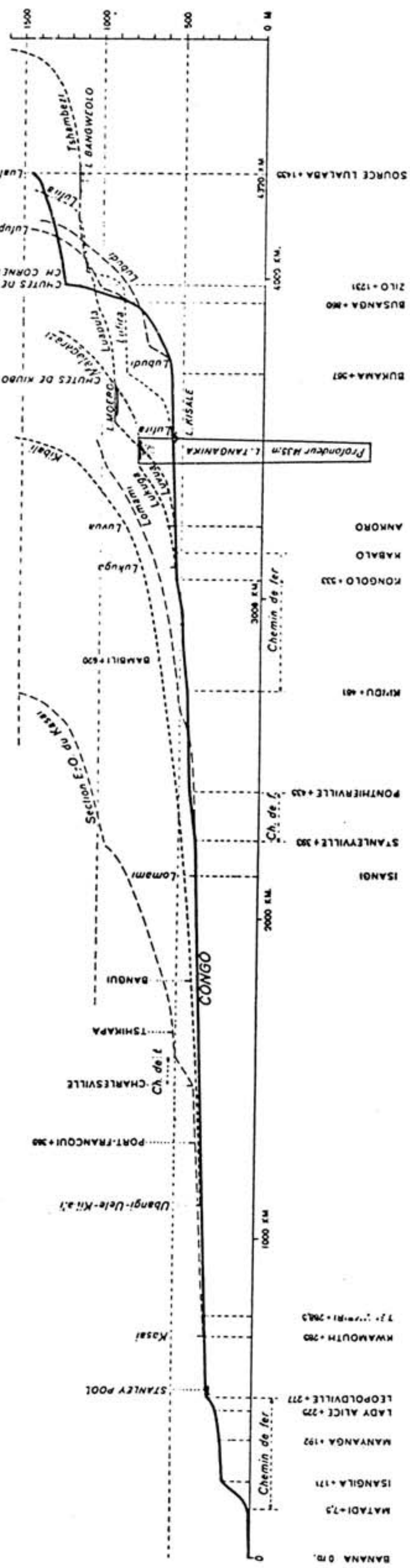


Carte hypsométrique du bassin du Congo.
1. de 0 à 200 m.; 2. de 200 à 500 m.; 3. de 500 à 1000 m.; 4. de 1000 à 1500 m; 5. de 1500 à 2000 m.; 6. au-dessus de 2000 m.

Fig. 4. Hypsometry of the DRC (Robert, 1946)

Fig. 5. Transects through the Congo Basin (NID, 1944)





Le profil du fleuve Congo et de ses principaux affluents.

Fig. 6. Profiles of the Congo river and its main affluents (Robert, 1946)

4.2. Surrounding stepped plateaux

Towards the N and the E, the Congo Basin is bordered by upper Precambrian sandstones.

The region includes stepped and dissected plateaux (500-1,000 m a.s.l.), which surround the Congo Basin. Nearly the whole region drains into the Congo river. The plateaux are higher, further away from the Basin (terrain units 410, 420, 430).

It is an undulating region with tilted, Middle to Late Tertiary planation levels. Many higher plateaux are covered by sands (Kalahari). Most rivers have cut deep valleys in the sandy plateaux, into the underlying rocks (terrain unit 840). Lower Pleistocene sands cover large parts of the Kasai plateau.

The lower plateaux around the Central Congo Basin are overlain by thick Pleistocene layers (Salonga and Yangambi deposits), formerly considered eolian sands, but rather of fluviatile and fluvio-lacustrine origin (Sys, 1983). Soils are Xanthic Ferralsols developed in these pre-weathered and transported materials.

Above the rapids, the river valleys are no longer broad and wide, as on the plain, but narrow and deep, whilst streams are swifter and broken. But for this fact, the relief of the plateaux differs little from that of the plain.

In the S and the E, dominating a first plateau step, occurs a second and somewhat higher Late-Tertiary step, very roughly semi-circular in plan, which stretches from near the confluent of the Kasai with the Congo and continues from W to E to the upper courses of the Uele river (tributary of the Ubangi).

As the plain lifts over the first and the second step, the true rain-forest ceases. Gallery forests continue to edge the rivers and savannah begins to cover larger and larger areas. Termite mounts become common.

Following succession of deposits exists (younger to older):

1. recent alluvial plain deposits
2. river terraces
3. Salonga deposits (two steps)
   a. clayey sands
   b. iron-cemented plateau gravels
4. Yangambi Series, Lodja and Opala deposits
   (sands and basal gravels)
5. Kwango or Lualaba Series (Mesozoicum)

4.2.1. Yangambi deposits plateaux

The Xanthic Ferralsols of the Yangambi-type plateaux (terrain unit 430) are covered by rainforest and surround the Congo basin in the NE section. Altitude is about 500 m a.s.l.

The plateau is undulating. The 40 to 50 m thick Yangambi deposits rest on an older Late-Tertiary surface. The clay content of the deposits is 20-45 %. The more clayey soils occur on the plateau summits and texture becomes more sandy downslope in the valleys (textural catena).

The Yangambi Series are a yellowish brown sandy layer, oblique stratified towards the west. In its lower parts small rolled gravels exist, sometimes forming an iron-cemented quartz conglomerate (> 35 m). Stratification indicates mainly an eolian origin, but strongly reworked by water. A layer of a few metres of ironstone concretions rests on the Yangambi Series, 40-50 m above the Congo river.

Along the Congo river, an upper river terrace (top 30-35 m, base at 20 m above the river) is covered by 10 m yellow sands. Eolian sands are rare, water-reworked sands overlie weathered gravels.

A middle river terrace (top 15-20 m, base at 10 m) is overlain by 5-10 m of water-reworked sands and gravels (more weathered and more siliceous).

4.2.2. Salonga deposits plateaux

a. The Lodja deposits (Upper Lukenie, Lomela and Tshuapa)

These are bright sands or sandstones with gravel layers.
Succession:

- lacustrine sands and gravels (25 m)
- alluvial sands and gravels (12 m)

b. Salonga cover deposits

At about 600 m a.s.l., the Salonga deposits (terrain unit 420) occupy an extensive region of the Kasai-Sankuru to the 1°S parallel, with an extension to the north to the Congo river. Most of the region is very sandy.

The Salonga deposits are much more extensive than the Lodja deposits (included in the former on the map).

They are clayey sand body, which may exceed 100 m of thickness, overlying a gravel layer of usually less than 25 m thick. The gravel layer follows the buried relief forms.

The sands are dark yellowish brown, becoming reddish in the south. Quartz is the main sand grain. These sediments are of lacustrine origin. The basal gravel layer consists of coarse sands and mainly quartz pebbles in the mass of the same sands as above, but sometimes ferruginous-cemented. Some sandstone and argilite gravels are included. All gravels were transported from other regions. The sands cover the Late-Tertiary planation surface.

Two steps can be distinguished, corresponding to two groups of stepped plateaux covered with gravels and sands in southern Kasai. Probably the higher Salonga step corresponds with the Plio-Pleistocene Yangambi Series, while the lower step is related to the Upper Pleistocene 30 m terrace cover at Yangambi.

Recent deposits comprise river terraces and alluvial plains.

The alluvial deposits in the valleys are usually 0.5-8 m thick, with a gravelly base (weathered, < 5 cm), passing gradually into sandy to coarse sandy layers. Clayey layers are rare. River terrace deposits are thicker and older. The deposits of the lower terraces are 6-10 m thick, those of the upper terraces 8-15 m. Textures are very different from the alluvial valleys.

4.2.3. Lower Lomami region (Higher Congo)

The Lomami river has 3 terraces:

- a lower terrace overlain by fine sands, without gravels;
- a middle terrace, top at 10-11 m and base at 4-5 m above the river, composed of a basal layer of sands, gravels or ironstone, grey clay, white sands, sands and ironstone cemented gravels; at Opala this terrace rests on soft sandstones, arkoses and conglomerates, called the Opala deposits, overlying the Lualaba Series;
- a higher terrace(?), top at 30 m, passing gradually to an extensive planation surface, top at 50-55 m, formed by locally iron-cemented gravels, covered by yellow clayey sands and getting more sandy towards the north (equivalent of Yangambi Series).

4.2.4. Mbandaka region (northern Bandundu-Equator)

The Busira layers are recent alluvio-lacustrine sediments of the Central Congo Basin.

The low plateaux of the Congo basin form 20-30 m high escarpments at the lakes Mai Ndombe and Tumba. Yellow sandy clay to sands overlie an ironstone pan on top of clays (equivalent of the Salonga deposits?).

Table 2. Texture of the B horizon of Ferralsols in the Congo according to different geological parent materials (modified from Sys, 1983)

Substratum	SOTER terrain units	particle size classes (micron)			
		0-2	2-20	20-50	50-2000
Central Congo Basin lower plateaux	410	40.7	2.0	2.3	55.0
Salonga plateaux	420	21.5	0.9	4.0	74.6
Yangambi plateaux	430	37.6	1.4	2.2	58.8
Kalahari sand plateaux	830	20.1	2.0	14.7	43.2

4.3. Northern plateaux

The Nile-Congo watershed is an undulating plateau with an altitude varying from 1,260 m a.s.l. in the east, near Aru, to about 600 m a.s.l. in the west.

Near the border of Uganda (Aru highlands, terrain unit 1230), topography is more irregular than it is farther west south of the river Bomu, on the border with the Central African republic (Bomu-Uele plateaux, terrain unit 960). Small mountains rise from the high plateau, and the country is broken as the edge of the Rift Valley is approached.

The hills of the Nile-Congo and Uele-Ituri watersheds rise 90 to 210 m above the plateau surface and are bush covered.

On the eastern part of the Nile-Congo watershed, small hills define the divide as far west as the point where the road from Faradje to Juba crosses the boundary. From here to the source of the Bomu river the watershed is a narrow strip of nearly flat bush-covered upland, sometimes as much as 3 km in width, but generally much less, and from 600 to 900 m above sea level. The streams, which rise on this flat upland, might easily flow in either direction.

Only in the NE Congo occur pediplains of different ages. In the rest of the area, only the Late-Tertiary planation surfaces group exists.

4.3.1. North-Western Congo (Lower Uele and Ubangi)

The valleys of the Uele and its tributaries are generally broad and shallow, rather than narrow and deep (Katanga) and the fall is slight. Gallery forests follow most rivers. The Uele is the northern limit of the tropical forest.

A group of flat Late-Tertiary surfaces is covered by a limonitic ironstone pan.

The group culminates in a wide ridge, descending towards the Ubangi-Bomu in the N and to the Congo in the S. The ridge starts at Libenge towards the east and rises 600 m a.s.l. It remains at this altitude to reach 700 m at Ango and rises further east to 800 m a.s.l. This surface is the equivalent of the Late-Tertiary ‘Western Oubangui surface’ in the Central African Republic.

4.3.2. NE Congo (Kibali-Ituri and High Uele)

A flat Late-Tertiary surface is covered by a limonitic ironstone pan. Towards the east older surfaces rise above it: Mid-Tertiary and End-Cretaceous. Below the Late-Tertiary surface, most rivers have a series of terraces.

- In the Lake Albert region (terrain unit 1240), monadnocks rise to 2,000-2,200 m a.s.l. above a regular surface at 1,700-1,900 m a.s.l. of the End-Cretaceous. It is covered by shallow grey or yellow sandy clays.

- The Mid-Tertiary planation surface occurs between 1,200-1,400 m (1,500 m); it forms valleys in the preceding; isolated remnants of the 1,700-1,900 m surface rise above it.

- The lower, Late Tertiary surface(s?) occur(s) between 800-1,100 m, descending to the west and the south west to an altitude of 400-500 m. This recent surface penetrates in the former one and itself it is covered by monadnocks of the former surface.

e.g. Garamba National Park region
(terrain unit 970, Gramba gneiss plateaux, Congo-Nile crest)

- Rocky inselbergs of a former cycle dominate a more flat region (planation surface)

- the Pliocene planation surface is found 25 m above the streams; it is covered by a thick Plio-Pleistocene ironstone pan on a deep red clayey soil layer in situ.

- a second Mid-Pleistocene planation surface at 8-10 m above the rivers; it is covered by a less thick heterogeneous Mid-Upper Pleistocene ironstone pan, with reworked elements, resting on a less developed red clayey soil layer

- the drainage system cuts in rocks of the Basement complex

4.4. Southern plateaux

4.4.1. Sand-covered plateaux of the Kwango

- The southern part of this region (in Angola) is occupied by a plateau, where rivers flow in shallow valleys. The flat surface is covered by sands (Ocre Sands series, Kalahari sands) of variable thickness. The plateau slopes 0.1 % S-N and 0.04 % E-W. The Benguela ridge is an open bush-covered grassland at 750-870 m a.s.l. The main plateau descends gently northwards. Relief is generally regular and undulating, though parts of the country are covered with rounded hillocks or bosses of resistant rock.

- More to the north, in the Congo, only fragmented crests remain of the high plateau and rivers flow in deep incised, thickly wooded valleys, with falls and rapids. Tributaries of the main rivers have cut the plateau into separate blocks and the break between the very eroded lower slopes and the gentler upper slopes is a sinuous and irregular curve (terrain unit 830).

- More to the north, the stepped late Tertiary pediplain becomes the main landscape unit, here and there dominated by residual remnants of the high plateau. As in the Kasai, this planation surfaces group, lower than the higher plateau, consists of a series of very flat surfaces, overlooking river terraces in the valleys (terrain unit 810).

- The Kwango river terraces are: T5 at 60m, T4 at 36-46 m, T3 at 15-26 m, T2 at 10 m, T1 at 6 m.

4.4.2. Sand-covered plateaux of the Kasai

In the Kasai basin, there are a number of late-Tertiary stepped pediplains, with residual hills of the high plateau, extending to the foot of the high plateaux of Katanga in the E and the SE, covered with Kalahari sands (terrain unit 830). These surfaces can be subdivided into three groups.

- An Upper Pliocene group I composed of 3 to 4 surfaces, containing a well-developed surface, along the upper courses of the rivers Lulua, Kasai and its main affluents, and less defined older surfaces.
- A younger group II or cycle (end-Pliocene-early Pleistocene)of 6 to 7 imperfect surfaces, along the middle courses of the main rivers.
- A group of Pleistocene river terraces, the result of Quaternary rejuvenation.

On each planation surface of group I and II, a gravel layer occurs at the base of a clayey sand cover. Gravels are composed of pieces of polymorphic sandstone, becoming smaller and less abundant on the lower surfaces of group 2. Much of the area between the upper Kasai and the upper Sankuru is boulder-covered.

Each gravel layer is covered by red clayey sands, equivalent of the Salonga deposits. Surfaces of group 1 are covered by finer sands than the lower surfaces of group 2.

At the confluent of the Luebo and the Lulua there are stepped planation surfaces situated at 690 m (A12), 640 m (A11), 610 m (A10), 595 m (A9), 505 m (A8) and 487 m (A7). The Lulua flows at 410 m.

Below these surfaces there are four river terraces: T4: top 20-27m, base 10-16m, T3: top 12-15 m, base 9-10 m; T2: 6-10m, base 5-8 m; T1: top at 2m.

There are more outcrops of the basement than at the Kwango.

4.4.3. High plateaux of Katanga

The eastern and southern parts of Katanga are an uplifted area (terrain units 1020, 1030, 1040), separated from the northern areas by the faults of the Upemba Graben or depression (terrain unit 204).

- The End-Cretaceous surface is found at 1,075-1,375 m a.s.l. NW of the Upemba Graben; it occurs at 1,525-1,890 m a.s.l. SE of this fault. It is usually covered by polymorphic sandstones, often with a conglomeratic base. If the latter is absent, the surface may be silicified and sometimes covered by some gravels and sands. This surface occurs below or above the mid-Tertiary surface.

- The Mid-Tertiary surface occurs at 1,100-1,250 m, NW of the fault and at 1,450-1,800 m a.s.l. SE of it. Cut across the polymorphic sandstone, it is marked by a thin gravel layer, sometimes lateritic. On the older rocks, a ferralitic ironstone pan is present. This surface is often covered by the “Ocre sand series”, especially in the non-uplifted areas.

- The Late Tertiary surfaces are typical for Katanga. The Lubumbashi plain occurs at 1,200-1,300 m. Two lower surfaces exist at 1,200 and 1,130 m.

- The Lufira plain, at 850-900 m is a Pleistocene surface.

Pronounced planation in the Mid-Tertiary produced the Miocene peneplain, which now forms much of the present higher plateau surfaces. The lower level surface follows the watershed of the Congo and the Zambezi. It also occurs in the south of the Kasai basin.

The polymorphic sandstone overlies the End-cretaceous planation surface and is overlain by the Mid-Tertiary surface.

The Rift Valley plains and lakes were produced by post-Miocene fault movements.

The Miocene pediplain of Southern Katanga is exceedingly monotonous. It is irregularly covered by sands. Kalahari sands occupy the higher plateaux (Kwango, Kamina, Biano, Kundelungu).

a. Congo-Zambezi watershed plateau and the Kamina region (SW Katanga)

This shrub-covered or open plateau on the southern border of the DRC with Zambia is generally situated at 1,000-1,350 m a.s.l (terrain units 830, 1010, 1030). The fact that the Congo-Zambezi watershed can be followed with ease on a map, it does not mean relief is simple.

A great spur of mountain country, which includes the Samba mountains, rises to 1,200 m a.s.l., and extends north of the watershed, separating the basin of the Lualaba from that of the Lulua and Sankuru (Kolwezi-Kamina). Near Kamina, this chain divides into two spurs and contains the sources of the Lomami. The two northern spurs on either side of the Lomami diminish to hills and soften into rolling forest-covered down.

A regular plateau at 1,050-1,100 m extends S, between Kamina and Nasondoye (only interrupted by the more recent surface at 900 m at the Lubudi river). The plateau consists of Ocre sands resting on the Mid-Tertiary pediplain, on a shallow layer of polymorphic sandstone, overlying the End-Cretaceous pediplain.

South of Nasondoye, the End-Cretaceous surface rises to 1,350 m and the Mid-Tertiary surface, now below the former, to 1,250 m at the Zambian Border.

b. Southern Katanga (900-1,200 m)

This extensive and folded plateau is an extension of the Zambian tableland (terrain unit 1030). It is largely open grass country, though studded with woods and interspersed by many ‘dambos’ or flat-bottom, grass-covered, often marshy valley floors, through which streams filter to the larger rivers.

At its western end, the Congo-Zambezi watershed is ill defined and bush covered, but it emerges more clearly, and higher, as it turns SE-wards to Sakania and the SE corner of the country. Upumpu peak, near the corner, is 1,800 m high. Surrounding hills average 1,500 m and the whole country (hills and valleys) is covered by open forest and bush.

80 km N of the watershed an E-W section would show innumerable small valleys as minor tributaries find their way to the three great rivers: the Lualaba, the Lufira and the Luapula. The southern tableland extends 200 km N of the watershed.

c. Higher plateau blocks and escarpments

In the N of Katanga the extensive plateau at 1,000 m is replaced by deep depressions in between steep blocks of flat-topped mountains, reaching > 1,500 m a.s.l. These blocks are bordered by escarpments, or by very steep slopes (terrain units 1020, 1040).

Gallery forests follow the rivers in the valleys, open woodlands grow near the sources of streams, but the higher areas are generally covered by grass, or orchard bush.

The various plateau blocks: Mitumba, Kibara, Kundelungu were once parts of a continuous plateau (pediplain), but are now divided by deep valleys, in which hot springs, marshes and marshy lakes appear. Lake Mweru and the Upemba depression are examples.

The Upemba depression lies between the Kibara mountains in the E and the Hakansson mountains in the west (terrain unit 204).

The Lufira river flows in between the Mitumba and Kariba blocks.

The northern Mitumba mountains descend westward to the eastern Congo plateau (east of the Congo Basin) and are crossed by many Lualaba tributaries.

c.1. Kundelungu plateau (terrain unit 1040)

On this plateau, only few spots remain of the End-Cretaceous and Mid-Tertiary Pediplain. The eastern part of the plateau is covered by the Kalahari System: polymorphic sandstone overlain by Ocre sands, sloping to the east. The End-Cretaceous and Mid-Tertiary pediplains are buried, respectively below and on top of the polymorphic sandstone.

All the rest of the plateau belongs to the Late-Tertiary surface covered with clayey sand deposits. An ironstone pan is common (Petroferric phase).

Kundelungu inselbergs cover the plain between the Luvua and the plateau, but none exist on the Lufira plain, in between the Biano and the Kundelungu plateaux.

The Kundelungu plateau reaches an altitude of 1,700 m in the Kiaka region. The more eastern Lukonzolwa plateau only reaches 1,500 m. In both places the same geological sequence occurs, with 200 m difference, due to faulting.

c.2. Uplifted Kibara-Biano-Kolwezi region - east of the Upemba Graben

- The region from the Kibaras to the SW, E of the Upemba Graben, has been strongly uplifted (terrain unit 1020). The fragmented End-Cretaceous surface occurs at 1,890 m a.s.l. at Lumbele (Kibaras). It is located 100 m above the Mid-Tertiary pediplain (Mkana, 1,800 m). N of Mitwaba the Mid-Tertiary surface only survived as the Mulubwe inselberg (1,809 m).

- The large valley of the Kalumengongo, around the Kibaras contains fragmented Late-Tertiary planation remnants at 1,620 m, 1,580 m, 1,490-1,570 m and 1,465-1,480 m a.s.l. (100-115 m above the river). Below those surfaces occur 6 river terraces: T6 (60-65 m), T5 (35-45 m), T4 (21-23 m), T3 (8.5-11 m), T2 (1.8-3.8 m) and T1 (-0.25 m). The alluvial plain is found at 1,364 m a.s.l.

- At the Biano plateau, the reverse occurs and polymorphic sandstone separates the Mid-Tertiary planation from the End-Cretaceous surface.

- Between the Kalule and Lualaba rivers, the End-Cretaceous surface occurs again in a higher position.

- From Kolwezi to the Zambian border, only inselbergs indicate the position of the End-Cretaceous pediplain above the mid-Tertiary surface.

c.3. Uplifted Kolwezi-Lubumbashi region

From Sakabinda to the Lufira river, the 1,450 m plateau (Mid-Tertiary) is continuous and it is dominated by monadnocks (Ditempa, 1,614 m). E of the Lufira, Mid-Tertiary surface remnants, or inselbergs, occur on an irregular 1,200-1,300 m surface of the Late Tertiary pediplain (Lubumbashi surface, terrain unit 1030).

c.4. Lubumbashi-Biano-Upemba Graben

- From Lubumbashi to the Lufira (terrain unit 1030), the Late Tertiary surface -at 1,200-1,300 m a.s.l.- is dominated by inselbergs reaching 1,400-1,425 m and belonging to the Mid-Tertiary surface.

- The Lufira plain is a younger surface, found at 850-900 m.

- The Biano plateau block (terrain unit 1020) rises to 1,648 m (Mupanda). There, the mid-Tertiary surface is buried below a shallow layer sands. Polymorphic sandstones overlie the End-Cretaceous pediplain. The plateau descends with an escarpment (fault) to the Upemba depression.

c.4. Upemba depression, Lomami plateau...

The extensive, 40-50 km wide, SSW-NNE-oriented Upemba depression (terrain unit 204), in which flows the Lualaba downstream of Bukama, is marked by an eastern uplifted block and fault line.

The flat bottom at 550 m a.s.l. is bordered in the W by the Hakansson Mountains, a strongly dissected plateau culminating at 1,000-1,100 m (terrain unit 1020).

Erosion has completely removed the polymorphic sandstone and Ocre sand cover of the more dissected Hakansson tops. Some higher points are silicified, an indication that they belonged to the End-Cretaceous surface.

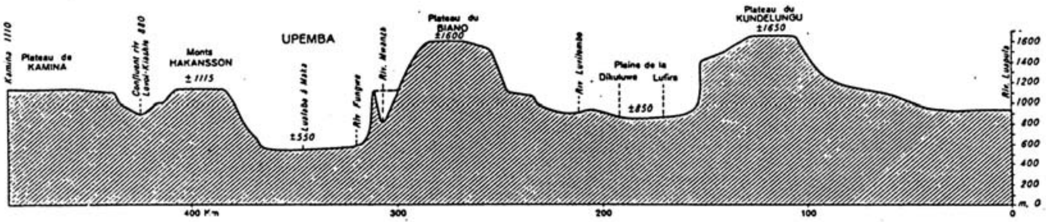
The western border of the depression follows the Lomami plateau, at 1,100 m. The latter has conserved its cover of polymorphic sandstone and Ocre sands.

To the E occur the Bia Mountains and the Biano at 1,650 m a.s.l., followed in the N by the Kibara Mountains, with an average altitude of 1,750 m, but culminating at 1,889 m. The eastern Fault-line Upemba escarpment is very steep, with thermo-mineral springs (terrain unit 1020).

d. Lake Mweru (Moero)-Luapula depression

This is also a tectonic depression (terrain unit 205). The red sands of the cliffs at Kasenga belong to the 20 m river terrace of the Luapala. The whole valley of the latter, in between the Johnston falls and the lake, has been cut in old alluvia, which cover large surfaces.

On both sides of the depression, north of the 10°S parallel, exist fault lines.



Coupe transversale schématique dans la région du Katanga méridional.

Fig. 7. Schematic transect through southern Katanga (Robert, 1946)

4.5. Eastern plateaux and mountains

4.5.1. Maniema-north Katanga plateaux

Mountain massifs with mainly flat tops reach 1,000-1,250 m a.s.l.

Planation surfaces exist at 1,200 m; 1,020 m (End-Cretaceous); 840 m (Mid-Tertiary) covered by 15-20 m sands; 750 m and 650 m (Late-Tertiary).

River terraces occur at 790 m a.s.l. (+290 m), 640 m (+140 m), 540 m (+40 m), 520 m (+20 m) and 515 m (+15 m).

In N Katanga (Mt Wissmann at Kabinda) the End Cretaceous surface, at 875 m a.s.l., is covered by 15-20 m polymorphic sandstone.

4.5.2. Rift valley and eastern highlands

East of the plateaux, the eastern highlands locally attain more than 3,000 m a.s.l. (terrain unit 1210)

The Rift Valley Graben or bottom is a tectonic depression at < 1,300 m a.s.l. (terrain unit 1220). It has been caused by the great system of fractures of the earth’s crust. This section is now occupied by lake Tanganyika, lake Kivu, lake Edward and lake Albert.

The bordering mountains descend abruptly lakewards and slope more gradually westward towards the Congo Basin. The Lukuga river makes the only breach in them and flows from lake Tanganyika to the Lualaba, through a region of wide plateaux and undulating hills.

Lake Tanganyika lies at 765 m a.s.l. This part of the Rift valley is relatively narrow, 60 to 80 km wide. The lake is 650 km long and 1,400 m deep. The western mountains about lake Tanganyika are often table-topped and contain some high ridges dotted with minor peaks.

N of this lake, the Rift Valley continues to keep the same general width as at the lake, until it is partially filled by lake Kivu, at 1,460 m a.s.l. The two lakes are joined by the Rusizi river. Except for a short canyon at the southern end of lake Kivu, the course of the Rusizi river is over a low marshy plain as far as Tanganyika.

The Virunga (Mfumbiro) range of active volcanoes, includes eight craters (Karisimbi 4,500 m). It forms the limit of the Congo basin, for lake Edward feeds the Nile (terrain unit 1150).

Overlooking Kivu are mountains, which exceed 2,400 m altitude. From Lake Edward north to lake Albert the mountains on the western border of the Rift mark the boundary of the Congo Basin (terrain unit 1240). The peaks of Ruwenzori rise 5,000 m a.s.l. These are the highest non-volcanic mountains of Africa. They stand as an isolated block within the Rift Valley, near the eastern side (terrain unit 1260). The Semliki river connects Lake Edward with Lake Albert.

The western slopes of the eastern highlands gradually lose height towards the Lualaba. The upper courses of most rivers are generally in savannah country, the lower courses in gallery forest.

The Rift valley escarpments in the Lake Albert-Semliki-Lake Edward region have slopes of less than 20 degrees; they have been strongly dissected. Other escarpments have similar upper slopes, but steep lower slopes (< 50 degrees), suspended valleys, falls. A third type of slope is steep all over.

The uplifted areas are step-like block systems. Isolated minor horsts rise, either connected to the main escarpments (horsts of Vieux-Beni and Kalumendo), or isolated in the plains (horst of Kaparata).

Horsts near the Graben are more uplifted than those further away.

The tectonic depressions have been filled up with lacustrine deposits (terrain unit 1220):

- Lake Albert (Lower Miocene and younger),
- Semliki valley (Lower Miocene and younger),
- Lake Edward,
- Rusizi valley,
- extreme N of Lake Tanganyika

Table 3. Characteristics of the Rift Valley sections (Cahen, 1954)

Section	width of the Graben (km)	altitude of the water level (m a.s.l.)	depth of the lake (m)	altitude of the lake bottom (m a.s.l.)	altitude of western mountains (m)	altitude of eastern mountains (m)
Lake Albert and lower Semliki	40	618			2,400	1,200-1,400 (*)
middle and	10-25				1,000-	5,119

upper Semliki					1,200 (*)	
Lake Edward	70	912			3,300	1,800-2,000 (*)
Rutshuru region	15-20					
Lake Kivu		1463	476	987		
N Tanganyika	50	771	1310	-539	2,400	1,200 (*)
S Tanganyika	40	771	1470	-699	2,200-2,400 (*)	1,300 (*)

(*) = plateau

4.6. Volcanic Regions

Recent volcanism is associated with the Rift Graben tectonics. Examples are (S to N):

- the basalt zone, SW of Lake Kivu,
- the extinct volcanoes of Kahusi and of Biega (S Kivu),
- the still active Virunga volcano chain,
- the Karibumba volcano

4.6.1. Basalt zone SW of Lake Kivu (Bukavu)

Extensive basalt flows characterize this area (terrain unit 1130). There are two subzones. The northern one extends around Bukavu, the southern one around Kamituga.

a. Kamituga basalt flows

There are no more volcanoes in this region. Lavas are mainly basalts, with some andesites. The lava flows occurred in a dissected region and only followed deeper valleys. There were several eruption stages and younger lava layers overlie older ones. Erosion periods, in between, are marked by gravel layers. Up to 6 gravel layers were successively covered by lava, reaching a total thickness of several hundreds of metres.

Since the Tertiary deposition a relief inversion has occurred: the lava-filled old valleys are now hard basaltic hills, while the old divides between the old valleys are now recent valleys.

b. Bukavu basalt flows

Numerous lava flows occur around Bukavu. They reach a thickness of several hundreds of metres. Rocks are basalts or doleritic basalts. Three trachyte zones are known: at Kalele, trachytes originate from the Ruonga crater.

4.6.2. Extinct volcanoes of the Kahusi and Biega massifs

The Kahusi massif (3,308 m) is located SW of Lake Kivu. It includes 10 main craters, volcano-types with siliceous ashes and Pelée-types. A basaltic phase is followed by a rhyolitic phase. The third phase, limited to the Kahushi consists of potassic rhyolites, quartz-porphyrites...

4.6.3. Virunga chain (Mufumbiro)

The Virunga chain is located in the Rift Valley Graben, north of Lake Kivu. The volcanoes aligns in a west-east direction, across the bottom of the tectonic depression, over a length of 80 km, from one to the other side of the Graben, perpendicular on its direction. The central group is located on the Congo border: the Karisimbi (4,507 m), the Visoke (3,711 m) and the Sabinio (3,634 m). These are Recent formations. Large lava plains cover the areas around them. The Nyiragongo and the Nyamlagira rise from those plains.

Typical is the absence of basalts.

- The Sabinio, on the three borders point, is the most eroded volcano. The crater has been completely eroded. There are deep ravines. Rocks are shoshonites and latites.
- The Vishoke has a wide and well-developed truncated cone, with a crater of 600 m diameter. lavas are mainly leucitites.
- The Karisimbi is the highest volcano, with an eroded cone and crater. Lavas are latites and absarokites.
- The Mikeno summit is composed of two peaks (300-400 m high). The crater has been eroded. Lavas are leucitites.
- The Nyiragongo has a truncated cone with a 1 km wide main crater. Lavas are leucitic nephelinites.
- The Nyamuragira is a shield volcano with a large caldera (2300 m diameter).
- Minor volcano cones rise in the plain, Most of them are less than 50 m high, rarely more than 100 m. They are not eroded. These are

stromboli-type volcanoes, the results of one explosive phase of blocs, lapilli and ashes. Minor lava flows also exist.

4.6.4. Karibumba volcano

This small volcano, along the road from Butembo to Beni is an isolated ash and tuff cone on a granitic plateau.

4.7. Ruwenzori massif

The Ruwenzori is the highest non-volcanic mountain of Africa (5,119 m). It is located in between two tectonic depressions: the Graben of Lake Albert-Semliki-Lake Edward and the Graben of Lake George. The mountain is an uplifted block. On top of the mountain exist remnants of pediplanations.

4.8. Western plateaux

4.8.1. Batéké plateau

The Batéké plateau has an average altitude of 1,000 in the S to 700 m a.s.l at the Congo river. It is composed of lower Cainozoic polymorphic sandstone, overlain by sands (terrain unit 820). The plateau surface is uniform and flat.

However, the area is markedly different from the surrounding country, for the Neogene, 60 m thick, sandy loam cover over the Paleogene Polymorphic sandstone has neither the necessary fertility nor the needed water holding capacity to support a dense forest vegetation.

These sandy loams, or ‘Ocre Sands’; (yellowish-brown) are loose, slightly clayey fine sands, becoming darker with depth. Colour is uniform (10 YR 5/6-5/8). Often the sands have been reworked by erosion, as slope and valley deposits are mixed with the similar weathering products of the underlying Polymorphic Sandstone. The Ocre Sands occupy the plateaux surfaces and have a thickness of 60-100 m.

The plateau has a monotonous regular surface, flat over huge areas. Valleys have steep slopes and flow 75 m lower on flat bottoms on the polymorphic sandstone. Plateau soils are homogenous and deep Geric Ferralsols and Ferralic Arenosols.

There are many closed depressions in the NW (blowouts or dissolution hollows). Carbic Podzols occur in depressions

The entrenched valley of the Congo continues through the western barrier for 200 km above Stanley Pool (terrain component 810/4). The valley is not so deep as in the Cataract region. Steep hills rise 100-250 m above the river, receding from the water’s edge. The Kasai river joins the Congo through a canyon in rocky hills. Along the Congo valley, the Batéké plateau rim is a zone of intense erosion. Hill tops and steep slopes are devoid of vegetation and ravines of tens of metres deep are common.

4.8.2. Cataracts plateau

The Cataracts plateau divides the Congo and Niari valleys. Its average altitude is about 500 m, reaching almost 800 m in the west near Boko-Songho (terrain unit 720).

The undulating plateau, formed on rocks of the Schisto-Greseux, extends towards the Republic of the Congo.

The Plateau is characterized by a sub-horizontal ironstone pan at shallow depth. Outcrops of the pan occur on valley slopes and on the plateau rim. The same pan can be traced on the foothills of the Mayombe.

In its western parts, the Cataracts plateau has been cut into isolated massifs or blocks, separated by valleys with outcrops of the older underlying Schisto-Calcaire.

The plateau surface is an old erosion surface, somewhat remodelled during later cycles. Rivers on the plateau surface flow slowly and meander in sometimes swampy valleys. They descend in falls or rapids to the Congo or Niari rivers.

In the east, the Schisto-Calcaire and Schisto-Greseux rocks disappear below the sands of the Batéké plateau. Relief then consists of low and rounded hills (Koechlin, 1961).

In the south, streams have completely eroded the upper layers of the Schisto-Greseux (Inkisi Series). The rivers, especially the Louenga, flow on Upper-M'Pioka Series. The break of slope at the contact is marked by strong erosion ravine activity.

From Stanley Pool (277 m) to Mayanga (192 m) the Congo river flows in a canyon, with hanging valleys of the tributaries. The river flows max. 480 m below the Cataracts plateau surface (Kendelo). Further away from the river the plateau is less dissected (NID, 1944).

4.8.3. Schisto-Calcaire depression (Manyanga-Isangila)

This term designs in broad lines the savannah zones located on a Schisto-Calcaire rocks (terrain unit 710).

It is a large syncline, formed by rocks of the Schisto-Greseux and Schisto-Calcaire of the Western Congo Group. The syncline touches the Mayombe chain in the W.

An old pediplain extends to the foot of the Cataracts Plateau.

A series of parallel hill chains (600 m a.s.l.) indicate the tectonic trend. Some hills preserved a top layer of the Schisto-Greseux. They look like rounded and finger-like inselbergs, with calcareous outcrops in concentric layers around them. Slopes of all hills are steep, the summits are flattened, sometimes forming plateaux.

Karst phenomena on limestone resulted in small basins (dolines) filled up by clays.

From Manyanga (192 m) to Isangila (172 m) the Congo river crosses the Schisto-Calcaire zone. The river is more calm and wide. Some rapids occur on vertical schist layers.

4.8.4. Mayombe highlands (Crystal Mountains)

The border with the narrow coastal plain along the Atlantic is formed by the Mayombe highlands (terrain unit 600). It is a succession of sharp ridges, with elevations of 500-800 m a.s.l. The Mayombe are composed of the strongly metamorphosed late Precambrian Mayombe system. Folded layers have a general S-SE to N-NW orientation.

The highlands are deeply dissected by the Congo river and its tributaries. It is through these mountains that the Congo River cuts its way from the Congo Basin to the Atlantic Ocean; descending from Isangila (172 m) to Matadi (7.5 m a.s.l.).

The Mayombe belong to the western barrier of the Congo Basin, extending from Angola to Cameroon. The general direction is SSE to NNW, parallel to the coast.

It is a highly dissected plateau, cut into hills and valleys. It rarely exceeds 780 m a.s.l (Mount Uia, 1,030 m a.s.l.). In Angola this area belongs to Plateau II.

4.9. Coastal lowlands

The coastal lowlands, at an altitude of < 200 m a.s.l., are bordered by the Mayombe highlands in the E. The coastal plateau is 60-80 km wide.

The coastal Belt extends over Meso-Cenozoic sedimentary rocks (marl, limestone, sandstone...) and part of the Precambrian soccle (frequently gneiss).

Following succession exists (top to bottom)

- Plio-Pleistocene deposits of the Cirques Series
- Marine early Tertiary and continental Tertiary Ocre clayey sands
- Marine Cretaceous rocks

- Sub-littoral sandstone

The Plio-Pleistocene Ocre clayey sands rest on a mid-Tertiary planation surface, cut across all older rocks.

4.9.1. Coastal plain

The Congolese coastline is short, extending from Point N'gelo on the Cabinda (Angola) border to Banana spit. The coastal plain is low, swampy and thickly woods, with sandy beaches (terrain unit 100).

From the Cabinda border to 36 km N of Banana, thick swamps occur. Farther S the coast is edged with red 10 m high cliffs for 25 km (Moanda). This is a coastal terrace (see 4.9.2.). The remaining 11 km from Moanda southwards to Banana, consist of a sand spit, with swamps behind the beach, covered by mangrove.

A great part of the first 50 km of the Congo estuary shores inland from Banana are overgrown with thick forest, with occasional swamps with papyrus.

4.9.2. Coastal plateau (terrain unit 300)

a. Coastal terrace

Near Moanda lighthouse, the coast is edged with high reddish cliffs, over 25 km. This is the coastal terrace: from the coastal plain the land rises abruptly to this low plateau. Two or three uplifted marine terraces exist along the coast.

- The coastal terrace of the Moanda lighthouse occurs at 20.8 m a.s.l. North of the Tonde it occurs at 19.1 m. Towards the interior, it rises to attain 40 m at the foot of the fossil cliffs of the Tshikay plateau (Cirques Series).

- A more recent terrace is located at Vista. This terrace is covered by the high tide.

- North of Banana and in the Kinloa cirque exist remnants of marine terraces

In Angola, there are two “coastal terraces”.

- A higher terrace A is found at 80-130 m a.s.l. and
- a lower terrace B, at 40-75 m a.s.l..

These marine terraces were dated Late Tertiary-Early Quaternary; their surface slopes 0.8 % towards the W.

b. Coastal plateau

Further inland and parallel to the coast rises a second and higher plateau (Cirques Series), which extends to the broken country of the Mayombe. It is slightly undulating at an altitude of 100-120 m. Deep valleys with flat bottoms cut steeply (slopes > 50 %) in the plateau. Those slopes are characterized by theatre-like erosion forms, called cirques (Cirques sand series). Many circular closed depressions are probably the result of subsoil dissolution. On the edge of the plateaux, towards the coast, a layer of coarse white-grey sands occasionally covers the Cirques sand series.

In Angola this corresponds to Coastal Plateau I: a pediplain remnant cut across rocks dating from the Precambrian Basal Complex to the Tertiary and it formed during the Miocene or Pliocene.

4.10. Planation surfaces of Congo

Pediplains are erosion surfaces, uniformly cut across all types and ages of rocks. Due to subsequent periods of uplift, these planation surfaces have been partly destroyed by younger cycles of pediplanation and the older surfaces survived as plateau surfaces.

- group of the pre-Upper Cretaceous
- group of the End-Cretaceous
- group of the Mid-Tertiary
- group of the recent surfaces:
  - Pliocene (Late-Tertiary)
  - Plio-Pleistocene
  - Pleistocene (only river terraces)

There are exposed surfaces (N Congo) and buried surfaces (S Congo). The polymorphic sandstone overlies the End-cretaceous planation surface and is overlain by the Mid-Tertiary surface.

4.10.1. Lower Congo and Bandundu

a. Kinshasa-Boma

The Mid-Tertiary pediplain is buried below Ocre sand series, west of the Kwango and on different higher locations of the Lower Congo. West of the Kwango to Mbanza Ngungu, the mid-Tertiary pediplain (at 750-800 m) is buried below the Ocre Sand Series, resting on a few metres of polymorphic sandstone, overlying the Schisto-Calcaire.

More to the W the Mid-Tertiary planation directly overlies the Schisto-Greseux Bangu massif (S Cataracts plateau) at 825 m a.s.l. Its highest point, Mount Uia, is an older monadnock. Further to the west, the planation surface overlies rocks of the Mayombe system (on the highest summits).

Late Tertiary stepped planations (from older to younger):

- a Pliocene group I of surfaces occurs, between 600 m at Kisantu and 800 m at the Angola border (Lower Congo); these are overlain by limonitic ironstone pans, with pebbles of polymorphic sandstone. They are covered by up to 75 m red clayey sands. These surfaces are very clear at the Bangu Massif, east of the Inkisi river and in the Nsele valley.

- Group II of Pliocene surfaces occurs between 550 and 450 m. A limonitic ironstone pan of 1-2 m thick on top of them is covered by 25 m of Pleistocene reddish or brownish loamy deposits. This group occurs below the first group in the Inkisi valley, but is better developed west of the Bangu massif and in the Mayombe.

- two imperfect Pleistocene planation surfaces occur at 375-400 m and at 225-275 m. They are more undulating than the preceding and covered by limonitic ironstone pans of generally 2 m thick, covered by 0-5 m of loamy soils.

Terrace levels occur in between the surfaces of the second and third group, in between the two surfaces of the third group and below the first group.

On the Binza hills (SW of Stanley Pool), a planation surface of the second group has been cut at 435 m a.s.l., on 100 m of sands, overlying the mid-Tertiary pediplain on top of the polymorphic sandstones. The Congo river flows at 280 m a.s.l, 155 m below the second group surface. A lower surface or terrace occurs at 75.5 m above the river; still lower occur a series of river terraces (T8 at 65.5 m.. T1 at -1m).

b. Boma-coast

Beside the uplifted coastal terrace, the coastal plateau conserved two buried planation levels.

- The Late-Tertiary planation surface occurs under the Cirques Series, which rests with basal gravels on Neogene sands and clays (Ocre clayey sands). More recent surfaces are marked by ironstone crusts in the Cirques Series.

- The Ocre clayey sands rest with a discontinuous ironstone pan, with or without gravels, on the mid-Tertiary planation surface, cut across rocks from Cretaceous to Palaeocene.

4.10.2. Other areas

- A pre-Kwango-Series Cretaceous surface is buried by the Kwango Series. It has been cut on the Lualaba and older rocks. It slopes towards the NNW (0.16 %).

- The buried End-Cretaceous, frequently silicified surface is observed at the Kwango, Kasai, Lomami, in Katanga and at Kalemie and the 5 °S parallel. It is exposed on the Mayombe and numerous regions of Katanga. It slopes towards the N (0.07 % at the Kwango). The E-W slope is less (0.05 %)

- The Ocre sand series rest with a thin gravel layer or an ironstone pan on the Mid-Tertiary planation on top of the polymorphic sandstone at the Kwango, Kasai, Lomami and on the high plateaux of Katanga (e.g. Biano). The Ocre sand series rest on a very flat surface cut on the polymorphic sandstones and older rocks, frequently with an ironstone pan (versus the silicified End-Cretaceous surface). A large area of the upper Lulua and Lubilash is formed by this surface, cut across old basement rocks.

- The Late Tertiary pediplain consists of a group of 4 surfaces, with one well developed surface along the upper courses of the main rivers (Lulua, Kasai and their affluents) and three less developed surfaces (Upper Pliocene). A group with 6-7 imperfectly developed surfaces occurs along the middle and lower courses of the main rivers; dating from the Plio-Pleistocene boundary, while river terraces indicate another cycle of incision. The planation surfaces are covered by gravels and clayey sands. The altitude differences between two of these steps is 20-60 m.

4.11. Kalahari Sands

In the DRC, the Kalahari deposits belong to the Upper Kalahari, of Mio-Pliocene age, covering the high plateaux of Katanga (Ocre sand series). Younger Pleistocene sands are found on the Kasai plateau and the Central Congo Basin (Sys, 1961).

The Kalahari region in the DRC has a much more humid climate than in Namibia/Botswana and it does not look like a desert. It is not a sea of shifting sand dunes and it generally possesses a significant natural vegetation cover.

The Kalahari is probably the largest continuous sand surface in the world. Only locally the sand is broken by rock or boulder surfaces.

Its basal structure is an ancient plain upon which terrestrial Cretaceous sediments accumulated upon a Gondwana erosion surface. Although in places the Kalahari sand is obviously of alluvial origin, it was deposited on the basin floor by wind transportation under desert conditions. The Kalahari System consists of 3 groups:

(1) the basal group or Botletle beds (chalcedonic sandstone and grits);

(2) the Kalahari limestone group, with limestones, calcareous sandstones, marl and calcareous tuff;

(3) and the Kalahari sands, with secondary calcretes, ferricretes and silcretes (present in the DRC).

The Kalahari Basin is surrounded by a belt of peripheral highlands. The flatness of the basin surface is mainly due to its sedimentary infill.

The basin formed by the uplifting of the surrounding highlands.

The precise origin of the Kalahari sands is unknown, but they probably originated from Karroo or Stormberg sandstone sediments, transported by ancient rivers and distributed over the basin floor by wind action is later arid periods.

5. Vegetation

Most of the Central Congo Basin, including all lower grounds, is covered by tropical evergreen **rainforest**, while the surrounding low plateaux are occupied by **savannah**, grassland with a variable number of trees or shrubs, or both.

The border between these two main types is not clearly defined, especially in the S, where large areas of forest or savannah may be found in regions covered predominantly by the other type. The distribution of those two types is mainly determined by rainfall and particularly by the presence or absence of a marked dry season. Rainforest grows usually where the dry season is shorter than two months, whereas savannah occurs in areas with a dry period of three to six months.

The numbers between () refer to the vegetation regions of FAO (1977).

5.1. (1) Tropical wet evergreen forest

The northern limit of this forest coincides approximately with latitude 4°N, where the proportion of large deciduous trees increases fairly rapidly. In the south, the limit is more difficult to trace. In the both Congo’s, the very sandy soils of the Batéké plateaux do not retain enough water to enable the forest to compensate for the short dry season. However, on the Mayombe highlands the forest extends into Angola, because of deep soils and mist and clouds of the cold Benguela stream. The eastern highlands block the Atlantic monsoon during summer and limit the tropical convergence zone in January and February. Beyond that ridge the number of dry months increases very rapidly and forest disappears. On the Kivu mountains dry season mists sustain a montaine evergreen forest.

5.1.1. (1.a.) Tropical lowland rain forest

a. Central Congo Basin

Essentially this is a zone of low dry ground, in which typical rain forest climbs to 1,400 m; above, it is replaced by a type transitional to true mountain forests.

On the whole, the forest is only developed in regions with a total annual rainfall of at least 1,500 mm, fairly evenly distributed throughout the year. In the N and S, a short relative dry period of one or two months may occur in some forest areas, while at higher altitudes in the east, the total rainfall may fall below the usual minimum of 1,500 mm.

In general the forest is evergreen, but some deciduous trees occur and these increase near the outskirts where the climate approaches that of the surrounding savannahs.

The tropical forest is never leafless. It consists of several strata, including an upper strata of large trees, which may be 40-60 m high. It is very heterogeneous and among its numerous species are:

- *Brachystegia laurentii,*
- *Gilbertiodendron dewevrei,*
- *Diogoa zenkeri,*
- *Scorodophloeus,*
- *Oxystigma oxyphyllum,*
- *Celtis soyauxii,*
- *Chlorophora excelsa*, African oak, Kamba, Kambala, Bondulu,
- *Ceiba pentandra*, silk-cotton tree or faux-cottonier,
- *Piptadenia africana,*
- *Albizzia gummifers*, flat-crown tree, libamba or camba,
- *Alstonia congoensis*, pattern-wood tree, tsongati,
- *Canarium schweinfurthii*, incense tree or Elémier d'Afrique, Mbidi,
- *Copaifera demeusei,* copal tree or copalier, mbaka or kongo,
- *Coula edulis,* african walnut,
- *Cynometra alexandri,* beira,
- *Entandophragma*, Khaya, african mahogany,
- *Erythrophloeum guineense*, ordeal tree,
- *Macrolobium dewevrei*, limbali or mbalu,

- *Mitragyna stipulosa*, african linden, vuku,
- *Symphonia gabonensis*, bolungu,
- *Terminalia superba*, Congo walnut, limba or ngo*tto,*
- *Uapaca guineensis,* red cedar or sugar plum, boss*enghe,*
- *Elaeis guineensis*, oil palm or palmier à huil*e,*
- *Spathodea campanulata*, african tulip, flame tree, or tulipier,
- *Klainedoxa longifolia*, ekelle,
- *Pentaclethra macrophylla,* oil-bean tree.

The underwood includes:

- *Alchornea floribunda,*
- *Geophila obvallata* and
- *Scaphopetalum thonneri.*

Where ironstone pans occur near the surface, the forest is replaced by short grassy turf, with shrubs growing in small pockets on the pan.

The rain-forest keeps the soil almost permanently moist, shelters an intense biological life, maintains a rather constant temperature and suffers practically no erosion. Nevertheless, it is a virtually closed life cycle in which decomposing dead matter nourishes the living matter. This equilibrium is precarious and is upset by deforestation and cultivation.

- In the E, a narrow band of forest in the Semliki river valley follows the northern slopes of the Ruwenzori range to join up with similar forest in Uganda.

- Extensive forests of limbali *(Macrolobium dewevrei*) grow on the outer parts of the main forest, particularly towards the N and E in the valleys of the rivers Mongala, Itimbiri, Aruwimi, lower Ituri and around Kisangani (Higher Congo). It prefers light, deep, sandy soils.

- Beira (*Cynometra alexandri*) forests, on the other hand, occupy the basin of the upper Ituri and form a tongue of forest connecting with the Ugandese forests (Higher Congo).

Secondary forest

The rain-forest has in many places been degraded and secondary forests are composed of fast growing soft-wood species, such as:

- *Pycnanthus kombo*, wild nutmeg,
- *Ricinodendron africanum* or *R. heudelotii,* african wood-oil-nut tree,
- *Albizzia ealaensis,*
- *Irvingia grandifolia,*
- *Musanga cecropoides* or *M. smithii*, umbrella tree or parasolier,
- *Trema guineensis,*
- *Harungana madagascariensis,*
- *Sterculia tragacantha.*

Oil palm (*Elaeis guineensis*) is an almost certain indicator of secondary forest, as it cannot grow in the deep shade of the virgin forest. Gradually seedlings of the harder, slower-growing, species appear.

b. Lower Congo highlands (Mayombe)

An important rain-forest area occurs in Mayombe, on the borders of Cabinda and the Republic of the Congo.

The Mayombe forest, north of Boma, agrees in general with the dry ground forest of the central basin. In specific composition it is closely related to the neighbouring forests of the Congo Republic, many species common in the Mayombe being comparatively rare in the rest of the Congo.

The most important trees are:

- *Chlorophora*, kamba,
- *Terminalia*, limba,
- *Combretodendron africanum*, minzu,
- *Sarcocephalus diderrichii*, ngulu maza,

but there is the usual mixture of species characteristic of the Congo Basin forest, and ferns over 3 m high are a striking feature.

In the Mayombe, only a quarter of the forest area is thought to be primary. Generally, secondary forest is much denser, with numerous small trees and considerable undergrowth, especially of tall herbs and shrubs.

5.1.2. (1.b.) Regularly flooded tropical forest (W Congo Basin)

This vegetation grows in the western part of the country, along the middle course of the Congo river and its affluents. In the lower parts of the valleys there are widespread floods during the period of heaviest rainfall. The riverain or flooded forest follows the lower courses of most rivers, forming a strip of varying width, depending on the nature of the banks and the width of the whole valley. Some flooded areas are very extensive. After the water subsides the soil dries and is relatively firm.

The forest vegetation of the islands or river valleys begins with *Mimosa pigra*. It is often invaded by:

- *Alchornea cordifolia,*
- *Bridelia ripicola,*
- *Ficus mucuso,*
- *Lannea welwitschii,*
- *Oxystigma buchholzii*
- wild oil palm *(Elaeis guineensis).*

There is no marked lower tree- or shrub layer. Lianas are large and abundant. The tree canopy is composed of:

- *Lannea welwitschii,*
- *Oxystigma buchholzii,*

- *Spondianthus preussii,*
- *Copaifera demeusei,* copal gum,
- *Cynometra gilletii,*
- *Uapaca guineensis,* bossenghe.

Many other trees are characteristic of this type of forest, most with buttresses or stilt roots. Climbing spiny rattan palms (*Calamus* and *Eremospatha*) may combine with the other lianas and with the stilt roots to form an impenetrable mass. Along the river banks there is often a fringe of raphia palms (*Raphia sese* and R. *laurentii*).

5.1.3. (1.c.) Tropical swamp forest (western Congo Basin)

This type is especially common between the lower courses of the Ubangi and Congo and in the region around Mbandaka and near lake Mai Ndombe. The soil is always soft and spongy.

Despite an asphyxiating soil, the immense swampy area of the confluence of the Congo and the Ubangi rivers carries a tree cover in which the tree roots have prop or stilt roots. The main tree canopy is dense, but there are also well-developed lower layers and matted undergrowth. Large lianas are abundant. Many of the trees are the same as in the temporary flooded forest, especially copal trees and Uapaca. Some of the trees are of rather spare appearance (raffia palm), while others are more exuberant and composed of other specialized genera of fresh water swamp forest. Characteristic species are:

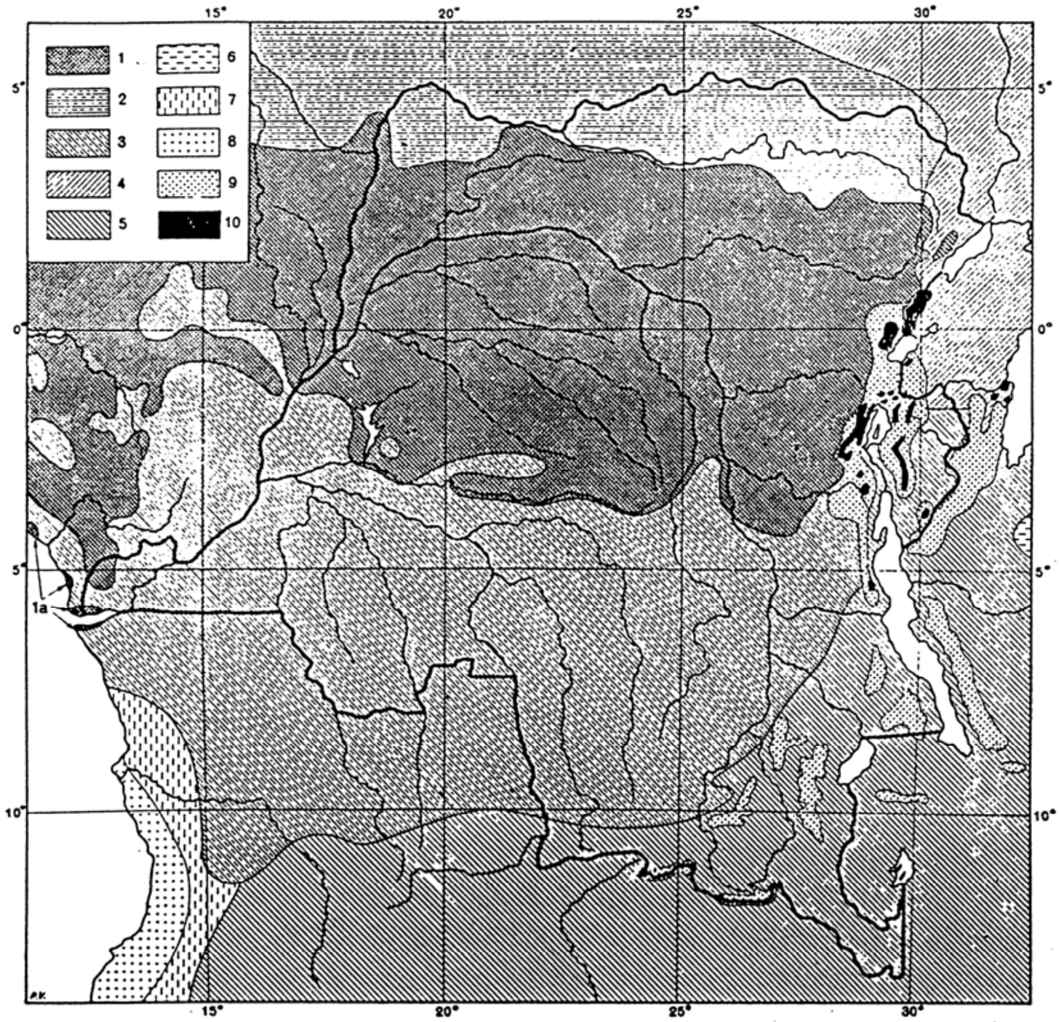
- *Uapaca heudelotii,*
- *Albizzia laurentii,*
- *Coffea congensis,*
- *Entandrophragma palustre,*
- *Sersalia palustre,*
- *Symphonia globulifera,*
- *Myrianthus scandens,*
- *Elaeis guineensis,*
- *Mitragyna stipulosa,* vuku.

Uapaca and *Mitragyna* sometimes form almost pure stands.

The open water is often invaded by *Eichhornia crassipes* and fragments of *Ultricularieto nymphacetum* and *Lemneto pistretum*.

The occurrence of grasslands of *Echinochloa stagnina* and E. *pyramidalis*, *Leersia hexandra*, *Phragmites mauritianus* and *Cyperus papyrus* is determined by the thickness of the peat and the depth of the water.

The Mbandaka region is rich in small grassy clearings, called ‘esobe’, which occur in the forest near the rivers and are developed on sandbanks, the soil of which is not yet suitable to bear forest.



1. Equatorial forest
1.a. Mangrove
2. Park forests and Guinean savannahs
3. Park forests and southern savannahs
4. Sudanese woodland savannahs
5. Southern woodland savannahs with *Brachystegia*
6. Grass savannahs or steppes, with Sahelian thorn bushes
7. Grass savannahs or steppes, with eastern and southern thorn bushes
8. South African deserts
9. Mesophyle and sclerophyle forest
10. High plateaux savannahs

Fig. 8. Vegetation zones of the DRC (Robert, 1946)

5.2. (2) Tropical deciduous and semi-deciduous forests

From the centre of the country to the borders, the proportion of forest tends to decrease steadily until it is replaced by savannah.

5.2.1. (2.a.) Tropical semi-deciduous rain forests

This vegetation unit surrounds the Central Congo Basin and covers:

- parts of Kasai and South Kivu.
- the Lower Congo and western Bandundu
- the north boundary strip

Rain forest species are intermixed with deciduous species. Semi-deciduous rain forests grow especially along rivers and in groves on hills and plateaux. Climate differs little from that of rain forests and it seems that the presence of savannah is due to degradation or to various ecological conditions, especially the insufficient water-holding capacity of sandy soils. These tall grass savannahs are composed of:

- *Pennisetum purpureum,*
- *Loudetia arundinacea,*
- *Imperata cylindrica,*

together with a number of fire-tolerant shrubs, such as *Hymenocardia acida*. The grass steppes are frequently burned off by farmers and hunters.

a. Short-grass savannah or steppe

Short-grass savannah grows:

- On the plateaux between the rivers of the Lower-Congo,
- Kasai and E nearly to the river Lualaba

On rather poor dry sandy stony or gravelly soils, mostly on the plateaux between the watercourses in the Lower-Congo, Kasai, and eastwards, nearly to Lualaba, occur short-grass savannahs or steppes, with grasses reaching a height of about 0.9-1.2 m at most.

The grass cover never becomes continuous. Visibility is good over long distances. The main grasses are:

- *Aristida dewildemanii,*
- *Rhynchelytrum roseum* and *R. amethysteum,* red top grass,
- *Heteropogon contortus,* spear grass,
- *Sporobolus,*
- *Eragrostis.*

The short-grass savannah may be almost entirely devoid of trees over large areas, but also frequently more or less wooded with small trees and shrubs of which *Hymenocardia acida* is the most common. Other species of trees are *Annona senegalensis* and *Sarcocephalus sambucinus* or negro peach.

Short grass savannahs frequently occur on ironstone pan soils, with rooting problems for larger grasses. The bracken fern (*Pteridium aquilinum*) sometimes forms dense brakes on the dry sandy soils of areas abandoned for cultivation.

b. Medium-grass savannah

The medium-grass savannahs grow N and S of the forest zone. The grasses, when mature, are 1.5 to 2.0 m in height, and the tussocks, though separate, interlace completely and make walking difficult. This type grows usually on soils of medium fertility and moisture, which often possess enough organic matter. Grasses are:

- *Andropogon spp.,*
- *Hyparrhenia (*especially *H. diplandra),*
- *Cymbopogon,* lemon grass*,*
- *Sorghum,* wild millets*,*
- *Heteropogon,* spear grass*...*

There are also herbs, as well as rubber-yielding climbers *Landolphia humilis* and L. *Thollonii*. The woody plants vary in number and in kinds from west to east:

- In the savannahs of Boma and Matadi the baobab (*Adansonia digitata*) is common.

- Towards the east *Hymenocardia acida* is he main tree (resistant to fires).

- In the Ubangi region the copaiba balsam (*Daniellia oliveri*) forms tree savannahs.

- To the east (Uele and Bomu basin) the meni-oil tree (*Lophira alata*) is prominent.

- It is replaced further east by the coral flower or arbre coral (*Erythrina abyssinica*) and the shrubby *Protea madiensis*.

A special form of medium-grass savannah is dominated by lalang or alang-alang (*Imperata cylindrica*). This is a perennial grass, 1.2 to 2 m in height, which spreads rapidly from underground runners. It is characteristic of abandoned fields. Large areas of alang-alang savannahs occur in between Libenge and Banzyville, S of the Ubangi river and also in between the Uele and Bomokandi rivers.

c. Tall-grass savannah or Madiadia

This vegetation is found on rich soils: alluvial plains or highly organic soils at the forest margins. The main constituent is elephant grass (*Pennisetum purpureum*), a giant grass reaching a height of 3.5 to 5 m when fully grown. Very few other herbs occur.

5.2.2. (2.b.) Tropical semi-deciduous montaine forest (eastern highlands)

a. Mountains

From the low ground on either side of the mountains, rainfall gradually increases upwards until a maximum is reached at about 2,200 to 2,400 m, above which it decreases in quantity , but is finer and more continuous. Rainfall and altitude determine vegetation.

This rather heterogeneous formation is composed of an evergreen rain forest with *Podocarpus* and *Olea*, as well as woodland associations of trees and shrubs, such as *Hagenia abyssinica*, *Lasiosiphon glaucus*, Erica, *Philippia*, *Protea*, *Hypericum*, tree ferns (*Cyathea dregei*) and bamboos such as *Arundinaria alpina*. Climate varies rapidly with altitude, as do the species.

Tree species (*Senecio* and *Lobelia*) and shrubby species (*Alchemilla* and *Helichrysum*) occur at the higher levels. Also found in this formation are grasslands of *Themeda triandra*, *Pennisetum clandestinum*, P. *schimperi* and *Loudetia simplex*, and, at higher altitudes, *Festuca abyssinica*, *Agrostis isopholis* and *Pentaschistis mannii*.

a.1. Lower slopes of the mountains

A subdivision can be made between the western slopes and the eastern slopes.

- Western slopes (1,200-1700 m)

The lower parts of these slopes are covered by forest, although similar to the lowland forest of the Congo basin, shows many transitions towards the mountain forest of higher altitude. Trees are considerably smaller and closer together than in the lowland forest, while undergrowth is denser. Tree ferns are common in deep valleys or ravines. Human influence altered natural vegetation.

The upper parts of these slopes, are largely cultivated. As a result, a belt of grass savannah and scrub patches has sprung up between the two types of forest. Secondary formations contain elephant grass, forming dense stands on clayey soils of up to 4.5 m high, and bracken fern, which occurs on drier sandy soils. In the valleys and on steeper slopes forest belts frequently remain.

In the extreme N, near the Uganda border, and in the S between Uvira and Kalemie, the western slopes are almost completely savannah-covered.

The northern savannahs may extend up to 2,000 m and consist of short grasses, usually about 1 m in height. *Themeda triandra* of the *Andropogon* group is common and sometimes almost pure. Trees and scrubs occur at intervals, especially in shallow valleys or depressions.

The savannahs of the southern portion contain some plants of the Katanga plateaux, e.g. *Brachystegia*.

- **Eastern slopes**

The lower slopes on either side of the Rift valley are drier and support a savannah or steppe vegetation, very similar to that of the valley floor, alternating with forest in gullies. Rocky areas have a sparse vegetation. At higher altitudes, with increasing rainfall, the savannahs are similar to those on the western slopes.

a.2. Mountain forest (maximum rainfall zone)

1,700-2,600 m

This forest occupies considerable stretches of upper slopes of the mountains, from lake Albert to lake Tanganyika. The most important parts are located on the Ruwenzori massif, parts of the mountain range E of lakes Edward and Kivu, the Virunga mountains. There is a lower and upper zone.

- **Evergreen mixed forest (1,700-2,300/2,400 m)**

Many trees lose a portion of their leaves in the short dry season. The trees form two layers, one of the dominant species and a subsidiary layer of smaller trees. The main canopy is located at 20 to 25 m. The tree crowns do not form a dense canopy. There are many epiphytes: mosses, lichens, ferns, orchids, begonias, balsams (*Impatiens*). Parasitic mistletoes abound. The undergrowth is dense and consists of two layers, composed of larger and smaller scrubs, associated to the young trees of the upper layer. Herbs are only abundant in clearings. In the lower zones growth is more luxuriant, with tree ferns and wild bananas (*Musa ensete*). In the upper zone there is a much lower canopy of 10 to 15 m, while epiphytes, especially lichens and mosses, are abundant and bamboos (*Arundinaria alpina*) occur in groups.

The following list contains trees of 20-25 m high (30 m or more in favourable places), many have trunks of 1 to 1.5 m in diameter.

- *Podocarpus milanjianus,* east african yellow wood*,*
- *Podocarpus usambarensis*
- *Carapa grandiflora,* crabwood*,* mukwete or muheti*,*
- *Ekebergia rueppeliana,*
- *Entandophragma speciosum,* ikambi*,*
- *Ficalhoa laurifolia,* kikenzi*,*
- *Lebrunia bushaie,* bushaie*,*
- *Ocotea usambarensis,*
- *Olea hochstetteri,* east african olive*,*
- *Parinari mildbraedii,*
- *Polyscias fulva,* munge or ndongi*,*
- *Sideroxylon adolfi-friederici,*
- *Strombosia grandiflora,* musika or muhika*,*
- *Symphonia gabonensis, var. macrantha, musimba* or *muzizi.*

After clearing, secondary forest appears, which can revert again to a primary forest. The early appearing trees include:

- *Hagenia anthelmintica,* muzeti*,*
- *Harungana madagascariensis,* mushayo-shayo*,*
- *Spathodea campanulata,* flame tree*,*
- *Trema guineensis.*

When destruction radically affects soil fertility, the forest cannot re-establish itself and it is replaced by bracken fern or savannah, either grassy or with scrubs, and leading sometimes to dense bush.

On the Virunga mountains little of the broad-leaved forest is left, while on the mountains on both sides of the Rift Valley, much of the mountain forest zone is occupied by extensive short grasslands, now used as pasture land.

- **Bamboo forest (2,300/2,400-2,600 m)**

The common African Bamboo occurs in clumps in the upper zone of the broad-leave forest and is also found on lower altitudes, e.g. on the mountains W of Lake Albert. Usually it forms a narrow band, which is quite distinct from the forest below and the sub-alpine region above.

In some places, as on Mts. Kahuzi and Karisimbi, the bamboo zone may extend as high as 3,000 m, while on the active volcano Nyamlagira it is completely absent. Bamboo occurs often in almost pure stands; in other places there is a mixture with broad-leaved trees, especially *Podocarpus milanjianus* and *Sideroxylon adolfi-friederici*. There is practically no woody undergrowth. A few herbs grow in openings, but often the black organic soil is bare. Towards the upper edge of the forest bushes of tree heath (*Erica* and *Philippia*) may be found.

a.3. Sub-alpine zone (2,600/2,700-3,900 m)

Low temperature and continuous mist are typical. The scrub vegetation is composed of tree or bush heaths (*Erica arborea*, E. *bequaertii* and *Philippia johnstoni*), which may attain a height of 6-9 m in the lower and more favourable parts. At higher altitude the heaths become smaller and *Philippia* dominates. Small trees or large scrubs associated are:

- *Hagenia anthelmintica*, yellow wood (up to 3,300 m),
- *Hypericum lanceolatum*.

Smaller scrubs include:

- *Helichrysum*,
- *Senecio*,
- *Conzya*.

The scrubs are almost completely draped by lichens (*Usnea*). A ground carpet of mosses may be 1 m thick.

On the three central mountains of the Virunga group (Karisimbi, Mikeno and Visoke), the lower part of the heath vegetation (2,700-3,100 m) is replaced by a very open forest of *Hagenia anthelmintica*, with a lower scrub layer. Herbs cover the ground, with members of the Parsley family (*Umbelliferae*).

a.4. Alpine zone (> 3,900 m)

This region is cold and misty. Characteristic are tree groundsels, mainly *Senecio adnivalis* and S. *alticola*, and giant lobelias (*Lobelia wollastonii*). They form often dense forests, sometimes reaching 8 to 9 m high. The forest is more open on some mountains, with an admixture of other woody forms. These include heaths (*Philippia*) etc. Under the *Senecios* grow mosses, lichens and a few herbs. At higher altitudes the *Senecios* become smaller and the forest disappears.
Dwarf scrubs of *Alchemilla* are found on gentler slopes with better soils. These form a thick layer of 0.5-0.75 m in height. There are a few grasses resembling European types (*Poa*, *Festuca*, *Anthoxanthum*).

On the Ruwenzori, rocky slopes are covered by a more or less dense scrub of scrubby everlastings (*Helichrysum*), which may be 2 m high. Similar species occur on other mountains, generally mixed with *Senecios* and *Alchemillas*.

Where the ground is swampy, a large sedge (*Carex runsso-roensis*) is dominant on higher levels, while bog-moss (*Sphagnum*) may occur on lower slopes. Extensive marshes only occur on the Ruwenzori.

At the highest level (Ruwenzori, > 4,200 m) only small herbs occur, with mosses and lichens. The mountain meadow grass (*Poa glacialis*) grows up to 5,100 m.

b. Rift valley floor

The Rift Valley is broken into several more or less isolated parts, e.g. by the volcanic Virunga mountains.

- The Semliki valley, W and NW of the Ruwenzori is covered by a tongue of tropical rain forest.
- W of the Virunga mountains the extensive lava deposits support a special type of vegetation.

otherwise dry savannah or steppe vegetation is the prevailing type.

b.1. Steppe (Rift Valley bottom)

Steppe occupies the flat terraces on the bottom of the Rift Valley. The grass cover is relatively short and open. The main grasses are species of:

- *Hyparrhenia,* spear grass*,*
- *Themeda triandra,*
- *Chloris gayana,*
- *Sporobolus,*
- *Aristida,*
- *Eragrostis.*

There is a variable content of herbs and flowering plants, especially of the Pea family:

- *Crotalaria,*
- *Indigofera,*
- *Tephrosia.*

There are many plants with succulent leaves or cactus-like stems. These include:

- *Aloe,*
- *Asparagus,*
- *Sansevieria,*
- *Euphorbia trees,*
- *Cissus.*

The steppe is devoid of trees or shrubs, but some woody plants exist:

- *Acacia hebecladoides,*
- *Acacia seyal*

On lower hills, the woody growth may be thicker, with a greater variety of trees and shrubs.

b.2. Riparian forest and swamps

Along the main rivers, there are either fringing forests with dominance of the wild spiny date (Phoenix reclinata), or else marshes covered by tall grasses, such as elephant grass or common reed (*Phragmites communis*). These forests also occur on heavier poorly drained soils. The fan palm is common in the flat areas near the rivers. Lalang is dominant on abandoned fields. A dense woody vegetation develops in ravines along the smaller tributary streams. Tree Euphorbia and other small trees and shrubs, many of them spiny, form the upper vegetation, which is matted with small climbing plants.

b.3. Lava Plains

The lava plains W and SW of the active Virunga volcanoes show all stages from almost bare surface to a well-developed forest of a dry type. Block type lava colonizes more readily than smooth lava. Mosses and other lower plants are the first to grow, followed by grasses, herbs, and small shrubs. Woody plants e.g. *Rumex maderensis* gradually appear and grow up to form, first scrub, and then a drought-enduring 'maquis'-type of forest with hard shining leaves. The scrub is most completely developed on block lava, whereas on smooth lava open savannah with clumps of dense scrub tends to be the rule. The main forest trees are:

- *Myrica salicifolia*,
- *Olea chrysophylla*, an olive,

Common shrubs are:

- *Agauria salicifolia,*
- *Faurea saligna,*
- *Rhus natalensis,*
- *Carissa edulis,*
- *Jasminum dichotomum,* jasmine climber

5.2.3. (2.c.) Large-leafed rain-green dry forest (Myombo) (Most of Katanga)

Trees in the upper storey belong to the *Isoberlinia* and *Brachystegia* genera, which retain their leaves during part of the dry season. The lower storey is composed of *Uapaca*, which lose only some of their broad leaves. *Brachystegia* and *Julbernardia* are dominant, but *Monotes*, *Terminalia*, *Combretum* and *Acacia* occur at the limit between Myombo and valley grasslands.

This formation subsists on a lower rainfall. In drier regions, especially on Kalahari sands, there are distinctive species, such as *Marquesia acuminata*, *Cryptosepalum pseudotaxus* and *Guibourtia coleosperma*, as well as a few dense dry forests of *Baikiacea*. Treeless steppes are found on the plateaux.

Wellington (1955) classified this zone as "*Brachystegia-Isoberlinia* savannah".

Although the general appearance is that of parkland, there is a variation in tree density from almost open grassland to almost closed forest. With the dominant trees *Brachystegia spiciformis* (also known as B. *randii* and B. *hockii*, or 'Panda' tree) and *Isoberlinia globiflora* are associated many other species of *Faurea*, *Monotes*, *Strychnos*, *Swartzia*, *Albizzia*, *Combretum*...

5.2.4. (2.d.) Small-leafed rain-green forest with umbrella trees

In the Kikwit region the tropical rainforest is partly interrupted by this formation.

This area represents a transition from woodland to *Acacia* wooded steppe. *Acacia* predominates and associations of *Combretum* and *Terminalia* and *Adansonia digitata* and *Sclerocarya* also occur.

The valleys are dominated by a tall grass alluvial savannah, with *Acacia polyacantha* and *Acacia sieberiania*, and especially woodlands of *Colophospermum mopane*, which has a fire-tolerant bark and can subsist on poorly drained soils. These forests usually reach heights of 15 m or more, but my be low and stunted in regions subject to frost.

5.3. (3) Tropical inundated coastal formations

(3.a.) Mangroves (Congo estuary)

In the estuary of the Congo river exists a network of creeks, lined by mangrove and other coastal forests, stretching from Banana as far as Mateba island, below Boma. The mangrove forests only occur below high-tide level.

Extensive mangrove forests are found on saline loamy soils, exposed directly to the tides along the coast. The stands are dominated by *Rhizophora racemosa, R. harrisonni and R. mangle. Avicennia nitida* sometimes occurs behind the areas of Rhizophora. Tropical mistletoes (*Loranthus*), with bright scarlet or orange flowers, are perched on the mangroves.

As the water becomes less saline, mangroves are gradually replaced up-river and on higher grounds by a mixture of wild date palms (*Phoenix reclinata*), raphia palms (*Raphia laurentii* and R. *Sese*), screw-pines (*Pandanus*) and other trees. Many of these plants also have stilt roots and this forest is very similar to that of the mangroves, although much more varied in appearance. Large woody climbers (lianas) occur in places.

5.4. (4) Savannah

The density of these stands varies greatly, but is generally open, leaving the grass cover visible. The savannah extends on either side of the forest zone into regions of marked dry season and often merges imperceptibly with semi-desert steppe where the grassy ground cover is exposed.

5.4.1. (4.a.) Large-leafed semi-deciduous tree savannah

This type of savannah, near the Sudanese border, is fairly humid and stages range from woodland to grassy savannah. Tree cover density varies greatly with edaphic conditions and nature and extend of human activity. Grass heights varies from 80 cm to 3-4 m; the trees tend to be of the C. *oliveri*, *Lophira lanceolata* and *Combretum*, *Anogeissus*, *Khaya* and *Pterocarpus* genera. The grasses are mainly of the *Hyparrhenia* genus.

In the DRC, *Hyparrhenia* occurs in association with *Hymenocardia acida*, *Annona arenaria* and *Bridelia ferruginea* on clay soils.

5.4.2. (4.c.) Moist savannah

This vegetation occurs:

- in southern Bandundu and
- on the Sudanese border.

This formation is often found in association with large-leafed, semi-deciduous, tree savannah (4.a). Although *Isoberlinia doka* and *Isoberlinia dalzielli* woodlands are intermixed with clumps of *Uapaca togoensis*, these species are often replaced on eroded slopes by *Monotes kerstingii* and in poorly drained clay depressions by *Terminalia macroptera* and *laxiflora*. Tall-grass savannahs, sometimes with *Borassus palms*, occur in wide valleys.

5.4.3. (4.e.) Dry savannah

a. Coastal belt

The sandy coastline, backed by low cliffs is thinly covered by herbaceous plants, mainly grasses, but there are no true dunes.

The hinterland of the coast is a grassy plateau with scattered stunted shrubs, intersected by shallow and more or less wooded depressions. Grassland, with or without shrubs, often occupies the interior of the Congo estuary islands. Farther up the river vegetation becomes more luxuriant, forming a transition to the grasslands of the next region.

b. Eastern Katanga

Acacia dominate in this wooded savannah, but many broad-leaved trees (*Combretum* and *Terminalia*) occur in association with *Adansonia digitata*, *Sclerocarya*, *Celtis*, *Sisyphus* and *Gymosporia*.

Medium to tall grasses predominate: *Hyparrhenia hirta*, *Themeda triandra*, *Heteropogon contortu* and *Trachypogon spicatus*. *Setaria*, *Sehima* and *Ischaemum* occur on Vertisols.

Wellington (1955) classified this zone as "Mixed savannah".

5.4.4. **(4.f) Highland dry savannah** (Lake Edward mountains)

This category includes communities of tall grasses, about 1 metre high, at altitudes of between 1,800 and 2,500 m, and shorter grasses at altitudes above 2,500 metres. The most common grass species are *Themeda triandra*, *Loudetia simplex* and *Andropogon distachyus* and at higher elevations, *Festuca abyssinica*, *Pentaschistis mannii* and *Eragrostis isopholis*. They are often associated with evergreen or *Acacia* thickets.

5.4.5. **(4.h) Reed swamps** (Upemba depression, Central Katanga)

These are swamps, which are periodically or permanently inundated. The vegetation in them or their surroundings varies enormously with the depth of the water, the peat content and the period of submersion.
The commonest species, which often form pure stands, are *Cyperus papyrus*, *Typha*, *Juncus* and *Scirpus*. The most characteristic hygrophilous grasses are *Echinochloa pyramidalis*, *Vetiveria nigritana*, *Oryza barthii*, *Phragmites*, *Leersia hexandra*, *Saccharum spontaneum* and *Panicum repens*. In temporary swamps the vegetation consists of *Hyparrhenia rufa*, *Chloris gayana*, *Ischaemum afrum* and *Setaria palustris*. It is common to see cattle enter the water up to their bellies to graze on floating species such as *Echinochloa pyramidalis* and *Stagnina* or *Vossia cuspidata*.

5.5. Vegetation of Katanga

5.5.1. Wooded savannah (Savane boisé or forêt claire) Myombo

Wooded savannah covers most of the slightly undulating high plateaux (1,500-1,800 m) of southern Katanga and also the flanks of the higher plateaux farther north.

Usually it is an open low tree forest, which may be replaced by a scrubby bush in less favourable parts, especially on the valley slopes. Almost all the trees lose their leaves during the dry season and remain leafless for some time. Most trees are 6 to 15 m high, some reach 24 m. The dominant trees are nearly all of the Pea family (*Leguminosae*), the most common species being *Brachystegia* (Mputu, mutondo, musamba, miombo).

Other leguminous trees are species of:

- *Isoberlinia,*
- *Swartzia,*
- *Cryptosepalum,*
- *Pterocarpus,*
- *Acacia.*

Other trees include species of:

- *Combretum,*
- *Parinari,*
- *Uapaca,*
- *Monotes,*
- *Diplorrhynchus.*

The open canopy allows ample herbaceous growth, consisting mainly of grasses and flowering herbs. They include members of the Pea and Daisy families (*Compositae*).

In more open spaces there are small shrubs (*Protea* and *Hymenocardia acida*), which in the larger openings form dense scrub and this merges into the bush of poor soils.

Large areas are covered with savannah woodland with sparser and smaller trees. This variant is called ‘orchard bush’.
Termite hills are very common in savannah woodlands. They support a peculiar vegetation. These evergreen patches stand out among the leafless woodlands in the dry season. Trees and shrubs form a thicket with:

- *Euphorbia,*
- *Boscia,*
- *Vitex,*
- *Oxytenanthera abyssinica,* small bamboo*,*
- *Aloe,*
- *Chlorophytum,*
- *Sansevieria.*

Dembos or dambos

Scattered throughout the savannah woodland are open grassy areas, usually along the upper parts of streams, called dambos. The soil is waterlogged during the rainy season. Trees are therefore absent and replaced by grasses. These grow denser and taller than in the surrounding woodland. Sedges (*Cyperaceae*) are abundant and there is a rich flora of flowering herbs.

5.5.2. Grasslands (savannahs or steppes)

Valley bottoms and high plateau blocks

Apart from the dambos, the Katanga grasslands can be subdivided into a lowland variety of the river valleys and the upland grasslands, or steppe, on the top of the high plateaux of the Mitumba, Kibara, Kundelungu and Marunga mountains.

a. Lowland grasslands or savannahs

These occur in the deep and wide valleys of the Lualaba, Lufira, Luvua and Luapula rivers, in between the central swamps of Katanga and the woodland savannah on the high plateau. They also grow along minor valleys, usually with bush on either side.

They consist of grasses of up to 4 m high, including extensive stretches of elephant grass. Grass fires prevent most woody growth, but fire-resistant shrubs, e.g. *Bauchinia thonningii*, *Terminalia*, *Strychnos* and *Acacia campylacantha*, are scattered about.

b. Upland grasslands or steppes (> 1,500 m)

These are found on the summits of most high plateaux (Mitumba, Kibara, Kundelungu and Marunga).

The soils are generally poor, sandy and partly lateritized, becoming impermeable. During the rainy season numerous small lakes are formed, some of which never wholly dry out, but otherwise the ground becomes very dry in the dry season. The vegetation is low grassland or steppe, with little woody growth, except near springs or around valleys. Important grasses are *Hyparrhenia cymbaria* and H. *variabilis* and species of *Panicum*, *Eragrostis* and *Ctenium*, very few exceed 1 m in height. Dwarf shrubs, such as *Philippia* occur and numerous herbaceous perennials.

5.5.3. Marshes (Upemba and Mweru depressions)

A very extensive marsh tract occurs along the river Lualaba in between Mulongo and Bukama. The most characteristic plant is papyrus, which forms extensive swamps in the Lualaba and Lufira rivers and by lake Mweru and Bangweulu (Zambia). The soil is usually flooded and peat is common. Floating mats of sudd are frequent in which occur sedges, grasses and ambatch. In some places tall grasses constitute the main vegetation.

5.5.4. Forest (riparian and ravine slopes, Marunga forest)

True forest, as distinct from savannah woodland, covers only limited areas in Katanga. It occurs as fringing forest along the streams, on alluvial soils, or on steep ravines. These narrow forests may be 0.5 km wide at places. The trees are evergreen and attain a height of up to 30 m. There is often a dense shrubby layer with abundant lianas. The herbaceous vegetation contains species not found in the surrounding woodlands. The small bamboo sometimes forms belts immediately outside the fringing forest.

A limited area of the Marunga massif, W of Lake Tanganyika, at > 1,650 m and on moist soil, is also covered by forest. It occurs on mount Nzawa and consists of tall dense stands with more open canopy than in the lowland forest. The undergrowth is shrubby, including tree ferns, lianas and brambles (*Rubus*). Among the herbaceous vegetation are bracken and columbines (*Aquilegia*). Probably this area was much more extensive formerly.

6. Geology

Three groups of rocks occupy nearly the whole area of the DRC:

- Mesozoic and Cainozoic marine rocks on the coastal belt,
- folded metamorphic rocks of the Precambrian basement complex,
- subhorizontal, mainly continental, cover formations (Karroo to Pleistocene).

6.1. **Basement complex (crystalline complex,** Precambrium)

The first group of rocks, and the oldest, is the Basement complex, composed of highly folded metamorphosed rocks, intruded by granites, pegmatites and basic igneous rocks, which constitute everywhere in Africa the platform on which lie younger rocks.

The complex forms the broad rim of the Congo Basin, from the Ubangi-Shari watershed in the N, through the eastern highlands, to the southern end of Lake Tanganyika. It is also prominent in the SE (upper Kasai and Lubilash basins) and in the Lower Congo.

Relief is subdued through profound denudation except where it has been freshened by tectonic movements or fairly recent erosion. Relicts of intrusive rocks and old peneplain remnants stand out as isolated mountains and ridges (inselbergs).

Table 4. Groups of the Precambrian basement complex, according to location, from younger to older (Cahen, 1954 and Geological map of Congo, 1974)

Katanga	E Congo	NE Congo	NW Congo	W Congo	Kasai-Lomami west	Kasai-Lomami east
- Groups -						
Katangian	Lindian	Lindian	Lindian (Ubangian)	Western Congolian	Bushimaie, Luamba	
Kibarian, Marunga rhyolites	Burundian Bilati and Luhule-Mobishio formations		Liki-Bembian	Crystal Mountains =	sedimentary and volcanic complex of the Lulua	Kibarian
Rusizian, Ante-Kibarian	Rusizian, Kibalian	Kibalian Western Nile	Ganguan (Banzyville formation)	Mayombian Zadinian	Luizian Kalundwe formations	
	Ante-Rusizian, Mount Speke gneiss	gneiss complex of the Garamba	amphibolitic and gneissic complex of the Bomu	gneiss and migmatite complex of Mpozo-Tombagadio	Granitic complex of Dibaya, gabbro-noritic, charnockitic complex of Kasai-Lomami, gneiss of Upper-Luanyi	Ante-Kibarian (Lukoshi format.)

A description follows, dividing the country in broad regions.

6.1.1. Katanga (exclusive of West Katanga)

The Katanga Group is composed of non-metamorphic and non-folded rocks, which overlie the Kibara Group.

A few ante-Kibara Group rocks occur (quartzites, schists...)
In the N there are Rusizian granites.

a. Kibara Group or Kibarian (1,970-1,300 m.y.)

This is one of the most important geological units of Katanga. It forms a SW-NE oriented strip of folded rocks in central Katanga.

Subdivision, top to bottom (Cahen, 1954):

a.1. Lubudi System

- K5 - limestones and dolomitic limestones (1,000 m)
- K4C - black schists
- K4B - dark feldspathic quartzites
- K4A - black schists
- K3 - bright schists and sandstones, with local basal conglomerate (K3+K4 = 2,000-3,000 m)

a.2. Nzilo System

- Kv - local lavas
- K2 - bright quartzites (400-4,000 m)
- K1B - alternating layers of shales, sandstones, quartzites and conglomerates (K1 = 4,000-5,000 m)
- K1A - shales with fine quartzite intercalations

There are intrusions of dolerites and granites.

b. The Katanga Group (1,300-845 m.y.)

Important surfaces, especially in SW Katanga are covered by these rocks (copper ores). Folded and faulted in the S and SE of Katanga, these rocks are tabular in the N, NE and E.

Subdivision, top to bottom (Cahen, 1954):

b.1. Kundelungu System (most extensive and mainly marine)

- Upper Kundelungu Series (1,500-3,500 m)

+ upper stage

- red sandy schists
- red, pink, feldspathic sandstones and quartzites
- pink, feldspatic fine quartzites
- eolian coarse sandstone
- red fine quartzites, often dolomite cemented

+ lower stage

- red sandy schists, on top locally calc-schists and limestones
- clayey schists and red calc-schists, with a white chert layer
- red, green, yellow quartzites and feldspatic sandstones
- pink clayey fine sandstone

- Middle Kundelungu Series (100-750 m)

- clayey schists and red sandstones
- schists on calc-schists
- grey, blue, pink oolithic limestone, massive limestone and calc-schists on basal breccia
- bright sandstones, quartzites, calc-schists
- reddish or yellowish sandy limestone or schist-limestone
- banded blue limestone
- white, pink, yellow, cavernous dolomitic limestone
- red or green calcareous conglomerate, feldspatic sandstones

- Little conglomerate Series or tillite (0-80 m)

- Lower Kundelungu Series, southern Katanga (0-2,000 m)

  - greyish brown sandstones, quartzites, sandy limestones
  - grey sandy schists, schists, calc-schists
  - calc-schists, limestones and dolomites
  - conglomerate (only N)

b.2. Grand Conglomérat and Mwashya System (mainly continental)

- Great conglomerate Series or tillite (150-300 m)

- Mwashya Series(600-800 m)

  - schists, calc-schists with sandstones and feldspathic quartzites, black schists
  - grey-green dolomitic schists with tillite intercalations (conglomerate of Mwashya)

b.3. Roan System (mainly marine)

- Upper Roan Series (> 1,200 m)

- siliceous oolithes, jaspis
- alternating layers of magnesian limestones and micro-sandy schists
- chlorito-talc schists, micro-sandstones, feldspathic quartzitic sandstones and siliceous dolomites
- generally calcareous feldspathic clayey sandstone and micro-sandstones
- coarse layers of limestone, siliceous dolomitic limestone
- dolomitic schists with graphitic layers on siliceous dolomites
- siliceous massive dolomites
- sheet-layered banded siliceous dolomites
- lower dolomites, schists, feldspathic sandstones
- dolomites and limestones

- Lower Roan Series (200-600 m)

  - often conglomeratic, feldspathic and arkosic quartzite
  - conglomerate

There are intrusions of granites (N), andesitic dolerites, gabbros, peridotites, pyroxenites.

6.1.2. Eastern Congo (Kivu, Maniema)

In the Kivu ridge, middle Precambrian rocks comprise strongly metamorphized gneisses, amphibolites, quartzites and micaschists, as well as granitic intrusions.

Subdivision (top to bottom):

a. Burundian or Burundi Group (equivalent of the Kibara Group) 2,100-1,300 m.y.

7. dark grey schists, almost without quartzites
6. quartzites, arkoses and conglomerates
5. schists with rare marble and also conglomerate lenses
4. banded and black schists, with rare quartzite lenses
3. same as 2, but thick layers of quartzites
2. banded and black schists, numerous thin quartzite layers, thin marble lenses
1. arkoses and conglomerates, with local shale intercalations

There are intrusions of Burundian granites, dolerites, pegmatites.

b. Muhila Formation

- micaschists, quartzites, white cherts, itabirites

c. Rusizian or Rusizi Group (> 2,100 m.y.)

- Upper layers

  - shales and schists, mica-schists, quartzites
  - shale conglomerate, with limestone pieces, mica-schists

- Lower layers

  - graphytic micaceous shales and schists, with fine limestone lenses
  - dark quartzites, arkoses, schists
  - graphytic dark schists, quartzites, gneiss

There are intrusions of Rusizian gneissic granites, gneisses and amphibolites.

6.1.3. NE Congo (Higher Congo, E of Yangambi)

The northern edge of the Congo Basin is formed by upper-Precambrian non-metamorphic sandstones and shales.

Following subdivision can be made, younger to older (Cahen, 1954):

a. Lindian or Lindi Group (< 1,300 m.y.)

a.1. (G) Sandstone System (plateau red sandstone)

- (G1) Upper Series (200-500 m)
  - sandstones, quartzites, red clayey quartzitic coarse sandstones with red schist intercalations, with basal blue schists layers
- (G0) Lower Series (0- >600 m)
  - alternating layers of cross-bedded, red or brown quartzites and sandstones, conglomerate lenses and schists
- (Ct) Tillite of the lower Lenda (<50 m) and fluvial conglomerate of the Opienge caves (8 m)

a.2. (C) Calcareous System

- (C6) red oolithic limestones
- (C5) thick layers of pink, yellow, pearl-grey and on top reddish and brown dolomites, passing to purple calcareous schists (30-40 m)
- (C4) psammites and reddish or green sandstones, quartzitic sandstones, schist, marls with silex (50m)
- (C3) clayey limestones, limestones, dolomites (50-75 m)
- (C2) silicified oolithic limestones (30-50 m)
- (C1,C0) white sandstones and arkoses with conglomerate (50m)

b. Kibalian or Kibali Group (> 2,190 m.y.)

- schists, talc-schists, quartzites, conglomerates, calcareous rocks, dolomites, itabirites, schistified lavas

There are post-Kibali granite intrusions.

c. Gneissic Complex of the Garamba (Western Nile Formation, extreme NE Congo)

Gneisses, mica-schists, mica-quartzites, crystalline limestone, migmatites, gneissic granites and pegmatites.

The Mount Stanley Group of the Ruwenzori Massif is related to the Western Nile Formation: gneiss, amphibolite, amphibole-schists, with gabbro, granite, dolerite intrusions.

6.1.4. NW Congo

(N Equator and Higher Congo, W of Yangambi)

Two regions can be defined:

- *Congo-Ubangi interfluve*

  - Ubangi Group (Lindian)
  - Liki-Bembe Group

- *Lower Uele*

  - Ganguan (Banzyville formation)
  - Metasedimentary and migmatic complex of the Ubangi
  - Amphibolithic and gneissic complex of the Bomu
    (Crystalline Series, with granites, basic intrusive rocks and lavas)

Following stratigraphic subdivision can be made (younger to older):

a. Ubangi Group (Lindian)

a.1. Upper System (Quartzito-greseux)

- pink quartzitic sandstone, coarse sandstone intercalations and arkosic conglomerate, arkosic sandstones, quartzites

a.2. Lower System (Schisto-quartzito-calcaire)

- red oolithic limestones, grey limestones, schists, red calc-schists, arkoses, arkosic sandstones, cherts, quartzites

b. Liki-Bembe Group

b.1. Upper System

- Upper Series
  - schists and on top calcareous schists, green limestones

- Lower Series
  - white quartzites, with rare schist intercalations, on basal conglomerate

b.2. Lower System

- purple shales, conglomerates, quartzitic coarse sandstones, green schists

c. Ganguan (Banzyville Formation)

- mica-quartzites, schists

d. Crystalline Series

- intensely folded mica-schists, gneiss, with granites

6.1.5. Western Congo region (Lower Congo and Bandundu)

a. Crystal Mountains Group (equivalent of the Kibara Group)
Upper Precambrium

a.1. The Mayombe System (Zadinian and Mayombian)

The Mayombe mountains are composed of the late Precambrian Mayombe system, which is strongly metamorphosed. The folded layers have a general S-SE to N-NW orientation. Rocks are crystalline schist, quartzite, greenstone and intrusives such as granite and diorite.

- Duizi Series

  chlorito-, talc-, mica-schists, sometimes granitized, quartzitic schists, quartzites, porphyric rhyolites

- Tschela Series (Loukoula?)

  - west: black graphytic schists and quartzites, with white to grey fine quartzite intercalations
  - east: pink, white, grey or black quartzites, with black graphitic schist intercalations
  - SE: amphibolised doleritic lavas (Matadi)

- Matadi Series (Bikossi?)

  - bright and grey micaceous quartzites; granitized at Boma and Matadi

- Palabala Series (Loémé?)

  - mica-schists, quartzitic mica-schists, migmatites, gneiss; granitised at Boma and Matadi

Intrusions exist of granites and some gabbros

a.2. The Sansikwa System

Republic of the Congo		*D.R.of the Congo*
Bamba Mountains System	=	Sansikwa System
Moussouva Series	=	(S2) upper assise of Sansikwa
M'Vouti Series	=	(S1) lower assise of Sansikwa
		(S0) basal conglomerate

- Upper assise (S2) 875 m

S2b yellowish grey to white feldspathic coarse quartzites, with chert intercalations, purple or grey psammites and schists

S2a fine quartzites, purple schists and psammites, chert level

- Lower assise (S1) < 500 m

  shales, purple psammites, grey-purple coarse quartzites

- Basal Conglomerate (S0) 4-5 m

  arkosic-schistic conglomerate, with quartz and schist pebbles

b. Western Congo Group (equivalent of the Katanga Group) (Upper Precambrian-Devonian, 1,000-615 m.y.)

Following subdivision can be made (bottom to top)

D.R. of the Congo	*Republic of the Congo*
Lower tillite of Lower Congo	= same
Higher Shiloange System	= Bouenza and Louila Series
Upper tillite of Lower Congo	= same, also called Niari tillite
Schisto-Calcaire System	= same
Schisto-Greseux System	
- M’Pioka Series	= same
- Inkisi Series	= same

b.1. Lower tillite of the Lower Congo (450-1,000 m)

- tillites, schists, quartzites, doleritic lavas

b.2. Higher Shiloange System (Sh)

Higher Shiloange System (DRC)= Bouenza and Louila Series (R.Congo)

Subdivision (top to bottom):

- Sekelolo stage (Sh8) 200 m

Sh8i	breccia with dark limestone pieces, in a clayey limestone cement
Sh8h	dark clayey limestones and calc-schists
Sh8g	dark reef limestones, calc-schists
Sh8f	dark clayey limestones and grey calc-schists
Sh8e	dark clayey limestones
Sh8d	nodular clayey limestones, with limestone and calc-schist lenses
Sh8c	dark very clayey limestones, alternating with Sh8b
Sh8b	dark schists with dark limestone nodules
Sh8a	dark schists

- Mouyondzi stage
  - quartzites
  - basal conglomerate

b.3. The upper tillite of the Lower Congo (Niari tillite of R.Congo)

b.4. The Schisto-Calcaire System (1,000 m)
Upper Precambrian-Cambrian

Succession (top to bottom)

- C5 Bangu stage, 225 m (eq. SCIII)

  bright, grey or black (hydro-carbon) dolomitic limestones and dolomites, limestones, cherts, schists, calc-schists, basal breccia and conglomerates

- C4 Lukunga stage, 300 m (eq. SCII)

  limestones and clayey dolomites, oolithic limestones, numerous chert layers; schists; calc-schists; calcareous psammites; macignos; characteristic red weathering

- C3, C2 and C1 Kwilu stage (eq. SCI)

  C3 - oolithic limestones, brechoid limestones, 100 m (equivalent of the SCIc)

  C2 - layers of clayey limestones, schists, calc-schists, calcareous sandstones, 350 m (equivalent of the SCIb)

  C1 - grey and pink banded dolomites, 6-10 m (equivalent SCIa)

b.5. Schisto-Greseux System
Cambrian-Devonian

The Schisto-Greseux forms the top of the basement complex. There are 3 series. Each series may rest directly on the older Schisto-Calcaire. A typical area is the Cataracts plateau (terrain unit 720) From top to bottom:

(1) Inkisi Series, 2,000-2,200 m

This is an important quartzito-arkosic series

- Stage II (1,000-1,100 m)

  (I2c) banded sandy schists, schists, feldspathic quartzites, all red or purple and often micaceous, 300 m

  (I2b) quartzitic arkoses, with quartz and schist pebbles; psammites; all red or purplish, greenish, 300 m

- Stage I (650 m)

  (I2a) schists, psammites, fine quartzites; all red or purplish, 20-30 m

  (I1) reddish brown, or greenish massive layers of coarse arkosic quartzites, frequently cross-bedded, with pebbles of quartz, feldspathic, cherts, 300-400 m

  (I0) Basal conglomerate of Mount Bidi (< 15 m)
  arkosic mass with quartz, quartzite pebbles and angular gravels of cherts, limestones and schists

(2) M'Pioka Series, 1,000 m

This Series covers extensive surfaces on the Cataracts plateau and Bangu.

- Stage II, (550 m)

(P3b) feldspathic fine quartzites, with red schist fragments, on often calcareous, red sandy schists, feldspathic quartzites, 240 m thick;

(P3a) often sandy, green-grey schists and quartzite, 60 m thick;

(P2) often cross-bedded, pink feldspathic quartzites, with schist and chert pebbles, on basal conglomerate, 250 m thick;

- Stage I (450 m)

(P1c) red, stratified, sandy-mica-schists, grey mica-feldspathic fine quartzites; breccia and conglomerate lenses, with schist or limestone gravels; calcareous sandstone lenses, 370 m thick;

(P1b) grey feldspathic mica-quartzites; on top quartzite and schist layers, 14 m thick;

(P1a) red sandy, often micaceous, schists, green schists, calcareous sandstone and conglomerate layers, 33 m thick;

(P0) conglomerate-breccia of the Bangu and the Niari layers of red or green schists and conglomerates, with limestone and chert gravels, 25-30 m thick.

(3) M'Fidi Series (F) > 50 m (only in valley bottoms)

- (F2) Luvemba Stage < 60 m

    (F2b) grey feldspathic quartzites, sometimes on conglomerates

    (F2a) grey feldspathic quartzites, on arkosic conglomerate

- (F1) Gidinga Stage < 30 m

    (F1b) often calcareous, green and grey schists and sandstones; feldspathic fine quartzites, red psammites

    (F1a) often calcareous, green and grey schists and sandstones; red or green schists and psammites,

    (F0) locally with a basal clayey conglomerate

6.1.6. The Kasai-Lomami region (including West Katanga)

In this region, rock outcrops only occur in dissected valleys.

Succession from top to bottom

- Katangian - Bushimaie System
- Lulua group in the W, Kibarian in the E
- Luizian (Kalundwe Formation)
- Ante-Kibarian (Lukoshi Formation)

a. Ante-Kibarian (Lukoshi Formation)

This formation has outcrops in the higher Lulua basin. It consists of schists, talc-schists, mica-quartzites, arkoses and conglomerates. There are granitic intrusions.

b. Luizian (Kalundwe Formation)

This formation is N-S to NE-SW oriented; it comprises chlorito-schists, amphibole schists, metamorphic schists, quartzites, leptynites, itabirites, amphibolites and gneisses.

c. Lulua Group

Limestones, schists, shales, quartzites, mica-schists, migmatites; all in a SW-NE direction.

d. Ante-Bushimaie eruptive rocks

- gabbro-norite massif of the Lulua
- gabbro-tonalite-granite massif in between Lubilash-Lubishi
- granites of Kasai-Lomami
- pegmatites S of Sandoa-Kafakumba
- dolerites

e. The Bushimaie System

This system occupies large areas in NE Katanga (Haut-Lomami) and in the E of Kasai. It is a syncline starting at the Kibara Mountains, extending over 400 km towards the NW.

e.1. **Upper Series** (> 250 m)

- limestones, dolomitic limestones, clayey limestones, calcareous breccia, calc-schists, and schists

e.2. **Lower Series** (1,800-3,000 m)

- conglomerates, arkoses, quartzites, schists, cherts

There are dolerite intrusions

6.2. Continental cover formations

A practical distinction is made between the marine deposits of the narrow coastal belt (next chapter) and the continental cover deposits in and around the Congo Basin.

The cover formations overlie the basement complex. They are composed of shales, sandstones (sometimes with calcareous intercalations), conglomerates and eolian sands.

In the Congo basin, Precambrian rocks are covered by continental sediments from Karroo to recent age; about 3,500 m thick. They comprise Karroo beds, continental intercalaire, continental terminal (Kalahari sands) and Quaternary sediments.

Table 5. Continental cover formations of the D.R. Congo
(modified from Cahen, 1954 and Geological map, 1974)

Quaternary	Holocene	river alluvium
	Pleistocene	river terraces
	Plio-Pleistocene	Salonga deposits
Tertiary	Pliocene	Yangambi Series Lodja layers Ocre Sands Series (upper Kalahari)
	Miocene	Ocre Sands Series Rift Graben deposits
	Eogene	Polymorphic Sandstone Series (lower Kalahari) (**)
Mesozoicum	Upper Cretaceous	Kwango Series (**)
	Cretaceous	Kamina Series
	Lower Cretaceous	Lualaba beds (*) (**) - Loia Series
	Upper Jurassic	- Stanleyville Series
	Triassic Liassic(?)	Upper Lueki Series Red Rock Series (*)
Paleozoicum	Permian	Lukuga Series (*)
	Upper Carboniferous	
Lower Paleozoicum	Basement complex	
Precambrian		

(*) Formerly those Series were named Karroo deposits (Upper Carboniferous to Cretaceous

(**) Formerly the name Lualaba-Lubilash System was used for all beds of the Lualaba Series, Kwango Series and Tertiary Polymorphic sandstone.

6.2.1. Cover formations of the Paleozoicum (Upper Carboniferous and Permian)

a. Lukuga Series

The Karroo deposition begun with an ice age and ended with a volcanic episode. These rocks are mainly shallow fresh water and terrestrial deposits. Basal glaciogene rocks of the Lower Stage (equivalent of the S African Dwyka Series, Karroo) are overlain by shales, sandstones, mudstones and coal-bearing shales of the Upper Stage (equivalent of the S African Ecca Series, Karroo).

These deposits form the basal parts of the cover formations. Outcrops are located in the S and E of the Congo basin. They occur in old depressions of the basement complex.

The base of the Congo basin is formed by the Upper Carboniferous tillite, or glacial conglomerate. These tillites should not be confused with the tillites of the older Kundelungu or Western Congo Group. Above the glacial beds are coals.

On the soil map of the Congo (Sys, 1960), material derived from Karroo rocks is presented by symbol K. These materials have a sandy clay to clayey sand texture. Commonly the clay fraction contains enough montmorillonite.

At Lukuga, N Katanga, following layers exist:

a.1. Upper stage (Upper Permian)

- Transition Assise (55-100 m)

T4	green, red, grey schists, nodular limestones, thin coal seam
T3	red, green banded sandstones and sandy psammites, thin coal seam
T2	schists, red and green banded psammites and sandstones
T1	coarse sandstones, often banded; schists

- Coal Layer Assise (20-125 m)

K	feldspathic coarse sandstones, thin coal seam
R5	grey, black schists, often carboniferous
R4	sandstones, banded psammites and schists, thin coal seam
R3	schists and banded psammites
R2	banded psammites
R1	coarse sandstones and conglomerates
H8	upper coal layer, banded sandy psammites and sandstones
V	coal layer 5, black schists
H7	banded often sandy psammites
IV	coal layer 4
H6	black schists
III	coal layer 3, grey schists
H5	banded often sandy psammites, thin coal seam
H4	banded psammites and sandstones
H3	feldspathic coarse sandstones and nodular limestone
II	coal layer 2, grey-blue psammitic sandstones
H2	banded often sandy psammites
H1	feldspathic coarse sandstone, often conglomeratic
I	coal layer 1, grey clayey schists
B3	banded psammites, black carboniferous schists, thin coal seam
B2	often coarse or banded and psammitic sandstones, thin coal seam
B1	often coarse sandstones, banded sandy psammites, thin coal seam

a.2. Lower stage (Upper Carboniferous-Lower Permian)

- Black Schist Assise (10-120 m)

SN2	banded often sandy soft psammites
SN1	black schists with basal greywacke

- Walikale Assise (100-420 m)

LK3	tillites, conglomerates and sandstones
LK2	black schists with limestone nodules, greenish and purplish schists, conglomerates
LK1	sandstones, quartzites, conglomerates; all red

6.2.2. Cover formations of the Mesozoicum (Triassic, Jurassic, Cretaceous)

Very similar rocks characterize these deposits, either clayey rocks, or feldspathic sandstones.

A subdivision can be made between the:

- Karroo rocks (Jurassic to Cretaceous) of the Lualaba beds,
- Upper Cretaceous rocks of Kwango Series.

For a greater part these are lacustrine beds with highly coloured cross-bedded sandstones. All rocks are slightly consolidated (sandstones and shales).

Formerly the name Lualaba-Lubilash System was used for all beds of the Lualaba and Kwango Series and the Tertiary Polymorphic Sandstone.

a. Lualaba beds
(Karroo: Upper Jurassic to Cretaceous)

The Lualaba beds lie along the river of that name and may be traced across the Congo to the Ubangi N of Bangui. They also occur in the river valleys of the SE, where they are exposed below Kwango Series sandstones.

On the soil map of the Congo (Sys, 1960), material derived from Karroo rocks is presented by symbol K. These materials have a sandy clay to clayey sand texture. Commonly the clay fraction contains enough montmorillonite.

The Upper or Loia Series occurs in valley bottoms of the central Congo Basin, while the Lower or Stanleyville Stage occurs in the peripheric zones of the basin.

a.1. Loia Series (Wealdian, Cretaceous)

Brown clayey sandstones and grey or green sandy argilites

a.2. Stanleyville (Kisangani) Series (Upper Jurassic)

Red argilites, soft sandstones, sandy argilites, red calcareous argilites, calcareous or clayey sandstones, bituminous schists, basal conglomerate, cross-bedded sandstones, red psammites, red calcareous schists, red schistose sandstones, schists with limestone nodules, dark limestones

b. Upper-Cretaceous Kwango Series

The Kwango Series forms the floor of the central parts of the Congo Basin, being extensively exposed in the drainage system of the Kasai and SW Congo. Farther N, it is covered by alluvial deposits and it reappears on the northern side of the basin, between the Congo and the Ubangi. No younger beds (other than alluvium and cover sands) are seen in the Congo Basin.

The upper part of the Stanley Pool Series (R.Congo) belongs to the Kwango Series, the lower part to the Lualaba Series.

The Calonda Group of Angola is the equivalent of the Kwango Series in Zaire.

- basal conglomerate
- cross-bedded, purple, fine sandstone
- sandstone, with fine conglomerate layers

b.1. Upper or Nsele Stage, sub-aerial deposits (110 m)

This stage belongs to the Lower Kalahari Series
The Kamina Series probably also belong to this stage.

- Pink to purplish or red, very fine soft sandstones, sometimes coarse in the upper part; with silex layers and locally argilite lenses.

b.2. Lower or Inzia Stage, water-deposited (< 290 m)

5 red or green, locally calcareous, argilites, with red, white, green, sandstone intercalations, or conglomerate (25-40 m)
4 pink, red, white sandstones, sometimes with small quartz gravels or silex (25-90 m)
3 crumb argilites and soft sandstones, green argilites, grey limestones, white marls and white sandstones (25 m)
2 brown, white, green soft sandstones (15-40 m)
1 red argilites (calcareous, sandy, micaceous, crumb) and red sandstones (> 25 m); a basal conglomerate may be present

c. Mesozoic volcanic rocks

- basalts of Kasenga (Luapula)
- kimberlites of the Kundelungu, Bushimaie, Kasai-Lunda

6.2.3. Tertiary cover formations

The history of the Congo in the Tertiary and Quaternary has been a continuous succession of denudation, slight deposition and vertical movement. Only on the Atlantic slopes marine Jurassic, Cretaceous and Eocene deposits are found (see next chapter).

A Late-Cretaceous pediplain has been cut across the Mesozoic and older rocks.

On top of it, sediments accumulated: 40-50 m for the Pleistocene cover of the Congo Basin and Kasai; 120 m for the Tertiary Kalahari sands.

Aridity became marked, interrupted by limestone-producing lakes. Deposits, at that time at the surface, became silicified (down to 90 m deep). Sands became chalcedonic quartzites (Polymorphic sandstone or Mid-Kalahari Series).

Pronounced planation in the mid-Tertiary produced the Miocene or Mid-Tertiary pediplain on top of polymorphic sandstone and older rocks, which now forms much of the present-day higher plateau surfaces. The “Ocre sands” were deposited on top of it (Upper-Kalahari Series).

The Miocene pediplain of Southern Katanga is exceedingly monotonous. It has been partly dissected by a further stage of planation, which produced the stepped Pliocene pediplain (Late-Tertiary pediplain). The latter is covered by patches of gravels, called the “Plateau Gravels”, which in turn are covered by “Plateau Sands”. These sands formed under arid conditions and attain a thickness of 45 m. This pediplain with its mantle of gravel and sand is well developed north of the Angolan border, but is here essentially limited to the region of soft Kwango Series beds.

A distinction is made between the Kalahari sands of Mio-Pliocene age; covering the high plateaux of Katanga (Kwango, Kundelungu, Kamina, Biano) and the Pleistocene sands found on the (lower) Kasai plateau and the Central Congo Basin.

The Rift Valley tectonic system started in Late Mesozoic times and associated volcanic activity has occurred throughout the Tertiary and Quaternary. The present-day Rift Valley lakes were produced by post-Miocene fault movements.

a. Polymorphic sandstones (Eocene) “Lower or Middle Kalahari”

This deposit is the equivalent of the Mid-Kalahari Series. It was deposited on the deformed surface of the Late-Cretaceous pediplain, during a continental aridic period. It is top by the very flat Mid-Tertiary pediplain. The pediplanation has cut its plain across the polymorphic sandstones and older rocks.

The sandstones have only been conserved in depressed sites of the deformed Late-Cretaceous pediplain. The Ocre sands overlie the polymorphic sandstones.

At the Kwango, following succession exists (top to bottom):

6 soft sandstones, rarely silicified, or white or red sands; variable thickness; this layer has usually been eroded in the Kasai and Katanga
5 white, brown, pink, hard, siliceous quartzitic sandstones
4 chalcedony, chalcedony-cemented sandstones, quartzitic sand-stones; variable thickness
3 grey sandstones with plant fossils (0.5-1 m)
2 chalcedonic or quartzitic sandstones (10-20 m)
1 basal conglomerate, silicified sandstone, often with chalcedony gravels (0.5-2 m)

b. Ocre Sands Series (DRC) or Batéké sandy loams (Republic of the Congo) “Upper Kalahari”

These Pliocene clayey sands are the equivalent of the Upper-Kalahari Series. They rest on the Mid-Tertiary pediplain surface, often on top of the polymorphic sandstone. As the Mid-Tertiary pediplain has been deformed, the Ocre sands have been conserved only in the lower parts.

They are yellowish-brown (ocre) clayey sands, getting more reddish with depth. Often there is a basal conglomerate with small rounded gravels of quartz and ironstone pieces (a few metres thick). Lithology is different from the topographic lower and Pleistocene Plateau sands.

The Ocre sands are older than the oldest step of the Late-Tertiary pediplain system. The latter is a stepped complex of Plio-Pleistocene surfaces.

The Kalahari Sequence, of Tertiary to Recent age, forms an extensive cover of terrestrial origin.

A lime-cemented sand and conglomerate at its base is followed by a green sandy clay, white partly-calcareous sand and calcrete. Unconsolidated eolian sand covers most of the Kalahari succession.

Six major lithological components can be identified within the Kalahari Group: (1) conglomerate and gravel; (2) marl; (3) sandstone, mainly secondary duricrusts; (4) alluvium and lacustrine deposits (swamps and pans); (5) Kalahari sand and (6) duricrusts.

A division into three groups can also been made:

(1) basal gravels, or Botletle deposits, composed of chalcedonic sandstone and grits, overlain by

(2) the Kalahari limestone group, composed of limestone, calcareous sandstone, pipe sandstone, overlain by salt, marl and calcareous tuff, in most places is covered by

(3) a mantle of sand, almost completely hiding the underlying rocks. In some places the Kalahari sands are 100-150 m thick. Usually sands are red, with iron-oxide coatings on sand grains; white sands have lime coatings. Sands are composed of quartz, but feldspar, epidote, chalcedony and mica also occur. These deposits have many accretions of secondary calcrete, silcrete and ferricrete.

Of all these units the Kalahari sands and the duricrusts (silcrete, calcrete and ferricrete) are most significant in terms of extend.

The term Kalahari Sand is not applied to a homogeneous deposit but to one which varies markedly in colour, composition, thickness and even age. Towards the Kalahari fringes it becomes mixed up with and indistinguishable from the weathering products of the underlying Karroo and Precambrian rocks.

The colour of the sand is commonly described as red, though in fact it is frequently ochreous and surface layers are sometimes bleached, particularly when the sand has been reworked in water. Colouring resulted of sand particles being coated by a pellicle of precipitated iron-oxide, derived from weathering of iron-rich minerals within the sand matrix.

Little of environmental significance can currently be gained from attempting to interpret the regional scale colour variations (Thomas and Shaw, 1991).

The Kalahari sand is largely composed of quartz grains (90 % or more by weight) with accessory heavy minerals. Much of the sand is of local origin, including weathering products of the pre-Kalahari rocks, with additions derived from sources in an easterly direction. Secondary formations are duricrusts, mostly in the calcrete-silcrete spectrum, which are among the most extensive in the world. Much difficulty is experienced in identifying and distinguishing between calcrete and silcrete without chemical or petrological analysis. This has led to much confusion in field identification. There exist a large number of intermediate forms, termed cal-silcretes and sil-calcretes.

Duricrusts are usually assumed to form prominent features in the landscape. In erosional landscapes this is generally true, but in a depositional setting, such as the Kalahari, such resistant features are encountered only where the duricrust has been exposed to sub-aerial processes, as in fossil valleys, escarpments, pan rims and surface pavements.

Late Tertiary tectonic movements have tilted the middle Tertiary pediplain on polymorphic sandstone, towards the N, in the direction of the Congo Basin. Eolian sands were later on deposited (probably during the Pliocene). Also rolled gravels layers were deposited, probably during the Plio-Pleistocene.

A tilting towards the N occurred of the not yet completed late Tertiary Pediplain and a new dry phase provoked the silicification of the Plio-Pleistocene coarse sandstones.

6.2.4. Plio-Pleistocene cover formations

The plateau gravels on the stepped Late-Tertiary pediplain are Late-Pliocene. The Yangambi Series and in the Central Congo Basin the Lodja and Opala deposits are probably of the same age.

The clayey sands covering the stepped Late-Tertiary pediplain are Plio-Pleistocene.

6.2.5. Quaternary formations

Quaternary deposits are Holocene alluvial valleys and Pleistocene river terraces. Important are also the lacustrine deposits in the Rift Valley, also along the lakes Moero and Upemba.

Some typical deposits and surfaces(from older to younger)

- laterite 1 of the Lunda (Angola)
- pediplain step A7 of Kasai
- laterite 2 of the Lunda (Angola)
- Semliki Series (partially)
- sands on stepped pediplains of Kasai
- lower terraces and Holocene alluvium

a. Busira layers of the Central Congo Basin

These are mostly Quaternary alluvial and lacustral-alluvial sediments, covered by Pleistocene ironstone pans, below loose soils. Alluvial materials received symbol F on the soil map of Congo (Sys, 1960).

6.2.6. Deposits of the coastal belt

The Precambrian Mayombe rocks descends with a few degrees towards the ocean.

They are covered by Cretaceous sediments, and overlain in the W by Tertiary deposits (top to bottom):

- Holocene alluvium
- Plio-Pleistocene deposits (cirques Series)
- Marine and continental Tertiary rocks
- Marine Cretaceous rocks
- Sublittoral sandstone

The early Cretaceous (Aptian) to Miocene rocks were intensively folded and faulted during the middle Tertiary uplift. After erosion and planation, the truncated folds were covered by a series of Pliocene beds, which were also uplifted. The Plio-Pleistocene Ocre clayey sands rest on a planation surface, cut across all older rocks.

a. Sublittoral sandstone (400-700 m)
Lower Cretaceous

The sublittoral sandstone, on top of the Mayombe rocks and below Cretaceous marine sediments occur in the Boma-Lukunga region. Some isolated deposits occur on the Mayombe.
These are continental deposits.

GS2 grey-purple, yellowish marly argilites, clayey sandstones, chert layers; on feldspathic sandstones and arkoses

GS1 red, pink conglomeratic arkoses, feldspathic sandstones, clayey sandstones.

b. Cretaceous marine rocks

The marine Cretaceous rocks have a total thickness of 335-395 m in the outcrop regions. The layers are slightly inclined towards the ocean, interrupted with some wide foldings.

b.1. Albian-Aptian

The oldest marine Cretaceous rocks are Albian and rest discordant on the sublittoral sandstone.

There are 3 complexes (top to bottom):

- Clayey deposits of the lower river (40 m)

    sometimes kaolinitic marls and clays, soft coarse sandstones

- Mavuma (Tshimpanga) deposits (40 m)

    - yellow, grey, compact dolomitic limestones, with sandstone lenses
    - sandy limestones, sandstones with clay layers
    - grey or yellow clays or sandy marls

- Makungu-Lengi deposits (40 m)

    - yellow, grey, marls and clays
    - stratified coarse and medium sandstones, with sandy and conglomeratic intercalations
    - slightly sandy and micaceous, blue and yellow clays and marls
    - basal conglomerate with coarse (1m) gravels

b.2. Cenomanian-Turonian

Succession, 50-60 m (top to bottom):

- yellowish, soft or silicified limestones
- fossiliferous limestones, calc-schists; weathering to clay with sand grains
- mica-limestones, with conglomerate levels
- fine limestones, sandy limestones, yellow coarse limestones

b.3. Senonian

There are extensive deposits, marked by numerous silex and quartz geodes.

The Vonzo deposits are composed of 40 m of yellow sandstones, sandstone and marl layers, calcareous sandstones, white limestones, conglomerates.

The other Senonian rocks have following succession (top to bottom):

S3 (Kimesu)

6 red sandy clay, with basal silex and siliceous breccia
5 fine limestone
4 fine conglomerate
3 fossiliferous limestone
2 conglomerate
1 very weathered fossilliferous limestone

S2 (Tombe, near Kanzi)

yellow or reddish limestones, sometimes with silex levels

S1 (Lundu and Kindesi), 17 m

7 brown sandy clay
6 soft fossiliferous limestones
5 gravelly rock
4 fine conglomerate
3 calcareous sandstones
2 gravels
1 disturbed zone

b.4. Maastrichtian

Succession, 50-70 m (top to bottom):

3 yellowish, soft, fossiliferous limestone and yellow calcareous sand layers
2 sandy clay, limestone layers, phosphates
1 conglomerate with coarse quartz, quartzite and gneiss gravels

c. Tertiary marine rocks

c.1. Lower Eocene

At Manzadi and Bololo there is a succession of limestones, siliceous rocks, white and brown clays, calcareous sandstones, gravel layers, brown sandy clays...

c.2. Middle Eocene

Only present in a reworked stage at Bololo (Lutetian)

c.3. Miocene

Reworked fossiliferous deposits are known from Bololo.
Grey, white or yellowish clays , with lenses of whitish or yellowish sands occur in several points.

d. Tertiary continental rocks

d.1. he Ocre clayey sands (Neogene)

A well developed erosion surface has been cut across all rocks, from the Precambrian crystalline rocks to, and including, the Palaeocene (Mid-Tertiary surface). A thick formation, mainly build of ocre clayey sands covers all the areas to the east of the Bola (Lusona), except the valley bottoms and the plateau surfaces where Cretaceous outcrops exist.

At the base of the sands occurs a sometimes cemented gravel layer, or an ironstone pan (< 10 m thick)

Typical succession at Kungu Mbambi:

3	5-10 m of white-grey sands
2	60-65 m of ocre clayey sands
1	2 m of ironstone pan iron-cemented gravel

Weathering below the ironstone pan is deep. The white sands could be a younger formation.

These deposits are older than the Cirques Series of Plio-Pleistocene age (next point).

d.2. Plio-Pleistocene

The Plio-Pleistocene deposits start with an important gravel layer, with abundant fossil wood. Along the coastal cliffs the gravels are overlain by reddish clay sands.

(1) The Cirques Series

Towards the interior, the Cirques Series may attain 60-80 m thickness. This series forms the Senze and Tshikay plateaux (120 m a.s.l.). Towards the ocean these plateaux end with an escarpment of about 60 m high, which is an fossil cliff, build of soft sandstones, clays and multi-coloured sands. Its origin is mainly eolian. At the Lusona, the Cirques Series overlies the Ocre clayey sands.

Succession at Kifuindi (Luibi river)

- 10 m brick red sands
- 7 m multi-coloured sands with gravels
- 2-3 m white sands
- 2-5 m conglomeratic coarse sands
- 2 m ironstone fine sandstone

The valley heads form real funnels or circular depressions (Cirques), giving the name to this formation.

Above this Series occur white-grey coarse sands.

(2) The coastal terraces

Two or three uplifted marine terraces exist along the coast.

- The coastal terrace of the Moanda lighthouse occurs at 20.8 m a.s.l. North of the Tonde it occurs at 19.1 m. Towards the interior, it rises to attain 40 m at the foot of the fossil cliffs of the Tshikay plateau.
- A more recent terrace is located at Vista. This terrace is covered by the high tide.
- North of Banana and in the Kinloa cirque exist remnants of marine terraces

6.2.7. Tertiary and Quaternary volcanic rocks

The formation of the East-African Rift Valley resulted in active volcanism. Two volcanic districts, of Tertiary and Quaternary age can be distinguished.

S of Lake Kivu essentially basalt lavas, with some trachytes, date from a Miocene cycle of activity.

During the Tertiary and Quaternary period, the impressive Virunga volcanoes, of the border zone with Rwanda and Uganda, spread large amounts of volcanic material out on the landscape (ABOS, 1983). The volcanic activity of the Virungas resulted in lava flows of benmoreite and trachyte and more rarely in pyroclasts (scories, lapilli’s, ashes and volcanic bombs).

Material derived from basic rocks received <u>symbol</u> <u>B</u> on the soil map of Congo (Sys, 1960). Only the extensive basalt flows in the Kivu were mapped. Materials which originated from volcanic ashes received <u>symbol</u> <u>Z</u>.

7. Soils

There is no up to date soil map of the DRC. Appropriate information on soils and soil properties is lacking and makes it difficult to assess the land use potential for specific areas.

The soil distribution in the country is mainly influenced by climate and topography.

- In the Congo Basin, soils are always moist. There is a leaf-litter layer on top of the soils. Decomposition of organic matter is purely biological, as there are no bush fires. There is a biological equilibrium and erosion is limited. Infiltrating rainwater provokes a continuous leaching of the soils.

- In the surrounding stepped plateau region, under open forest or savannah, the soils dry out temporarily, there is no leaf-litter layer. Mineralisation of the organic matter happens partially through bush fires. Erosion is prominent (Sys, 1961).

- Most of central and south Congo is covered by Kalahari or younger sands, with a low nutrient status and water retention. Sands cover large areas in the Central basin, the Kwango, Kasai and northern Katanga.

  - True Upper-Kalahari sands or Ocre Sand Series (Mio-Pliocene) occupy the high plateaux of southern Katanga: Kwango, Kamina, Biano, Kundelungu. Clay content is less than 10 % and sand is very fine (45 % of 100-250 micron).

  - Pleistocene sands cover large parts of the lower Kasai plateaux and the Central basin.

  - Some sands originated from in situ weathering of Karroo sandstones, these are also called eluvial sands.

- On the Tertiary pediplains, Ferralsols are strongly weathered, without mineral reserves. Clay is mainly kaolinite mixed with large quantities of free oxides, such as gibbsite.

- On more recent surfaces, soils did not reach yet the ultimate stage of chemical weathering and there is still a mineral reserve; clays are a mixture of kaolinite, illite and micaceous clays.

7.1. Broad soil regions (FAO, 1977)

7.1.1. Congo Basin (Rain forest soils)

a. Wet soil Congo Basin
(Congo-Ubangi confluent swamps)

Drainage conditions on the bottom of the Congo Basin are very poor; soils are:

- Dystric, Humic and Plinthic Gleysols,
- Histosols,
- patches of Xanthic Ferralsols,
- Dystric Fluvisols on recent alluvium.

b. Dry soil Congo Basin

Surrounding the above region.
The very sandy Tertiary and Pleistocene sediments of the Congo Basin give rise to:

- Xanthic Ferralsols,
- Arenosols.

7.1.2. Northern Congo plateaux

This is a typical area of:

- Orthic, Rhodic, Xanthic and Plinthic Ferralsols on old planation surfaces.

On dissected or rejuvenated pediplains occur:

- Nitisols,
- Acrisols,
- Ferralic Cambisols.

Low wet areas are characterized by:

- Dystric Gleysols.

7.1.3. South-eastern Congo plateaux (Kasai-Katanga)

Region with similar soils as above:

- Orthic and Rhodic Ferralsols,
- Dystric Nitosols.

7.1.4. Western Congo plateaux (Southern Bandundu)

Kalahari and younger sands constitute the substratum of this region, covered with:

- Ferralic Arenosols,
- Regosols,
- Podzols,
- Xanthic and Geric Ferralsols,
- Dystric Nitosols on incised valley slopes.

7.1.5. Lower Congo highlands

On non-dissected plateaux old Ferralsols dominate, but erosion in this strongly dissected region has given rise to less weathered slope deposit soils:

- Ferralic Cambisols,
- Haplic Nitosols.

Partly lithic or rudic phase.

7.1.6. Coastal belt

Cretaceous to recent marine and alluvial deposits gave rise to:

- Ferralic Arenosols,
- Xanthic Ferralsols,
- Dystric Gleysols,
- Dystric Fluvisols.

7.1.7. Eastern highlands

Recent volcanism has produced Mollic Andosols (e.g. region W of the Virunga).

The mountains of the eastern highlands are covered with:

- Humic and Haplic Nitosols,
- Leptosols,
- Eutric Cambisols.

7.1.8. Rift Valley floor

- Vertisols,
- Solonetz,
- Humic Gleysols,
- Eutric Fluvisols.

7.2. Ironstone crusts (petroferric phase)

Ironstone crusts are widespread on the old plateau surfaces throughout the Congo. Many fossil deposits form hard near-surface crusts, often capping terraces or plateaux, as between the Kasai and the Lualaba (W. Katanga).

7.3. The Ferralsols of the Congo (Sys, 1983)

- Ferralsols on pré-Karroo rocks have been subjected to different phases of pediplanation.

- Karroo rocks are shales and sandstones. Ferralsols on these rocks only occur on pediplain remnants, west of Lake Mai Ndombe and in the NE of the Congo Basin.

- On the accumulation surfaces with fluvio-lacustrine cover sands, Ferralsols occur in pre-weathered materials.

Table 6. Texture of the B horizon of Ferralsols in the DRC, according to different geological parent materials (modified from Sys, 1983)

geological substratum	terrain unit	particle size classes (micron)			
		0-2	2-20	20-50	50-2000
shales		54.0	3.0	6.5	36.5
sandstones		34.9	2.1	3.2	59.8
limestones	720	64.0	4.9	11.0	20.1
granites	500	55.4	3.0	1.8	39.8
amphibolites		86.2	2.1	1.2	10.5
Kalahari sands	830	20.1	2.0	14.7	43.2
Salonga deposits	420	21.5	0.9	4.0	74.6
Yangambi deposits	430	37.6	1.4	2.2	58.8
lower plateaux of the Central Congo Basin	410	40.7	2.0	2.3	55.0

7.4. Legend of the revised soil map of the DRC

Table 8 shows a tentative correlation between the INEAC Soil Classification System (1960) and the FAO revised soil classification (1990).

The soil mapping units of the revised soil map (to a scale 1/5000,000) are presented in table 9.

The soil mapping symbols in the data base of this report refer to the FAO revised soil classification (1990). Textural classes and slope classes are those of the FAO soil map of the world legend of 1974 (e.g. LXh - 2a: Haplic Lixisols, medium textured, slope class 0-8 %).

a. Textural classes

1 = coarse textured: sand, loamy sand and sandy loam with less than 18 % of clay and more than 65 % sand;

2 = medium textured: sandy loam, loam, sandy clay loam, silty loam, silt, silty clay loam and clay loam with less than 35 % clay and less than 65 % sand; the sand fraction may be as high as 82 % if a minimum of 18 % clay is present;

3 = fine textured: clay, silty clay, sandy clay, clay loam and silty clay loam with more than 35 % clay.

b. Slope classes

a = level to gently undulating: dominant slopes range between 0 and 8 %

b = rolling to hilly: dominant slopes range between 8 and 30 %

c = steeply dissected to mountainous: dominant slopes are > 30%

7.5. Soil correlation and classification

This chapter presents a soil correlation between the INEAC Soil Classification and the revised FAO system (table 8). Table 9 shows the composition of the soil mapping units.

Several FAO soil phases were distinguished (table 7). These were NOT drawn on the soil map, as it could be interpreted that ALL soils of a mapping unit are characterized by that phase.

In many cases, a particular soil phase (e.g. petroferric phase) only affects part of the soils of that unit.

Table 7. Soil phases (FAO).

phase	Description
inundic	an area is flooded during more than 10 days, during the growing period
petro-ferric	a continuous ironstone crust occurs at < 1 m from the surface
phreatic	a groundwater table occurs at depth of < 5 m
rudic	stones and gravels in the topsoil and at the surface restrict mechanized agriculture
salic	the soils have an electrical conductivity of > 4 dS/m at a depth of < 1 m
skeletic	a layer of > 25 cm thick, with > 40 % ironstone concretions, or fragmented ironstone crust, occurs at a depth of < 50 cm
sodic	the soils have an exchangeable sodium percentage (ESP) of > 6, in some horizon, within 1 m of the surface
lithic	hard rock occurs at a depth of < 50 cm

Table 8. Tentative soil correlation
INEAC system, French ORSTOM system, FAO (1990), modified from Landon, 1984 and Sys, 1961

Terms of the INEAC system:

- Hydromorphic: aquic moisture regime
- Humic: mountain soils with high organic matter content, lower temperatures (isothermic temperature regime)
- Hygro: soils of the tropical rainforest, never dry for > 2 months a year (udic and perudic moisture regime)
- Hygro-xero: humid savannah soils, dry for > 2 months a year (ustic and partly udic moisture regime), base saturation < 50 %.
- Xero: xerophytic savannah soils, with a long dry season (ustic moisture regime), e.g. the Rift Valley, base saturation > 50 %.

INEAC classification [symbols]	ORSTOM system	FAO (1990) Classification
Recent materials		
Raw mineral soils (no A horizon)		Regosols
Recent tropical soils (A-C horizons)	Sols peu évolués	Fluvisols, Gleysols, Leptosols
• non-hydromorphic [FU] - Lithosols - Regosols - Saline Regosols	• d’apport modal	- Leptosols - Regosols, Fluvisols - Solonchaks (excl. Mollic)
• hydromorphic [FU] - Regogley - Humic Regogley	• d’apport hydromorphique	- Gleysols, Gleyic Arenosols - Umbric Gleysols
Black tropical soils [N]	Vertisols	Vertisols, Chernozems, Phaeozems
• non-hydromorphic - Melanic Regosols - Rendzinas - Prairie soils		- Mollic Fluvisols, Vertisols Chernozems Phaeozems - Mollic Leptosols Calcic Chernozems - (Luvic) Chernozems

INEAC classification [symbols]	ORSTOM system	FAO (1990) Classification
• hydromorphic - Melanic Regogley - Saline Melanic Regogley - Black trop.clays		- Mollic Gleysols - Mollic Solonchaks - Vertisols
Recent textural soils		
• Non-hydromorphic - Normal - Solonetz	à alcali et lessivés	- Luvisols and Alisols (except Gleyic) - Solonetz
• Hydromorphic		Gleyic Alisols and Luvisols
Brown tropical soils (Bw horizon, 2:1 clays) [B]	Sols bruns eutrophes tropicaux	
• Non-hydromorphic		Cambisols Alisols
• Hydromorphic		Gleysols Gleyic Alisols and Luvisols
Brown soils with allophane on volcanic ash [ZA]		Andosols
Podzols	Podzols	Podzols
• Non-hydromorphic		Podzols (except Gleyic)
• Hydromorphic		Gleyic Podzols
Kaolisols (*) (soils on 1:1 clays)	Sols ferralitiques et ferrugineux	Ferralsols Acrisols Lixisols
1. Ferrisols	Sols ferrugineux	Lixisols Acrisols Regosols
Hydro-ferrisols [8]	Sols hydromorphes minéraux gley de surface	Gleyic Acrisols (and Lixisols)
Hygro-ferrisols (V < 50 %)	Sols faiblement ferrallitiques et ferrallitiques typiques	Nitisols Acrisols Lixisols (no Humic)
Hygro-xeroferrisols (V < 50 %)	Sols ferrallitiques rouges et jaunes	Nitisols Acrisols Lixisols (no Humic)
Humic Ferrisols (highlands) [SH]	Sols ferrigineux humifères d'altitude	Humic Nitisols, or Acrisols Haplic Lixisols
Xero-ferrisols (Bt horizon, V >50 %) [E]	Sols ferrigineux lessivés	Nitisols Lixisols

INEAC classification [symbols]	ORSTOM system	FAO (1990) Classification
2. Ferralsols [F]	Sols ferrallitiques	Ferralsols
Hydro-Ferralsols		Humic (Plinthic) Ferralsols
Humic Ferralsols (highlands) [FH]	Sols ferrallitiques humifères d'altitude	Humic Ferralsols
Dark horizon Kaolisols		Humic Nitisols or Acrisols or Ferralsols
Hygro-ferralsols	sols ferrallitiques lessivés en argile	Ferralsols (no Humic)
Hygro-xeroferralsols	sols ferrallitiques lessivés modal en argile	Ferralsols (no Humic)
Arenoferrals (< 20 % clay to 1 m depth, V < 25 %) [Z]	Sols ferrallitiques lessivés podzoliques	Ferralic Arenosols
Hygro-arenoferrals		Ferralic Arenosols
Hygro-xero- and Xero-arenoferrals		Ferralic and Cambic Arenosols
Organic soils		Histosols

(*) Leached Kaolisols have an E horizon (former red and yellow podzolic soils) = Albic Acrisols and Lixisols

7.6. Notes on the soil map of Congo (Sys, 1960)

7.6.1. Soils on raw materials (Regosols)

These are raw mineral soils, without A horizon. Examples are recent soils on lava flows of North Kivu (terrain unit 1130). Soils on other types of rocks (Ruwenzori, terrain unit 1260) and on ferralitic ironstone pans are also included.

7.6.2. Recent tropical soils (Fluvisols, Leptosols)

These soils have an A+C soil profile, with or without a calcic gypsic or saline horizon. There is no mollic horizon. Parent material is slightly weathered with mainly 2:1 clays.

a. Recent tropical soils on alluvium [FU] (Gleysols, Fluvisols)

These soils occupy the Central Congo Basin, the Upemba depression (terrain unit 204), the Lake Mweru depression (terrain unit 205), the middle Lufira valley etc. Many are hydromorphic. Some are humiferous and poorly drained.

b. Slightly humiferous recent tropical soils [FU] (Fluvisols)

There is no calcic, gypsic or saline horizon. These are well drained alluvial soils.

7.6.3. Tropical black soils, [FN] (Vertisols)

Soils with an A-C. or A-B-C profile. Clays are of the swelling 2:1 type. Vertisols are typical for the semi-arid Rift Valley floor, e.g. in the Semliki valley and on the footslopes of the Ruwenzori (terrain unit 1220).

a. Non-hydromorphic tropical black soils

- **Melanic Regosols (Mollic Fluvisols)**

These soils occur mainly on recent alluvia. They have an A-C soil profile, a dark, mollic A-horizon and no slickensides. They have developed in sandy to sandy clay material of drier regions and are associated with Vertisols. Clays are of the 2:1 type.

- **Rendzinas on lime crusts (Rendzic Leptosols, Calcic Chernozems)**

These soils have an A-C soil profile and a dark mollic A horizon, with a crumb structure. There are no slickensides and clay minerals are mainly montmorillonite. Their is a clear transition the underlying petrocalcic horizon.

b. Hydromorphic tropical black soils

- **Melanic Rego-gleysoils (Mollic Gleysols)**

These are soils with an A-C profile and a dark, mollic A horizon. They cover permanent swamps of alluvial plains and have a clayey sand to sandy clay texture.

- **Tropical black clays (Calcic or Gypsic Vertisols)**

Soils with an A-C, or an A-B-C soil profile, a dark A horizon and slickensides, developed in expanding 2:1 clays. Usually free carbonates are present, sometimes associated to gypsum; some are saline, others have a gilgai micro-relief.

- **Solonetz**

Soils with an A-Bt-C soil profile and with 2:1 clays; pH is 6-7 in the topsoil, but may reach 9 in the calcareous subsoil. Salinity is high in the B and C horizons. These soils are common on the Rusizi plain, S of Lake Kivu (terrain unit 1220).

7.6.4. Tropical brown soils [B] (Cambisols, Andosols)

Soils with an A-Bw-C soil profile, mainly containing 2:1 clays, or allophane.

- **Brown soils on volcanic ash [ZA] (Mollic Andosols)**

These soils are extensive around Masisi, W of the volcanic Virunga chain (terrain unit 1140). The clay fraction is composed of allophane.

- **Brown forest soils on alluvium [FB] (Eutric Cambisols)**

These soils occur on the Semliki plain, on the Rift Valley Floor, under dense rain forest. They have an A-Bw-C profile, with 2:1 clays (terrain unit 1220).

7.6.5. Hygro- and Hygro-xeroferrisols [S]

(Ferralic and Dystric Cambisols, Acrisols)

Soils with an A-C or A-B-C soil profile, with a base saturation of < 50 % in the B and C horizons. The clay fraction is composed of kaolinite and free oxides; small quantities of gibbsite may be present. Either clay skins are present in the B-horizon, or the silt/clay ratio is > 0.20 on sedimentary rocks and alluvium, > 0.15 on eruptive and metamorphic rocks, or there are > 10 % weatherable minerals in the 50-250 micron sand fraction. Ferrisols are pedogenetic active soils.

a. Ferrisols on Karroo rocks [KS] (Haplic Nitisols)

These soils are common on the slopes of the Kwango and Kasai valleys, associated to Ferralic Arenosols of the plateaux (terrain unit 840). The middle valley sections of the Lomami and Maniema are also characterized by these soils. Locally they occur in the Sankuru valley and in the NE of the Congo Basin. Hygro-Ferrisols are very suitable for coffee and cocoa.

b. Ferrisols on non-defined rocks, [RS] (Haplic Nitisols)

These soils occur in Maniema and Kivu, below 1,500 m and in the Uele rainforest (Bambesa, Isiro), associated to Ferralsols.

Below 1,500 m on Precambrian and Palaeozoic rocks, they occur around rock outcrops and on recent river valley incisions. They are excellent agricultural lands (as above).

7.6.6. Humiferous Hygro- and Hygro-xeroferrisols [SH] (Humic Acrisols and Humic Nitisols)

These Ferrisols have a dark Umbric A horizon. The clay fraction is kaolinitic.

a. Humiferous Ferrisols on basic rocks [BSH]

These soils are found on the basaltic lava flows of Kivu, W and SW of Bukavu (terrain unit 1130). They are good agricultural soils, but erosion susceptible. The base saturation is very low. There is clay and iron leaching from the A to the B horizon.

b. Humiferous Ferrisols on non-defined rocks [RSH]

These soils occupy the main part of the High Kivu and the Ituri, above 1,400-1,500 m, associated to Humic Ferralsols, some with a sombric horizon. They developed on recent surfaces (terrain units 1210, 1230, 1240).

7.6.7. Hygro- and Hygro-xeroferralsols [F] (Orthic and Xanthic Ferralsols)

Clay fraction is mainly kaolinite, mixed with enough free oxides. Gibbsite is usually present. They correspond to the ultimate stage of weathering.

a. Ferralsols on Karroo rocks [KF]

These soils were mapped N of Banningville in the Mushie region. The soils occur on the late-Tertiary pediplain. The original material is strongly weathered and rests at variable depth on an ironstone concretions layer.

b. Ferralsols on non-defined rocks [RF]

These soils occupy large parts of the N, the NE, SE and the Lower Congo. They occur on a pediplain landscape. Generally the most reddish soils occur on the summits; colour becomes more yellowish downslope and bright yellow soils occur on the lower slopes (colour catena). More clayey soils occur on basic rocks, schists and shales. Less clayey soils occur on siliceous rocks, sandstone, granite and gneiss. An ironstone concretion layer is present (0.2-3 m of depth).

Old pediplain surface remnants are common in this region, covered by ferralitic ironstone pans.

The Ferralsols are often associated to Ferrisols. The latter occur around rock outcrops and on recent valley incisions.

- The Hygro-Ferralsols of the rain forest, have a weak to moderate agricultural potential. Deep sandy clay to clay soils are suitable for rubber, oil palm, coffee, but are not recommended for cocoa.

- The Hygro-xeroferralsols of the savannah have a very weak potential and degrade quickly under extensive agriculture.

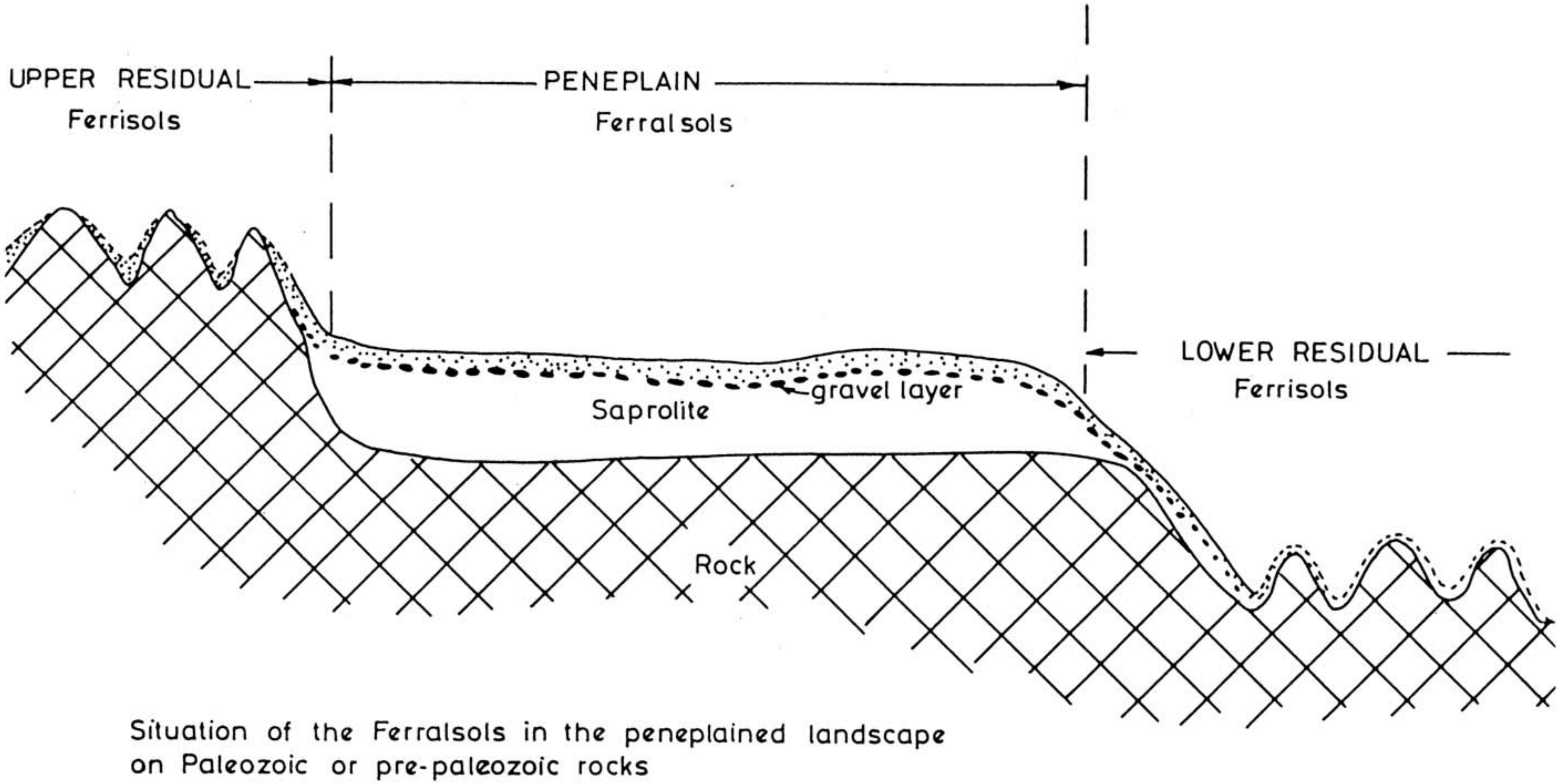


Fig. 9. Location of Ferralsols on non-dissected pediplain levels

Fig. 9. Location of Ferralsols on non-dissected pediplain levels of the DRC (Sys, 1983).

c. Ferralsols of the Yangambi plateaux [YF]
(Xanthic Ferralsols)

These soils under rain forest surround the Congo basin in the NE section (terrain unit 430). The region, at about 500 m a.s.l., consists of undulating plateaux, with an eolian-lacustrine cover of 40 to 50 m thick. Clay content of this deposit is 20-45 %.

Of these yellow Ferralsols, the more clayey soils occur on the plateau summits and texture becomes more sandy downslope in the valleys (textural catena). The more clayey soils are suitable for rubber and oil palm. Coffee can be grown on all parts of the catena. Cocoa is not recommended.

d. Ferralsols of the low plateaux of the Central Congo Basin [DF] (Xanthic Ferralsols)

The central part of the Congo basin has a subhorizontal relief (terrain unit 410). Between the extensive marshes (60-70 % of the total surface) occur W-E strips of dry land. Soils are yellowish and strongly weathered. Usually they have a sandy clay texture and are suitable for rubber, oil palm and coffee. Sandy areas have magnesium deficiencies.

7.6.8. Humiferous Ferralsols [FH]
(Humic Ferralsols)

These soils occur in the Ituri above 1,400-1,500 m (terrain unit 1240). In the Kivu they are rare, but in SE Congo, on the rhyolitic Marungu plateau they exist above 1,900 m (terrain unit 1120).

7.6.9. Hygro- and Hygro-xero-arenoferrals [Z] (Ferralic Arenosols)

The clay content is less than 20 % down to a depth of 1 m. There are almost no weatherable minerals. The clay fraction is kaolinitic, mixed with free oxides. Gibbsite may be present. Iron oxides are leached, down to 10 m. Base saturation is very low.

a. Arenoferrals of the Kalahari plateaux [HZ] (Ferralic or Cambic Arenosols)

These soils are very extensive in southern Congo, at the Kwango, Kasai, in the west of Katanga (terrain unit 830) and on the Kundelungu plateau (terrain unit 1040).

Soil profile development is virtually absent, though variations in texture with depth have been observed. In many areas soils have a very low content of organic matter (0.2-0.55 %) and nutrients. They are moderately acid.

b. Arenoferrals of the Salonga plateaux [SZ] (Xanthic Ferralsols)

At about 600 m a.s.l., the Salonga plateaux occupy an extensive region of the Kasai-Sankuru to the first south parallel, with an extension to the north to the Congo river (terrain unit 420). Most of the region is sandy, although soils are not Arenosols but Ferralsols.

c. Arenoferrals on non-defined rocks [RZ] (Ferralic Arenosols)

Important Arenoferrals areas occur in the Manono region, on the Kibaras (Mitwaba) plateaux (terrain unit 1020) and on the limits of the Kundelungu plateau (terrain unit 1030). They formed on siliceous rocks, e.g. the Upper-Kundelungu and Kibaras sandstones.

d. Arenoferrals intergrades to podzols on Kalahari plateaux [Hzp] (Ferralic Arenosols)

These soils have a bleached E horizon, developed in ferralitic material. They occur on the Kwango plateaux (950 m a.s.l.), under a steppe savannah vegetation and under forest (terrain unit 830). These are poor areas for agriculture.

e. Humiferous Arenoferrals intergrades to podzols on Kalahari plateaux [Hzp] (Cambic Arenosols)

The Biano plateau in Katanga (1,600 m, terrain unit 1020) is characterized by sandy soils on a ferruginous pan. Soils have a bleached E horizon, developed in ferralitic material, with a dark A horizon.

7.6.10. Kaolisols with a sombric horizon on non-defined rocks [RR] (Humic Ferralsols)

These soils have an A-B-C profile, a dark A horizon and often a Bw horizon. The latter covers a dark sombric horizon, sometimes with an increase of the organic carbon.

These soils are common in the high altitude savannahs of NE Congo (Ituri, terrain unit 1240) and more rarely in the Kivu. They have a low agricultural potential.

7.6.11. Xero-Ferrisols [E] (Lixisols, Nitosols)

These soils, with an A-B-C profile, have a clay fraction dominated by kaolinite and free oxides, but there are often some 2:1 clays as well. Base saturation is > 50 % in the B and C horizon. There is a weatherable mineral reserve. These soils occur on the Rift Valley floor (valleys of the Semliki, Rusizi and Rutshuru; terrain unit 1220).

7.6.12. Hydro-Kaolisols [8]

(Fluvisols, Gleysols)

These are hydromorphic soils with an A-C or A-B-C profile, developed in strongly weathered materials, with kaolinitic clays. These soils are extensive in High-Katanga in the ‘dambos’ or ‘dembos’.

More sandy soils exist between the Lualaba and the Lomami, W of Kindu. They characterize the large herb plains, called ‘esobe’, in the rain forest.

Table 9. Soil mapping units of the revised soil map of the DRC (FAO classification, 1990)

Associated soils cover > 20 %, inclusions < 20 % of the soil mapping unit.

region	soil mapping units	asso. soils	inclusions ; soil phases (partly)	corresponding terrain units
Congo estuary	FLe 1 - 2/3a	RG	salic, inundic, phreatic phases	201/1
Lower Congo alluvial plain	FLe 2 - 2/3a	-	inundic and phreatic phases	201/2
Coastal plain	GLe 1 – 1a	ARh	GLu, PT; inundic, salic and phreatic phases	100
Katanga depressions	GLe 2 - 2/3a	FLe	GLu, HS; inundic phase	204 205
Congo alluvial plain	GLd 1 - 2a	PT, FLd	HS; inundic and phreatic phases	202
Congo-Ubangi swamps	GLu 1 - 2a	FRx, HS	inundic phase	203
Lake Albert plains (Rift Valley)	GLu 2 - 2a	HS	FLe; inundic, phreatic, salic, sodic phase	1220
Lake Mweru depression	HS 1 – a	GL	FLe; inundic phase	205
Coastal plateau (E)	LXh 1 - 1a	-	ACh, CMe	300/2
Coastal plateau, main sector	ARo 1 - 1a	-	LXf, FRh, ACh	300/1
Kalahari and other cover sands	ARo 2 - 1a	ARa	GL, PZ; rudic phase	810/1, 810/5 830/1, 830/2
NW Kwango sandy plateau	ARo 3 - 1/2ab	FRh	RG, GL	810/2
SE Kwango sandy plateaux	ARo 4 - 1a	ARl	RGe, FRh, FRr	810/3
Katanga	ARo 5 - 1/2b	FRh	GL	1020 1030 530
Kundelungu plateau	ARo 6 - 1a	FRx	LXf, FRh, ACh; petroferric phase	1040

region	soil mapping units	asso. soils	inclusions ; soil phases (partly)	corresponding terrain units
W + central Katanga	ARb 1 - 1a	ARo	GL, PZ	830
Congo river slopes	RGd 1 - 1/2b	ARo, LPe	lithic, rudic phase	810/4
Katanga depressions	VRe 1 - 3a		Gle, FLe; inundic, phreatic phases	204
Rift Valley floor	VRe 2 - 3a	SCm	GL; phreatic, inundic, salic, sodic phase	1220
Mayombe, NW sector	NTh 1 – 2/3ab	FRh	ACp, FRp; lithic, rudic phases	600/1
Mayombe, NE sector	NTh 2 –3c	FRh	ACu lithic, rudic phases	600/3
Valley slopes (N)	NTh 3 - 2/3a	FRh, AR	-	840/1, 910
Kivu basalt plateaux	NTh 4 - 3bc	-	LP, GLe; rudic, lithic phase	1130
Lowa river	NTh 5 - 3b	-	GLe, PT	910, 990
Salonga plateaux	NTh 6 - 3a	-	-	420
Lindi plateaux	NTh 7 - 3b	FRh	GL; petroferric phase	930
Bunia (Lake Albert-Edward) highlands	NTh 8 – 3bc		rudic; lithic phase	1240
Schisto-Calcaire depression	NTh 9 - 2/3ab	FRh	ACp, FRp; rudic, lithic phase	710/2
NE Congo	NTh 10 - 2b	NTu, RGd	LPe; petroferric phase	970
Kindu	NTh 11 – 2/3a			420
Kivu	NTh 12 – 3b			990
Eastern highlands	NTu 1 - 2/3c	FRh	LPe; rudic phase	1210 1250 1120
Eastern highlands	NTu 2 - 2/3c	CMu	LPe; rudic, lithic phase	1210
Lake Edward	NTu 3 - 2/3c	FRh	CMd	1120
Mayombe, main sector	FRh 1 - 2/3ab	NTh, LXh	FRx, FRp; lithic, rudic phases	600/2
Schisto-Calcaire depression	FRh 2 - 2/3ab	NTh, FRx	FRr, FRp; rudic or lithic phase	710
Valley slopes (S)	FRh 3 - 2/3b	FRr	FRx, AR, LP	840/2, 1010
S Katanga plateaux, Lower Kasai	FRh 4 - 3ab	FRx	FRr, GL, NT	420, 1030

region	soil mapping units	asso. soils	inclusions ; soil phases (partly)	corresponding terrain units
S Katanga plateaux	FRh 5 - 2/3a	FRx	GL, LP, NT	1030, 1010
NE and NW Congo	FRh 6 - 3ab	GLd, FRr	petroferric phase	510, 930, 940, 950, 960, 970, 980, 1010,1110, 1120, 1240
"	FRh 7 - 3a	NTh	-	980 510
Schisto-Greseux Plateaux	FRh 8 - 3ab	FRx	FRr, GL, NT; petroferric, lithic, rudic phases	720
Salonga plateaux	FRx 1 - 1/2a	ARo	GLd, ARb	420, 420/2, 1010
Yangambi plateaux	FRx 2 - 2a	FRh	GL; petroferric, skeletic phase	430
Low plateaux of Congo Basin	FRx 3 - 2a	FRp, GL	FL; petroferric phase	410
Katanga Kalahari sands	FRx 4 – 1/2a	ARo	ARb	830/2, 830/3
Maniema plateaux	FRr 1 - 3ab	FRh	FRp, GL	910 920 990 1020 500
Marunga, Tanganyika	FRu 1 - 3b	NTu	GL; lithic, rudic phases	1120
Aru highlands	FRu 2 - 3bc	FRh, NTu	GLu; lithic, rudic phase	1230
Batéké plateau	FRg 1 - 1/2a	ARo	PZc, CMu, GL	820
Volcanic ash zone	ANm 1 - 2/3c	CMe, NT	GL	1140
Virunga chain	ANm 2 - 1/2c	CMu, RGe	LP; rudic, lithic phase	1150
Volcanic ash zone	LP-RGe-ANm-a	-	-	1140
Ruwenzori massif	LP-LPu-c	-	lithic, rudic phase	1260
North Virunga Mts	LP - c			1150
W Virunga lava plains	LP-RGe-ANm-a		rudic, lithic phase	1140
Lake Albert	CMe 1 - 2/3a	CMx	VRe	1220

~~ lakes, ocean
--- international border

PART II DATA BASE FOR THE DRC

1. Introduction

This chapter gives a description of each terrain unit and component. They were coded according to the SOTER programme (version 2.5).

As the SOTER programme does only allow one entry, even in complex regions, a more accurate description of the terrain units can be found in following chapter.

Information has been structured as follows:

number	Terrain unit code (SOTER)
(1) -	geological and geomorphological information (SOTER)
(2) -	soil units (FAO classification, 1990), textural classes and slope classes
(3) -	vegetation (FAO, 1977 and other sources)

1.1. SOTER terrain unit characterization

In the following descriptions, codings (see SOTER manual) are presented for:

Terrain unit (0000)

4 major landform
5 regional slope
6 hypsometry
7 general lithology

Terrain components (0000/0)

10 proportion of the SOTER unit (%)
11 dominant slope
12 local surface form
13 depth to bedrock
14 parent material
15 surface drainage
16 depth of groundwater
17 frequency of flooding

1.2. Main terrain regions

Terrain units have not been numbered at random, but according to the major land regions to which they belong.

0100	Coastal plain
0200	Alluvial plains and depressions
0300	Coastal plateau
0400	Low stepped plateaux of the Congo Basin
0500	Granitic massifs/plateaux
0600	Mayombe highlands
0700	Western Congo Group
0800	Sand-covered plateaux
0900	Medium altitude plateaux on Pre-Cretaceous rocks
1000	High plateaux of S Katanga
1100	Volcanic regions
1200	Rift Valley and eastern highlands

1.3. List of the terrain units of the DRC

100	Coastal plain
200	Alluvial plains
201	Lower Congo alluvial plain
202	Congo Basin alluvial plain
203	Ubangi-Congo Confluent swamps
204	Upemba depression and Katanga alluvial plains
205	Lake Mweru depression (east Katanga)
300	Coastal plateau
300/1	Main plateau sector
300/2	Eastern plateau sector
400	Stepped plateaux of the Congo Basin
410	Low plateaux of the Central Congo Basin
420	Salonga plateaux
420/2	Salonga plateaux, with outcrops of Cretaceous rocks
430	Yangambi plateaux
500	Granitic massifs/plateaux
510	Granite plateau of NE Congo
520	Dibaya granite massif (Kananga)
530	Katanga granite massifs
600	Mayombe highlands
600/1	NW sector
600/2	Main sector
600/3	NE sector
700	Western Congo Group
710	Schisto-Calcaire depression
710/2	Angola border area
720	Schisto-Greseux plateaux
800	Sand-covered plateaux
810/1	Kinshasa sandy plateau on Cretaceous rocks
810/2	NW Kwango sandy plateau on Cretaceous rocks
810/3	SE Kwango sandy plateau on Cretaceous rocks
810/4	Dissected Congo river slopes on Cretaceous rocks
810/5	Lower Kasai sandy plateau on Cretaceous rocks
820	Batéké sandy plateau on polymorphic sandstone
830	Kalahari plateau sands
830/1	Kwango
830/2	Kasai
830/3	Katanga

840	Dissected valleys in the sand-covered plateaux
840/1	Northern sections
840/2	Southern sections
900	Medium altitude plateaux (500-1,000 m) on Pre-Cretaceous rocks
910	Lueki-Lukuga plateaux (Kongolo, Kivu-Katanga)
920	Plateaux on Mbuji-Mayi (Bushimaie) rocks
930	Lindi plateaux (High Congo-N Equator)
940	Ubangi plateaux
950	Liki-Bembe plateaux (NW Equator)
960	Bomu-Uele plateau (N High Congo)
970	Garamba gneiss plateau (NE High Congo)
980	Kibali plateaux (High Congo)
990	Burundian-Rusizian plateaux (Kivu, E Katanga)
1000	High plateaux of Katanga (1,000-2,000 m)
1010	Ante-Kibarian or West Katanga plateaux
1020	Kibarian or Central Katanga high plateaux (Kibaras, Bia, Mulumbe Mts)
1030	Katangian or Southern Katanga plateaux (Lubumbashi)
1040	Kundelungu plateau (SE Katanga)
1100	Volcanic regions
1110	Gabbro-norite region of Kasai-Lomami
1120	Marunga rhyolite highlands
1130	Kivu basalt plateaux
1140	Volcanic ash region of N Kivu
1150	Virunga volcano chain
1200	Rift valley and eastern highlands
1210	Burundian-Rusizian Highlands (> 1,500 m)
1220	Rift Valley floor
1230	Aru highlands
1240	Bunia or Lake Albert and Edward highlands
1250	Muhila highlands (Lake Tanganyika)
1260	Ruwenzori Massif

2. Description of terrain units of the DRC

100 Coastal plain

- SOTER (4) SP, (5) WE, (6) 1, (7) UM
- The Congolese coast is short, extending from Point N’gelo on the Cabinda (Angola) border to the Banana spit. The coastal plain is low, swampy and thickly wooded, with sandy beaches and dunes.

  There are red, 10 m high, cliffs for 25 km at Moanda. This is an old coastal terrace (terrain unit 300). The remaining 11 km from Moanda southwards to Banana, consist of a sand spit, with swamps behind the beach, covered by mangrove.

- GLe 1 – 1a, partly inundic, salic phase
- Vegetation is dry savannah (4e): the sandy coastline, backed by low cliffs, is thinly covered by herbaceous plants, mainly grasses.

200 Alluvial plains

- FLe, FLu; Profile ZR004 (FLu)

201 Lower Congo alluvial plain

- SOTER (4) LV, (5) F, (6) 1, (7) UF
- The Congo river flows in a wide alluvial plain near the ocean. The estuarine part downstream is saline.
- Alluvial and estuarine sediments
- A great part of the first 50 km of the Congo estuary shores inland from Banana are overgrown with thick forest, with occasional swamps with papyrus. Mangrove grows on saline estuarine soils (FAO vegetation unit 3a).

201/1 Estuary plain

- SOTER (10) 50, (11) 0, (12) G, (13) 90, (14) UM
- Extensive mangrove forests are found on saline loamy soils, exposed directly to the tides along the coast.
- FLe 1 – 2/3a, partly inundic, salic phase; profile ZR033 (FLe)
- Tropical inundated coastal formations with mangroves (FAO vegetation unit 3a). In the estuary of the Congo river exists a network of creeks, lined by mangrove and other coastal forests, stretching from Banana as far as Mateba island, below Boma. The mangrove forests only occur below high-tide level. See chapter on vegetation for species. Grassland, with or without shrubs, often occupies the interior of the Congo estuary islands.

201/2 Lower Congo alluvial plain

- SOTER (10) 50, (11) 0, (12) D, (13) 90, (14) UF
- FLe 2 – 2/3a, partly inundic or phreatic phase
- As the water becomes less saline, mangroves are gradually replaced up-river and on higher grounds by a mixture of wild date palms (Phoenix reclinata), raphia palms (Raphia laurentii and R. Sese), screw-pines (Pandanus) and other trees. Many of these plants also have stilt roots and this forest is very similar to that of the mangroves, although much more varied in appearance. Large woody climbers (lianas) occur in places.

202 Congo Basin alluvial plain

- SOTER (4) LP, (5) F, (6) 2, (7) UF

- The Congo Basin traces out a rough ellipse, the major axis which runs SW-NE. Across this low level flows the Congo River, from Stanley Falls to near Kinshasa. In this plain the Congo is joined by its tributaries: Aruwimi, Lomani, Kasai, Ubangi and Sanga. All rivers flow wide and slowly between banks. They are entrenched in thick beds of alluvium. There are many swamps (confluents of the Mongala, Lulonga and Ubangi rivers) and lakes.

  Mai Ndombe lake (Leopold II Lake) in N Bandundu lies in one of the lowest parts of the plain. Around it are extensive marshes and to its margins extends waterlogged forest.

  The alluvial plain deposits have a gravely base, passing gradually into sandy to coarse sandy layers. Clayey layers are rare. There are lower and upper terraces. Textures are different from the alluvial plain.

- GLu 2 – 2a; profile ZR034 (GLe)

- Regularly flooded tropical forest (FAO vegetation unit 1b). In the lower parts of the valleys, there are widespread floods during the period of heaviest rainfall. The riverain of flooded forest follows the lower courses of most of the rivers, forming a strip of varying width depending on the nature of the banks and the width of the whole valley. Some flooded areas are extensive. After the water subsides the soil dries and is relatively firm (for species, see chapter on vegetation).

203 **Ubangi-Congo Confluent swamps** (Mbandaka, Equator)

- SOTER (4) LP, (5) W, (6) 2, (7) UF
- GLu 1 - 2a
- Tropical swamp forest (FAO vegetation unit 1c): between the lower courses of the Ubangi and Congo and in the region around Mbandaka and at lake Mai Ndombe. Despite an asphyxiating soil, the immense swampy area carries a tree cover in which the tree roots have prop or stilt roots. The main tree canopy is dense, but there are also well-developed lower layers and matted undergrowth. Large lianas are abundant. Many of the trees are the same as in the temporary flooded forest (see chapter on vegetation for species).

  The Mbandaka region is rich in small grassy clearings, called ‘esobe’, which occur in the forest, near the rivers and are developed on sandbanks, the soil of which is not yet suitable to bear forest.

204 **Upemba depression and other alluvial plains of Central Katanga**

- SOTER (4) LD, (5) IM, (6) 2, (7) UF
- The extensive, 40-50 km wide, SSW-NNE-oriented depression in which flows the Lualaba (downstream of Bukama), is located between uplifted plateau blocks. The flat bottom, at 550 m a.s.l., is bordered in the W by the Hakansson Mountains, a strongly dissected plateau (1,000-1,100 m). The western border follows the Lomami plateau (1,100 m). To the E occur the Bia and Biano (1,650 m a.s.l.), followed in the N by the Kibara Mountains (1,750 m). The eastern fault escarpment is very steep, with thermal springs.
- GLe 2 – 2/3a, VRe 1 – 3a; partly inundic or phreatic phase
- Periodically or permanently inundated reed swamps are common. Vegetation varies with water depth, peat content and flooding period (for species see chapter on vegetation).

205 Lake Mweru – Luapala depression

- SOTER (4) LD, (5) WE, (6) 3, (7) UF

- This is also a tectonic depression. The red sandy cliffs of Kasenga are a 20 m terrace of the Luapala river. The entire valley, in between Johnston falls and the lake, has been incised in old alluvia, which cover a large surface. Fault lines are bordering the depression on both sides, N of the 10°S parallel.

- GLe 2 – 2/3a, HS 1 – a; partly inundic or phreatic phase

300 Coastal plateau

- SOTER (4) LL, (5) R, (6) 1, (7) UE

- From the coastal plain, the land rises abruptly to the coastal plateau, at < 200 m a.s.l. and 60-80 km wide. In the central parts, red cliffs, of about 10 m high, reach the coast (coastal terrace of Moanda lighthouse). The plateau is covered by sands of the Cirques Series and extends to the broken country of the Mayombe chain in the east. The coastal plateau is a pediplain remnant (Miocene or Pliocene). The plateau extends over Meso-Cenozoic sedimentary rocks (marl, limestone, sandstone...) and part of the Precambrian soccle (frequently gneiss). The plateau is slightly undulating at an altitude of 100-120 m. Deep valleys with flat bottoms cut steeply (slopes > 50 %) in the plateau. Those slopes are characterized by theatre-like erosion forms, called cirques (Cirques series). Many circular closed depressions are probably the result of subsoil dissolution. On the edge of the plateaux, towards the coast, a layer of coarse white-grey sands occasionally covers the Cirques sand series.

  Following succession exists (top to bottom)

  - Plio-Pleistocene sandy deposits of the Cirques Series
  - Marine early Tertiary and continental Tertiary Ocre clayey sands
  - Marine Cretaceous rocks
  - Sub-littoral sandstone

- Vegetation is dry savannah (FAO vegetation unit 4e): a grassy plateau, with scattered stunted shrubs, intersected by shallow and more or less wooded depressions. Farther up the Congo river, vegetation becomes more luxuriant, forming a transition to the grasslands of the next region.

300/1 Main sector of the coastal plateau

- SOTER (10) 80, (11) 8, (12) L, (13) 50, (14) UE

- ARo 1 – 1a, profile ZR037 (ARl)

300/2 Eastern sector of the coastal plateau

- SOTER (10) 20, (11) 8, (12) L, (13) 50, (14) UE

- LXf 1 – 1a

400 Congo Basin plateaux

Following succession of cover deposits exists (younger to older):

1. recent alluvial plain deposits (202)
2. river terraces
3. low plateaux of the Central Congo Basin (410)
3. Salonga plateaux deposits (420)
   3.a. clayey sands
   3.b. iron-cemented plateau gravels
4. Yangambi plateaux Series, Lodja and Opala deposits (sand and basal gravels, 430)
5. Kwango or Lualaba Series (Mesozoicum)

410 Low plateaux of the Central Congo Basin

- SOTER (4) LL, (5) G, (6) 2, (7) UL

- The central part of the Congo basin has a subhorizontal relief and is covered by alluvial deposits. Between the extensive marshes (60-70 % of the total surface) occur W-E strips of dry land. A pediplain is located 10 m above the erosion basis of the large rivers. It is covered by 2-10 m of loose sediments.

  The Basin floor has an average altitude of 400 m and rises to the surrounding stepped plateaux.

- FRx 2 – 2a, partly petroferric phase; profile ZR015 (FRh).

  Soils are yellow Ferralsols. Usually they have a sandy clay texture and are suitable for rubber, oil palm and coffee. Sandy areas have magnesium deficiencies.

- Tropical lowland rain forest (FAO vegetation unit 1a). This is a zone of lower dry ground with typical rain forest. The forest is only developed in regions with an annual rainfall > 1,500 mm and fairly evenly distributed throughout the year. In the N and S a short relative dry period of one or two months may occur in some forest areas.

In general the forest is evergreen, but some deciduous trees occur and these increase near the outskirts where the climate approaches that of the surrounding savannahs. The tropical forest is never leafless. It consists of several strata, including an upper strata of large trees, which may be 40-60 m high. It is very heterogeneous (see chapter on vegetation for species).

Where ironstone pans occur near the surface, the forest is replaced by short grassy turf, with shrubs growing in small pockets in the pan.

The rain-forest has in many places been degraded to secondary forest (see chapter on vegetation for species).

420 Salonga deposits plateaux

- SOTER (4) LL, (5)G, (6) 3, (7) UL

- The Salonga deposits occur on two plateau steps. At about 600 m a.s.l., they occupy an extensive region of the Kasai-Sankuru to the first south parallel, with an extension to the north to the Congo river. Most of the region is very sandy.

  It is a clayey sand deposit, which may exceed 100 m of thickness, overlying a gravel layer of usually less than 25 m thick. The sands are dark yellowish brown, becoming reddish in the south. These sediments are of lacustrine origin. The basal gravel layer consists of coarse sands and mainly quartz pebbles in the mass of the same sands as above, but sometimes ferruginous cemented. Some sandstone and argilite gravels are included. All gravels were transported from other regions. The sands cover the Late-Tertiary planation surface.

  20-30 m high escarpments occur at lake Mai Ndombe and Tumba. Yellow sandy clay to sands overlie an ironstone pan on top of clays (equivalent of the Salonga deposits?).

- FRx 1 – 1/2a, profile ZR003 (FRx)

- Vegetation is tropical lowland rain forest (FAO vegetation unit 1a). The southern parts are covered by tropical semi-deciduous rain forest (2a). See chapter on vegetation for more details.

420/1 Salonga deposits without rock outcrops

- SOTER (10) 70, (11) 3, (12) D (13) 90, (14) UL

420/2 Salonga deposits with locally Cretaceous rock outcrops.

- SOTER (10) 30, (11) 5, (12) D, (13) 10, (14) UL

430 Yangambi deposits plateaux

- SOTER (4) LL, (5) U, (6) 2, (7) UL
- The Yangambi Series occur as undulating plateaux, surrounding the Congo basin in the N and NE sections, at about 500 m a.s.l. The deposits are 40 to 50 m thick and rest on an older Late-Tertiary step. The Yangambi deposits are yellowish brown sandy layers, oblique stratified towards the west. Basal rolled gravels occur, sometimes forming an iron-cemented quartz conglomerate (> 35 m). Stratification indicates mainly an eolian origin, strongly reworked by water. A layer of a few metres of ironstone concretions rests on the Yangambi Series, 40-50 m above the Congo river.
- FRx 2 – 2a, partly skeletic or petroferric phase,
  profiles ZR002 (FRx) and ZR014 (FRh)

  Clay content is 20-45 %. The more clayey soils occur on the plateau summits and texture becomes more sandy downslope in the valleys (textural catena).
- Tropical lowland rain forest (FAO vegetation unit 1a). Extensive rain forest with limbali (Macrolobium dewevrei) grows on the outer parts of the main rain forest, particularly towards the N and E in the valleys of the rivers Mongala, Itimbiri, Aruwimi, lower Ituri and around Kisangani (Higher Congo). It prefers light, deep, sandy soils.

500 Granitic massifs/plateaux

510 Granitic plateau of NE Congo

- SOTER (4) LL, (5) U, (6) 3, (7) IA1
- These are stepped plateaux. The hills of the Nile-Congo and Uele-Ituri watersheds rise 90 to 210 m above the plateau surface and are bush covered.
- FRh 6 – 3ab, FRh 7 – 3a, partly petroferric phase; profile ZR031 (FRh)
- Vegetation is tropical lowland rain forest (FAO vegetation unit 1a).

520 Dibaya granite massif (Kananga)

- SOTER (4) CV, (5) R, (6) 2, (7) IA1
- Exposed on incised valley slopes in areas covered by Salonga plateaux deposits (Kananga, West Kasai)
- FRh 6 - 3ab
- Vegetation is tropical semi-deciduous rain forest (FAO vegetation unit 2a).

530 Katanga granite plateaux

- SOTER (4) LL, (5) U, (6) 3, (7) IA1
- FRr 1 – 3ab

600 Mayombe highlands

- SOTER (4) SU, (5) RI, (6) 8, (7) MA1

- The Mayombe or Crystal Mountains are a succession of sharp ridges with elevations of 500-800 m a.s.l. Folded layers have a general S-SE to N-NW orientation. The highlands have been deeply dissected by the Congo and its tributaries. The general direction is SSE-NNW, parallel to the coast. Mount Uia reaches 1030 m a.s.l.

  Rocks belong to the “Crystal Mountains Group” (equivalent of the Kibara Group) of the Upper Precambrium, represented by the Zadinian and Mayombe System. Rocks are schists, quartzites, greenstones and intrusives such as granite and diorite (see chapter on geology for more details).

- The Mayombe forest agrees in general with the dry ground rain forest of the central Congo basin. In specific composition it is closely related to the neighbouring forests of the Congo Republic, many species common in the Mayombe being comparatively rare in the rest of the Congo (see chapter on vegetation for species). Ferns over 3 m high are a striking feature.

  Only a quarter of the forest area is thought to be primary. Generally, secondary forest is much denser, with numerous small trees and considerable undergrowth, especially of tall herbs and shrubs.

600/1 NW sector

- SOTER (10) 20, (11) 15, (12) R, (13) 2, (14) MA1

- NTh 1 – 2/3ab; partly rudic or lithic phase;
  profile ZR030 (NTh)

600/2 Main sector

- SOTER (10) 65, (11) 15, (12) R, (13) 2, (14) MA1

- FRh 1 2/3ab; partly rudic or lithic phase;
  profile ZR026 (FRh)

600/3 NE sector

- SOTER (10) 15, (11) 30, (12) R, (13) 2, (14) MA1
- This area is composed of steep dissected successions of Mayombe and Sansikwa System rocks. The latter is composed of quartzites, chert, psammites, schists, shales with a basal conglomerate (see chapter on geology for more details).
- NTh 2 – 3c; partly rudic or lithic phase

700 Western Congo Group

- The Western Congo Group is the equivalent of the Katanga Group of the Upper Precambrian-Devonian. It is divided into (bottom to top):

    - *Lower tillite of Lower Congo*: tillite, schist, quartzite, doloritic lavas;

    - *Higher Shiloange System*: breccia, limestones, calc-schists, clayey limestones, schists, quartzites, basal conglomerate;

    - *Upper tillite of Lower Congo*

    - Schisto-Calcaire System (important area, see below)

    - Schisto-Greseux System (important area, see below)
      - M'Pioka Series
      - Inkisi Series

- Tropical semi-deciduous rainforests occur in the Lower Congo (FAO vegetation unit 2a). Rainforest species are intermixed with deciduous species. Semi-deciduous rain forests grow especially along rivers and in groves on hills and plateaux. It seems that the presence of savannah is due to degradation or to various ecological conditions. These are tall grass savannahs, frequently burned off by farmers and hunters.

  On rather poor dry sandy, stony, or gravely soils, mostly on the plateaux between the watercourses in the Lower-Congo, occur short-grass savannahs or steppes. The grass cover is never continuous. Visibility is good over long distances. The short-grass savannah may be almost entirely devoid of trees over large areas, but also frequently more or less wooded with small trees and shrubs of which Hymenocardia acida is the most common. Short grass savannahs frequently occur on ironstone pan soils with rooting problems for larger grasses (see chapter on vegetation for species).

710 Schisto-Calcaire Depression

- SOTER (4) CD, (5) IN, (6) 2, (7) SO1

- The Schisto-Calcaire System is built of Upper Precambrian-Cambrian dolomitic limestones, dolomites, limestones, cherts, schists, calc-schists, breccia, conglomerates, clayey dolomites, chert, calcareous psammites and calcareous sandstones (see chapter on geology for more details).

  The region corresponds coincides in broad lines to a savannah zone on Schisto-Calcaire rocks. It is a large syncline. An old pediplain extends to the foot of the Cataracts Plateau (terrain unit 720).

  A series parallel hill chains (600 m a.s.l.) indicate the tectonic trend. Some hills have preserved a top layer of the Schisto-Greseux System (unit 720). They look like rounded and finger-like inselbergs, with calcareous outcrops in concentric layers around them. Slopes of all hills are steep, summits are flattened, sometimes forming plateaux. Karst phenomena on limestone resulted in small basins (dolines) filled up by clays.

  From Manyanga to Isangila the Congo river crosses the Schisto-Calcaire zone. The river is calm and wide. Some rapids occur on vertical schist layers.

- Vegetation is tropical semi-deciduous rain forest (see chapter on vegetation).

710/1 Main sector

- SOTER (10) 95, (11) 8, (12) M, (13) 2, (14) SO1

- FRh 2 – 2/3ab; partly rudic or lithic phase
  profile ZR019 (FRx)

710/2 Angola border region

- SOTER (10) 5, (11) 15, (12) M, (13) 2, (14) SO1

- NTh – 2/3ab; partly rudic or lithic phase

720 Schisto-Greseux plateaux (Cataracts plateaux)

- SOTER (4) LL, (5) R, (6) 3, (7) SC2

- The Schisto-Greseux System, of Cambrian-Devonian age, is composed of two major and a minor series. From top to bottom:

  - The Inkisi Series is an important quartzito-arkosic series, with schists, quartzites, arkoses, and a basal conglomerate.

  - The M’Pioka Series covers extensive surfaces on the Cataracts plateau. It is composed of quartzites, schists, breccia, calcareous sandstones and conglomerate.

  - The (minor) M’Fidi Series occurs only in valley bottoms and is composed of quartzites, conglomerates, schists and sandstones.

  The Cataracts plateau divides the Congo and Niari valleys. Its average altitude is about 500 m, reaching almost 800 m in the west near Boko-Songho. The undulating plateau extends towards the Republic of the Congo.

  The plateau surface is an old erosion surface, somewhat remodelled during later cycles. Rivers on the plateau surface flow slowly and meander in sometimes swampy valleys. They descend in falls or rapids to the Congo or Niari rivers. In its western parts, the Plateau has been cut into massifs or blocks, isolated by valleys with outcrops of the older Schisto-Calcaire rocks (terrain unit 710).

  From Stanley Pool (277 m) to Mayanga (192 m) the Congo river flows in a canyon, with hanging valleys of the tributaries. The river flows max. 480 m below the Cataracts plateau surface (Kendelo). Further away from the river the plateau is less dissected.

- The Plateau is characterized by a sub-horizontal ironstone pan, at shallow depth. Outcrops of the pan occur on valley slopes and on the plateau rim. The same pan can be traced on the foothills of the Mayombe.

- FRh 1 – 3ab, partly petroferric, lithic or rudic phase;
  profile ZR020 (FRh)

- Vegetation is tropical semi-deciduous rain forest (see chapter on vegetation 2a).

800 Sand-covered plateaux

- SOTER (4) LL, (5) U, (6) 3, (7) UE

- This region is part of the stepped and dissected plateaux, which surround the Congo Basin. The plateaux are higher further away from the Congo Basin. It is an undulating region build by tilted, middle to late Tertiary planation levels. The plateaux are covered by sandsheets. Most rivers have cut deep valleys through the sandsheet into the underlying rocks.

  Above the rapids, river valleys are no longer broad and wide, as in the Congo basin, but narrow and deep, whilst streams are swifter and broken. But for this fact, the plateau relief differs little from that of the plain.

- As the plain becomes a stepped plateau, the true rainforest ceases. Gallery forests continue to edge the rivers and savannah begins to cover larger and larger areas. Termite mounts become common.

810/1 Kinshasa sandy plateau on Cretaceous rocks

- SOTER (10) 15, (11) 5, (12) L, (13) 15, (14) UE

- The sandy plateaux covers Cretaceous rocks, mainly of the Kwango Series (see chapter on geology). Part of the sands have been eroded and only sandy hills remain.

- ARo 2 – 1a

- Vegetation is tropical semi-deciduous rain forest (FAO vegetation unit 2a). It also covers parts of Kasai, the Lower Congo and western Bandundu. Rain forest species are intermixed with deciduous species. Semi-deciduous rain forests grow especially along rivers and in groves on hills and plateaux. Climate differs little from that of rain forests and it seems that the presence of savannah is due to degradation or to various ecological conditions, especially the insufficient water-holding capacity of sandy soils. The grass steppes are frequently burned off by farmers and hunters (see chapter on vegetation for species).

810/2 NW Kwango sandy plateaux on Cretaceous rocks

- SOTER (10) 15, (11) 5, (12) L, (13) 20, (14) UE
- Part of the Cretaceous rocks belong to the Kwango Series (see chapter on geology), other rocks are not differentiated.
- ARo 3 – 1/2ab
- Vegetation is similar to that of terrain subunit 810/1.

810/3 SE Kwango sandy plateaux on Cretaceous rocks

- SOTER (10) 15, (11) 5, (12) L, (13) 15, (14) UE
- The Cretaceous rocks of this area are not differentiated.
- ARo 4 – 1ab
- Vegetation is large-leafed rain-green dry forest also called Myombo (FAO vegetation unit 2c). Trees in the upper storey belong to the Isoberlinia and Brachystegia genera, which retain their leaves during part of the dry season. The lower storey is composed of Uapaca, which lose only some of their broad leaves. Although the general appearance is that of parkland, there is a variation in tree density from almost open grassland to almost closed forest (see chapter on vegetation for species).

810/4 Congo river slopes on Cretaceous rocks

- SOTER (10) 15, (11) 20, (12) G, (13) 2, (14) SC2
- Along the Congo valley, the Batéké plateau rim is a zone of intense erosion and dissection. Hill tops and steep slopes are devoid of vegetation and ravines of tens of metres deep are common.
- RGd1 – 1/2b; partly lithic or rudic phase

810/5 Lower Kasai sandy plateau on Cretaceous rocks

- SOTER (10) 45, (11) 5, (12) L, (13) 20, (14) UE
- Plateaux are partly sand-covered; recent valley incision has cut into the clayey substratum below (see profile ZR016).
- ARo 2 – 1A;
  profile ZR016 (NTh)

820 Batéké sandy plateau on polymorphic sandstone

- SOTER (4) LL, (5) G, (6) 3, (7) UE
- The Batéké plateau is composed of the “Ocre sand series”, which overlie polymorphic sandstones (Eocene) or “Lower Kalahari”. The latter is topped by a very flat Mid-Tertiary pediplain.

  The Ocre sand series (Pliocene) or “Upper Kalahari” are yellowish-brown clayey sands, getting more reddish with depth (see chapter on geology for more details).

  The plateau, from 1,000 m (S) to 700 m a.s.l. (N), has a monotonous regular surface, flat over huge areas. Valleys have steep slopes in the sands and flow 75 m lower on flat bottoms on the polymorphic sandstone. Plateau soils are homogenous and deep Geric Ferralsols and Ferralic Arenosols.

  There are many hydromorphic closed depressions in the NW (blowouts or dissolution hollows).
- FRg 1 – 1/2a; profile ZR036 (FRg); profile ZR038 (PZc)

  Topographic position and drainage are important. On the sandy plateaux water infiltrates, but soils on slopes and depressions receive lateral drainage water. The plateau soils are Geric Ferralsols; the upper-mid slope soils are Humic Cambisols. Carbic Podzols occur on the lower slopes.
- Vegetation is moist savannah (FAO vegetation unit 4.c.). Although Isoberlinia woodlands are intermixed with clumps of Uapaca togoensis characterize this type, these species are often replaced on eroded slopes by Monotes kerstingii and in poorly drained clay depressions by Terminalia macroptera and laxiflora. Tall-grass savannahs, sometimes with Borassus palms, occur in wide valleys.

830 Kalahari sands plateaux

- SOTER (4) LL, (5) G, (6) 3, (7) UE
- These are sand-covered plateaux, dissected by the main rivers (valleys: see terrain unit 840). West of the Kasai river they overlie Cretaceous rocks (500-1,000 m), but in Katanga Precambrian rocks at higher altitudes (1,000-1,500 m).

830/1 Kwango basin

- SOTER (10) 50, (11) 3, (12) L, (13) 20, (14) UE
- The southern part of the Kwango basin (Angola) is occupied by a high plateau, with rivers in shallow valleys. The flat surface is covered by sands of variable thickness. In the DRC, only fragmented blocks remain of the high plateau and rivers flow in deep, incised, thickly wooded valleys, with falls and rapids. Tributaries have cut the plateau into separate blocks. The break between the very eroded lower slopes and the gentler upper slopes is a sinuous and irregular curve.

  Further north, the stepped late Tertiary pediplain becomes the main landscape unit, here and there dominated by residual parts of the high plateau. The former planation surfaces group, at a lower level than the fragmented high plateau, consists of a series of very flat surfaces, overlooking river terraces in the valleys. Terraces are found at 60 m, 36-46 m, 15-26 m, 10 m and at 6 m above the Kwango river.
- ARo 2 – 1a (W of Kasai)

830/2 Kasai basin

- SOTER (10) 50, (11) 3, (12) L, (13) 20, (14) UE

- In the Kasai river basin, there are late-Tertiary stepped pediplains, with residual hills of the higher plateau, extending to the foot of the high plateaux of Katanga in the E and the SE. On the planation surfaces, gravel layers are overlain by clayey sands. Much of the area between the upper Kasai and the upper Sankuru is boulder-covered. The gravels are overlain by red clayey sands. At a lower level there are four river terraces.

- ARo 2 – 1a, FRx 4 – 1/2a partly rudic phase;
  profile ZR012 (ARo)

- Vegetation is large-leafed rain-green dry forest, also called Myombo (FAO vegetation unit 2c). Trees in the upper storey belong to the Isoberlinia and Brachystegia genera, which retain their leaves during part of the dry season. The lower storey is composed of Uapaca, which lose only some of their broad leaves. Although the general appearance is that of parkland, there is a variation in tree density from almost open grassland to almost closed forest (see chapter on vegetation for species).

830/3 Sand covered plateaux of Katanga

- SOTER (10) 30, (11) 5, (12) L, (13) 5, (14) UE

- FRx4 – 1/2a, ARb 1 – 1a

840 Dissected valleys in sand-covered plateaux

- SOTER (4) CV, (5) R, (6) 3, (7) MA2

- Along the main rivers, e.g. the upper Kwango and upper Wamba, valleys have cut through the sand covered plateaux (terrain units 810, 830) into Cretaceous rocks and Precambrian amphibolites, gneisses and granites, with pegmatite dykes.

  Only fragmented crests remain of the high plateau and rivers flow in deep incised, thickly wooded valleys, with falls and rapids. Tributaries of the main rivers have cut the plateau into separate blocks and the break between the very eroded lower slopes and the gentler upper slopes is a sinuous and irregular curve.

- Vegetation is large-leafed rain-green dry forest also called Myombo (FAO vegetation unit 2c).

840/1 Northern valley sections

- SOTER (10) 70, (11) 5, (12) D, (13) 3, (14) MA2

- NTh 3 – 2/3a

840/2 Southern valley sections

- SOTER (10) 3, (11) 15, (12) D, (13) 3, (14) MA2

- FRh 3 – 2/3b

900 Medium altitude plateaux (500-1,000 m) on Pre-Cretaceous rocks

- This region includes stepped and dissected plateaux of medium altitude (500-1,000 m a.s.l.), which surround the Congo Basin. Nearly the whole region drains into the Congo Basin. The plateaux are higher and further away from the Congo Basin. It is an undulating region build by tilted, middle to late Tertiary planation levels.

  High up between the Kasai and Luebo rivers rocky mountains, some of them of jagged limestone, rise about 300 m above the surrounding plain.

- As the plain lifts over the first and the second step, the true rainforest ceases. Gallery forests continue to edge the rivers and savannah begins to cover larger and larger areas. Termite mounts become common.

910 Lueki-Lukuga plateaux (Kongolo, Maniema-Katanga)

- SOTER (4) LL, (5) U, (6) 3, (7) SC2

- These hilly plateaux developed on Trias to Carboniferous rocks (Karroo), along the Lualaba, near to Kongolo. The Lukuga Series forms the base of the Congo basin. It is an Upper Carboniferous tillite, or glacial conglomerate, overlain by coal. At Lukuga (N Katanga) following rocks occur: schists, limestones, coal, sandstones, psammites, conglomerates, greywacke, tillites and quartzites.

  The Triassic Lueki Series belongs to the Lualaba beds. These are lacustrine layers, with highly coloured cross-bedded sandstones. All rocks are slightly consolidated (sandstones and shales).

  The Lukuga river flows from lake Tanganyika to the Lualaba through a region of wide plateaux and undulating hill country.

- FRr 1 – 3ab; profile ZR018 (CMu)

  On the soil map of the Congo (Sys, 1960), soils derived from Karroo rocks are presented by symbol K. Usually the clay fraction contains some montmorillonite.

- Tropical semi-deciduous rain forest (FAO vegetation unit 2a), see chapter on vegetation.

920 Plateaux on Mbuji-Mayi (Bushimaie) rocks

- SOTER (4) LL, (5) R, (6) 3, (7) IA

- The Bushimaie System occupies a large area in NE Katanga (Haut-Lomami) and in the E of Kasai. Rocks are limestones, dolomitic limestones, clayey limestones, calcareous breccia, calc-schists, schists, conglomerates, arkoses, quartzites and cherts. There are dolerite intrusions.

- FRr 1 – 3ab

- Vegetation is Tropical semi-deciduous rain forest (2a), see chapter on vegetation.

930 Lindi or Lindian plateaux (Higher Congo and N Equator)

- SOTER (4) LL, (5) U, (6) 3, (7) SC2

- The northern edge of the Congo Basin is formed by plateaux build of Upper-Precambrian sandstones and shales. The Lindi Group is composed of (1) a “Sandstone System” (plateau red sandstone): sandstones, quartzites, schists, conglomerates and tillites and (2) a “Calcareous System”: limestones, dolomites, schists, psammites, sandstones, marls, arkoses and conglomerate (see chapter on geology for more details).

  The flat Late-Tertiary surfaces are characterized by a limonitic ironstone pan. The group culminates in a wide ridge, descending towards the Ubangi-Bomu in the N and to the Congo in the S. The ridge starts at Libenge towards the east and rises 600 m a.s.l. It remains at this altitude to reach 700 m at Ango and rises further east to 800 m a.s.l. This surface is the equivalent of the Late-Tertiary ‘Western Oubangui surface’ in the Central African Rep.

- FRh 6 – 3ab, NTh 7 – 3b, partly petroferric phase;
  profile ZR021 (FRh)

- Vegetation is tropical lowland rain forest (FAO vegetation unit 1a), see chapter on vegetation.

940 Ubangi plateaux

- SOTER (4) LL, (5) U, (6) 3, (7) SC2

- The Ubangi plateau is composed of two minor areas along the northern border of the country (Equator). Landscapes are similar to terrain unit 950.

  The Ubangi Group (Lindian) is built of (1) an Upper System (Quartzito-greseux), composed of quartzitic sandstones, sandstones, arkosic conglomerates, arkosic sandstones and quartzites; and (2) a Lower System (Schisto-Quartzito-Calcaire): oolithic limestones, limestones, schists, calc-schists, arkoses, arkosic sandstones, cherts and quartzites.

- FRh 6 – 3ab; partly petroferric phase

- Vegetation is tropical semi-deciduous rain forest (FAO vegetation unit 2a).

950 Liki-Bembe or Congo-Ubangi watershed plateaux (NW Equator)

- SOTER (4) LL, (5) U, (6) 3, (7) MB2

- A group of flat Late-Tertiary surfaces is covered by a limonitic ironstone pan. The group culminates in a wide ridge, descending towards the Ubangi-Bomu in the N and to the Congo in the S. The ridge starts at Libenge towards the east and rises 600 m a.s.l. This surface is the equivalent of the Late-Tertiary 'Western Oubangui surface' in the Central African Republic.

  The Liki-Bembe Group is composed of (1) an Upper System: schists, calcareous schists, limestones, quartzites and a basal conglomerate: and (2) a Lower System: shales, conglomerates, quartzitic sandstones and green schists.

- FRh 6 – 3ab; partly petroferric phase; profile ZR028 (FRr)

- Vegetation is tropical lowland rain forest in the south (1a) and tropical semi-deciduous rain forest in the N (2a).

960 **Bomu-Uele plateau** (N Congo)

- SOTER (4) LL, (5) U, (6) 3, (7) MA2

- The valleys of the lower Uele and its tributaries are generally broad and shallow and the fall is slight. A group of flat Late-Tertiary surfaces is covered by a limonitic ironstone pan. The group culminates in a wide ridge, descending towards the Ubangi-Bomu in the N and to the Congo in the S. This surface is the equivalent of the Late-Tertiary 'Western Oubangui surface' in the Central African Republic.

  Rocks belong to the Ganguan (Banzyville formation): (1) the meta-sedimentary and migmatic complex of the Ubangi, with mainly mica-quartzites and schists; and (2) the amphibolitic and gneissic complex of the Bomu: a crystalline series, with granites, schists, gneiss, intrusive rocks and lavas.

- FRh 6 – 3ab; partly petroferric phase

- Vegetation is tropical semi-deciduous rain forest (2a). Gallery forests clothe the banks of most of the rivers. The Uele is the northern limit of the tropical lowland rain forest (1a).

970 Garamba gneiss plateaux (NE Higher Congo)

- SOTER (4) LL, (5) IN, (6) 3, (7) MA2

- The gneissic complex of the Garamba (Western Nile Formation) is built of gneiss, mica-schists, mica-quartzites, crystalline limestones, migmatites, gneissic granites and pegmatites. The Nile-Congo watershed is an undulating plateau with an altitude varying from 1,260 m in the east, near Aru, to about 600 m in the west.

  Small mountains rise from the high plateau. The hills of the Nile-Congo and Uele-Ituri watersheds rise 90 to 210 m above the plateau surface and are bush covered. On the eastern part of the Nile-Congo watershed, small hills define the divide as far west as the point where the road from Faradje to Juba crosses the boundary. From here to the source of the Bomu river the watershed is a narrow strip of nearly flat bush-covered upland, sometimes as much as 3 km in width, but generally much less, and from 600 to 900 m above sea level. The streams rising on this flat upland might easily flow in either direction.

  A group of flat Late-Tertiary surfaces is covered by a limonitic ironstone pan. In NE Congo, older surfaces rise above it.

  The lower, Late Tertiary surface(s?) occur(s) between 800-1100 m, are descending to the west and the south west to an altitude of 400-500 m. This recent surface is covered by monadnocks of older surfaces.

  The land units at Garamba National Park have been described in the chapter on physiography

- NTh 3 – 2b, partly petroferric phase.

- Vegetation is tropical semi-deciduous rain forest (2a) in the S and large-leafed semi-deciduous tree savannah near the Sudanese border (4a). The latter type of savannah is fairly humid and stages range from woodland to grassy savannah. Tree cover density varies greatly with edaphic conditions and the nature and extend of human activity (see chapter on vegetation for species).

980 Kibali plateaux (Higher Congo)

- SOTER (4) LL, (5) R, (6) 3, (7) MB2

- The fragmented plateaux are built of rocks of the Kibali Group: schists, talc-schists, quartzites, conglomerates, calcareous rocks, dolomites, itabirites and schistified lavas. There are also granite intrusions.

- FRh 7 – 3a, FRh 6 – 3ab; profile ZR022 (FRh)

- Beira (Cynometra alexandri) rain forest occupies the basin of the upper Ituri and form a tongue of forest connecting with the Ugandese forests (Higher Congo).

990 Burundian-Rusizian plateaux at medium altitude
(< 1,000 m a.s.l., Maniema, Kivu, E Katanga)

- SOTER (4) SH, (5) R, (6) 3, (7) MA1

- The Lukuga flows from Lake Tanganyika to the Lualaba, through a region of wide plateaux and undulating hill country. Rocks belong to the Burundian and Rusizian.

  Those comprise strongly metamorphized gneisses, amphibolites, quartzites and micaschists, as well as granitic intrusions.

  (1)The Burundi Group (equivalent of the Kibara Group) is composed of schists, quartzites, arkoses, conglomerates and shales, with intrusions of granites, dolerites and pegmatites. (2) The Rusizi Group consists of shales and schists, quartzites, conglomerates, arkoses and gneiss. There are intrusions of gneissic granites, gneiss and amphibolites.

- FRr 1 – 3ab, NTh 5 – 3b, NTh 10 – 3b;
  profile ZR024 (NTh)

- Vegetation is tropical semi-deciduous rain forest (2a).

The eastern and southern parts of Katanga are an uplifted area (> 1,000 m) separated from the north by the faults of the Upemba Graben.

- An End-Cretaceous surface is found at 1,075-1,375 m, NW of the Upemba Graben; it occurs at 1,525-1,890 m SE of this fault. It is covered by polymorphic sandstones, often with a conglomeratic base. When the latter is absent, the surface may be silicified and sometimes covered by gravels and sands. This surface occurs below or above the mid-Tertiary surface.

- The Mid-Tertiary surface occurs at 1,100-1,250 m, NW of the fault and at 1,450-1,800 m SE of it. Cut across the polymorphic sandstone, it is marked by a thin gravel layer, sometimes lateritic. On the older rocks a ferralitic ironstone pan is present. This surface is often covered by Ocre sands, especially in the non-uplifted areas.

- Late Tertiary surfaces are typical for Katanga. The Lubumbashi plain occurs at 1,200-1,300 m. Two lower surfaces exist at 1,200 and 1,130 m.

- The Lufira plain, at 850-900 m is a Pleistocene surface.

The Miocene pediplain of Southern Katanga is exceedingly monotonous. Kalahari sands occupy the higher plateaux (Kwango, Kamina, Biano, Kundelungu).

In the N of Katanga, the extensive plateau (1,000 m) is replaced by deep depressions in between steep blocks of flat-topped mountains, reaching > 1,500 m a.s.l.. These blocks are bordered by escarpments or very steep slopes.

The various plateau blocks: <u>Mitumba, Kibara, Kundelungu</u> were once parts of a continuous plateau (pediplain), but are now divided by deep valleys, in which hot springs, marshes and marshy lakes appear.

The Upemba depression lies between the Kibara mountains in the E and the Hakansson mountains in the west.

The Lufira river flows in between the Mitumba and Kariba blocks.

The northern Mitumba mountains descend westward to the eastern Congo plateau (east of the Congo Basin) and are crossed by many Lualaba tributaries.

Gallery forests occur along the rivers in the valleys, open woodlands at the sources of streams, but the higher areas are generally covered by grass, or orchard bush.

1010 Ante-Kibarian or West Katanga plateaux
(Congo-Zambezi watershed plateau and Kamina region)

- SOTER (4) LL, (5) IN, (6) 3, (7) IA

- This shrub-covered or open plateau on migmatites and granites is generally situated at 1,000-1,350 m a.s.l.

  A great spur of mountains (including the Samba mountains), rises to 1,200 m a.s.l., and extends north from the watershed, separating the basin of the Lualaba from that of the Lulua and Sankuru (Kolwezi-Kamina). Near Kamina, this chain divides into two spurs and contains the sources of the Lomami. The two northern spurs on either side of the Lomami diminish to hills and soften into rolling forest-covered down.

  From Kolwezi to the Zambian border, only inselbergs indicate the position of the End-Cretaceous pediplain above the mid-Tertiary surface.

- FRh 6 – 3ab, FRx 1 – 1a

- Vegetation is Large-leave rain-green dry forest or Myombo (FAO vegetation unit 2c).

1020 Kibarian or Central Katanga high plateaux

(Kibaras, Biano, Mulumbe Mts)

- SOTER (4) LL, (5) R, (6) 4, (7) MA1

- A regular plateau at 1,050-1,100 m a.s.l. extends to the S, between Kamina and Nasondoye (interrupted by a more recent surface at 900 m at the Lubudi river). The plateau is covered by Ocre sands resting on the mid-Tertiary pediplain on a shallow layer of polymorphic sandstone, overlying the End-Cretaceous pediplain.

  The Kibaras, east of the Upemba Graben, have been strongly uplifted. The fragmented End-Cretaceous surface at Lumbele (Kibaras) occurs at 1,890 m; it is situated 100 m above the Mid-Tertiary pediplain (Mkana, 1,800 m). N of Mitwaba the Mid-Tertiary surface only survived as the Mulubwe inselberg (1,809 m). The large valley of the Kalumengongo, around the Kibaras conserves partial late-Tertiary planations surfaces at 1,620 m, 1,580 m, 1,490-1570 m, 1,465-1480 m a.s.l. (100-115 m above the river). Below there are 6 river terraces: at 60-65 m, 35-45 m, 21-23 m, 8.5-11 m, 1.8-3.8 m and -0.25 m above the river; the alluvial plain is found at 1,364 m.

  The Biano plateau block rises to 1,648 m (Mupanda). The mid-Tertiary surface is buried below a shallow layer of sands. Polymorphic sandstones overlie the End-Cretaceous pediplain. The Biano plateau descends with an escarpment (fault) to the Upemba depression

  The Upemba depression (550 m a.s.l.) is bordered in the W by the Hakansson Mountains, a strongly dissected plateau, culminating at 1,000-1,100 m. Erosion has completely removed the polymorphic sandstone and Ocre sand cover of the more dissected Hakansson tops. Here and there some higher points are silicified, an indication that they belonged to the End-Cretaceous surface.

  The western border follows the Lomami plateau, at 1,100 m. The latter has conserved its cover of polymorphic sandstone and Ocre sands.

  The rocks of the Kibara Group or Kibarian are one of the most important geological units of central Katanga. They form a SW-NE oriented strip of folded rocks. The Lubudi System is built of limestones and dolomitic limestones, schists, quartzites, sandstones and a basal conglomerate. The Nzilo System is composed of lavas, quartzites, shales, sandstones and conglomerates, with intrusions of dolerites and granites.

- FRr 1 – 3ab, ARo 5 – 1/2b

- Vegetation is Large-leave rain-green dry forest or Myombo (FAO vegetation unit 2c). The upland Katanga grasslands or steppe grows on the top of the high plateaux of the Mitumba, Kibara, Kundelungu and Marunga mountains

1030 **Katangian or South Katanga plateaux** (Lubumbashi)

- SOTER (4) LL, (5) R, (6) 4, (7) MA1

- Late Tertiary surfaces are typical in Katanga. The Lubumbashi plain occurs at 1,200-1,300 m. Two lower surfaces exist at 1,200 and 1,130 m. This extensive plateau of folded rocks is an extension of the Zambian tableland.

  At its western end, the Congo-Zambezi watershed is ill defined, but emerges more clearly, and higher, as it turns SE-wards to Sakania and the SE corner of the country. Upumpu peak, near this corner, is 1,800 m high. Surrounding hills average 1,500 m and the whole country (hills and valleys) is covered by open forest and bush.

  80 km N of the watershed an E-W section would show innumerable small valleys as minor tributaries find their way to the three great rivers: the Lualaba, the Lufira and the Luapula. The southern tableland extends 200 km N of the watershed.

  From Sakabinda to the Lufira the 1,450 m plateau (Mid-Tertiary) is continuous and it is dominated by monadnocks (Ditempa, 1,614 m). E of the Lufira river, mid-Tertiary surface remnants or inselbergs occur on an irregular 1,200-1,300 m surface of the Late Tertiary pediplain (Lubumbashi surface).

  From Lubumbashi to the Lufira, the Late Tertiary surface at 1,200-1,300 m is dominated by inselbergs of 1,400-1,425 m high of the mid-Tertiary surface. The Lufira plain is a younger surface at 850-900 m.

  The rocks of the Katanga Group cover important surfaces, especially in SW Katanga (copper ores). Folded and faulted in the S and SE of Katanga, these rocks are tabular in the N, NE and E. The Kundelungu System is the most extensive (mainly marine): sandy schists, sandstones, quartzites, limestones, conglomerate, tillite, dolomites

- FRr1 – 3ab, FRh 4 – 3ab, FRh 5 – 2/3a;
  profiles ZR027 (FRr) and ZR025 (FRh)

- It is open grass country, though studded with woods and interspersed by many ‘dambos’ or flat-bottom, grass-covered, often marshy valley floors, through which streams filter to the larger rivers. Vegetation is also called wooded savannah (Savane boisé or forêt claire) or Myombo.

It covers most of the plateaux of southern Katanga and also the flanks of the higher plateaux farther north. Usually it is an open low tree forest, which may be replaced by a scrubby bush in less favourable parts, especially on the valley slopes. Almost all the trees lose their leaves during the dry season and remain leafless for some time. Most trees are 6 to 15 m high, some reach 24 m. Large areas are covered with savannah woodland with sparser and smaller trees. This variant is called 'orchard bush' (see chapter on vegetation for species).

Scattered throughout the savannah woodland are open grassy areas, usually along the upper parts of streams, called dambos. The soil is waterlogged during the rainy season. Trees are therefore absent and replaced by grasses. These grow denser and taller than in the surrounding woodland. Sedges (Cyperaceae) are abundant and there is a rich flora of flowering herbs.

1040 Kundelungu plateau (SE Katanga)

- SOTER (4) LL, (5) R, (6) 4, (7) UE

- On this plateau only few parts still preserve the End-Cretaceous and Mid-Tertiary Pediplain. The eastern part of the plateau is covered by the Kalahari System: polymorphic sandstone, overlain by Ocre clayey sands, sloping to the east. The End-Cretaceous and Mid-Tertiary pediplains are only present in the east, respectively below and on top of the polymorphic sandstone. All the rest of the plateau belongs to the Late-Tertiary surface covered with clayey sand deposits. An ironstone pan is common.

  The plateau reaches 1,700 m in the Kiaka region. The more eastern Lukonzolwa plateau only reaches 1,500 m. In both places the same geological sequence occurs, with 200 m difference, due to faulting.

- ARo 6 – 1a, partly petroferric phase;
  profile ZR013 (FRx)

- Vegetation is Large-leave rain-green dry forest or Myombo (FAO vegetation unit 2c) and dry savannah (4e). The upland Katanga grasslands or steppe grows on the top of the high plateaux of the Mitumba, Kibara, Kundelungu and Marunga mountains.

1100 Volcanic regions

Most volcanic areas are located in the Rift Valley. Examples are (S to N):

- the basaltic zone of Bukavu, S of Lake Kivu,
- the extinct volcanoes of Kahusi and of Biega (S Kivu),
- the still active Virunga volcano chain,
- the Karibumba volcano (a small volcano, along the road from Butembo to Beni: an isolated ash and tuff cone on a granitic plateau.

1110 Gabbro-norite region of Kasai-Lomami

- SOTER (4) LL, (5) R, (6) 2, (7) IB1
- It is a hilly, dissected plateaux region at 500-1,000 m a.s.l.
- FRh 6 – 3ab
- Vegetation is tropical semi-deciduous rain forest (2a).

1120 Marunga rhyolite highlands

- SOTER (4) SU, (5) RI, (6) 4, (7) IA4
- These table highlands occur W of Lake Tanganyika at > 1,500 m a.s.l.
- FRu 1 – 3b; partly rudic or lithic phase
- Vegetation is Large-leave rain-green dry forest or Myombo (FAO vegetation unit 2c). Forest (riparian and ravine slopes, Marunga forest). True forest, occurs on the Marunga massif, W of Lake Tanganyika, at > 1,650 m and on moist soil. It grows on Mount Nzawa and consists of tall dense stands with more open canopy than in the lowland forest. The undergrowth is shrubby, including tree ferns, lianas and brambles (Rubus). Among the herbaceous vegetation are bracken and columbines (Aquilegia). Probably this area was much more extensive formerly. The upland Katanga grasslands or steppe grows on the top of the high plateaux of the Marunga.

1130 **Kivu basalt plateaux** (Bukavu)

- SOTER (4) LL, (5) R, (6) 4, (7) IB2
- Extensive basalt flows characterize this area. There are two zones. The northern one extends around Bukavu, the southern one around Kamituga.

  At Kamituga, lavas are mainly basalts, with some andesites. The lava flows occurred in a dissected region and only followed deeper valleys. There were several eruption stages and younger lava layers overlie older ones. Erosion periods, in between, are marked by gravel layers. Up to 6 gravel layers were successively covered by lava, reaching a total thickness of several hundreds of metres. Since the Tertiary deposition a relief inversion has occurred: the lava-filled old valleys are now hard basaltic hills, while the old divides between the old valleys are now recent valleys.

  Numerous lava flows occur around Bukavu. They reach a thickness of several hundreds of metres.

Rocks are basalts or doleritic basalts. Three trachyte zones are known: at Kalele, trachytes originate from the Ruonga crater.

The Kahusi massif (3,308 m) is located SW of Lake Kivu. It includes 10 main craters, volcano-types with siliceous ashes and Pelée-types (Kahusi). A basaltic phase is followed by a rhyolitic phase. The third phase, limited to the Kahushi consists of potassic rhyolites, quartz-porphyrites...

- NTh 4 – 3bc; profile ZR029 (NTu)

- The lava plains show all stages from almost bare surface to a well-developed forest of a dry type. Block type lava colonizes more readily than smooth lava. Mosses and other lower plants are the first to grow, followed by grasses, herbs, and small shrubs. Woody plants e.g. Rumex maderensis gradually appear and grow up to form, first scrub, and then a drought-enduring 'maquis'-type of forest with hard shining leaves. The scrub is most completely developed on block lava, whereas on smooth lava open savannah with clumps of dense scrub tends to be the rule (see chapter on vegetation for species).

1140 Volcanic ash region of N Kivu

- SOTER (4) LL, (5) S (6) 4, (7) IB

- Volcanic ashes from the Virunga chain have been deposited on the dissected western Precambrian plateaux.

- ANm 1 – 2/3c; profiles ZR009 (ANm) and ZR010 (ANm)

1150 Virunga volcano chain (Mufumbiro)

- SOTER (4) TM (5) T (6) 11, (7) II

- The Virunga chain is located in the Rift Valley Graben, north of Lake Kivu. The group of volcanoes aligns in a west-east direction, across the bottom of the tectonic depression, over a length of 80 km, from one to the other side of the Graben, perpendicular on its direction. The central group is located on the Congo border: the Karisimbi (4,507 m), the Visoke (3,711 m) and the Sabinio (3,634 m). These are Recent formations. Large lava plains cover the areas around them. The Nyiragongo and the Nyamlagira rise from those plains. Typical is the absence of basalts.

- ANm 2 – 1/2c; partly rudic or lithic phase

- Vegetation is mountain rain forest (2b) (see chapter on vegetation).

1200 Rift valley and eastern highlands

The Rift Valley and lakes were produced by post-Miocene fault movements.

1210 Burundian-Rusizian Highlands

- SOTER (4) TM, (5) T, (6) 10, (7) MA1
- The highlands east of the plateaux and bordering the western slopes of the Rift Valley locally attain more than 3,000 m a.s.l. The lakes are bordered by high mountain blocks, descending abruptly lake ward and sloping more gradually westward towards the Congo Basin.

  The western slopes of the eastern highlands gradually lose height towards the Lualaba. The upper courses of most rivers are generally in savannah country, the lower courses in gallery forest.

  The uplifted areas are composed of step-like block systems. Isolated minor horsts rise, either connected to the main escarpments (horsts of Vieux-Beni and Kalumendo), or isolated in the plains (horst of Kaparata). Horsts near the Graben are more uplifted than those further away.

  Middle Precambrian rocks comprise strongly metamorphized gneiss, amphibolites, quartzites and micaschists, as well as granitic intrusions. The Burundi Group (equivalent of the Kibara Group) is composed of schists, quartzites, arkoses, conglomerates and shales. There are intrusions of granites, dolerites, pegmatites. The Rusizi Group consists of shales and schists, quartzites, conglomerates, arkoses and gneiss. There are intrusions of gneissic granites, gneiss and amphibolites.
- NTu 1 – 2/3c, NTu 2 – 2/3c; partly rudic or lithic phase profiles ZR001 (CMu), ZR006 (ACu), ZR011 (NTu)
- Vegetation is mainly mountain forest (2b) (see chapter on vegetation)

1220 Rift Valley floor

- SOTER (4) CD, (5) U, (6) 3, (7) UL

- The Rift Valley Graben is a tectonic depression at < 1,300 m a.s.l. This section is now occupied by lake Tanganyika, lake Kivu, lake Edward and lake Albert.

  Lake Tanganyika lies at 765 m a.s.l. This part of the Rift valley is relatively narrow, 60 to 80 km wide. The lake is 650 km long and it is 1,400 m deep.

  N of this lake the Rift continues to keep the same general breadth as at the lake, until it is partially filled by lake Kivu, at 1,460 m a.s.l. The two lakes are joined by the Rusizi river. Except for a short canyon at the southern end of lake Kivu, the course of the Rusizi river is over a low marshy plain as far as Tanganyika. The Semliki river connects Lake Edward with Lake Albert.

- GLu 3 – 2a, CMe 1 – 2/3a, VRe 1 – 3a, VRe 2 – 3a; partly inundic, phreatic, sodic or salic phase
  profile ZR035 (VRe)

- Vegetation is mainly steppe (see chapter on vegetation).

1230 Aru highlands

- SOTER (4) SM, (5) S, (6) 3, (7) IA1

- The Nile-Congo watershed is an undulating granite and gneiss plateau with an altitude at 1,260 m in the east, near Aru. Near the border of Uganda, topography is more irregular than farther west. Small mountains rise from the high plateau, and the country is broken as the edge of the Rift Valley is approached.

  The Mid-Tertiary planation surface occurs between 1,200-1,400 m (1,500 m); it forms valleys in the preceding; isolated remnants of the 1,700-1,900 m surface (see terrain unit 1240) rise above it. The lower, Late Tertiary surface(s?) occur(s) between 800-1,100 m, descending to the west and the south west to an altitude of 400-500 m. This recent surface penetrates in the former one and itself it is covered by monadnocks of the former surface.

- FRu 2 – 3bc; partly rudic or lithic phase
  profile ZR023 (FRu)

- Vegetation is tropical semi-deciduous rain forest (2a).

1240 Bunia or Lake Albert-Edward highlands

- SOTER (4) TM, (5) RI, (6) 4, (7) MA2

- In the Lake Albert region, gneiss and granite monadnocks rise to 2,000-2,200 m a.s.l., above a regular surface at 1,700-1,900 m a.s.l. of the End-Cretaceous. It is covered by shallow, grey or yellow, sandy clay soils.

  The Mid-Tertiary planation surface occurs between 1,200-1,400 m a.s.l. (1,500 m). It forms valleys in the preceding; isolated remnants of the 1,700-1,900 m surface rise above it.

  The Rift valley escarpments in the Lake Albert-Semliki-Lake Edward region have slopes of less than 20° and have been strongly dissected.

- NTh 8 – 3bc, FRh 6 – 3ab; partly rudic or lithic phase;
  profiles ZR007 (FRx), ZR032 (NTu)

- Tropical mountain forest (see chapter on vegetation).

1250 **Muhila highlands** (Lake Tanganyika)

- SOTER (4) TM, (5) T, (6) 4, (7) MA1

- The western mountains about lake Tanganyika are often table-topped and contain some high ridges dotted with minor peaks. The Muhila Formation is composed of mica-schists, quartzites, cherts and itabirites.

- NTu 1 – 2/3b; partly rudic or lithic phase

1260 **Ruwenzori Massif**

- SOTER (4) TM, (5) T (6) 12, (7) MA2

- The Ruwenzori is the highest non-volcanic mountain of Africa (5,119 m). It is located in between two tectonic depressions: the Graben of Lake Albert-Semliki-Lake Edward and the Graben of Lake George. The mountain is an uplifted block. On top of the mountain exist remnants of pediplanations. It is an isolated block within the Rift Valley, near the eastern side.

  The Mount Stanley Group of the Ruwenzori Massif is related to the Western Nile Formation: gneiss, amphibolite, amphibole-schists, with gabbro, granite, dolerite intrusions.

- LP – LPu – c

- Vegetation is tropical mountain forest and alpine zone vegetation (see chapter on vegetation).

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APPENDIX I

SOIL PROFILE DESCRIPTIONS

Introduction

The following soil profile descriptions have been selected for - and entered in - the SOTER programme (version 2.5m). A database diskette has been sent, together with the report, to FAO, Land and Water Development Division.

The SOTER programme only considers part of the soil data. Therefore, the soil profile descriptions have been completely reproduced and translated in this volume of the report.

Soil surveys in the DRC mainly took place during the fifties/sixties and soils were classified according to the INEAC Soil Classification System.

During this study typical soil profiles have been given a tentative FAO soil classification (1990).

An attempt has been made to choose adequate master horizon symbols (A,B,C) and to give symbols to the subordinate properties (concretions, salts, cementations...).

Climatic regimes and symbols belong to the Köppen classification.

A new numbering was attributed to the soil profiles, starting with the country ISO code (ZR…). The former profile numbers are also mentioned.

IMPORTANT

Attention is drawn to the fact that part of the soil analyses at the INEAC were done with other methods than those required for the SOTER database. In this way:

- Exchangeable cations (Ca and K) were determined with the HCl N/20 test. Magnesium and sodium were not determined.
- The cation exchange capacity (CEC) was determined with the calcium method (using NH_4Cl).

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ZR035	1220	Eutric Vertisols	77
ZR036	820	Geric Ferralsols	79
ZR037	300	Luvic Arenosols	81
ZR038	820	Carbic Podzols	83
ZR039	710	Xanthic Ferralsols	85
ZR040	600/2	Haplic Lixisols	89

Profile ZR001

Classification:	Humic Cambisols, CMu (FAO, 1990)
Source:	INEAC (1960) and FAO (1977)
Location:	Eastern slope of the Luholo, Kivu
Coordinates:	02° 05’S; 28° 30’E -02.08°; 28.50°
Terrain unit:	1210, eastern highlands
Altitude:	1,170 m a.s.l.
Physiography:	Hilly landscape, midslope, SW exposure
Slope:	60 %
Drainage:	Well drained
Parent material:	granite
Climate:	2,200 mm annual precipitation, mean temperature of the coldest month 22°C; slight seasonal variations.
Vegetation:	Secondary forest.

Profile description

Ah1	0-13 cm	Very dark brownish grey (10 YR 3/2); clayey sand; moderate, medium crumb structure; loose; non-plastic, non sticky; many roots; diffuse boundary.
Ah2	13-28 cm	Dark greyish brown; clayey sand; micaceous and with fine gravels; weak medium to coarse crumb with blocky elements; friable, non-sticky, non-plastic; many roots; gradual smooth boundary.
Bw	28-60 cm	Brown (10 YR 5/3); gravelly clayey sand; micaceous, with humus infiltration; moderate, medium to coarse blocky structure, with fairly continuous greyish coatings; fairly firm in situ, non-plastic, non-sticky; common roots; diffuse boundary.
C	> 60 cm	Clayey micaceous fine gravels from granite weathering.

Analytical data of profile ZR001

horizon	depth (cm)	> 2 mm %	coarse sand	fine sand	silt 0.05 -	clay <	tex-ture

			0.2-2 mm	0.05-0.2 mm	0.002 mm	0.002 mm	USDA
Ah1 Ah2 Bw C	0-13 13-28 28-60 > 60	26.8 42.9 47.9 41.0	42.1 51.7 54.2 57.4	19.4 17.0 17.0 15.2	8.9 7.9 8.2 4.6	29.6 23.4 20.6 22.8	SCL SCL SCL SCL
cmol(+)/kg							
Ca (HCl N/20)	Mg	K (HCl N/20)	Na	Acidity	Ex. Al.	Al sat. (m)	Base sat. %
1.4 1.0 1.1 1.1		0.11 0.06 0.04 0.03					
cmol(+)/kg						bar	%
CEC_{soil} sum cat.	CEC_{soil} NH_4OAc	CEC_{soil} bases +Al	CEC_{soil} (Ca)	pH H_2O	pH KCl	1/3	15
			8.3 6.0 4.8 4.8	4.7 4.9 4.5 4.5			
organ. matter %	organ. C %	N %	free Fe_2O_3 %	avail. P Truog ppm	P. total mg/100g	$CaCO_3$%	EC sat. dS/m
	1.94 1.50 0.46 0.23	0.260 0.185 0.079 0.040	2.2 2.1 2.8 2.8	7 6 1 1			

Profile ZR002

Classification: Xanthic Ferralsols, FRx (FAO, 1990)

Source: INEAC (1960) and FAO (1977)

Location:	West of Yangambi, near Opala (Lomami)
Coordinates:	0^o 45'S; 24^o 20'E -0.75°, 24.33°
Terrain unit:	430, Yangambi deposits plateaux
Altitude:	490 m a.s.l.
Physiography:	Plateau with slopes rarely exceeding 2 to 3 %
Slope:	2-3 %
Drainage:	Well drained
Parent material:	Yangambi lacustrine-eolian deposits
Climate:	Köppen Aw; continental characteristics; global radiation and amount of solar heat received are low, being 45 % of the solar heat possible; equatorial double periodicity; driest season January-February; annual rainfall 1,800 mm, mean annual temperature 25^oC.
Vegetation:	Semi-deciduous forest with Scorodophloeus zenkeri, Cynometra hankei, Dialum corbisieri, Celtis soyanxic, Oxystigma oxyphyllum, Achornea floribunda undergrowth.

Profile description

O	0- 1 cm	Shallow litter layer; roots, fine roots and leaves in various degrees of decomposition.
Ah	1-20 cm	Dark brown (7.5 YR 4/4); moist humus-bearing horizon; clayey sand; strong, fine to medium crumb structure; friable; many fine roots; clear smooth boundary.
AB	20-45 cm	(7.5 YR 5/6); infiltration horizon; clayey sand; weak, medium crumb structure; friable; few fine roots; diffuse boundary.
Bw	45-65 cm	(7.5 YR 5/8); structural horizon; clayey sand; weak, medium, subangular blocky structure; firm; few fine roots; diffuse boundary.
Co1	65-110 cm	Parent material (7.5 YR 5/8); Clayey sand; strong (floury) very fine crumb; friable; few fine roots.
Co2	110-150 cm	Idem

Analytical data of profile ZR002

horizon	depth (cm)	> 2 mm %	coarse sand 0.25-2 mm	fine sand 0.05-0.25 mm	silt 0.05 - 0.002 mm	clay < 0.002 mm	tex-ture USDA
Ah	20		55.2	16.4	2.1	26.3	SCL
AB	45		49.9	18.1	2.0	30.0	SCL
Bw	65		41.8	17.4	2.1	38.7	SC
Co1	110		46.8	15.9	1.7	35.6	SC
Co2	150		43.1	17.1	2.2	37.6	SC
cmol(+)/kg							
Ca (HCl N/20)	Mg	K (HCl N/20)	Na	Acidity	Ex. Al.	Al s. (m)	Base s. %
1.3	0.14	0.18	0.08				
0.6							
0.4							
0.4							
cmol(+)/kg						bar	%
CEC_{soil} sum cat.	CEC_{soil} NH_4OAc	CEC_{soil} bases + Al	CEC_{soil} (Ca)	pH H_2O	pH KCl	1/3	15
			3.5	4.6			
			4.5	4.5			
			4.6	4.4			
			4.3	4.5			
			4.6	4.6			
organ. matter %	organ. C %	N %	Free Fe_2O_3 %	Avail. P Truog ppm	P.total mg/100g	$CaCO_3$%	EC sat. DS/m
	1.15	0.098	3.8	4			
	0.52	0.056	3.4	1			
	0.43	0.039	3.9				
	0.29	0.031	3.6				
	0.25	0.020	3.8				

Profile ZR003 (formerly 22)

Classification: Xanthic Ferralsols, FRx (FAO, 1990)
Yellow hygro-arenoferrals on Salonga deposits, series SE-Z3 (INEAC)

Source: Sys (1972) and FAO (1977), description in 1959

Location: Lodja region

Coordinates: 03° 30’S; 23° 30’E
-03.50°; 23.50°

Terrain unit: 420

Altitude: 625 m a.s.l.

Physiography: Salonga deposits plateau, covering a vast region of the Kasai-Sankuru, as far as 1° S.

Slope: plateau summit, slightly sloping

Drainage: well drained, very deep groundwater

Parent material: eolian sands, resting on a Late-Tertiary planation; fine sands; clay content 12-35 %; the clay fraction is kaolinitic and only exceptionally contains traces of gibbsite.

Climate: annual rainfall 1,750 mm, mean annual temperature 25°C.

Vegetation: dense humid forest

Profile description

O 5- 0 cm Highly decomposed layer of organic matter, consisting mainly of fine roots, mixed with some black sand.

Ah 0- 8 cm Very dark greyish brown (10YR 3.5/2); loamy sand; single grain; loose; many fine roots; many grey sand specks; gradual boundary.

AB 8-23 cm Dark brown (10YR 5/6); loamy sand; single grain; loose; few fine roots; few grey grains; diffuse boundary.

Bo1 23-38 cm Yellowish brown (10YR 5/6); sandy loam; single grain; loose; less fine roots; few grey grains; diffuse boundary.

Bo2 38-85 cm Yellowish brown (10YR 5/6); sandy loam; loose; floury; diffuse boundary.

C 85-200 cm Yellowish brown (10YR 5/8 to 7.5YR 5/8); sandy loam.

Analytical data of profile ZR003

horizon	depth (cm)	> 2 mm %	coarse sand 0.25-2 mm	fine sand 0.05-0.25 mm	silt 0.05 - 0.002 mm	clay < 0.002 mm	texture USDA
Ah	0-8		23.2	63.5	1.5	11.8	LS
AB	8-23		19.6	67.9	1.4	11.1	LS
Bo1	23-38		18.2	62.6	2.1	17.1	SL
Bo2	38-85		21.3	61.2	2.0	15.5	SL

C	85-200		20.1	60.6	1.7	17.6	SL
cmol(+)/kg							
Ca (HCl N/20)	Mg	K (HCl N/20)	Na	Acidity	Ex.Al.	Al sat. (m)	Base sat. %
0.85		0.06					
0.35		0.04					
0.80		0.03					
0.50		0.06					
0.55		0.06					
cmol(+)/kg						bar	%
CEC_{soil} sum cat.	CEC_{soil} NH_4OAc	CEC_{soil} bases + Al	CEC_{soil} (Ca)	pH H_2O	pH KCl	1/3	15
			4.25	4.1			
			2.95	4.1			
			2.1	4.2			
			1.6	4.3			
			1.5	4.5			
organ. matter %	organ. C %	N %	free Fe_2O_3 %	avail. P Truog ppm	P. total mg/100g	$CaCO_3$%	EC sat. DS/m
	1.32	0.105	5.2				
	0.80	0.055	6.2				
	0.30	0.024	8.5				
	0.14	0.015	8.7				
	0.12	0.013	9.7				

Profile ZR004

Classification: Umbric Fluvisols, FLu (FAO, 1990)
Typic Humitropepts (USDA)
Dystric, humiferous, recent, tropical soils (INEAC)

Source: Sys (1991)

Location: Bweremana village, on border of N and S Kivu

Coordinates: 02° 00’S; 28° 30’E (approximate)
-02.00°; 28.50°

Terrain unit:	200
Altitude:	some tens of metres above Lake Kivu (1,460 m)
Physiography:	natural levee of an alluvial plain
Drainage:	moderately well drained
Parent material:	alluvium, with metamorphic rock influence: mica-schist, gneiss, amphibolite.

Profile description

Ap	0-25 cm	Micaceous silty clay; (10YR 3/1); black when moist; well developed, fine to medium, crumb structure; friable; abundant, fine roots; clear boundary.
AC	25-50 cm	Micaceous silty clay;(10YR 3/1); gradual transition.
A/C	50-60 cm	Micaceous silty clay; (10YR 3/1); well-developed, medium, prismatic structure; loose; common, fine and distinct mottles.

Analytical data of profile ZR004

horizon	depth (cm)	> 2 mm %	coarse sand 0.25-2 mm	Fine sand 0.05-0.25 mm	silt 0.05 - 0.002 mm	clay < 0.002 mm	tex-ture USDA
Ap	0-25	0.16	1.1	5.1	21.1	72.7	C
A/C	50-60	0.17	0.5	4.2	20.3	75.0	
cmol(+)/kg							
Ca	Mg	K	Na	Acidity	Ex. Al.	Al sat.	Base sat.

						(m)	%
35.59 31.17	13.75 14.37	2.17 1.41	0.06 0.21				
cmol(+)/kg						bar	%
CEC_{soil} sum of cat.	CEC_{soil} NH_4OAc	CEC_{soil} bases + Al	CEC_{soil} (Ca)	PH H_2O	pH KCl	1/3	15
	50.67 44.07			6.3 6.7	5.5 5.9		
organic matter %	organ. C %	N %	free Fe_2O_3 %	avail. P ppm (o-d)	P. total mg/100g	$CaCO_3$%	EC sat. dS/m
	5.94 2.21	0.45 0.21		405 223			

Profile ZR005

Classification: Humic Nitisols, NTu (FAO, 1990)
Oxic Tropohumults (USDA)
Humiferous Ferrisols (INEAC)

Source: Sys (1991)

Location: Mbobandana, south of the border river between N- and S-Kivu

Coordinates: 01°45’S; 28° 55’E
-01.75°; 28.92°

Terrain unit: 1210, eastern highlands

Altitude: about 1,500 m

Physiography: hill slope, south of the river

Slope: 4 %

Drainage: well drained

Parent material: slightly micaceous clay, reworked from Rusizi System (amphibolites, mica-schists)

Vegetation: permanent agriculture

Profile description

Ap 0-25 cm Slightly micaceous clay; (10 YR 3/2, moist); very dark greyish brown; well developed, medium, crumb structure; friable; many, fine roots; clear boundary.

AB 25-50 cm Slightly micaceous clay; somewhat compact; gradual transition.

BA 50-60 cm Slightly micaceous clay; (10 YR 3/4, moist); dark yellowish brown; subangular structure; ped faces covered by clay-humus shiny cutans; few roots.

Analytical data of profile ZR005

horizon	depth (cm)	> 2 mm %	coarse sand 0.25-2 mm	fine sand 0.05-0.25 mm	silt 0.05 - 0.002 mm	clay < 0.002 mm	texture USDA
Ap BA	0-25 50-60	0.21 0.15	6.5 5.4	16.4 17.9	21.6 15.5	55.5 61.2	C
cmol(+)/kg							
Ca	Mg	K	Na	H^+	Al^{3+}	Al sat. (m)	Base sat. %
20.06	8.49	3.09	0.03	-	-		

12.80	9.44	2.30	0.03	0.11	0.02		
cmol(+)/kg						bar	%
CEC_{soil} sum of cations	CEC_{soil} NH_4OAc	CEC_{soil} bases + Al	CEC_{soil} effec-tive	pH H_2O	pH KCl	1/3	15
	32.82 29.65		- 31.94	6.4 6.3	5.5 5.1		
organic matter %	organ. C %	N %	free Fe_2O_3 %	avail. P ppm (o-d)	P. total mg/100g	$CaCO_3$%	EC sat. dS/m
	4.13 0.84	0.33 0.11		435 80			

Profile ZR006

Classification: Humic Acrisols, ACu (FAO, 1990)
Palehumults (USDA)
Humiferous Ferrisols (INEAC)

Source: Sys (1991)

Location: ACUCOBA farmers association, Kirumba village, Kanyabayonga region, Kivu

Coordinates: 00° 45’ S; 29° 15’ E
-00.75°; 29.25°

Terrain unit: 1210

Altitude: 1,800 m

Physiography: hill slopes

Drainage: well drained

Parent material: Rusizi System gneiss

Vegetation: permanent agriculture

Profile description

Ah 0-60 cm Sandy clay; (5YR 3/2); very weak, subangular blocky structure, starting with very fine and fine granular; friable; many roots; clear boundary.

Bt 60-200 cm Clay (5YR 5/6); moderate, coarse, subangular blocky; broken, thin clay cutans; moderate root development, down to 1 m, some fine roots deeper.

A quartz stone layer is common in these soils, in between the surface and a depth of more than 2 m.

Analytical data of profile ZR006

horizon	depth (cm)	> 2 mm %	coarse sand 0.25-2 mm	fine sand 0.05-0.25 mm	silt 0.05 - 0.002 mm	clay < 0.002 mm	tex-ture USDA
A	0-60						SC
Bt	60-200	0.13	22.8	30.8	11.9	34.5	SC
cmol(+)/kg							
Ca	Mg	K	Na	H^+	Al^{3+}	Al sat. (m)	Base sat. %
5.53	2.42	0.32	0.14	0.13	0.08		
2.41	1.19	0.19	0.07	0.22	1.83		
Cmol(+)/kg						bar	%

CEC_{soil} sum cat.	CEC_{soil} NH_4OAc	CEC_{soil} bases + Al	CEC_{soil} Effect-tive	pH H_2O	pH KCl	1/3	15
	10.64 7.06		8.68 5.91	5.3 4.5	4.0 4.4		
organic matter %	organ. C %	N %	free Fe_2O_3 %	avail. P ppm (o-d)	P. total mg/100g	$CaCO_3$%	EC sat. dS/m
	2.06 0.34	0.18 0.06		10 10			

Profile ZR007

Classification:	Xanthic Ferralsols, FRx (FAO, 1990) Kandiudults (USDA) Ferralsols (INEAC)
Source:	Sys (1991)
Location:	Beni
Coordinates:	00°30’N; 29°30’E 00.50°; 29.50°
Terrain unit:	1240, Bunia or Lake Albert-Edward highlands
Altitude:	900 m
Physiography:	Late Tertiary pediplain on granite
Drainage:	well drained
Parent material:	granite

Vegetation: open space with weeds in a banana plantation

Profile description

Ap 0-20 cm Sandy clay to clay; moderate, fine and medium subangular blocky structure; friable; many roots; clear boundary.

Bo 60-80 cm Kandic horizon; clay with quartz grains; (10YR 5/6); weak blocky structure; clay nodules; no clay cutans; moderate root development down to 1 m, somewhat compact.

Analytical data of profile ZR007

horizon	depth (cm)	> 2 mm %	Coarse sand 0.25-2 mm	fine sand 0.05-0.25 mm	silt 0.05 - 0.002 mm	clay < 0.002 mm	tex-ture USDA
A Bo	0-20 20-80	0.14 0.07	31.4 28.6	27.3 21.2	9.3 6.0	32.0 44.2	SCL SC
cmol(+)/kg							
Ca	Mg	K	Na	H^+	Al^{3+}	Al sat. (m)	Base sat. %
6.02 2.71	0.49 0.04	0.08 0.03	0.07 0.02	0.02	0.05		93.0 79.3
cmol(+)/kg						bar	%
CEC_{soil} sum	CEC_{soil} NH_4OAc	CEC_{soil} bases +	CEC_{soil} Effec-	pH H_2O	pH KCl	1/3	15

cat.		Al	tive				
	7.16 3.53		6.73	5.5 6.0	5.0 5.0		
organic matter %	organ. C %	N %	free Fe_2O_3 %	avail. P ppm (o-d)	P. total mg/100g	$CaCO_3$%	EC sat. dS/m
	1.86 0.36	0.18 0.05		10 25			

Profile ZR008 (formerly 10)

Classification: Humic Acrisols, ACu (FAO, 1990)
Sombrihumults (USDA)

Source: Sys (1991)

Location: Butembo-Mushienene

Coordinates: 00°05’N; 29°15’E
00.08°; 29.25°

Terrain unit: 1210

Altitude: 1,600 m

Physiography: rounded hill

Slope: 2-4 %

Drainage: well drained

Parent material: schists

Vegetation: demonstration field

Profile description

Ah 0-45 cm Clay; (5YR 4/2); weak, fine blocky structure, starting with fine granular; friable; many roots; distinct boundary.

Bt 45-100 cm Clay; (5YR 4/4); crushed 5 YR 5/4); strong, coarse, blocky structure, with prismatic tendency; continuous clay cutans; firm; common roots; clear transition.

Bso 100-140 cm Sombric horizon, clay; (5YR 3/4).

Analytical data of profile ZR008 (formerly 10)

horizon	depth (cm)	> 2 mm %	coarse sand 0.25-2 mm	fine sand 0.05-0.25 mm	silt 0.05 - 0.002 mm	clay < 0.002 mm	tex-ture USDA
A Bo Bso	0-45 45-100 100-140	0.16 0.13 0.11	17.0 11.2 11.1	16.1 13.6 13.7	15.2 12.3 11.8	51.7 62.9 63.4	C C C
cmol(+)/kg							
Ca	Mg	K	Na	H^+	Al^{3+}	Al sat. (m)	Base sat. %
7.77 1.72 0.59	2.83 1.54 1.02	0.63 0.60 1.02	0.07 0.05 0.07	0.37 0.14 0.36	0.01 0.99 2.12		73.7 34.0 19.1
cmol(+)/kg						bar	%
CEC_{soil} sum of cat.	CEC_{soil} NH_4OAc	CEC_{soil} bases + Al	CEC_{soil} Effec-	pH H_2O	pH KCl	1/3	15

			tive				
	15.33 11.50 14.12		11.68 5.04 5.18	5.3 5.2 5.2	4.7 4.2 4.2		
organic matter %	organ. C %	N %	free Fe_2O_3 %	avail. P ppm (o-d)	P. total mg/100 g	$CaCO_3$%	EC sat. dS/m
	3.61 0.90 1.54	0.34 0.12 0.13		225 123 118			

Profile ZR009 (formerly 199; 24 Series Zé U 3hE)

Classification: Mollic Andosols, ANm (FAO, 1990)
Brown sandy eutrophic humiferous recent tropical soils on volcanic ash, series ZE-U3hE (INEAC)

Source: Sys (1991), Pécrot (1960)

Location: Goma-Masisi, North Kivu

Coordinates: 01° 25’S; 29° 02’E
-01.42°; 29.03°

Terrain unit: 1140, volcanic ash region

Altitude: 2,170 m

Physiography: steep relief, top slope,

Slope: 10 % NE

Drainage: well drained

Parent material: volcanic ash

Climate: Cf; mean annual temperature 14°C, mean annual rainfall 1,800 mm; 50 days of dry season

Vegetation: fallow with *Pennisetum* in pyrethrum fields

Profile description

Ap 0-30 cm Sandy clay loam; very dark brown (10YR 2/2); moderate, medium crumb; loose; abundant roots; gradual and smooth boundary.

AB 30-50 cm Sandy loam; very dark greyish brown (10YR 3/2); weak, medium to coarse, blocky structure, with crumb pockets around roots; friable; common roots; gradual and smooth transition.

C1 50-80 cm Loamy sand; dark brown (10YR 3/3); elementary structure; loose; few roots; distinct and smooth transition.

C2 80-170 cm Sandy clay loam; dark brown (10YR 3/3-4); weak, coarse, blocky structure; friable; broken, very thin clay cutans; very few roots; distinct and smooth transition.

C3 170-230 cm Fine gravelly sand, with pockets of black very coarse volcanic ash in the lower part of the horizon; dark brown (10YR 3/3).

C4 > 230 cm Gravelly sand, with white spots when dry; dark brown (10YR 3/3).

Analytical data of profile ZR009 (formerly 24)

horizon	depth (cm)	> 2 mm %	coarse sand 0.25-2 mm	fine sand 0.05-0.25 mm	Silt 0.05 - 0.002 mm	clay < 0.002 mm	texture USDA
Ap	0-30		51.5	10.5	11.4	26.6	SCL
AB	30-50		66.5	8.8	7.6	17.1	SL
C1	50-80		77.8	7.8	4.5	9.9	LS
C2	80-170		44.9	19.1	15.3	20.7	SCL
C3	170-210		58.7	14.2	11.0	16.1	SL
C3	210-230		94.6	0.5	0.3	4.6	S
C4	> 230		69.3	12.2	6.9	11.6	LS
cmol(+)/kg							
Ca	Mg	K	Na	H^+	Al^{3+}	Al sat. (m)	Base sat. %
19.0		0.65					
14.9		0.74					
10.2		0.65					
-		-					
-		-					
-		-					

cmol(+)/kg						bar	%
CEC$_{soil}$ sum cat.	CEC$_{soil}$ NH_4OAc	CEC$_{soil}$ bases + Al	CEC$_{soil}$ (Ca)	pH H_2O	pH KCl	1/3	15
			24.2	6.7			
			13.8	6.8			
			10.9	6.6			
			16.8	6.6			
			15.8	6.6			
			4.2	6.8			
organ. mat. %	organ. C %	N %	free Fe_2O_3 %	avail. P ppm Truogh	P. total mg/100 g	$CaCO_3$%	EC sat. dS/m
	4.70	0.756	5.2	21			
	2.38	0.461	5.4	24			
	1.51	0.252	5.4	40			
	-	-	7.5	21			
	-	-	5.7	34			
	-	-	3.5	18			

Profile ZR010 (formerly 201; 26 Series Za A 3 E)

Classification: Mollic Andosols, ANm (FAO)
Brown eutrophic, humiferous, sandy clay, tropical soils on volcanic ashes, series ZA-A3hE (INEAC)

Source: Sys (1991), Pécrot (1960)

Location: Masisi, North Kivu

Coordinates: 01^{o} 20’S; 28^{o} 40’E
-01.33°; 28.67°

Terrain unit: 1140, volcanic ash region

Altitude: 1,680 m

Physiography: steep sloping region; summit of a convex slope (W)

Climate: Cf; mean annual temperature 17°C, mean annual rainfall 2200 mm; 50 days of dry season

Drainage: well drained

Parent material: recent volcanic ash on older ashes

Vegetation: former quinine plantation

Profile description

Ap1	0-13 cm	Sandy clay; very dark brown (10YR 2/2); strong, fine crumb structure; loose; abundant roots; gradual and smooth boundary.
Ap2	13-26 cm	Clay; very dark greyish brown (10YR 3/2); strong, fine crumb structure; loose; abundant roots; gradual and smooth transition.
AB	26-40 cm	Sandy clay loam to sandy clay; dark brown (10YR 3/3); moderate, fine to medium, blocky structure, with crumb pockets; friable; common roots; gradual and smooth transition.
BA	40-80 cm	Sandy clay loam; dark brown (10YR 3/3); moderate, fine blocky structure; thin, discontinuous cutans; friable; non plastic; common roots; diffuse transition.
Bw1	80-120 cm	Sandy clay loam; dark brown (9YR 3/3); strong, fine, angular blocky structure; continuous, very thin clay cutans; few roots; friable; very slightly plastic; diffuse transition.
Bw2	120-150cm	Sandy clay loam; dark brown (7.5YR 3/4); strong, fine, angular structure; continuous, very thin clay cutans; few roots; friable; slightly plastic; diffuse transition.
Bw3	150-175 cm	Clay; dark brown (9 YR 3/3); strong, fine angular structure; continuous, very thin clay cutans; friable; slightly plastic; diffuse and smooth transition.
C	> 175 cm	Clayey; brown (7.5 YR 4/2); strong, medium, angular blocky structure; continuous clay cutans; no roots; friable; slightly plastic; locally firm; slightly plastic; this older volcanic ashes layer continues to > 3 m depth, and contains towards its base some pieces of very weathered mica schists.

Analytical data of profile ZR010 (26)

horizon	depth (cm)	> 2 mm %	coarse sand 0.25-2 mm	fine sand 0.05-0.25 mm	silt 0.05 - 0.002 mm	clay < 0.002 mm	texture USDA
Ap1	0-13		8.3	17.8	29.8	44.1	C
Ap2	13-26		8.2	19.9	18.7	53.2	C
AB	26-40		12.2	37.3	16.1	34.4	SCL
BA	40-80		16.2	42.4	13.8	27.6	SCL
Bw1	80-120		36.8	29.3	6.9	27.0	SCL
Bw2	120-150		45.7	24.4	4.6	25.3	SCL
Bw3	150-175		6.8	19.6	26.2	47.4	C
C	175-250		2.2	23.5	25.3	49.0	C
C	> 250		2.1	21.2	24.3	52.4	C
cmol(+)/kg							
Ca	Mg	K	Na	H^+	Al^{3+}	Al sat. (m)	Base sat. %
11.5		0.10					
7.4		0.07					
7.2		0.04					
12.8		0.04					
16.9		0.02					
13.6		0.03					
11.2		0.04					
8.2		0.05					
7.9		0.07					
cmol(+)/kg						bar	%
CEC_{soil} sum cat.	CEC_{soil} NH_4OAc	CEC_{soil} bases + Al	CEC_{soil} (Ca)	pH H_2O	pH KCl	1/3	15
			22.1	5.6			
			18.0	5.5			
			15.9	5.7			
			21.2	6.1			
			21.1	6.2			
			19.2	6.3			
			16.7	6.2			
			8.3	6.2			
			10.6	6.2			
organic	organ.	N %	free	avail.	P. total	$CaCO_3$	EC

matter %	C %		Fe_2O_3 %	P ppm Truogh	mg/100g	%	sat. dS/m
	5.40	0.689	6.8	20			
	3.96	0.607	7.5	18			
	2.84	0.363	8.5	18			
	1.95	0.316	9.3	25			
	1.04	0.150	11.2	92			
	0.92	0.137	10.8	11			
	0.54	0.077	11.2	8			
	-	-	8.8	8			
	-	-	8.3	12			

Profile ZR011 (formerly 1 Series Pî S 2 h)

Classification: Humic Nitosols, NTu (FAO, 1990)
Red Ferrisols (INEAC)

Source: Sys (1991), Pécrot (1960)

Location: E-W oriented mountain chain, W of the Kahuzi chain, Kivu

Coordinates: 02° 15’S; 28° 40’E
-02.25°; 28.67°

Terrain unit: 1210, eastern highlands

Altitude: 2,000 m

Physiography: elongated mountain chain, W-E oriented

Drainage: well drained

Parent material: slightly sandy clay; weathering product of the metamorphic complex

Vegetation: secondary mountain forest

Profile description

O 8-0 cm 1 cm thick layer of well-decomposed humus, on a thick layer of fine roots.

Ah1	0-10 cm	Slightly sandy clay; dark reddish brown (5YR 3/2); strong, fine crumb structure; loose; abundant roots; gradual and smooth boundary.
Ah2	10-22 cm	Slightly sandy clay; dark reddish grey (5YR 4/2); weak, medium crumb structure; friable; non plastic; abundant roots; gradual to diffuse and undulating transition.
Bt1	22-45 cm	Slightly sandy clay; reddish brown (5YR 4/3); fine to medium, blocky structure; discontinuous, tiny cutans; firm in situ; slightly plastic; non sticky; common roots; diffuse transition.
Bt2	45-100 cm	Slightly sandy clay; yellowish red (5YR 4/6); moderate, fine, blocky structure; thin, continuous cutans; firm in situ; slightly plastic; non sticky; common biological activity, getting weak deeper; distinct and smooth transition.
C	> 100 cm	Brown clay with quartz gravels.

Analytical data of profile ZR011

horizon	depth (cm)	> 2 mm %	coarse sand 0.25-2 mm	fine sand 0.05-0.25 mm	silt 0.05 - 0.002 mm	clay < 0.002 mm	tex-ture USDA
Ah1 Ah2 Bt1 Bt2	0-10 10-22 22-45 45-100		13.3 11.0 10.8 12.1	18.5 21.5 23.8 14.0	14.4 15.6 14.9 16.1	53.8 51.9 50.5 49.3	C C C C
cmol(+)/kg							
Ca	Mg	K	Na	H^+	Al^{3+}	Al sat. (m)	Base sat. %
0.75 0.55 0.30 -		0.19 0.11 0.03 -					
cmol(+)/kg						bar	%
CEC_{soil} sum of cations	CEC_{soil} NH_4OAc	CEC_{soil} bases + Al	CEC_{soil} (Ca)	pH H_2O	pH KCl	1/3	15
			28.75 18.50 10.25 7.50	4.0 4.5 4.4 4.4			
organic matter %	organ. C %	N %	free Fe_2O_3 %	avail. P ppm Truogh	P. total mg/100g	$CaCO_3$ %	EC sat. dS/m

	9.02 4.44 1.33 -	0.932 0.404 0.107 -	5.9 7.0 7.5 7.1	2 1 tr. tr.			

Profile ZR012 (formerly 2)

Classification: Ferralic Arenosols, ARo (FAO, 1990)
Yellow hygro-xero-arenoferrals on Kalahari sands, series HE-Z13 (INEAC)

Source: Sys (1972), description in 1956

Location: Kwango-Kwilu, Kiyaka station, SE of Kikwit

Coordinates: 05^{o} 30’S; 19^{o} 20’E
-05.50°; 19.33°

Terrain unit: 830/2, sand-covered plateaux

Altitude: 660 m

Topography: 3 % slope, plateau limit

Drainage: excessively well drained, groundwater deep

Parent material: Kalahari sands

Vegetation: wooded savannah, near to dense forest

Profile description

Ah 0-10 cm Humiferous sand; very dark brown (10YR 2/2, moist); weak, fine, granular structure; loose; abundant grass roots; gradual and smooth transition.

AC1 10-25 cm Humiferous sand; dark greyish brown (10YR 3/2, moist); some darker organic matter spots; single grain; loose; common roots; gradual and smooth boundary.

AC2 25-60 cm Slightly humiferous sand; dark greyish brown (10YR 4/2, moist); weak, medium, subangular blocky; slightly firm in situ, but friable after removal; common roots; gradual and smooth transition.

C1 60-85 cm Slightly humiferous sand; dark greyish brown (10YR 4/2, moist); single grain; gradual transition.

C2 85-120 cm Sand; yellowish brown (10YR 5/4, moist); single grain; loose; a few dark organic matter spots; gradual and smooth transition.

C3 120-170 cm Sand, brown (7.5YR 5/6, moist); loose.

Analytical data of profile ZR012

horizon	depth (cm)	> 2 mm %	coarse sand 0.25-2 mm	fine sand 0.05-0.25 mm	silt 0.05 - 0.002 mm	clay < 0.002 mm	texture USDA
Ah	0-10		31.9	58.0	2.5	7.6	S
AC1	10-25		32.1	59.1	1.9	6.9	S
AC2	25-60		25.9	65.7	1.6	6.8	S
C1	60-85		26.0	65.2	2.4	6.4	S
C2	85-120		26.9	64.1	2.2	6.8	S
C3	120-170		24.0	66.8	2.2	7.0	S
cmol(+)/kg							
Ca (HCl N/20)	Mg	K (HCl N/20)	Na	H^+	Al^{3+}	Al sat. (m)	Base sat. %
0.5		0.8					
0.4		0.8					
0.4		0.4					
0.4		0.6					
0.4		0.4					
0.5		0.4					
cmol(+)/kg						bar	%
CEC_{soil} sum cat.	CEC_{soil} NH_4OAc	CEC_{soil} bases + Al	CEC_{soil} (Ca)	pH H_2O	pH KCl	1/3	15
			3.9	5.5			
			2.8	5.7			
			2.4	5.9			
			2.1	6.0			
			1.8	5.9			

			1.6	5.8			
organ. matter %	organ. C %	N %	free Fe_2O_3 (%)	avail. P ppm Truogh	P. total mg/100g	$CaCO_3$ %	EC sat. dS/m
	0.73	0.065	0.62				
	0.50	0.037	0.67				
	0.36	0.026	0.75				
	0.28	0.021	0.74				
	0.16	0.017	0.84				
	0.14	0.013	1.06				

Profile ZR013 (formerly 9)

Classification: Xanthic Ferralsols, FRx (FAO, 1990)
Yellow hygro-xero-ferralsols, on Kalahari sands, with a clayey sand texture, series HU-F13 (INEAC)

Source: Sys (1972), description in 1957

Location: Kundelungu plateau, Central Katanga

Coordinates: 10°00’S; 28° 00’E
-10.00°; 28.00°

Terrain unit: 1040, Kundelungu plateau

Altitude: 1,550 m

Topography: subhorizontal plateau

Drainage: well drained, groundwater very deep

Parent material: Kalahari sands, influenced by Kundelungu sandstone

Vegetation: savannah

Profile description

Ah 0-12 cm Loamy sand; dark greyish brown (10YR 4/2, moist); single grain, friable; abundant roots; clear and smooth transition.

AB 12-30 cm Loamy sand; bright brown (10YR 5/3, moist); single grain; loose; common roots; gradual and smooth boundary.

Bo1 30-60 cm Sandy loam; yellowish brown (10YR 5/4, moist); weak, subangular blocky structure; slightly firm in situ, but very friable after removal; few roots; gradual and smooth transition.

Bo2 60-110 cm Sandy clay loam; yellowish brown (10YR 5/6, moist); single grain; very loose; gradual transition.

Bo3 110-200 cm Sandy clay loam; yellowish brown (10YR 5/6, moist); single grain.

Analytical data of profile ZR013

horizon	depth (cm)	> 2 mm %	coarse sand 0.25-2 mm	fine sand 0.05-0.25 mm	silt 0.05 - 0.002 mm	clay < 0.002 mm	texture USDA
Ah	0-12		34.5	47.3	6.5	11.7	LS
AB	12-30		23.4	59.8	6.1	10.7	LS
Bo1	30-60		23.1	50.2	11.6	15.1	SL
Bo2	60-110		20.9	42.5	16.5	20.1	SCL
Bo3	110-200		19.8	39.4	17.7	23.0	SCL
Cmol(+)/kg							
Ca (HCl N/20)	Mg	K (HCl N/20)	Na	H^+	Al^{3+}	Al sat. (m)	Base sat. %
0.7		0.09					
0.8		0.06					
0.7		0.05					
0.5		0.09					
0.7		0.08					
cmol(+)/kg						bar	%
CEC_{soil} sum of cations	CEC_{soil} NH_4OAc	CEC_{soil} bases + Al	CEC_{soil} (Ca)	pH H_2O	pH KCl	1/3	15
			3.1	5.2			
			2.2	5.2			
			2.2	5.3			
			2.1	5.3			
			2.2	5.4			
organic matter %	organ. C %	N %	free Fe_2O_3 (%)	avail. P ppm Truogh	P. total mg/100g	$CaCO_3$ %	EC sat. dS/m

	0.65 0.38 0.23 0.17 0.10	0.055 0.035 0.024 0.018 0.016	3.1 3.6 3.2 3.6 3.6				

Profile ZR014 (formerly 27)

Classification: Haplic Ferralsols, FRh (FAO, 1990)
Yellowish red hygro-ferralsols, on clayey sand Yangambi deposits, series YA-F2 (INEAC)

Source: Sys (1972), description in 1957

Location: Gazi, 80 km WNW of Kisangani

Coordinates: 01° 00'N; 24° 30'E
01.00°; 24.50°

Terrain unit: 430, Yangambi deposits plateaux

Altitude: 530 m

Topography: top of a large plateau

Drainage: well drained, groundwater very deep

Parent material: Yangambi deposits

Vegetation: dense humid forest

Climate: Af, mean annual temperature 24°C, mean annual rainfall 1,875 mm

Profile description

O 0.5-0 cm Very weak developed litter layer

Ah 0-7 cm Sand clay loam; dark brown (7.5YR4/2, moist); strong, fine to medium, crumb structure; friable; abundant roots; distinct and smooth transition.

AB 7-17 cm Sandy clay loam; reddish brown (5YR4/4, moist);

moderate, medium, crumb structure; friable; less roots; gradual boundary.

Bo1 17-30 cm Sandy clay loam; reddish brown (5YR4/4, moist); weak, medium, subangular blocky; friable to firm; less roots; diffuse transition.

Bo2 30-70 cm Sandy clay; yellowish red (5YR 4/6-8, moist); moderate, medium to coarse, subangular blocky; firm; few roots; diffuse transition.

Bo3 70-150 cm Sandy clay; yellowish red (5YR 5/8, moist); strong, fine crumb (floury); few roots.

Analytical data of profile ZR014

horizon	depth (cm)	> 2 mm %	coarse sand 0.25-2 mm	fine sand 0.05-0.25 mm	silt 0.05 - 0.002 mm	clay < 0.002 mm	texture USDA
Ah	0-7		39.0	27.8	1.9	31.3	SCL
AB	7-17		35.9	30.2	2.2	31.7	SCL
Bo1	17-30		37.6	26.3	2.7	33.4	SCL
Bo2	30-70		32.5	23.9	2.6	41.0	SC
Bo3	70-150		32.1	25.0	2.4	40.5	SC
Cmol(+)/kg							
Ca (HCl N/20)	Mg	K (HCl N/20)	Na	H^+	Al^{3+}	Al sat. (m)	Base sat. %
0.4		0.09					
0.3		0.08					
0.2		0.06					
0.4		0.10					
0.5		0.05					
cmol(+)/kg						bar	%
CEC_{soil} sum of cations	CEC_{soil} NH_4OAc	CEC_{soil} bases+Al	CEC_{soil} (Ca)	pH H_2O	pH KCl	1/3	15
			5.3	4.0			
			4.7	4.0			
			4.1	4.1			
			3.9	4.2			
			3.4	4.2			
organic matter %	organ. C %	N %	free Fe_2O_3 (%)	avail. P ppm Truogh	P. total mg/100g	$CaCO_3$ %	EC sat. dS/m
	1.52	0.122	3.3				

	0.93 0.62 0.35 0.19	0.080 0.060 0.037 0.021	2.9 3.3 3.9 4.8				

Profile ZR015 (formerly 32)

Classification: Xanthic Ferralsols, FRx (FAO, 1990)
Yellow hygro-ferralsols, on deposits of the low plateaux, series DA-F3 (INEAC)

Source: Sys (1972), description in 1958

Location: S of Bolomba, E of Mbandaka (Equator)

Coordinates: 00°05'N; 19°10'E
00.08°; 19.17°

Terrain unit: 410, low plateaux of the Central Congo Basin

Altitude: 370 m

Topography: plateau

Drainage: well drained, groundwater very deep

Parent material: low plateaux deposits

Vegetation: disturbed, old secondary forest

Climate: Af, mean annual temperature 25°C, mean annual rainfall 2,100 mm

Profile description

O Very weak developed litter layer

Ah 0-7 cm Sandy loam; dark brown (10YR 3/3, moist); locally weak, crumb structure; loose; moist; abundant roots, diffuse and smooth transition.

AB 7-27 cm Sandy clay loam; dark yellowish brown (10YR 4/4, moist); weak granular structure; loose to friable; common roots and faunal activity; clear boundary.

Bo1 27-45 cm Sandy clay loam; yellowish brown (10YR 5/4-6, moist); moderate, fine, granular structure; moist; friable; common roots; clear transition.

Bo2 45-87 cm Sandy clay loam; yellowish brown (10YR 5/6, moist); weak, fine, subangular blocky structure; moist; friable to firm; few roots; some traces of mottling; clear transition.

Bo3 87-107 cm Sandy clay loam; yellowish brown (10YR 5/6, moist); moist; strong, fine, granular structure; friable; strong reduction of roots; gradual boundary.

Bo4 107-180 cm Sandy clay loam; yellowish brown (10YR 5/6, moist); moist; strong, fine granular structure; friable.

Analytical data of profile ZR015

horizon	depth (cm)	> 2 mm %	coarse sand 0.25-2 mm	fine sand 0.05-0.25 mm	silt 0.05 - 0.002 mm	clay < 0.002 mm	texture USDA
Ah	0-7		41.3	38.9	1.9	17.9	SL
AB	7-27		34.3	39.8	2.9	23.0	SCL
Bo1	27-45		30.7	32.8	2.9	33.6	SCL
Bo2	45-87		35.5	30.2	2.2	32.1	SCL
Bo3	87-107		30.3	32.7	2.2	34.8	SCL
Bo4	107-180		36.6	28.9	2.0	32.2	SCL
Cmol(+)/kg							
Ca (HCl N/20)	Mg	K (HCl N/20)	Na	H^+	Al^{3+}	Al sat. (m)	Base sat. %
1.15		0.10					
1.65		0.05					
1.8		0.04					
1.65		0.04					
1.7		0.04					
1.8		0.05					
cmol(+)/kg						bar	%
CEC_{soil} sum of cations	CEC_{soil} NH_4OAc	CEC_{soil} bases+Al	CEC_{soil} (Ca)	pH H_2O	pH KCl	1/3	15
			5.50	4.2			
			3.35	4.3			
			3.45	4.4			
			3.15	4.7			
			2.80	4.8			
			2.90	4.8			
organic matter %	organ. C %	N %	free Fe_2O_3 (%)	avail. P ppm Truogh	P. total mg/100g	$CaCO_3$ %	EC sat. dS/m

	1.26	0.133	5.4				
	0.40	0.044	6.6				
	0.27	0.033	8.7				
	0.22	0.032	7.8				
	0.19	0.027	9.0				
	0.16	0.023	8.6				

Profile ZR016 (formerly 39)

Classification: Haplic Nitosols, NTh (FAO, 1990)
Yellow hygro-xeroferrisols, on Mesozoic rocks, series KO-S13 (INEAC)

Source: Sys (1972), description in 1958

Location: Mushie, between the Congo and Lower Kasai (Kwa)

Coordinates: 02° 40’S; 16° 50’E
-02.67°; 16.83°

Terrain unit: 810/5, lower Kasai sand-covered plateaux

Altitude: 400 m

Topography: recent incision in the plateau, moderate slope

Drainage: well drained

Parent material: sandy clay, weathering product of Karroo rocks

Vegetation: savannah

Climate: (Aw)s, mean annual temperature 25.5°C, mean annual rainfall 1,500 mm, 3 months of dry season

Profile description

Ah 0-4 cm Sandy clay; dark brown (10YR 4/3, moist); strong, fine, angular blocky structure; firm; abundant roots, abrupt transition.

AB 4-14 cm Sandy clay, brown to dark brown (10-7.5YR 4/4, moist); moderate to strong, angular blocky structure; firm when dry; common roots; gradual boundary.

Bt1 14-31 cm Sandy clay; brown (10-7.5YR 5/4, moist); strong, medium, angular blocky structure; thick, continuous clay cutans on ped faces; firm; few roots; diffuse transition.

Bt2 31-54 cm Sandy clay; dark brown (10YR 5/6, moist); weak, fine to medium, angular blocky structure; discontinuous clay cutans, on about 60 % of the ped surfaces; loose; few roots; diffuse transition.

Bt3 54-150 cm Sandy clay; strong, angular, blocky structure; clay stains; loose.

Analytical data of profile ZR016

horizon	depth (cm)	> 2 mm %	coarse sand 0.25-2 mm	fine sand 0.05-0.25 mm	silt 0.05 - 0.002 mm	clay < 0.002 mm	texture USDA
Ah, AB	0-14		4.3	36.3	22.2	37.2	CL
Bt1	14-31		4.0	35.5	23.4	37.1	CL
Bt2	31-54		3.0	32.5	22.8	41.7	C
Bt3	54-150		2.5	28.8	22.6	46.1	C
cmol(+)/kg							
Ca (HCl N/20)	Mg	K (HCl N/20)	Na	H^+	Al^{3+}	Al sat. (m)	Base sat. %
1.3		0.10					
1.2		0.03					
0.8		0.03					
0.7		0.02					
cmol(+)/kg						bar	%
CEC_{soil} sum of cations	CEC_{soil} NH_4OAc	CEC_{soil} bases+Al	CEC_{soil} (Ca)	pH H_2O	pH KCl	1/3	15
			4.7	4.8			
			3.6	4.3			
			3.45	4.3			
			3.05	4.5			
organic matter %	organ. C %	N %	free Fe_2O_3 (%)	avail. P ppm Truogh	P. total mg/100 g	$CaCO_3$%	EC sat. dS/m
	1.03	0.093	10.3				
	0.62	0.063	8.1				
	0.42	0.054	9.8				
	0.29	0.051	10.5				

Profile ZR017 (formerly 42)

Classification:	Haplic Acrisols, ACh (FAO, 1990) Red hygro-ferrisols, on Mesozoic sandstones, intergrades to recent tropical soils; series KE-(s)1 (INEAC)
Source:	Sys (1972), description in 1956
Location:	Kikwit-Gungu, Kwango-Kwilu rivers
Coordinates:	05° 30’ S; 19° 00’E -05.50°; 19.00°
Terrain unit:	840, dissected valleys in sand covered plateaux
Altitude:	560 m
Topography:	steep relief, slope of 50 % in the Kwilu valley
Drainage:	well drained
Parent material:	clayey sand, weathering product of Karroo sandstone
Vegetation:	dense humid forest
Climate:	(Aw)S, mean annual temperature 24.5°C, mean annual rainfall 1,650 mm, 3 months of dry season

Profile description

Ah	0-14 cm	Loamy sandy; greyish reddish brown (2.5YR 4/2, moist); moderate, coarse, crumb structure; loose; abundant roots; gradual transition.
AB1	14-23 cm	Loamy sand, reddish brown (2.5YR 4/4, moist); weak, Medium, blocky structure; loose; many roots; diffuse boundary.
AB2	23-56 cm	Sandy loam; reddish brown (2.5YR 4/4, moist); weak, medium, blocky structure; slightly firm in situ; many roots; diffuse transition.
BA	56-80 cm	Sandy loam; reddish brown to dark red (2.5YR 4/3-3/6, moist); massive; loose; diffuse transition.

Bt1 80-130 cm Sandy clay loam; dark red (2.5YR 3/6, moist); weak structure; slightly mottled; diffuse transition.

Bt2 130-200 cm Sandy clay loam; dark red (2.5YR 3/6, moist).
Analytical data of profile ZR017

horizon	depth (cm)	> 2 mm %	coarse sand 0.25-2 mm	fine sand 0.05-0.25 mm	Silt 0.05 - 0.002 mm	Clay < 0.002 mm	tex-ture USDA
Ah	0-14		29.8	54.5	2.9	12.8	LS
AB1	14-23		26.5	55.7	3.4	14.4	SL
AB2	23-56		30.1	50.4	3.8	15.9	SL
BA	56-80		28.5	52.0	4.0	15.5	SL
Bt1	80-130		24.7	50.4	4.4	20.5	SCL
Bt2	130-200		22.8	50.5	4.8	21.9	SCL
cmol(+)/kg							
Ca (HCl N/20)	Mg	K (HCl N/20)	Na	H^+	Al^{3+}	Al sat. (m)	Base sat. %
0.7		0.18					
0.6		0.14					
0.3		0.19					
0.5		0.20					
0.3		0.25					
0.4		0.15					
cmol(+)/kg						bar	%
CEC_{soil} sum of cations	CEC_{soil} NH_4OAc	CEC_{soil} bases+Al	CEC_{soil} (Ca)	pH H_2O	pH KCl	1/3	15
			4.5	4.6			
			4.2	4.8			
			4.0	5.1			
			3.6	5.2			
			4.4	5.2			
			4.2	4.9			
organic matter %	organ. C %	N %	free Fe_2O_3 (%)	avail. P ppm Truogh	P. total mg/100 g	$CaCO_3$%	EC sat. dS/m
	0.75	0.087	1.5				
	0.44	0.067	1.8				
	0.26	0.052	1.8				
	0.16	0.036	1.8				
	0.18	0.041	1.9				

	0.12	0.039	2.3				

Profile ZR018 (formerly 45)

Classification:	Ferralic Cambisols, CMo (FAO, 1990) Hygro-xeroferrisols, intergrades to brown tropical soils, on Mesozoic sandstone; series KY-s12 (INEAC)
Source:	Sys (1972), description in 1959
Location:	Maniema
Coordinates:	04° 30’S; 27°30’ E -04.50°; 27.50°
Terrain unit:	910, Lueki-Lukuga plateaux
Altitude:	620 m
Topography:	slightly E sloping relief
Drainage:	well drained
Parent material:	sandy clay, weathering product of Karroo sandstone: Lukuga deposits
Vegetation:	savannah with *Imperata cylindrica*
Climate:	(Aw)S, mean annual temperature 23°C, mean annual rainfall 1,450 mm, 3 months of dry season

Profile description

Ah1	0-10 cm	Sandy loam; dark brown (7.5YR 3/2, moist); moderate, fine, crumb structure; loose; moist; abundant roots; distinct and smooth transition.
Ah2	10-27 cm	Sandy clay loam; dark brown (7.5YR 4/2, moist); moderate medium, crumb structure; loose; moist; many roots; gradual and smooth boundary.
BA	27-56 cm	Sandy clay loam; reddish brown (5YR 4/4, moist); weak, medium, subangular blocky structure; friable; moist; gradual and smooth transition.
Bw	56-80 cm	Sandy clay; reddish brown (5YR 4/4, moist); weak, coarse, blocky structure; friable; moist; fine rounded gravel fragments; gradual and smooth transition.
C	80-120 cm	Sandy clay; reddish brown (5YR 4/4, moist) to yellowish red (5YR 4/4, moist); stone layer of schists and fine sandstones, with a few rounded

pebbles and dispersed ironstone concretions; friable to firm.

Analytical data of profile ZR018

horizon	depth (cm)	> 2 mm %	coarse sand 0.25-2 mm	fine sand 0.05-0.25 mm	silt 0.05 - 0.002 mm	clay < 0.002 mm	tex-ture USDA
Ah1	0-10		4.4	34.6	42.0	19.0	L
Ah2	10-27		4.5	28.3	43.9	23.3	L
BA	27-56		4.8	25.3	38.2	31.9	CL
Bw	56-80	38	5.4	21.2	38.2	35.2	CL
C	80-120	63	5.2	20.4	37.7	36.7	CL
Cmol(+)/kg							
Ca (HCl N/20)	Mg	K (HCl N/20)	Na	H^+	Al^{3+}	Al sat. (m)	Base sat. %
2.4		0.30					
1.2		0.10					
1.3		0.08					
1.3		0.09					
1.3		0.12					
cmol(+)/kg						bar	%
CEC_{soil} sum of cations	CEC_{soil} NH_4OAc	CEC_{soil} bases+Al	CEC_{soil} (Ca)	pH H_2O	pH KCl	1/3	15
			5.7	6.0			
			5.5	5.3			
			5.5	5.2			
			5.7	5.4			
			5.8	5.2			
organic matter %	organ. C %	N %	free Fe_2O_3 (%) clay	avail. P ppm Truogh	P. total mg/100 g	$CaCO_3$%	EC sat. dS/m
	0.94	0.095	7.3				
	0.53	0.069	7.7				
	0.29	0.059	8.3				
	0.20	0.054	8.9				
	0.20	0.055	8.1				

Profile ZR019 (formerly 52)

Classification:	Xanthic Ferralsols, FRx (FAO, 1990) Yellow typic hygro-xeroferralsols, on the Schisto-Calcaire System, series IO-F13 (INEAC)
Source:	Sys (1972), description in 1958
Location:	Mbanza Ngungu, Lower Congo
Coordinates:	05° 20’S; 14°30’ E -05.33°; 14.50°
Terrain unit:	710, Schisto-Calcaire depression
Altitude:	410 m
Topography:	widely undulating to flat
Drainage:	well drained
Parent material:	clay, weathering product of the Schisto-Calcaire
Vegetation:	savannah
Climate:	(Aw)s, mean annual temperature 24°C, mean annual rainfall 1,275 mm, 130-140 days of dry season

Profile description

Ah	0-14 cm	Clay; very dark greyish brown (10YR 3/2, moist); dark greyish brown (10YR 4/2 dry); fine, blocky structure, with crumb pockets around roots; loose; moist; abundant roots; gradual transition.
AB	14-29 cm	Clay; dark brown (10YR 4/3, moist); dark yellowish brown (10YR 4/4, dry); moderate, fine, subangular blocky structure; firm; common roots; gradual transition.
Bo1	29-56 cm	Clay; yellowish brown (10YR 5/4, moist and dry); weak, fine and very fine, subangular blocky structure; friable; few roots; diffuse transition.
Bo2	56-12O cm	Clay; yellowish brown (10YR 5/6, moist and dry); weak, fine and medium, subangular blocky structure; very friable.

Analytical data of profile ZR019

horizon	depth (cm)	> 2 mm %	coarse sand 0.25-2 mm	fine sand 0.05-0.25 mm	silt 0.05 - 0.002 mm	Clay < 0.002 mm	tex-ture USDA
Ah1	0-14		4.5	21.4	18.5	55.6	C
AB	14-29		4.2	20.1	17.7	58.0	C
Bo1	29-56		3.9	19.0	18.0	59.1	C
Bo2	56-120		3.3	18.0	17.4	63.1	C
Cmol(+)/kg							
Ca (HCl N/20)	Mg	K (HCl N/20)	Na	H^+	Al^{3+}	Al sat. (m)	Base sat. %
1.3		0.17					
1.3		0.07					
1.6		0.04					
0.9		0.02					
cmol(+)/kg						bar	%
CEC_{soil} sum of cations	CEC_{soil} NH_4Oac	CEC_{soil} bases+Al	CEC_{soil} (Ca)	PH H_2O	pH KCl	1/3	15
			6.10	4.9			
			5.15	4.8			
			4.45	4.9			
			3.95	5.1			
organic matter %	organ. C %	N %	free Fe_2O_3 (%)	avail. P ppm Truogh	P. total mg/100 g	$CaCO_3$%	EC sat. dS/m
	1.40	0.129	5.8				
	0.96	0.102	5.7				
	0.71	0.086	6.9				
	0.53	0.053	6.6				

Profile ZR020 (formerly 56)

Classification:	Haplic Ferralsols, FRh (FAO, 1990) Yellowish red, clayey, hygro-xeroferralsols, on the Schisto-Greseux System, series IO-F12 (INEAC)
Source:	Sys (1972), description in 1958
Location:	Mbanza Ngungu, Lower Congo
Coordinates:	05° 20’S; 14°30’E -05.33°; 14.50°
Terrain unit:	720, Schisto-Greseux plateaux
Altitude:	585 m
Topography:	undulating
Drainage:	well drained
Parent material:	clay, weathering product of the Schisto-Greseux
Vegetation:	wooded savannah
Climate:	(Aw)S, mean annual temperature 24°C, mean annual rainfall 1,275 mm, 130-140 days of dry season

Profile description

Ah	0-10 cm	Sandy clay; dark brown (7.5YR 3/2, moist), (75YR 4/2 dry); strong, medium, crumb and fine, blocky structure; firm; abundant roots; gradual and smooth transition.
AB	10-22 cm	Sandy clay; dark brown (7.5YR 4/2, moist); reddish brown (5YR 4/4, dry); strong, fine, subangular blocky structure; firm; many roots; gradual and undulating transition
BA	22-45 cm	Sandy clay to clay; reddish brown (5YR 4/4, moist), yellowish red (5YR 4/6, dry); strong, fine, subangular blocky structure; firm; few roots; diffuse and smooth transition.
Bo1	45-76 cm	Clay; reddish brown (5YR 5/4, moist), yellowish red (5YR 4/6, dry); strong, fine, subangular blocky structure; compact when dry; diffuse transition.
Bo2	76-150 cm	Sandy clay to clay; yellowish red (5YR 5/6, moist), (5YR 4/6, dry); weak, coarse, subangular blocky structure falling apart into fine granules; friable; no roots.

Analytical data of profile ZR020

horizon	depth	> 2 mm	coarse	fine	silt	Clay	tex-

	(cm)	%	sand 0.25-2 mm	sand 0.05-0.25 mm	0.05 - 0.002 mm	< 0.002 mm	ture USDA
Ah AB BA Bo1 Bo2	0-10 10-22 22-45 45-76 76-150		13.9 12.8 10.8 9.7 11.0	33.6 32.5 27.5 26.8 28.1	7.9 8.8 8.6 9.5 9.5	44.6 45.9 53.0 54.0 51.4	SC SC C C C
cmol(+)/kg							
Ca (HCl N/20)	Mg	K (HCl N/20)	Na	H^+	Al^{3+}	Al sat. (m)	Base sat. %
1.05 0.6 0.5 0.5 0.5		0.11 0.06 0.05 0.04 0.04					
cmol(+)/kg						bar	%
CEC_{soil} sum of cations	CEC_{soil} NH_4OAc	CEC_{soil} bases+Al	CEC_{soil} (Ca)	pH H_2O	pH KCl	1/3	15
			6.9 5.9 4.7 4.2 3.8	4.6 4.6 4.8 5.0 5.0			
organic matter %	organ. C %	N %	free Fe_2O_3 (%)	avail. P ppm Truogh	P. total mg/100g	$CaCO_3$%	EC sat. dS/m
	1.72 1.30 0.69 0.54 0.36	0.115 0.111 0.102 0.056 0.047	3.0 4.1 3.6 3.4 3.4				

Profile ZR021 (formerly 58)

Classification: Haplic Ferralsols, FRh (FAO, 1990)
Dark red, clayey, hygro-xeroferralsols, on schists of the laterised Plio-Pleistocene pediplain, series ILI-F10 (INEAC)

Source:	Sys (1972), description in 1955
Location:	ENE of Gemena (Equator)
Coordinates:	03° 35’N; 20°25’E 03.58°; 20.42°
Terrain unit:	930, Lindi plateaux
Altitude:	460 m
Topography:	plateau with termite hills
Drainage:	well drained
Parent material:	weathering products of schists of the Lower Ubangi (Lindian)
Vegetation:	savannah
Climate:	(Aw)N, mean annual temperature 24°C, mean annual rainfall 1,700 mm, 60-65 days of dry season

Profile description

Ah1	0-05 cm	Clay; greyish reddish brown (2.5YR 4/2, moist); firm; moist; abundant roots; diffuse transition.
Ah2	05-18 cm	Clay; greyish reddish brown (2.5YR 4/2, moist); firm; moist; crumb structure; abundant roots; clear transition.
AB	18-28 cm	Clay with some coarse sand; greyish reddish brown (2.5YR 4/2, moist); subangular blocky structure; firm; moist; weak biological activity; many roots; gradual transition.
BA	28-48 cm	Clay; light purplish red (10R 4/4, moist); moderate, subangular blocky structure; firm; moist; many roots; clear transition.
Bo1	48-83 cm	Clay (10R 4/6, moist); strong, angular blocky structure; few cutans; weak biological activity; many roots; firm; moist; clear transition.
Bo2	83-90 cm	Clay; red (10R 4/6, moist); weak, subangular blocky; firm; moist; few roots; diffuse transition.
Bo3	90-140 cm	Clay; red (10R 4/6 to 2.5YR 4/8, moist); massive; firm; few roots; abrupt transition.
IIBo4 cs	140-200cm	Gravelly layer composed of ironstone concretions and clay.

Analytical data of profile ZR021

horizon	depth (cm)	> 2 mm %	coarse sand 0.25-2 mm	fine sand 0.05-0.25 mm	silt 0.05 - 0.002 mm	Clay < 0.002 mm	tex-ture USDA
Ah1	0-5		10.5	21.4	22.3	45.8	C
Ah2	5-18		22.0	21.6	18.4	38.0	SC
AB	18-28		22.4	16.1	8.8	52.7	C
BA	28-48		17.7	12.5	5.0	64.8	C
Bo1	48-83		14.1	10.0	4.3	71.6	C
Bo2	83-90		13.8	8.8	3.8	73.6	C
Bo3	90-140		13.8	8.6	4.0	73.6	C
IIBo4	140-200	67	17.8	7.1	5.4	69.7	C
cmol(+)/kg							
Ca (HCl N/20)	Mg	K (HCl N/20)	Na	H^+	Al^{3+}	Al sat. (m)	Base sat. %
10.5		0.80					
7.4		0.62					
3.1		0.38					
2.5		0.23					
2.3		0.34					
2.2		0.29					
2.2		0.25					
1.9		0.32					
cmol(+)/kg						bar	%
CEC_{soil} sum of cations	CEC_{soil} NH_4OAc	CEC_{soil} bases+Al	CEC_{soil} (Ca)	pH H_2O	pH KCl	1/3	15
			14.1	6.5			
			9.7	6.3			
			6.7	6.2			
			6.1	6.2			
			5.6	6.1			
			5.2	6.1			
			5.1	6.2			

			4.8	6.2			
organic matter %	organ. C %	N %	free Fe_2O_3 (%)	avail. P ppm Truogh	P. total mg/100 g	$CaCO_3$%	EC sat. dS/m
	2.3	0.190	7.5				
	1.84	0.155	8.2				
	0.86	0.099	7.0				
	0.55	0.054	7.8				
	0.29	0.040	5.3				
	0.24	0.034	8.5				
	0.24	0.037	6.1				
	0.27	0.026	11.5				

Profile ZR022 (formerly 62)

Classification: Haplic Ferralsols, FRh (FAO, 1990)
Yellowish red clayey hygro-ferralsols, on gravels of the Plio-Pleistocene pediplain, series ILO-F2 (INEAC)

Source: Sys (1972), description in 1957

Location: Isiro, Uele, Higher Congo

Coordinates: 02° 15’N; 27°37’E
02.25°; 27.62°

Terrain unit: 980, Kibali plateaux

Altitude: 820 m

Topography: isolated relief overlooking the end-Tertiary pediplain

Drainage: well drained

Parent material: clay, weathering product of the schists of the Kibali Group

Vegetation: equatorial forest

Climate: (Aw)N, mean annual temperature 23-24°C, mean annual rainfall 1,850 mm

Profile description

Ah 0-04 cm Clay; reddish brown (5YR 4/4, moist); crumb structure.

AB 04-14 cm Clay; yellowish red (5YR 4/6, moist); strong fine blocky and crumb structure.

BA 14-27 cm Clay; yellowish red (5YR 4/6, moist); moderate, fine, blocky structure; firm.

Bo1 27-51 cm Clay; yellowish red (5YR 5/6, moist); moderate to strong, medium, blocky structure; firm.

Bo2 51-80 cm Clay; yellowish red (5YR 4/6, moist); weak, blocky structure; loose.

IIBo3 cs 80-160 cm Heterogeneous gravelly layer, composed of dominantly ironstone concretions, mixed with slightly red-coloured schist gravels.

Analytical data of profile ZR022

horizon	depth (cm)	> 2 mm %	coarse sand 0.25-2 mm	fine sand 0.05-0.25 mm	silt 0.05 - 0.002 mm	clay < 0.002 mm	texture USDA
Ah	0-4	20	5.2	12.6	21.3	60.9	C
AB	4-14	5	5.0	17.0	18.9	59.1	C
BA	14-27		5.6	15.6	16.7	62.1	C
Bo1	27-51		5.7	13.0	18.2	63.1	C
Bo2	51-80	25	4.1	15.5	18.9	62.2	C
IIBo3cs	80-160	43	6.5	14.5	17.1	59.8	C

cmol(+)/kg							
Ca (HCl N/20)	Mg	K (HCl N/20)	Na	H^+	Al^{3+}	Al sat. (m)	Base sat. %
8.1		0.68					
1.9		0.16					
1.6		0.15					
1.6		0.12					
1.1		0.14					
1.3		0.24					
cmol(+)/kg						bar	%
CEC_{soil} sum of cations	CEC_{soil} NH_4OAc	CEC_{soil} bases+Al	CEC_{soil} (Ca)	pH H_2O	pH KCl	1/3	15
			9.4	5.4			
			7.9	4.9			
			6.8	4.7			
			6.1	4.7			
			5.6	5.2			
			5.4	5.4			
organic matter %	organ. C %	N %	free Fe_2O_3 (%)	avail. P ppm Truogh	P. total mg/100 g	$CaCO_3$%	EC sat. dS/m
	2.84	0.281	7.8				
	1.13	0.117	8.9				
	0.86	0.102	8.8				
	0.68	0.076	9.6				
	0.59	0.071	9.1				
	0.54	0.057	8.9				

Profile ZR023 (formerly 71)

Classification:	Humic Ferralsols, FRu (FAO, 1990) Red clayey ferralsols, with a sombric horizon, on schists, series IO-FR21 (INEAC)
Source:	Sys (1972), description in 1958
Location:	Higher Ituri, N of Nioka, Higher Congo
Coordinates:	02° 18’N; 30°32’E 02.30°; 30.53°
Terrain unit:	1230, Aru highlands
Altitude:	1,750 m

Topography: top of a large hill

Drainage: well drained

Parent material: clay, weathering product of schists

Vegetation: grass savannah

Climate: Cf, mean annual temperature 18.1°C, mean annual rainfall 1,400 mm, 70 days of dry season

Profile description

Ah 0-20 cm Clay; dark reddish brown (5YR 2/2, moist); strong, fine and medium, crumb structure; friable; slightly moist; abundant roots; gradual transition.

AB 20-32 cm Clay; dark reddish brown (5YR 3/2, moist); strong, medium, crumb structure; firm in situ; slightly moist; common roots; gradual transition.

BA 32-54 cm Clay; dark reddish brown to dark brownish red (2.5YR 3/4 to 5YR 3/4, moist); moderate, medium, subangular blocky structure; hard; moist; very few roots; diffuse transition.

Bo1 54-80 cm Clay; dark red (2.5YR 3/6, moist); moderate, fine, subangular blocky structure; firm; moist; few roots; diffuse transition.

Bo2 80-150 cm Clay; dark red (2.5YR 3/6, moist); massive; very friable; presence of some dark reddish brown nodules (5YR 3/3).

Analytical data of profile ZR023

horizon	depth (cm)	> 2 mm %	coarse sand 0.25-2 mm	fine sand 0.05-0.25 mm	silt 0.05 - 0.002 mm	clay < 0.002 mm	texture USDA
Ah	0-20		11.0	14.7	16.1	60.2	C
AB	20-32		12.2	14.5	13.4	60.9	C
BA	32-54		10.0	15.3	13.8	60.9	C
Bo1	54-80		8.0	14.3	13.5	64.2	C
Bo2	80-150		7.3	14.2	12.3	66.4	C
cmol(+)/kg							
Ca (HCl N/20)	Mg	K (HCl N/20)	Na	H^+	Al^{3+}	Al sat. (m)	Base sat. %

5.4 1.0 0.6 0.5 _		0.25 0.05 0.05 0.02 _					
cmol(+)/kg						bar	%
CEC_{soil} sum of cations	CEC_{soil} NH_4OAc	CEC_{soil} bases+Al	CEC_{soil} (Ca)	pH H_2O	pH KCl	1/3	15
			15.2 10.8 8.0 6.0 7.2	5.4 4.9 5.1 5.2 5.2			
organic matter %	organ. C %	N %	free Fe_2O_3 (%)	avail. P ppm Truogh	P. total mg/100 g	$CaCO_3$%	EC sat. dS/m
	3.30 2.10 1.37 0.76 -	0.285 0.167 0.116 0.084 -	12.0 7.8 7.8 13.4 13.4				

Profile ZR024 (formerly 79)

Classification: Haplic Nitisols, NTh (FAO, 1990)
Yellow clayey hygro-ferrisols, on schists, series IO-S3 (INEAC)

Source: Sys (1972), description in 1965
Location: N of Kasongo, Kisamba, Maniema

Coordinates: 04° 05’S; 26°32’E
-04.08°; 26.53°

Terrain unit: 990, Rusizian-Burundian plateaux at medium altitude

Altitude: 660 m
Topography: undulating plateau, slope 1-2 %
Drainage: well drained

Parent material: clay, weathering product of schists

Vegetation: cleared forest

Climate: (Aw)S, mean annual temperature 24°C, mean annual rainfall 1,550 mm, 80 days of dry season

Profile description

O 0.5 cm litter layer

Ah1 0-05 cm Fine clayey; dark brown (7.5YR 4/4, moist); moderate, fine, crumb structure; loose; moist; abundant roots; strong biological activity; gradual and smooth transition.

Ah2 05-10 cm Fine clayey; dark brown to brown (7.5YR 4.5/4, moist); strong, fine, granular structure; loose to friable; moist; abundant roots; strong biological activity; gradual and smooth transition.

BA 10-30 cm Fine clayey; brown (7.5YR 5/4, moist); moderate, fine, subangular to angular blocky structure; friable; moist; many roots; discontinuous, fine, clay cutans cover 20-30 % of the ped surfaces; distinct and smooth transition.

Bt1 30-50 cm Fine clayey; brown (7.5YR 5/4, moist); strong, very fine, angular blocky structure; friable to firm; moist; many roots; continuous, fine, clay coatings cover 50-60 % of the ped surfaces; gradual and smooth transition.

Bt2 50-90 cm Fine clayey; brown (7.5YR 5/4, moist); strong, very fine, angular blocky structure; friable to firm; moist; few roots; almost continuous, fine, clay coatings cover 40-50 % of the peds; gradual and smooth transition.

Bt3 90-160 cm Fine clayey; brown (7.5YR 5/4, moist); strong, very fine to very fine, angular to subangular blocky structure; friable; moist; few roots; 20-30 % clay cutans on the peds.

Analytical data of profile ZR024

horizon	depth (cm)	> 2 mm %	coarse sand 0.25-2 mm	fine sand 0.05-0.25 mm	silt 0.05 - 0.002 mm	clay < 0.002 mm	texture USDA
Ah1	0-5		5.0	14.7	36.4	43.9	C
Ah2	5-10		4.7	16.6	35.0	43.7	C
BA	10-30		4.5	14.2	31.5	49.8	C
Bt1	30-50		3.8	11.8	28.5	55.9	C
Bt2	50-90		4.0	11.0	27.6	57.4	C
Bt3	90-150		4.0	10.5	26.2	59.3	C
cmol(+)/kg							
Ca (HCl N/20)	Mg	K (HCl N/20)	Na	H^+	Al^{3+}	Al sat. (m)	Base sat. %

1.3		0.39					
0.9		0.28					
0.8		0.19					
0.6		0.13					
0.5		0.12					
0.7		0.11					
cmol(+)/kg						bar	%
CEC_{soil} sum of cations	CEC_{soil} NH_4OAc	CEC_{soil} bases+Al	CEC_{soil} (Ca)	pH H_2O	pH KCl	1/3	15
			8.0	4.5			
			6.5	4.4			
			5.9	4.5			
			5.9	4.9			
			6.1	4.9			
			6.0	4.8			
organic matter %	organ. C %	N %	free Fe_2O_3 (%)	avail. P ppm Truogh	P. tot.mg /100g	$CaCO_3$%	EC sat. dS/m
	0.88	0.138	8.1				
	0.54	0.084	8.1				
	0.29	0.067	8.9				
	0.19	0.053	9.4				
	0.19	0.056	10.4				
	0.14	0.055	9.2				

Profile ZR025 (formerly 86)

Classification: Haplic Ferralsols, FRh (FAO, 1990)
Yellowish red, clayey, hygro-xeroferralsols, on schists on the Plio-Pleistocene pediplain, series ILO-F12 (INEAC)

Source: Sys (1972), description in 1956
Location: Lubumbashi, High Katanga

Coordinates: 11° 38’S; 27°25’E
-11.63°; 27.45°

Terrain unit: 1030, High plateaux of Katanga

Altitude: 1,250 m
Topography: flat plateau
Drainage: well drained
Parent material: clay, weathering product of schists

Vegetation: degraded open forest

Climate: Cw, mean annual temperature 20.1°C, mean annual rainfall 1,244 mm, 180 days of dry season

Profile description

Ah1 0-02 cm Clay; dark brown (7.5YR 4/2, moist); strong, fine, crumb structure; loose; abundant roots; clear transition.

Ah2 02-06 cm Clay; dark brown (7.5YR 4/4, moist); strong, coarse, crumb structure; many roots; termite activity; gradual and smooth transition.

AB 06-15 cm Clay; reddish brown (5YR 4/4, moist); moderate, medium, blocky structure; firm; diffuse and smooth transition.

BA 15-24 cm Clay; reddish brown (5YR 4/4, moist); moderate, coarse, blocky structure; firm; good root penetration; diffuse transition.

Bo1 24-41 cm Clay; yellowish red (5YR 4/6-5/6, moist); weak, coarse, blocky structure; very firm; many roots; diffuse transition.

Bo2 41-72 cm Clay; yellowish red (5YR 4/6, moist); as above, but somewhat less firm; diffuse transition.

Bo3 72-100 cm Clay; yellowish red (5YR 4/6-2.5YR 5/8, moist); massive; very friable; very few roots; diffuse transition.

Bo4 100-150 cm Same as above.

Analytical data of profile ZR025

horizon	depth (cm)	> 2 mm %	co.sand 0.25-2 mm	f.sand 0.05-0.25mm	Silt 0.05 - 0.002mm	clay < 0.002 mm	tex-ture USDA
Ah1	0-2		5.0	15.6	23.6	55.8	C
Ah2	2-6		4.1	15.9	21.6	58.4	C
AB	6-15		4.1	14.9	22.3	58.7	C
BA	15-24		2.7	11.3	20.5	65.5	C
Bo1	24-41		2.4	8.9	16.8	71.9	C
Bo2	41-72		1.6	8.0	15.2	75.2	C
Bo3	72-100		1.7	8.8	17.2	72.3	C
Bo4	100-150		1.6	9.8	18.9	69.7	C
cmol(+)/kg							
Ca(HCl N/20)	Mg	K (HCl N/20)	Na	H^+	Al^{3+}	Al sat. (m)	Base sat. %
15.3		2.6					
6.3		1.2					
4.1		0.9					
2.7		0.8					
2.4		0.8					
2.1		0.6					
2.3		0.7					
2.0		0.5					

cmol(+)/kg						bar	%
CEC$_{soil}$ sum cat	CEC$_{soil}$ NH_4OAc	CEC$_{soil}$ bases+Al	CEC$_{soil}$ (Ca)	pH H_2O	pH KCl	1/3	15
			-	5.5			
			-	5.3			
			-	5.0			
			-	5.2			
			5.8	5.4			
			5.0	5.6			
			4.9	5.9			
			4.9	5.9			
organic mat. %	organ. C %	N %	free Fe_2O_3(%)	avail. P ppm	P.tot. mg/100g	$CaCO_3$%	EC dS/m
	3.3	0.216	4.0				
	1.91	0.157	5.0				
	1.32	0.125	5.0				
	0.82	0.088	6.2				
	0.55	0.065	6.0				
	-	-	6.6				
	-	-	6.4				
	-	-	7.0				

Profile ZR026 (formerly 92)

Classification: Haplic Ferralsols, FRh (FAO, 1990)
Yellow, sandy clayey, hygro-xeroferralsols, on sandstone, series QA-F13 (INEAC)

Source: Sys (1972), description in 1959

Location: Mayombe highlands, Lower Congo

Coordinates: 05° 30’S; 13°00’E
-05.50°; 13.00°

Terrain unit: 600/2, Mayombe highlands

Altitude: 265 m

Topography: undulating, slope 4 %

Drainage: well drained

Parent material: sandy clay, weathering product of sublitoral sandstone.

Vegetation: grazing savannah

Climate: (Aw)S, mean annual temperature 22°C, mean annual rainfall 1,225 mm, 140 days of dry season

Profile description

Ah	0-07 cm	Sand; dark grey (10YR 4/1, moist); moderate, fine and medium, crumb structure; loose; many roots; distinct and smooth transition.
AB	07-23 cm	Loamy sand; light brown (10YR 5/3, moist); moderate, medium, subangular blocky structure; loose; common roots; gradual and smooth transition.
BA	23-36 cm	Sandy clay loam; brown (7.5YR 5/5, moist); strong to moderate, medium, subangular blocky structure; firm; common roots; gradual and smooth transition.
Bo1	36-50 cm	Sandy clay; strong brown (7.5YR 5/6, moist); moderate, medium, blocky structure; firm; common roots; diffuse and smooth transition.
Bo2	50-65 cm	Sandy clay; same as above.
Bo3	65-107 cm	Sandy clay loam; yellowish brown to light yellowish red (6.5YR 6/6, moist); moderate, medium, blocky structure; firm; few roots; diffuse transition.
Bo4	107-150 cm	Sandy clay; yellowish red (5YR 5/6, moist).

Analytical data of profile ZR026

horizon	depth (cm)	> 2 mm %	co.sand 0.25-2 mm	fine sand 0.05-0.25 mm	silt 0.05 - 0.002 mm	clay < 0.002 mm	texture USDA
Ah	0-7		39.7	43.2	7.5	9.6	LS
AB	7-23		35.4	43.8	8.5	12.3	LS
BA	23-36		27.7	33.2	7.2	31.7	SCL
Bo1	36-50		25.8	31.2	7.7	35.3	SC
Bo2	50-65		29.1	29.5	7.1	34.2	SCL
Bo3	65-107		28.3	30.7	7.6	33.3	SCL
Bo4	107-150		30.2	32.9	9.0	27.6	SCL
cmol(+)/kg							
Ca (HCl N/20)	Mg	K (HCl N/20)	Na	H^+	Al^{3+}	Al sat. (m)	Base sat. %
1.4		0.34					
0.7		0.20					
0.6		0.28					
0.6		0.29					
0.7		0.28					
0.7		0.32					
-		-					

cmol(+)/kg						bar	%
CEC_{soil} sum cat	CEC_{soil} NH_4OAc	CEC_{soil} bases+Al	CEC_{soil} (Ca)	pH H_2O	pH KCl	1/3	15
			3.9	6.6			
			3.1	5.6			
			4.8	5.1			
			5.5	5.0			
			5.0	5.2			
			4.7	5.2			
			4.6	4.9			
organ. matter %	organ. C %	N %	free Fe_2O_3(%)	avail. P ppm	P.tot. mg/100 g	$CaCO_3$%	EC sat. dS/m
	0.55	0.059					
	0.31	0.043					
	0.42	0.069					
	0.38	0.070					
	0.25	0.061					
	0.16	0.057					
	-	-					

Profile ZR027 (formerly 125)

Classification: Rhodic Ferralsols, FRr (FAO, 1990)
Red clayey hygro-xeroferralsols, on dolomite, series CO-F11 (INEAC)

Source: Sys (1972), description in 1955

Location: Lubumbashi, Katanga

Coordinates: 11° 42'S; 27°25'E
-11.70°; 27.42°

Terrain unit: 1030, S Katanga high plateaux

Altitude: 1,250 m

Topography: large well drained depression

Drainage: well drained

Parent material: clay, weathering product of Kakontwe limestone

Vegetation: open forest with *Brachystegia*

Climate: Cw, mean annual temperature 20°C, mean annual rainfall 1,250 mm, 180-190 days of dry season

Profile description

Ah	0-03 cm	Clay; dark red (2.5YR 3/2, moist); strong, fine crumb structure; loose; many roots; clear and smooth transition.
AB	03-10 cm	Clay; reddish brown (2.5YR 4/4, moist); strong, coarse, crumb structure; loose; abundant roots; gradual transition.
BA	10-19 cm	Clay; reddish brown (2.5YR 3/4, moist); moderate, medium, blocky structure; firm; many roots; diffuse transition.
Bo1	19-63 cm	Clay; dark red (2.5YR 3/6, moist); slightly structured; few, weakly developed, blocky aggregates in a massive mass; firm; many roots; diffuse transition.
Bo2	63-90 cm	Clay; dark red (10R 3/6, moist); massive; very friable; few roots; diffuse transition.
Bo3	90-150 cm	Same as above.

Analytical data of profile ZR027

horizon	depth (cm)	> 2 mm %	co.sand 0.25-2 mm	fine sand 0.05-0.25 mm	silt 0.05 - 0.002 mm	clay < 0.002 mm	tex-ture USDA
Ah	0-3		21.8	16.8	11.6	49.8	C
AB	3-10		20.6	15.6	11.7	51.2	C
BA	10-19		18.0	16.7	11.7	53.6	C
Bo1	19-63		18.0	16.6	11.7	53.7	C
Bo2	63-90		16.3	16.6	12.5	54.6	C
Bo3	90-150		16.5	15.9	11.7	55.9	C
cmol(+)/kg							
Ca (HCl N/20)	Mg	K (HCl N/20)	Na	H^+	Al^{3+}	Al sat. (m)	Base sat. %
7.1		0.90					
0.9		0.33					
0.7		0.28					
0.7		0.24					
0.9		0.27					
0.5		0.30					
cmol(+)/kg						bar	%
CEC_{soil} sum of cations	CEC_{soil} NH_4OAc	CEC_{soil} bases+Al	CEC_{soil} (Ca)	pH H_2O	pH KCl	1/3	15

			11.9	5.8			
			6.1	5.0			
			5.9	5.0			
			5.3	5.1			
			4.8	4.8			
			4.2	4.5			
organic matter %	organ. C %	N %	free Fe_2O_3(%)	avail. P ppm	P.tot. mg/100 g	$CaCO_3$%	EC sat. dS/m
	5.6	0.455					
	2.24	0.202					
	1.63	0.131					
	0.84	0.078					
	-	-					
	-	-					

Profile ZR028 (formerly 135)

Classification: Rhodic Ferralsols, FRr (FAO, 1990)
Dark red, clayey, hygro-xeroferralsols, on the Plio-Pleistocene pediplain, series BLO-F1Oe (INEAC)

Source: Sys (1972), description in 1960

Location: Gemena, Ubangi, Equator

Coordinates: 03° 50’N; 20°22’E
03.83°; 27.37°

Terrain unit: 950, Liki-Bembe plateaux

Altitude: 530 m

Topography: widely undulating

Drainage: well drained

Parent material: clay, weathering product of gabbro and diabases

Vegetation: savannah

Climate: (Aw)N, mean annual temperature 24°C, mean annual rainfall 1,675 mm, 60-70 days of dry season

Profile description

Ah1 0-15 cm Clay; (2.5YR 2/4, moist); strong, crumb structure; earth worm activity; abundant roots; firm and moist; clear transition.

Ah2 15-27 cm Clay; (2.5YR 3/4, moist); moderate crumb and angular blocky; firm and moist; many roots; clear transition.

Bo1 27-53 cm Clay; (10R 3/4, moist); moderate, subangular blocky structure; firm and moist; common roots; diffuse transition.

Bo2 53-72 cm Clay; (10R 3/4, moist); weak, subangular blocky structure; few roots; firm and moist; diffuse transition.

Bo3 72-150 cm Clay; (10R 3/4, moist); massive; firm and moist; rare roots.

Analytical data of profile ZR028

horizon	depth (cm)	> 2 mm %	coarse sand 0.25-2 mm	fine sand 0.05-0.25 mm	silt 0.05 - 0.002 mm	clay < 0.002 mm	tex-ture USDA
Ah	0-15		16.3	17.7	7.7	58.3	C
Ah2	15-27		20.7	9.2	5.8	64.3	C
Bo1	27-53		10.5	12.9	5.2	71.4	C
Bo2	53-72		11.3	13.8	5.4	69.5	C
Bo3	72-150		11.7	15.0	5.8	67.5	C
Cmol(+)/kg							
Ca (HCl N/20)	Mg	K (HCl N/20)	Na	H^+	Al^{3+}	Al sat. (m)	Base sat. %
4.1		0.50					
1.9		0.15					
1.5		0.13					
1.4		0.13					
1.0		0.15					
cmol(+)/kg						bar	%
CEC_{soil} sum of cations	CEC_{soil} NH_4OAc	CEC_{soil} bases+Al	CEC_{soil} (Ca)	pH H_2O	pH KCl	1/3	15
			8.1	6.4			
			5.0	5.3			
			3.1	5.6			
			3.4	5.6			
			3.0	5.3			

organic matter %	organ. C %	N %	free Fe_2O_3 (%)clay	avail. P ppm	P.tot. mg/100 g	$CaCO_3$%	EC sat. dS/m
	1.58	0.126	5.3				
	0.87	0.081	11.9				
	0.60	0.056	16.2				
	0.40	0.035	17.5				
	0.33	0.023	16.6				

Profile ZR029 (formerly 151)

Classification: Humic Nitisols, NTu (FAO, 1990)
Yellowish red clayey humiferous Ferrisols, on basalt, series BO-S22 (INEAC)

Source: Sys (1972), description in 1960
Location: Bukavu, Kivu

Coordinates: 02° 30'S; 28°45'E
-02.50°; 28.75°

Terrain unit: 1130, Basalt plateaux
Altitude: 2,370 m
Topography: top in an area of gullied relief

Drainage: well drained

Parent material: clay, weathering product of basalt

Vegetation: bamboo forest

Climate: Cf, mean annual temperature 16°C, mean annual rainfall 1,850 mm, < 50 days of dry season

Profile description

0 2-0 cm litter layer

Ah1 0-17 cm Clay; black (7.5YR 2/1-2/2, moist); moderate, granular structure, with coarse elements; dense fine root network; friable to loose; gradual and smooth transition.

Ah2 17-30 cm Clay; very dark brown (7.5YR 2/2-3/2, moist); moderate blocky structure, with crumb pockets; abundant roots; friable; plastic; gradual and smooth transition.

AB 30-45 cm Clay; (7.5 YR 4/4, moist).

Bt1 45-80 cm Clay; reddish brown (5YR 4/5, moist); moderate, blocky structure; discontinuous, thin cutans; common roots; friable, plastic, slightly sticky; diffuse transition.

Bt2 80-120 cm Clay; yellowish red (5YR 4/6, moist); moderate, blocky structure; continuous, thin cutans; formation of very coarse prisms when drying; few roots; friable; plastic, slightly sticky; diffuse transition.

Bt3 120-170 cm Clay; reddish brown (5YR 4/4, moist); moderate, fine, blocky structure; continuous cutans of the same colour; firm in situ, slightly plastic, non-sticky; rare roots.

Analytical data of profile ZR029

horizon	depth (cm)	> 2 mm %	coarse sand 0.25-2 mm	fine sand 0.05-0.25 mm	silt 0.05 - 0.002 mm	clay < 0.002 mm	tex-ture USDA
Ah	0-17		2.5	1.6	17.2	78.7	C
Ah2	17-30		1.4	1.4	14.8	82.4	C
AB	30-45		1.1	1.5	13.7	83.7	C
Bt1	45-80		0.7	1.7	13.3	83.9	C
Bt2	80-120		0.8	1.5	13.9	83.5	C
Bt3	120-170		1.0	1.6	13.3	83.6	C
cmol(+)/kg							
Ca (HCl N/20)	Mg	K (HCl N/20)	Na	H^+	Al^{3+}	Al sat. (m)	Base sat. %
0.9		0.25					
0.4		0.13					
0.6		0.05					
0.5		0.03					
0.4		0.03					
-		-					
cmol(+)/kg						bar	%
CEC_{soil} sum of cations	CEC_{soil} NH_4OAc	CEC_{soil} bases+Al	CEC_{soil} (Ca)	pH H_2O	pH KCl	1/3	15
			26.65	5.1			
			19.00	5.0			
			13.55	4.6			
			12.90	4.6			
			12.20	4.5			
			13.10	4.5			

organic matter %	organ. C %	N %	free Fe_2O_3 (%)clay	avail. P ppm	P.tot. mg/100 g	$CaCO_3$%	EC sat. dS/m
	8.12	0.855	9.4				
	4.84	0.500	9.4				
	2.98	0.308	11.6				
	2.01	0.215	11.9				
	1.60	0.206	11.1				
	-	-	-				

Profile ZR030 (formerly 157)

Classification: Haplic Nitisols, NTh (FAO, 1990)
Yellowish red, clayey, hygro-xeroferrisols, on gneiss, series NI-S12 (INEAC)

Source: Sys (1972), description in 1959

Location: S of Tshela, Mayombe, Lower Congo

Coordinates: 05° 15’S; 12°50’E
-05.25°; 12.83°

Terrain unit: 600/1, Mayombe highlands

Altitude: 400 m ?

Topography: undulating, near a hill top, slope 6 %

Drainage: well drained

Parent material: clay, weathering product of gneiss

Vegetation: forest clearing

Climate: (Aw)S, mean annual temperature 23.5°C, mean annual rainfall 1,000 mm, 150-160 days of dry season

Profile description

0 0.5-0 cm decomposing organic matter layer

Ah 0-21 cm Sandy clay; reddish brown (2.5YR 4/4, moist); strong, fine, angular blocky structure; friable to firm; many roots; distinct and smooth transition.

AB 21-46 cm Clay; reddish brown (2.5YR 5/4, moist); strong, medium, angular blocky; firm; many roots; gradual and smooth transition.

Bt1 46-76 cm Clay; red (2.5 YR 5/6, moist); strong, medium, angular blocky; thick and continuous cutans on the ped surfaces; firm to compact; common roots; diffuse and smooth transition.

Bt2 76-97 cm Same as above, but with coarser structural elements.

Bt3 97-120 cm Clay; red (2.5YR 5/6, moist); strong, medium, subangular blocky structure; continuous, thick cutans on the ped surfaces; few roots; friable; diffuse transition.

Bt4 120-200 cm Clay; red (2.5YR 5/6, moist); weak, coarse, blocky structure; discontinuous, thin cutans; friable.

Analytical data of profile ZR030

horizon	depth (cm)	> 2 mm %	co.sand 0.25-2 mm	fine sand 0.05-0.25 mm	silt 0.05 - 0.002 mm	clay < 0.002 mm	tex-ture USDA
Ah	0-21		26.1	22.5	9.1	42.3	SC
AB	21-46		25.8	16.9	7.3	50.0	C
Bt1	46-76		20.0	16.5	6.9	56.6	C
Bt2	76-97		20.8	13.5	7.4	58.3	C
Bt3	97-120		17.5	13.5	8.1	60.9	C
Bt4	120-200		14.4	11.3	9.0	65.3	C
cmol(+)/kg							
Ca (HCl N/20)	Mg	K (HCl N/20)	Na	H^+	Al^{3+}	Al sat. (m)	Base sat. %
5.9		0.34					
2.1		0.28					
1.4		0.26					
1.3		0.24					
1.3		0.22					
-		-					
cmol(+)/kg						bar	%
CEC_{soil} sum of cations	CEC_{soil} NH_4OAc	CEC_{soil} bases+Al	CEC_{soil} (Ca)	pH H_2O	pH KCl	1/3	15
			11.3	6.5			
			6.5	6.4			
			4.8	6.3			
			4.7	6.2			
			4.9	6.2			
			4.7	6.2			
organic matter	organ. C %	N %	free Fe_2O_3	avail. P ppm	P.tot. mg/100	$CaCO_3$%	EC sat.

%			(%)clay		g		dS/m
	0.63	0.133	10.8				
	0.40	0.058	12.7				
	0.28	0.050	12.9				
	0.22	0.047	11.8				
	0.19	0.039	12.6				
	-	-	12.7				

Profile ZR031 (formerly 161)

Classification: Haplic Ferralsols, FRh (FAO, 1990)
Yellowish red, clayey, hygro-ferralsols, slightly ferralsolic, on granite, on the Plio-Pleistocene pediplain, series NLI-(F)2 (INEAC)

Source: Sys (1972), description in 1960

Location: Bambesa, Uele

Coordinates: 03° 21’N; 25°45’E
03.35°; 25.75°

Terrain unit: 510, NE Congo granite plateaux

Altitude: 500 m ?

Topography: upper slope of a large plateau

Drainage: well drained

Parent material: clay, weathering product of granite

Vegetation: dense forest

Climate: (Am)N, mean annual temperature 24°C, mean annual rainfall 1,775 mm, 60 days of dry season

Profile description

Ap 0-18 cm Sandy clay; reddish brown (5YR 4/3, moist); moderate, fine and medium, crumb structure; friable in situ; moist to humid; many roots; intense biological activity; distinct and undulating transition.

AB	18-29 cm	Humiferous sandy clay (5YR 3/4); and yellowish red clay (5YR 4/6, moist); moderate, medium, subangular blocky; firm in situ; moist; many roots; gradual and smooth transition.
Bo1	29-43 cm	Clay; yellowish red (5 YR 4/6, moist); moderate, medium, subangular blocky, few discontinuous cutans; firm in situ; moist; important biological activity; common roots; gradual and smooth transition.
Bo2	43-65 cm	Clay; yellowish red (5YR 4/6, moist); moderate, medium and coarse, subangular blocky structure, thin cutans on 30 % of the ped surfaces; intense biological activity; few roots; firm in situ; moist; gradual and smooth transition.
Bo3	65-98 cm	Same as above, but the structure is less developed; there are also less cutans; gradual and smooth transition.
Bo4	98-138 cm	Clay; yellowish red (5YR 4/6, moist); weak to moderate, medium to coarse, blocky structure; rare cutans; few roots; rare nodules; reduced biological activity; slightly firm to friable in situ; gradual and smooth transition.
Bo5	138-200 cm	Clay; yellowish red (5YR 4/6, moist) to red (2.5YR 4/6); massive tendency; weak, medium, subangular blocky structure, no cutans; friable in situ; moist; rare, slightly firm, nodules; distinct and smooth transition.

Analytical data of profile ZR031

horizon	depth (cm)	> 2 mm %	coarse sand 0.25-2 mm	fine sand 0.05-0.25 mm	silt 0.05 - 0.002 mm	clay < 0.002 mm	tex-ture USDA
Ap	0-18		30.6	27.3	11.3	30.8	SCL
AB	18-29		29.5	19.5	10.6	40.4	SC
Bo1	29-43		21.5	17.8	8.7	52.0	C
Bo2	43-65		20.2	15.3	7.9	56.6	C
Bo3	65-98		18.1	14.9	7.5	59.5	C
Bo4	98-138		22.8	13.6	7.6	56.0	C
Bo5	138-200		25.2	12.6	9.4	52.6	C
cmol(+)/kg							
Ca (HCl N/20)	Mg	K (HCl N/20)	Na	H^+	Al^{3+}	Al sat. (m)	Base sat. %
3.4		2.4					
1.7		3.25					
1.3		2.60					
1.1		1.30					
1.1		0.25					
1.1		0.10					
-		-					
cmol(+)/kg						bar	%
CEC_{soil} sum of cations	CEC_{soil} NH_4OAc	CEC_{soil} bases+Al	CEC_{soil} (Ca)	pH H_2O	pH KCl	1/3	15
			9.6	7.2			
			8.4	6.6			
			8.1	4.8			
			7.4	4.7			
			6.3	4.8			
			6.9	4.7			
			5.3	4.9			
organic matter %	organ. C %	N %	free Fe_2O_3 (%)clay	avail. P ppm	P.tot. mg/100 g	$CaCO_3$%	EC sat. dS/m
	0.77	0.076	7.6				
	0.66	0.058	7.6				

	0.56 0.53 0.44 - -	0.045 0.046 0.032 - -	7.3 7.7 7.9 8.5 8.3				

Profile ZR032 (formerly 193)

Classification: Humic Nitosols, NTu (FAO, 1990)
Humiferous, clayey, xeroferrisols, intergrades to brown tropical soils, on mica schists, series MO-s11hE (INEAC)

Source: Sys (1972), description in 1958

Location: Ituri, Mahagi, Angal zone, Higher Congo

Coordinates: 02° 25’N; 30°58’E
02.42°; 30.97°

Terrain unit: 1240, Bunia or Lake Albert Highlands

Altitude: 1,345 m

Topography: top of a rounded hill in Kakot valley, slope 2 %.

Drainage: well drained

Parent material: micaceous clay, weathering product of mica schists

Vegetation: cassava field

Climate: (Am)N, mean annual temperature 21°C, mean annual rainfall 1,200 mm, 70-80 days of dry season

Profile description

Ap 0-25 cm Micaceous silty clay; (7.5YR 3/2, moist); strong, medium and fine, angular blocky structure; friable; dry; many roots; distinct transition.

AB 25-42 cm Micaceous silty clay (5YR 3/2); strong, fine and medium, angular blocky; firm; some weathered mica schist dispersed in the horizon; gradual transition.

BA 42-60 cm Micaceous silty clay; (5 YR 3/4, moist); strong, fine and medium, angular blocky, firm to compact; few, thin cutans on the ped surfaces; gradual transition.

Bt1 60-150 cm Micaceous silty clay; (2.5YR 3/4, moist); strong, fine, angular blocky structure; thick cutans on the ped surfaces; hard; few roots; distinct and undulating transition.

IIBt2 150+ cm Gravel layer of quartz and weathered rock fragments, mixed with silty clay.

Analytical data of profile ZR032

horizon	depth (cm)	> 2 mm %	coarse sand 0.25-2 mm	fine sand 0.05-0.25 mm	silt 0.05 - 0.002 mm	clay < 0.002 mm	tex-ture USDA
Ap	0-25		9.5	16.5	17.0	57.0	C
AB	25-42		7.9	14.8	15.0	62.3	C
BA	42-60		7.9	15.3	15.3	61.4	C
Bt1	60-150		7.2	13.0	15.8	64.0	C
IIBt2	150+	78.5	14.5	7.8	14.9	62.8	C
cmol(+)/kg							
Ca (HCl N/20)	Mg	K (HCl N/20)	Na	H^+	Al^{3+}	Al sat. (m)	Base sat. %
9.9		0.38					
6.9		0.10					
6.5		0.08					
6.3		0.08					
-		-					
cmol(+)/kg						bar	%
CEC_{soil} sum of cations	CEC_{soil} NH_4OAc	CEC_{soil} bases+Al	CEC_{soil} (Ca)	pH H_2O	pH KCl	1/3	15
			17.6	5.7			
			14.6	5.6			
			13.9	5.6			
			14.6	5.7			
			13.0	5.9			
organic matter %	organ. C %	N %	free Fe_2O_3 (%)clay	Avail. P ppm	P.tot. mg/100 g	$CaCO_3$%	EC sat. dS/m
	2.17	0.173	10.7				
	1.34	0.147	10.5				
	0.88	0.091	10.9				
	0.53	0.072	10.7				
	-	-	10.2				

Profile ZR033 (formerly 207)

Classification:	Eutric Fluvisols, FLe (FAO, 1990) Imperfectly drained, humiferous, eutrophic, tropical brown soil soils, series FO-B6hE (INEAC)
Source:	Sys (1972), description in 1958
Location:	Mateba, Lower Congo
Coordinates:	05° 50’S; 12°55’E -05.83°; 12.92°
Terrain unit:	201/1, Congo estuarine plain
Altitude:	0-5 m
Topography:	alluvial swamps
Drainage:	imperfect, groundwater at 1 m
Parent material:	recent alluvium with shells
Vegetation:	fallow
Climate:	(Aw)S, mean annual temperature 25°C, mean annual rainfall 1,050 mm, 140-150 days of dry season

Profile description

Ap1	0-15 cm	Loam to clay loam; dark grey (10YR 4/1, moist); moderate crumb structure; many roots; firm; many shells; distinct and smooth transition.
Ap2	15-30 cm	Clay loam ; dark grey (10YR 4/1); moderate, fine and very fine, angular blocky; firm; many roots; distinct and smooth transition.
C1g	30-52 cm	Clay loam; olive brown (2.5Y 5/3, moist), with mottles; strong, fine, angular blocky, compact when dry; common roots; gradual and smooth transition.
C2g	52-81 cm	Clay loam; olive brown (2.5Y 5/3, moist), with grey spots (2.5Y 5/1) and mottles; strong, coarse, prismatic structure; compact when dry; few roots; distinct and smooth transition.

C3r 81-100 cm Clay; pale grey (2.5Y 7/2); massive; plastic; few roots.

Analytical data of profile ZR033

horizon	depth (cm)	> 2 mm %	coarse sand 0.25-2 mm	fine sand 0.05-0.25 mm	silt 0.05 - 0.002 mm	clay < 0.002 mm	texture USDA
Ap	0-15		2.6	23.6	43.7	30.1	CL
Ap2	15-30		2.0	23.0	40.9	34.1	CL
C1g	30-52		0.8	20.6	41.7	36.9	CL
C2g	52-81		0.4	17.7	44.3	37.6	SiCL
C3r	81-100		0.4	17.8	37.1	44.7	C
cmol(+)/kg							
Ca (HCl N/20)	Mg	K (HCl N/20)	Na	H^+	Al^{3+}	Al sat. (m)	Base sat. %
24.7		0.40					
25.5		0.41					
24.2		0.33					
12.1		0.43					
6.8		0.52					
cmol(+)/kg						bar	%
CEC_{soil} sum of cations	CEC_{soil} NH_4OAc	CEC_{soil} bases+Al	CEC_{soil} (Ca)	pH H_2O	pH KCl	1/3	15
			19.3	7.2			
			19.8	7.4			
			16.2	7.7			
			12.7	7.9			
			12.8	7.6			
organic matter %	organ. C %	N %	free Fe_2O_3 (%)clay	avail. P ppm	P.tot. mg/100 g	$CaCO_3$%	EC sat. dS/m
	1.72	0.149					
	1.39	0.120					
	0.74	0.071					
	0.18	0.038					
	0.10	0.033					

Profile ZR034 (formerly 210)

Classification:	Eutric Gleysols, FLe (FAO, 1990) Poorly drained, hydro-ferralsols, on clayey sand alluvium, series FÊ-F8 (INEAC)
Source:	Sys (1972), description in 1966
Location:	Lisala, Bolamba zone, Congo river
Coordinates:	01° 55’N; 21°20’ E 01.92°; 21.33°
Terrain unit:	202, Central Congo basin alluvial plain
Altitude:	400 m ?
Topography:	alluvial valley
Drainage:	very poor
Parent material:	clayey sand alluvium
Vegetation:	temporary inundated forest
Climate:	(Am)N, mean annual temperature 24°C, mean annual rainfall 1,800 mm

Profile description

O	3-0 cm	Decomposing organic matter
Ah1	0-11 cm	Sandy clay loam; (10YR 3/3, moist); massive; loose; moist; abundant roots; clear transition.
Ah2	11-40 cm	Sandy clay loam; (2.5YR 4/1); massive; loose; moist; abundant roots; few localised mottles; gradual transition.
ACg	40-74 cm	Sandy clay loam; (2.5Y 5-6/2, moist); massive; loose; moist; common mottles; many roots; gradual transition.
C1g	74-120 cm	Sandy clay loam; (2.5Y 6/2, moist); massive; loose; moist; no roots; intense mottling; clear transition.
C2r	120+ cm	Sandy clay loam; (2.5Y 7/0); massive; loose; humid; reduced substratum.

Analytical data of profile ZR034

horizon	depth (cm)	> 2 mm %	coarse sand 0.25-2 mm	fine sand 0.05-0.25 mm	silt 0.05 - 0.002 mm	clay < 0.002 mm	texture USDA
Ah1	0-11		39.0	37.3	2.7	21.0	SCL
Ah2	11-40		39.5	35.5	3.0	22.0	SCL
ACg	40-74		33.6	41.3	2.8	22.3	SCL
C1g	74-120		43.9	33.7	2.2	20.3	SCL
C2r	120+		47.7	30.0	1.9	19.9	SL
cmol(+)/kg							
Ca (HCl N/20)	Mg	K (HCl N/20)	Na	H^+	Al^{3+}	Al sat. (m)	Base sat. %
1.0		0.15					
1.65		0.10					
1.9		0.07					
1.7		0.06					
1.9		0.06					
cmol(+)/kg						bar	%
CEC_{soil} sum of cations	CEC_{soil} NH_4OAc	CEC_{soil} bases+Al	CEC_{soil} (Ca)	pH H_2O	pH KCl	1/3	15
			5.3	4.4			
			3.15	4.8			
			2.3	5.3			
			1.9	5.2			
			1.85	4.9			
organic matter %	organ. C %	N %	free Fe_2O_3 (%)clay	avail. P ppm	P.tot. mg/100 g	$CaCO_3$%	EC sat. dS/m
	1.89	0.187					
	1.82	0.090					
	0.49	0.052					
	0.15	0.024					
	0.09	0.014					

Profile ZR035 (formerly 211)

Classification:	Eutric Vertisols, VRe (FAO, 1990) Tropical black clays on alluvium, series FI-N3 (INEAC)
Source:	Sys (1972), description in 1958
Location:	Ituri, Ishwa plain
Coordinates:	02° 10'N; 31°05' E 02.17°; 31.08°
Terrain unit:	1220, Rift valley floor
Altitude:	700 m ?
Topography:	flat
Drainage:	well drained
Parent material:	clayey alluvium
Vegetation:	savannah with *Imperata*
Climate:	(Aw)N, mean annual temperature 20°C, mean annual rainfall 1,300 mm, 70 days of dry season

Profile description

Ah1	0-12 cm	Micaceous sandy clay loam; black (10YR 2/1, moist); moderate, medium and coarse, crumb structure; very friable; moist to dry; abundant roots; gradual transition.
Ah2	12-39 cm	Slightly micaceous clay; black (10YR 2/1); strong, angular blocky structure; very hard to extremely firm; dry; common roots; gradual transition.
AC	39-75 cm	Clay; very dark greyish brown (10YR 3/2, moist); some slickensides; massive; very hard when dry; diffuse transition.
C	75-120 cm	Clay; very dark greyish brown (10YR 3/2, moist); same as above.

Analytical data of profile ZR035

horizon	depth	> 2 mm	coarse	fine	silt	clay	tex-

	(cm)	%	sand 0.25-2 mm	sand 0.05-0.25 mm	0.05 - 0.002 mm	< 0.002 mm	ture USDA
Ah1	0-12		25.2	31.2	15.2	28.4	SCL
Ah2	12-39		16.9	24.3	13.4	45.4	C
AC	39-75		17.5	24.5	13.0	45.0	C
C	75-120		14.9	13.2	14.9	47.0	C
cmol(+)/kg							
Ca (HCl N/20)	Mg	K (HCl N/20)	Na	H^+	Al^{3+}	Al sat. (m)	Base sat. %
8.8		0.63					
10.0		0.30					
9.8		0.12					
10.3		0.15					
cmol(+)/kg						bar	%
CEC_{soil} sum of cations	CEC_{soil} NH_4OAc	CEC_{soil} bases+Al	CEC_{soil} (Ca)	pH H_2O	pH KCl	1/3	15
			14.7	6.0			
			20.2	6.0			
			19.8	6.4			
			20.8	6.8			
organic matter %	organ. C %	N %	free Fe_2O_3 (%)clay	avail. P ppm	P.tot. mg/100 g	$CaCO_3$%	EC sat. dS/m
	0.97	0.104					
	0.53	0.071					
	0.23	0.042					
	0.27	0.048					

Profile ZR036 (formerly KIN25)

Classification: Geric Ferralsols, FRg (FAO, 1990)
Fine-loamy siliceous isohyperthermic Acrustoxic Kandiustult (USDA), Phonzo Series (PH)

Source:	Marcelino (1995) descript. in 1988 by Baert G.
Location:	road Kinshasa-Kikwit, between 3.2 to 3.6 km after Menkau, 200 m before the first depression on the right.
Coordinates:	04° 11’S; 15°43’E -04.18°; 15.72°
Terrain unit:	820, Batéké plateau, dissected towards the N
Altitude:	705 m
Topography:	plateau, slope < 1 %, numerous mushroom termite hills
Drainage:	well drained
Parent material:	Ocre Sand Series, Kalahari
Vegetation:	shrub savannah
Climate:	Aw4

Profile description

Ah1	0-15 cm	Loamy sand; very dark grey (10YR 3/1, moist); weak, fine to medium, subangular blocky structure; very friable; non sticky; non-plastic; abundant very fine and medium, tubular pores; abundant roots throughout; gradual and smooth transition.
Ah2	15-50 cm	Sandy loam; very dark greyish brown (10YR 3/2, moist); weak, medium to coarse, subangular blocky structure; slightly sticky, non plastic, very friable; common, very fine to fine, tubular pores; common fine roots throughout; gradual and smooth transition (note: termite nests).
ABh	50-88 cm	Sandy clay loam; yellowish brown (10YR 5/6, moist); weak, coarse, subangular blocky; slightly plastic, slightly sticky, friable; common, very fine and fine pores; common, very fine to fine roots throughout; diffuse and smooth transition (note: organic matter infiltration).
Bws1	88-137 cm	Sandy clay loam; yellowish brown (10YR 5/8, moist); weak, medium to coarse, subangular blocky; slightly sticky, slightly plastic, very friable; common, very fine and fine tubular pores; few, very fine and fine roots throughout; diffuse and smooth transition (note: organic matter infiltration).
Bws2	137-185 cm	Sandy clay loam; yellowish brown (10YR 6/8, moist); weak, coarse, subangular blocky structure; slightly sticky, slightly plastic, very friable; common, very fine and fine, tubular pores; very few, very fine and fine roots throughout (note: little organic matter infiltration).

Analytical data of profile ZR036

horizon	depth (cm)	> 2 mm %	coarse sand 0.25-2 mm	fine sand 0.05-0.25 mm	silt 0.05 - 0.002 mm	clay < 0.002 mm	tex-ture USDA
Ah1	0-15	0	12.4	70.0	1.9	15.7	SL
Ah2	15-50	0	9.7	66.6	5.8	17.9	SL
ABh	50-88	0	9.8	60.1	6.2	23.9	SCL
Bws1	88-137	0	8.8	62.0	6.8	22.4	SCL
Bws2	137-185	0	9.3	57.1	4.1	29.5	SCL
by NH_4Oac, in cmol(+)/kg							
Ca	Mg	K	Na	Exchan. Acidity	Al^{3+}	Al sat. (m)	Base sat. %
0.18	0.05	0.08	0.41	0.83	0.46	30	11
0.05	0.02	0.05	0.02	0.86	0.60	60	3
0.10	0.02	0.03	0.03	0.24	0.19	45	6
0.06	0.01	0.02	0.05	0.41	0.39	71	4
0.07	0.01	0.01	0.03	0.38	0.32	64	5
cmol(+)/kg						bar	%
CEC_{soil} sum of bases + acidity	CEC_{soil} NH_4OAc	$ECEC_{soil}$ sum of bases + Al	CEC_{soil} (Ca)	pH H_2O	pH KCl	1/3	15
1.55	6.86	1.18		5.2	4.1		
1.00	5.22	0.74		4.7	4.2		
0.42	2.92	0.37		4.7	4.3		
0.55	3.30	0.53		4.7	4.4		
0.50	2.62	0.44		4.9	4.5		
organic matter %	organ. C %	N %	free Fe_2O_3 (%)clay	avail. P mg/kg (Bray2)	P.tot. mg/100 g	$CaCO_3$%	EC sat. dS/m
	1.36	0.088		98.78			
	0.93	0.059		20.99			
	0.67	nd		nd			
	0.23	nd		nd			
	nd	nd		nd			

Profile ZR037 (formerly MA4)

Classification: Luvic Arenosols, ARl (FAO, 1990)
Siliceous isohyperthermic Ustic Quartzipsamment (USDA), Mpese series (Mp)

Source: Marcelino (1995), descrip. in 1988 by Baert G.

Location: road Boma-Moanda, beside the Kitona military base

Coordinates:	05° 53'S; 12°24'E -05.88°; 12.40°
Terrain unit:	300, coastal plateau
Altitude:	120 m
Topography:	dissected plateau, with deep valleys (> 100 m), with swampy flat bottoms; slope < 1 %
Drainage:	somewhat excessive
Parent material:	Cirques Sand Series
Vegetation:	steppe to open shrub savannah, burned beans and cassava field
Climate:	Aw5

Profile description

Ah1	0-24 cm	Sand; dark brown (10YR 3/3, moist); weak, medium, subangular blocky structure; very friable; non sticky; non plastic; many very fine and fine, tubular pores; abundant fine roots throughout; gradual and smooth transition (note: few bleached sand grains).
Ah2	24-70 cm	Sand; dark yellowish brown (10YR 3/2, moist); weak, medium, subangular blocky structure; non sticky, non plastic, very friable; common, very fine and fine, tubular pores; many very fine and fine roots throughout; gradual and smooth transition (note: few bleached sand grains).
Bws1	70-103 cm	Loamy sand; yellowish brown (10YR 4/6, moist); single grain to weak, coarse, subangular blocky; non sticky, non plastic, very friable; common, very fine, tubular pores; few, very fine and fine roots throughout; diffuse and smooth transition (note: organic matter infiltration in spots and pockets).
Bws2	103-145 cm	Loamy sand; yellowish brown (10YR 5/6, moist); single grain, non-sticky, non-plastic, very friable; few, very fine, tubular pores; few, very fine roots throughout; diffuse and smooth transition (note: organic matter infiltration in spots and pockets).
Bws3	145-200 cm	Loamy sand; yellowish brown (10YR 5/8, moist); single grain; non-sticky, non-plastic, very friable; few, very fine tubular pores; very few, very fine and fine roots throughout (note: organic matter infiltration in spots and pockets).

Analytical data of profile ZR037

horizon	depth	> 2 mm	coarse	fine	silt	clay	tex-

	(cm)	%	sand 0.25-2 mm	sand 0.05-0.25 mm	0.05 - 0.002 mm	< 0.002 mm	ture USDA
Ah1	0-24	0	75.8	15.2	4.5	4.5	S
Ah2	24-70	0	73.8	14.2	6.5	5.5	S
Bws1	70-103	0	63.0	22.4	5.8	8.8	LS
Bws2	103-145	0	68.1	20.4	3.5	8.0	LS
Bws3	145-200	0	61.7	24.1	4.7	9.5	LS
by NH_4Oac, in cmol(+)/kg							
Ca	Mg	K	Na	Exchan. Acidity	Al^{3+}	Al sat. (m)	Base sat. %
0.26	0.23	0.03	0.03	-	-	-	30
0.05	0.01	0.01	0.01	0.45	0.39	74	5
0.03	0.01	0.01	0.01	0.40	0.32	70	4
0.05	0.01	0.01	0.01	0.17	0.15	60	6
0.04	0.01	0.02	0.01	0.22	0.20	67	5
cmol(+)/kg						bar	%
CEC_{soil} sum of bases + acidity	CEC_{soil} NH_4OAc	$ECEC_{soil}$ sum of bases + Al	CEC_{soil} (Ca)	pH H_2O	pH KCl	1/3	15
0.55	1.82	0.55		5.8	4.5		
0.53	1.66	0.47		5.2	4.3		
0.46	1.68	0.38		5.3	4.3		
0.25	1.40	0.23		5.5	4.5		
0.30	1.50	0.28		5.4	4.5		
organic matter %	organ. C %	N %	free Fe_2O_3 (%)clay	avail. P mg/kg (Bray2)	P.tot. mg/100 g	$CaCO_3$%	EC sat. dS/m
	0.39	0.026		112.43			
	0.18	0.019		47.48			
	0.14	nd		nd			
	0.11	nd		nd			
	nd	nd		nd			

Profile ZR038 (formerly KIN22)

Classification: Carbic Podzols, PZc (FAO, 1990) Sandy siliceous isohyperthermic Typic Haplohumod (USDA), Lingezi Series (Li)

Source: Marcelino (1995), description in 1988 by Baert G. and Embrechts J.

Location: road Kinshasa-Kikwit, 3.6 km after Menkau, 200 m before the first depression on the right

Coordinates: 04° 11’S; 15°43’E

-04.18°; 15.72°

Terrain unit: 820, Batéké plateau, dissected towards the N

Altitude: 696 m

Topography: Lower slope of minor closed depression in the Batéké plateau, slope %

Drainage: imperfectly drained

Parent material: Ocre Sand Series, Kalahari

Vegetation: Slightly shrub-covered steppe with *Loudetia simplex*

Climate: Aw4

Profile description

Ah 0-20 cm Sand; very dark grey (2.5YR 3/0, moist); weak, medium to coarse, subangular blocky structure; non sticky; non plastic; loose; common, fine and medium, tubular pores; many, fine roots throughout; distinct to gradual, smooth transition (note: bleached sands and termite activity).

AE 20-35 cm Sand; dark greyish brown (2.5Y 4/1, moist); single grain, non-sticky, non-plastic, loose; common, fine, tubular pores; few to common fine roots throughout; gradual and smooth transition (note: bleached sand and termite activity).

E 35-50/70 cm Sand; light grey (10YR 7/1, moist); single grain; non plastic, non sticky, loose; common, fine tubular pores; few, very fine to fine roots throughout; distinct to abrupt and undulating transition (note: humus in pockets and sheets in the lower part of the horizon, few prehistoric arrow points).

Bh 50/70-53/75 cm Sand to loamy sand; black (10YR 2/1, moist) and light grey (10YR 7/1, moist); single grain; non-sticky, non-plastic, very friable; few, very fine and fine tubular pores; few, very fine roots throughout; distinct and undulating transition.

Bhsm1 53/75-60/110 cm Sand to loamy sand; black (2.5Y 2/0, moist); massive; very firm, extremely hard; moderately cemented; gradual and undulating transition.

Bhsm2 60/110-100/125 Loamy sand; strong brown (7.5YR 4/6, moist); massive; extremely firm, extremely hard; moderately cemented; abrupt and undulating transition.

BC
100/125-145cm+ Loamy sand to sandy loam; dark brown (10YR 4/3, moist); massive; slightly sticky, non-plastic, very friable; common, very fine and fine, tubular pores (note: between the Bhsm2 and the BC occurs a lens of very loose white sand, with visible sedimentary structure).

Analytical data of profile ZR038

hori-zon	depth (cm)	> 2 mm %	coarse sand 0.25-2 mm	fine sand 0.05-0.25 mm	silt 0.05 - 0.002 mm	clay < 0.002 mm	tex-ture USDA
Ah	0-20	0	11.2	81.5	4.6	2.7	S
AE	20-35	0	12.0	80.7	6.8	0.5	S
E	35-50/70	0	13.0	81.3	5.0	0.7	S
Bh	50/70-53/75	0	10.5	79.2	5.6	4.7	S
Bhsm1	53/75-60/110	0	10.9	76.3	6.6	6.2	S
Bhsm2	60/110-100/125	0	10.4	67.2	3.7	18.7	SL
BC	100/125-145+	0	10.6	70.8	4.1	14.5	SL
by NH_4Oac, in cmol(+)/kg							

Ca	Mg	K	Na	Exchan. Acidity	Al^{3+}	Al sat. (m)	Base sat. %
0.57	0.15	0.06	0.02	2.04	1.60	56	8
0.15	0.03	0.01	<0.01	0.43	0.25	40	9
0.14	0.04	0.01	0.01	-	-	-	27
0.20	0.04	0.02	0.02	2.80	2.25	73	1
0.08	0.03	0.01	0.01	4.18	3.50	81	<1
0.12	0.03	<0.01	0.01	2.47	2.10	80	<1
0.21	0.04	0.01	0.01	1.85	1.45	68	2
cmol(+)/kg						bar	%
CEC_{soil} sum of bases + acidity	CEC_{soil} NH_4OAc	$ECEC_{soil}$ sum of bases + Al	CEC_{soil} (Ca)	pH H_2O	pH KCl	1/3	15
2.84	9.48	2.40		4.4	3.3		
0.62	2.08	0.44		5.3	4.3		
0.20	0.74	0.20		5.6	4.4		
3.08	19.68	2.53		5.0	3.9		
4.31	34.74	3.63		4.2	3.6		
2.63	30.66	2.26		4.7	3.9		
2.12	12.24	1.72		5.0	4.1		
organic matter %	organ. C %	N %	free Fe_2O_3 (%)clay	avail. P mg/kg (Bray2)	P.tot. mg/100 g	$CaCO_3$%	EC sat. dS/m
	2.70	0.076		38.72			
	0.74	0.012		6.95			
	0.23	nd		nd			
	5.08	nd		nd			
	7.50	nd		nd			
	4.04	nd		nd			
	3.06	nd		nd			

Profile ZR039 (formerly SO13)

Classification: Xanthic Ferralsols, FRx (FAO, 1990)
Typic Haplustox (USDA)
Hygro-xeroferrisols, intergrades to Ferralsols (INEAC)

Source: Baert (1995), description in 11/1988

Location: road Matadi-Kinshasa, at the bridge over the Kwilu river, at 34 km from Songololo towards Kimpese

Coordinates: 05° 38’S; 14°16’E
-05.63°; 14.27°

Terrain unit: 710, Schisto-Calcaire depression

Altitude:	270 m
Topography:	summit of rounded hill, slope < 1 %; surroundings: steeply dissected landscape, maximal slopes > 30 %.
Drainage:	well drained
Parent material:	calcareous schists and limestone
Vegetation:	shrub savannah
Climate:	Aw4

Profile description

Ah	0-12 cm	Clay; black (10YR 2/1, moist) and very dark grey (10YR3/1, dry); weak to moderate, medium, subangular blocky structure; friable, sticky, slightly plastic; common, fine and medium, tubular and vesicular pores; frequent, fine and medium roots, throughout the horizon; clear and wavy transition.
ABh	12-30 cm	Clay; dark brown (10YR 4/3, moist) and brown (10YR 5/3); weak to moderate, medium to coarse, subangular blocky structure; sticky, slightly plastic, firm to friable; common, very fine and fine, tubular pores; common, very fine and fine roots, throughout the horizon; gradual and wavy transition (note: termite nests).
Bt1	30-66 cm	Clay; yellowish brown (10YR 5/6, moist), brownish yellow (10YR 5/8, dry); weak, medium to coarse, subangular blocky; sticky, slightly plastic, firm; common patchy clay coatings, with iron-oxides and hydroxides on ped surfaces and in root channels and pores; common, very fine and fine, tubular pores; few, very fine roots, throughout the horizon; clear to diffuse and smooth transition (note: organic matter infiltration in between aggregates).
Bt2	66-104 cm	Clay; yellowish brown (10YR 5/8, moist), brownish yellow (10YR 6/6, dry); weak, coarse, subangular blocky; sticky, slightly plastic, firm; common, patchy clay coatings, with iron-oxides and hydroxides, on ped surfaces; common, very fine, tubular pores; few, very fine roots, throughout the horizon; diffuse and smooth transition (note: organic matter infiltration in between aggregates).
Bt3	104-152 cm	Clay; yellowish brown (10YR 5/8, moist) and brownish Yellow (10YR 6/7, dry); weak, medium to coarse, subangular blocky; sticky, slightly plastic, firm to friable; common patchy clay coatings, with iron-oxides and hydroxides, on ped surfaces; few to common, very fine, tubular pores; very few, very fine roots, throughout the horizon; abrupt and wavy transition (note: organic matter infiltration in between aggregates).
2St.L	152-164cm	Clay; brownish yellow (10YR 6/8, moist) and yellow

(10YR 7/6, dry); weak, fine, subangular blocky structure; sticky, slightly plastic, friable; few patchy clay coatings, with iron-oxides and hydroxides, in root channels, pores and on iron nodules; few, very fine, tubular pores; abundant, small, spherical, hard and irregular, red iron nodules; very few, very fine roots throughout the horizon; abrupt and wavy transition.

3BSA 164-210 cm Clay to silty clay; light yellowish brown (2.5Y 4/8, moist), with many red (2.5YR 4/8), fine and medium, prominent, sharp mottles; massive to weak, coarse, subangular blocky; sticky, slightly plastic, friable; few, very fine, tubular pores; few, fresh to slightly weathered chert fragments, gravel size; few to common, small, soft, irregular, red iron nodules; very few, very fine roots throughout the horizon; gradual and smooth transition (note: thin layer of weathered chert at the base of the horizon).

3SA 210-290 cm Silty loam; yellow (10YR 7/8, moist), with common, red (2.5YR 4/8), fine, clear, distinct mottles; stratified; slightly sticky, slightly plastic, very friable; few, very fine, tubular pores; fine layers of parallel, non weathered chert in the horizon; clear, wavy transition.

R 290+ cm Shallow transition of weathered limestone (< 5 cm) over non weathered rock.

Analytical data of profile ZR039

horizon	depth (cm)	> 2 mm %	co.sand 0.25-2 mm	f.sand 0.05-0.25 mm	silt 0.05 - 0.002 mm	cl. < 0.002 mm	tex-ture USDA
Ah	0-12		1.2	7.1	28.4	63.3	C
ABh	12-30		0.9	5.1	32.7	61.3	C
Bt1	30-66		0.8	4.0	25.7	69.5	C
Bt2	66-104		0.8	3.7	24.0	71.5	C
Bt3	104-152		0.6	3.7	27.2	68.5	C
2St.L.	152-164	60	1.0	4.8	26.9	67.3	C
3BSA	164-210		1.3	5.9	35.3	57.3	C-SiC
3SA	210-290		1.6	9.3	71.5	19.0	SiL
CR	460-490		2.6	7.5	72.9	17.8	SiL
by NH_4Oac, in cmol(+)/kg							
Ca	Mg	K	Na	Exchan. Acidity	Al^{3+}	Al s. (m)	Base s. %

1.07	0.39	0.39	0.02	4.65	4.45	70	13
0.18	0.07	0.08	0.01	4.60	4.45	93	7
0.15	0.05	0.11	0.01	4.10	3.85	92	7
0.15	0.04	0.11	0.01	4.13	3.75	92	6
0.17	0.04	0.10	0.01	3.58	3.90	92	2
0.46	0.13	0.23	0.02	3.53	2.95	78	9
0.35	0.11	0.05	0.01	2.42	3.10	86	11
0.42	0.11	0.10	0.03	-	-	-	5
3.65	3.00	0.16	0.07	-	-	-	53
cmol(+)/kg						bar	%
CEC_{soil} bases+ acidity	CEC_{soil} NH_4OAc	$ECEC_{soil}$ sum of bases+Al	CEC_{soil} (Ca)	pH H_2O	pH KCl	1/3	15
	14.02	6.32		4.6	3.8		
	5.24	4.81		4.6	3.8		
	4.94	4.17		5.3	3.8		
	5.08	4.06		5.2	3.9		
	13.84	4.22		5.2	3.8		
	9.90	3.79		4.3	3.8		
	4.86	3.62		5.1	3.8		
	15.24	0.66		5.6	4.3		
	12.96	6.88		6.3	5.2		
organic matter%	organ. C %	N %	free Fe_2O_3(%)	avail. P ppm	P.tot.	$CaCO_3$%	EC dS/m
	2.27	0.201		23			
	0.98	0.130		6			
	0.38	nd		nd			
	0.28	nd		nd			

Profile ZR040 (formerly BO52)

Classification: Haplic Lixisols, LXh (FAO, 1990)
Fine clayey, mixed-kaolinitic, isohyperthermic Kanhaplic Rhodustalfs (USDA)
Typic xeroferrisols (INEAC)

Source: Baert (1995), description in 03/1989

Location: Boma, road to Bralima, 900 m before the factory

Coordinates: 05° 51'S; 13°06'E
-05.85°; 13.10°

Terrain unit: 600/2, Mayombe, main sector

Altitude: 150 m

Topography: strongly dissected area; slightly convex upper slope; slope 15 %; irregular micro-topography due to stoniness and erosion.

Drainage:	well drained
Parent material:	biotite mica schists
Vegetation:	open shrub savannah
Climate:	Aw4-5
Surface stoniness:	abundant angular and subangular quartz gravels and stones, many rock outcrops
Erosion:	sheet erosion, often rill and gully erosion

Profile description

Ah	0-12 cm	Sandy clay loam, extremely gravelly; dark reddish brown (5YR 2/2, moist; 5YR 3/2, dry); moderate, fine, subangular blocky structure; hard, friable to firm, slightly sticky, slightly plastic; many, very fine and fine, tubular pores; abundant fresh angular quartz gravels; many, fine roots throughout the horizon and around stones; clear and smooth transition (note: many mica flakes).
Bt1	12-43 cm	Clay, very gravelly; dark reddish brown (2.5YR 3/4, moist) and dark red (2.5YR 3/6, dry); moderate, fine to medium, subangular blocky structure; sticky, slightly plastic, hard, firm; common patchy clay cutans, with iron-oxides and hydroxides on ped surfaces; common, very fine and fine, tubular pores; abundant fresh angular quartz gravels; common, very fine and fine roots throughout the horizon; clear to gradual and smooth transition (note: many mica flakes).
Bt2	43-82 cm	Light clay, slightly gravelly; dark red (10R 3/6) and light yellowish brown (10YR 6/4) moist; with common, medium, faint, diffuse, red (7.5R 4/6) mottles; moderate, medium, subangular blocky; sticky, slightly plastic, firm; common discontinuous clay coatings, with iron-oxides and hydroxides, on ped surfaces; few to common, very fine and fine, tubular pores; few fresh angular quartz gravels; few, very fine roots throughout the horizon; gradual and smooth transition (note: many mica flakes).
BtSA	82-115 cm	Clay loam, slightly gravelly; dark red (10R 3/6, moist), with many, medium, faint, diffuse, red (7.5R 4/6) mottles; weak to moderate, coarse subangular blocky; sticky, slightly plastic, firm; common,

discontinuous clay coatings, with iron-oxides and hydroxides, on ped surfaces; few, very fine and fine, tubular pores; few fresh angular quartz gravels and many strongly weathered and iron-impregnated rock fragments; few, very fine roots throughout the horizon; clear and smooth transition (note: many mica flakes).

SA1 115-185 cm Sandy loam; red (7.5R 4/6, moist); massive; stratified; sticky, slightly plastic, friable; few, very fine tubular pores; very few, very fine roots all throughout the horizon; gradual and smooth transition (note: many mica flakes).

SA2 185-230 cm Sandy loam to loamy sand; red (7.5R 4/6, moist); massive; stratified; sticky, slightly plastic, friable to firm; few very fine, tubular pores; very few, very fine roots throughout the horizon; gradual and wavy transition (note: many mica flakes).

Analytical data of profile ZR040

horizon	depth (cm)	> 2 mm %	coarse sand 0.25-2 mm	fine sand 0.05-0.25 mm	silt 0.05 - 0.002 mm	clay < 0.002 mm	tex-ture USDA
Ah	0-12	70	32.2	28.6	11.9	27.3	SCL
Bt1	12-43	26	16.4	10.5	17.6	55.5	C
Bt2	43-82	6	8.2	11.0	33.5	47.3	C
BtSA	82-115	5	12.9	19.8	30.8	36.3	CL
SA1	115-185	-	28.5	45.1	19.9	6.5	SL
SA2	185-230	-	40.8	35.2	20.2	3.8	SL-LS
by NH_4Oac, in cmol(+)/kg							
Ca	Mg	K	Na	Exchan. Acidity	Al^{3+}	Al sat. (m)	Base sat. %
1.32	2.31	0.33	0.03				64
0.31	3.68	0.39	0.02				52
0.20	4.66	0.45	0.04				59
0.20	4.23	0.42	0.05				68

0.31 0.10	2.75 3.25	0.29 0.18	0.03 0.01				100 84
cmol(+)/kg						bar	%
CEC_{soil} sum of bases + acidity	CEC_{soil} NH_4OAc	$ECEC_{soil}$ sum of bases + Al	CEC_{soil} (Ca)	pH H_2O	pH KCl	1/3	15
	6.24 8.50 9.02 7.24 3.24 4.24	3.99 4.40 3.35 4.90 3.38 3.54		6.3 6.1 6.2 6.2 6.4 6.4	5.0 5.2 5.7 5.7 5.6 5.0		
organic matter %	organ. C %	N %	free Fe_2O_3(%)	avail. P ppm	P.tot. g/100g	$CaCO_3$%	EC sat. dS/m
	1.28 0.92 0.28 0.50 nd nd	0.087 0.071 nd nd nd nd		10 10 nd nd nd nd			

Appendix 2

Legend for the revised soil map of the DRC (FAO classification, 1990)

Associated soils cover > 20 %, inclusions < 20 % of the soil mapping unit.

region	soil mapping units	asso. soils	inclusions ; soil phases (partly)	corresponding terrain units	IDNr.
Congo estuary	FLe 1 - 2/3a	RG	salic, inundic, phreatic phases	201/1	1
Lower Congo alluvial plain	FLe 2 - 2/3a	-	inundic and phreatic phases	201/2	2
Coastal plain	GLe 1 – 1a	ARh	GLu, PT; inundic, salic and phreatic phases	100	3
Katanga depressions	GLe 2 - 2/3a	FLe	GLu, HS; inundic phase	204 205	4
Congo alluvial plain	GLd 1 - 2a	PT, FLd	HS; inundic and phreatic phases	202	5
Congo-Ubangi swamps	GLu 1 - 2a	FRx, HS	inundic phase	203	6
Lake Albert plains (Rift Valley)	GLu 2 - 2a	HS	FLe; inundic, phreatic, salic, sodic phase	1220	7
Lake Mweru depression	HS 1 – a	GL	FLe; Inundic phase	205	8
Coastal plateau (E)	LXh 1 - 1a	-	ACh, CMe	300/2	9
Coastal Plateau, main sector	ARo 1 - 1a	-	LXf, FRh, ACh	300/1	10
Kalahari and other cover sands	ARo 2 - 1a	ARa	GL, PZ; rudic phase	810/1, 810/5 830/1, 830/2	11
NW Kwango sandy plateau	ARo 3 - 1/2ab	FRh	RG, GL	810/2	12
SE Kwango sandy plateaux	ARo 4 - 1a	ARl	RGe, FRh, FRr	810/3	13

region	Soil mapping units	asso. soils	inclusions; soil phases (partly)	corresponding terrain units	IDNr.
Katanga	ARo 5 - 1/2b	FRh	GL	1020 1030 530	14
Kundelungu plateau	ARo 6 - 1a	FRx	LXf, FRh, ACh; petroferric phase	1040	15
W + central Katanga	ARb 1 - 1a	ARo	GL, PZ	830	16
Congo river slopes	RGd 1 – 1/2b	ARo, LPe	lithic, rudic phase	810/4	17
Katanga depressions	VRe 1 - 3a		GLe, FLe; inundic, phreatic phases	204	18
Rift Valley floor	VRe 2 - 3a	SCm	GL; phreatic, inundic, salic, sodic phase	1220	19
Mayombe, NW sector	NTh 1 – 2/3ab	FRh	ACp, FRp; lithic, rudic phases	600/1	20
Mayombe, NE sector	NTh 2 –3c	FRh	ACu lithic, rudic phases	600/3	21
Valley slopes (N)	NTh 3 - 2/3a	FRh, AR	-	840/1, 910	22
Kivu basalt plateaux	NTh 4 - 3bc	-	LP, GLe; rudic, lithic phase	1130	23
Lowa river	NTh 5 - 3b	-	GLe, PT	910, 990	24
Salonga plateaux	NTh 6 - 3a	-	-	420	25
Lindi plateaux	NTh 7 - 3b	FRh	GL; petroferric phase	930	26
Bunia (Lake Albert-Edward) highlands	NTh 8 – 3bc		rudic; lithic phase	1240	27
Schisto-Calcaire depression	NTh 9 - 2/3ab	FRh	ACp, FRp; rudic, lithic phase	710/2	28
NE Congo	NTh 10 - 2b	NTu, RGd	LPe; petroferric phase	970	29
Kindu	NTh 11 – 2/3a			420	30
Kivu	NTh 12 – 3b			990	31
Eastern highlands	NTu 1 - 2/3c	FRh	LPe; rudic phase	1210 1250 1120	32
Eastern highlands	NTu 2 - 2/3c	CMu	LPe; rudic, lithic phase	1210	33
Lake Edward	NTu 3 - 2/3c	FRh	CMd	1120	34
Mayombe, main sector	FRh 1 - 2/3ab	NTh, LXh	FRx, FRp; lithic, rudic phases	600/2	35
Schisto-Calcaire depression	FRh 2 - 2/3ab	NTh, FRx	FRr, FRp; rudic or lithic phase	710	36

region	Soil mapping units	asso. soils	inclusions ; soil phases (partly)	corresponding terrain units	IDNr.
Valley slopes (S)	FRh 3 - 2/3b	FRr	FRx, AR, LP	840/2, 1010	37
S Katanga plateaux, Lower Kasai	FRh 4 - 3ab	FRx	FRr, GL, NT	420, 1030	38
S Katanga plateaux	FRh 5 - 2/3a	FRx	GL, LP, NT	1030, 1010	39
NE and NW Congo	FRh 6 - 3ab	GLd, FRr	petroferric phase	510, 930, 940, 950, 960, 970, 980, 1010,1110, 1120, 1240	40
"	FRh 7 - 3a	NTh	-	980 510	41
Schisto-Greseux plateaux	FRh 8 - 3ab	FRx	FRr, GL, NT; petroferric, lithic, rudic phases	720	42
Salonga plateaux	FRx 1 - 1/2a	ARo	GLd, ARb	420, 420/2, 1010	43
Yangambi plateaux	FRx 2 - 2a	FRh	GL; petroferric, skeletic phase	430	44
Low plateaux of Congo Basin	FRx 3 - 2a	FRp, GL	FL; petroferric phase	410	45
Katanga Kalahari sands	FRx 4 – 1/2a	ARo	ARb	830/2, 830/3	46
Maniema plateaux	FRr 1 - 3ab	FRh	FRp, GL	910 920 990 1020 500	47
Marunga, Tanganyika	FRu 1 - 3b	NTu	GL; lithic, rudic phases	1120	48
Aru highlands	FRu 2 - 3bc	FRh, NTu	GLu; lithic, rudic phase	1230	49
Batéké plateau	FRg 1 - 1/2a	ARo	PZc, CMu, GL	820	50
Volcanic ash zone	ANm 1 - 2/3c	CMe, NT	GL	1140	51
Virunga chain	ANm 2 - 1/2c	CMu, RGe	LP; rudic, lithic phase	1150	52
Volcanic ash zone	LP-RGe-ANm-a	-	-	1140	53
Ruwenzori massif	LP-LPu-c	-	lithic, rudic phase	1260	54
North Virunga Mts	LP - c			1150	55
W Virunga lava plains	LP-RGe-ANm-a		rudic, lithic phase	1140	56
Lake Albert	CMe 1 - 2/3a	CMx	VRe	1220	57

~~ water surfaces (lakes, ocean)

APPENDIX I

SOIL PROFILE DESCRIPTIONS

Introduction

The following soil profile descriptions have been selected for - and entered in - the SOTER programme (version 2.5m). A database diskette has been sent, together with the report, to FAO, Land and Water Development Division.

The SOTER programme only considers part of the soil data. Therefore, the soil profile descriptions have been completely reproduced and translated in this volume of the report.

Soil surveys in the DRC mainly took place during the fifties/sixties and soils were classified according to the INEAC Soil Classification System.

During this study typical soil profiles have been given a tentative FAO soil classification (1990).

An attempt has been made to choose adequate master horizon symbols (A,B,C) and to give symbols to the subordinate properties (concretions, salts, cementations...).

Climatic regimes and symbols belong to the Köppen classification.

A new numbering was attributed to the soil profiles, starting with the country ISO code (ZR…). The former profile numbers are also mentioned.

IMPORTANT

Attention is drawn to the fact that part of the soil analyses at the INEAC were done with other methods than those required for the SOTER database. In this way:

- Exchangeable cations (Ca and K) were determined with the HCl N/20 test. Magnesium and sodium were not determined.
- The cation exchange capacity (CEC) was determined with the calcium method (using NH_4Cl).

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1210	ZR006	Humic Acrisols	16
1210	ZR001	Humic Cambisols	6
1210	ZR011	Humic Nitisols	27
1220	ZR035	Eutric Vertisols	77
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1240	ZR007	Xanthic Ferralsols	18

soil profiles - terrain units/components

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ZR006	1210	Humic Acrisols	16
ZR007	1240	Xanthic Ferralsols	18
ZR008	1210	Humic Acrisols	20
ZR009	1140	Mollic Andosols	22
ZR010	1140	Mollic Andosols	24
ZR011	1210	Humic Nitisols	27
ZR012	830/2	Ferralic Arenosols	29
ZR013	1040	Xanthic Ferralsols	31
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ZR022	980	Haplic Ferralsols	50
ZR023	1230	Humic Ferralsols	52
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ZR025	1030	Haplic Ferralsols	56
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soil profile	terrain unit	soil classification	page
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ZR040	600/2	Haplic Lixisols	89

Profile ZR001

Classification:	Humic Cambisols, CMu (FAO, 1990)
Source:	INEAC (1960) and FAO (1977)
Location:	Eastern slope of the Luholo, Kivu
Coordinates:	02° 05’S; 28° 30’E -02.08°; 28.50°
Terrain unit:	1210, eastern highlands
Altitude:	1,170 m a.s.l.
Physiography:	Hilly landscape, midslope, SW exposure
Slope:	60 %
Drainage:	Well drained
Parent material:	granite
Climate:	2,200 mm annual precipitation, mean temperature of the coldest month 22°C; slight seasonal variations.
Vegetation:	Secondary forest.

Profile description

Ah1	0-13 cm	Very dark brownish grey (10 YR 3/2); clayey sand; moderate, medium crumb structure; loose; non-plastic, non sticky; many roots; diffuse boundary.
Ah2	13-28 cm	Dark greyish brown; clayey sand; micaceous and with fine gravels; weak medium to coarse crumb with blocky elements; friable, non-sticky, non-plastic; many roots; gradual smooth boundary.
Bw	28-60 cm	Brown (10 YR 5/3); gravelly clayey sand; micaceous, with humus infiltration; moderate, medium to coarse blocky structure, with fairly continuous greyish coatings; fairly firm in situ, non-plastic, non-sticky; common roots; diffuse boundary.
C	> 60 cm	Clayey micaceous fine gravels from granite weathering.

Analytical data of profile ZR001

horizon	depth (cm)	> 2 mm %	coarse sand 0.2-2 mm	fine sand 0.05-0.2 mm	silt 0.05 - 0.002 mm	clay < 0.002 mm	tex-ture USDA
Ah1	0-13	26.8	42.1	19.4	8.9	29.6	SCL
Ah2	13-28	42.9	51.7	17.0	7.9	23.4	SCL
Bw	28-60	47.9	54.2	17.0	8.2	20.6	SCL
C	> 60	41.0	57.4	15.2	4.6	22.8	SCL
cmol(+)/kg							
Ca (HCl N/20)	Mg	K (HCl N/20)	Na	Acidity	Ex. Al.	Al sat. (m)	Base sat. %
1.4		0.11					
1.0		0.06					
1.1		0.04					
1.1		0.03					
cmol(+)/kg						bar	%
CEC_{soil} sum cat.	CEC_{soil} NH_4OAc	CEC_{soil} bases +Al	CEC_{soil} (Ca)	pH H_2O	pH KCl	1/3	15
			8.3	4.7			
			6.0	4.9			
			4.8	4.5			
			4.8	4.5			
organ. matter %	organ. C %	N %	free Fe_2O_3 %	avail. P Truog ppm	P. total mg/100g	$CaCO_3$%	EC sat. dS/m
	1.94	0.260	2.2	7			
	1.50	0.185	2.1	6			
	0.46	0.079	2.8	1			
	0.23	0.040	2.8	1			

Profile ZR002

Classification: Xanthic Ferralsols, FRx (FAO, 1990)

Source:	INEAC (1960) and FAO (1977)
Location:	West of Yangambi, near Opala (Lomami)
Coordinates:	0^{o} 45’S; 24^{o} 20’E -0.75°, 24.33°
Terrain unit:	430, Yangambi deposits plateaux
Altitude:	490 m a.s.l.
Physiography:	Plateau with slopes rarely exceeding 2 to 3 %
Slope:	2-3 %
Drainage:	Well drained
Parent material:	Yangambi lacustrine-eolian deposits
Climate:	Köppen Aw; continental characteristics; global radiation and amount of solar heat received are low, being 45 % of the solar heat possible; equatorial double periodicity; driest season January-February; annual rainfall 1,800 mm, mean annual temperature 25^{o}C.
Vegetation:	Semi-deciduous forest with Scorodophloeus zenkeri, Cynometra hankei, Dialum corbisieri, Celtis soyanxic, Oxystigma oxyphyllum, Achornea floribunda undergrowth.

Profile description

O	0- 1 cm	Shallow litter layer; roots, fine roots and leaves in various degrees of decomposition.
Ah	1-20 cm	Dark brown (7.5 YR 4/4); moist humus-bearing horizon; clayey sand; strong, fine to medium crumb structure; friable; many fine roots; clear smooth boundary.
AB	20-45 cm	(7.5 YR 5/6); infiltration horizon; clayey sand; weak, medium crumb structure; friable; few fine roots; diffuse boundary.
Bw	45-65 cm	(7.5 YR 5/8); structural horizon; clayey sand; weak, medium, subangular blocky structure; firm; few fine roots; diffuse boundary.
Co1	65-110 cm	Parent material (7.5 YR 5/8); Clayey sand; strong (floury) very fine crumb; friable; few fine roots.
Co2	110-150 cm	Idem

Analytical data of profile ZR002

horizon	depth (cm)	> 2 mm %	coarse sand 0.25-2 mm	fine sand 0.05-0.25 mm	silt 0.05 - 0.002 mm	clay < 0.002 mm	tex-ture USDA
Ah	20		55.2	16.4	2.1	26.3	SCL
AB	45		49.9	18.1	2.0	30.0	SCL
Bw	65		41.8	17.4	2.1	38.7	SC
Co1	110		46.8	15.9	1.7	35.6	SC
Co2	150		43.1	17.1	2.2	37.6	SC
cmol(+)/kg							
Ca (HCl N/20)	Mg	K (HCl N/20)	Na	Acidity	Ex. Al.	Al s. (m)	Base s. %
1.3	0.14	0.18	0.08				
0.6							
0.4							
0.4							
cmol(+)/kg						bar	%
CEC_{soil} sum cat.	CEC_{soil} NH_4OAc	CEC_{soil} bases + Al	CEC_{soil} (Ca)	pH H_2O	pH KCl	1/3	15
			3.5	4.6			
			4.5	4.5			
			4.6	4.4			
			4.3	4.5			
			4.6	4.6			
organ. matter %	organ. C %	N %	Free Fe_2O_3 %	Avail. P Truog ppm	P.total mg/100g	$CaCO_3$%	EC sat. DS/m
	1.15	0.098	3.8	4			
	0.52	0.056	3.4	1			
	0.43	0.039	3.9				
	0.29	0.031	3.6				
	0.25	0.020	3.8				

Profile ZR003 (formerly 22)

Classification: Xanthic Ferralsols, FRx (FAO, 1990)
Yellow hygro-arenoferrals on Salonga deposits, series SE-Z3 (INEAC)

Source: Sys (1972) and FAO (1977), description in 1959

Location: Lodja region

Coordinates: 03° 30'S; 23° 30'E
-03.50°; 23.50°

Terrain unit: 420

Altitude: 625 m a.s.l.

Physiography: Salonga deposits plateau, covering a vast region of the Kasai-Sankuru, as far as 1° S.

Slope: plateau summit, slightly sloping

Drainage: well drained, very deep groundwater

Parent material: eolian sands, resting on a Late-Tertiary planation; fine sands; clay content 12-35 %; the clay fraction is kaolinitic and only exceptionally contains traces of gibbsite.

Climate: annual rainfall 1,750 mm, mean annual temperature 25°C.

Vegetation: dense humid forest

Profile description

O 5- 0 cm Highly decomposed layer of organic matter, consisting mainly of fine roots, mixed with some black sand.

Ah 0- 8 cm Very dark greyish brown (10YR 3.5/2); loamy sand; single grain; loose; many fine roots; many grey sand specks; gradual boundary.

AB 8-23 cm Dark brown (10YR 5/6); loamy sand; single grain; loose; few fine roots; few grey grains; diffuse boundary.

Bo1 23-38 cm Yellowish brown (10YR 5/6); sandy loam; single grain; loose; less fine roots; few grey grains; diffuse boundary.

Bo2 38-85 cm Yellowish brown (10YR 5/6); sandy loam; loose; floury; diffuse boundary.

C 85-200 cm Yellowish brown (10YR 5/8 to 7.5YR 5/8); sandy loam.

Analytical data of profile ZR003

horizon	depth (cm)	> 2 mm %	coarse sand	fine sand	silt 0.05 -	clay <	tex- ture

			0.25-2 mm	0.05-0.25 mm	0.002 mm	0.002 mm	USDA
Ah	0-8		23.2	63.5	1.5	11.8	LS
AB	8-23		19.6	67.9	1.4	11.1	LS
Bo1	23-38		18.2	62.6	2.1	17.1	SL
Bo2	38-85		21.3	61.2	2.0	15.5	SL
C	85-200		20.1	60.6	1.7	17.6	SL
cmol(+)/kg							
Ca (HCl N/20)	Mg	K (HCl N/20)	Na	Acidity	Ex.Al.	Al sat. (m)	Base sat. %
0.85		0.06					
0.35		0.04					
0.80		0.03					
0.50		0.06					
0.55		0.06					
cmol(+)/kg						bar	%
CEC_{soil} sum cat.	CEC_{soil} NH_4OAc	CEC_{soil} bases + Al	CEC_{soil} (Ca)	pH H_2O	pH KCl	1/3	15
			4.25	4.1			
			2.95	4.1			
			2.1	4.2			
			1.6	4.3			
			1.5	4.5			
organ. matter %	organ. C %	N %	free Fe_2O_3 %	avail. P Truog ppm	P. total mg/100g	$CaCO_3$%	EC sat. DS/m
	1.32	0.105	5.2				
	0.80	0.055	6.2				
	0.30	0.024	8.5				
	0.14	0.015	8.7				
	0.12	0.013	9.7				

Profile ZR004

Classification: Umbric Fluvisols, FLu (FAO, 1990)
Typic Humitropepts (USDA)

	Dystric, humiferous, recent, tropical soils (INEAC)
Source:	Sys (1991)
Location:	Bweremana village, on border of N and S Kivu
Coordinates:	02° 00'S; 28° 30'E (approximate) -02.00°; 28.50°
Terrain unit:	200
Altitude:	some tens of metres above Lake Kivu (1,460 m)
Physiography:	natural levee of an alluvial plain
Drainage:	moderately well drained
Parent material:	alluvium, with metamorphic rock influence: mica-schist, gneiss, amphibolite.

Profile description

Ap	0-25 cm	Micaceous silty clay; (10YR 3/1); black when moist; well developed, fine to medium, crumb structure; friable; abundant, fine roots; clear boundary.
AC	25-50 cm	Micaceous silty clay;(10YR 3/1); gradual transition.
A/C	50-60 cm	Micaceous silty clay; (10YR 3/1); well-developed, medium, prismatic structure; loose; common, fine and distinct mottles.

Analytical data of profile ZR004

horizon	depth (cm)	> 2 mm %	coarse sand	Fine sand	silt 0.05 -	clay <	tex-ture

			0.25-2 mm	0.05-0.25 mm	0.002 mm	0.002 mm	USDA
Ap A/C	0-25 50-60	0.16 0.17	1.1 0.5	5.1 4.2	21.1 20.3	72.7 75.0	C
cmol(+)/kg							
Ca	Mg	K	Na	Acidity	Ex. Al.	Al sat. (m)	Base sat. %
35.59 31.17	13.75 14.37	2.17 1.41	0.06 0.21				
cmol(+)/kg						bar	%
CEC_{soil} sum of cat.	CEC_{soil} NH_4OAc	CEC_{soil} bases + Al	CEC_{soil} (Ca)	PH H_2O	pH KCl	1/3	15
	50.67 44.07			6.3 6.7	5.5 5.9		
organic matter %	organ. C %	N %	free Fe_2O_3 %	avail. P ppm (o-d)	P. total mg/100g	$CaCO_3$%	EC sat. dS/m
	5.94 2.21	0.45 0.21		405 223			

Profile ZR005

Classification: Humic Nitisols, NTu (FAO, 1990)
Oxic Tropohumults (USDA)
Humiferous Ferrisols (INEAC)

Source:	Sys (1991)
Location:	Mbobandana, south of the border river between N- and S-Kivu
Coordinates:	01°45'S; 28° 55'E -01.75°; 28.92°
Terrain unit:	1210, eastern highlands
Altitude:	about 1,500 m
Physiography:	hill slope, south of the river
Slope:	4 %
Drainage:	well drained
Parent material:	slightly micaceous clay, reworked from Rusizi System (amphibolites, mica-schists)
Vegetation:	permanent agriculture

Profile description

Ap	0-25 cm	Slightly micaceous clay; (10 YR 3/2, moist); very dark greyish brown; well developed, medium, crumb structure; friable; many, fine roots; clear boundary.
AB	25-50 cm	Slightly micaceous clay; somewhat compact; gradual transition.
BA	50-60 cm	Slightly micaceous clay; (10 YR 3/4, moist); dark yellowish brown; subangular structure; ped faces covered by clay-humus shiny cutans; few roots.

Analytical data of profile ZR005

horizon	depth (cm)	> 2 mm %	coarse sand 0.25-2	fine sand 0.05-	silt 0.05 - 0.002	clay < 0.002	tex-ture USDA

			mm	0.25 mm	mm	mm	
Ap BA	0-25 50-60	0.21 0.15	6.5 5.4	16.4 17.9	21.6 15.5	55.5 61.2	C
cmol(+)/kg							
Ca	Mg	K	Na	H^+	Al^{3+}	Al sat. (m)	Base sat. %
20.06 12.80	8.49 9.44	3.09 2.30	0.03 0.03	- 0.11	- 0.02		
cmol(+)/kg						bar	%
CEC_{soil} sum of cations	CEC_{soil} NH_4OAc	CEC_{soil} bases + Al	CEC_{soil} effec-tive	pH H_2O	pH KCl	1/3	15
	32.82 29.65		- 31.94	6.4 6.3	5.5 5.1		
organic matter %	organ. C %	N %	free Fe_2O_3 %	avail. P ppm (o-d)	P. total mg/100g	$CaCO_3$%	EC sat. dS/m
	4.13 0.84	0.33 0.11		435 80			

Profile ZR006

Classification: Humic Acrisols, ACu (FAO, 1990)
Palehumults (USDA)
Humiferous Ferrisols (INEAC)

Source: Sys (1991)

Location: ACUCOBA farmers association, Kirumba village, Kanyabayonga region, Kivu

Coordinates:	00° 45′ S; 29° 15′ E -00.75°; 29.25°
Terrain unit:	1210
Altitude:	1,800 m
Physiography:	hill slopes
Drainage:	well drained
Parent material:	Rusizi System gneiss
Vegetation:	permanent agriculture

Profile description

Ah 0-60 cm — Sandy clay; (5YR 3/2); very weak, subangular blocky structure, starting with very fine and fine granular; friable; many roots; clear boundary.

Bt 60-200 cm — Clay (5YR 5/6); moderate, coarse, subangular blocky; broken, thin clay cutans; moderate root development, down to 1 m, some fine roots deeper.

A quartz stone layer is common in these soils, in between the surface and a depth of more than 2 m.

Analytical data of profile ZR006

horizon	depth (cm)	> 2 mm %	coarse sand 0.25-2 mm	fine sand 0.05-0.25 mm	silt 0.05 - 0.002 mm	clay < 0.002 mm	tex-ture USDA

A Bt	0-60 60-200	0.13	22.8	30.8	11.9	34.5	SC SC
cmol(+)/kg							
Ca	Mg	K	Na	H^+	Al^{3+}	Al sat. (m)	Base sat. %
5.53 2.41	2.42 1.19	0.32 0.19	0.14 0.07	0.13 0.22	0.08 1.83		
Cmol(+)/kg						bar	%
CEC_{soil} sum cat.	CEC_{soil} NH_4OAc	CEC_{soil} bases + Al	CEC_{soil} Effect-tive	pH H_2O	pH KCl	1/3	15
	10.64 7.06		8.68 5.91	5.3 4.5	4.0 4.4		
organic matter %	organ. C %	N %	free Fe_2O_3 %	avail. P ppm (o-d)	P. total mg/100g	$CaCO_3$%	EC sat. dS/m
	2.06 0.34	0.18 0.06		10 10			

Profile ZR007

Classification: Xanthic Ferralsols, FRx (FAO, 1990)
Kandiudults (USDA)
Ferralsols (INEAC)

Source: Sys (1991)

Location: Beni

Coordinates:	00°30’N; 29°30’E 00.50°; 29.50°
Terrain unit:	1240, Bunia or Lake Albert-Edward highlands
Altitude:	900 m
Physiography:	Late Tertiary pediplain on granite
Drainage:	well drained
Parent material:	granite
Vegetation:	open space with weeds in a banana plantation

Profile description

Ap	0-20 cm	Sandy clay to clay; moderate, fine and medium subangular blocky structure; friable; many roots; clear boundary.
Bo	60-80 cm	Kandic horizon; clay with quartz grains; (10YR 5/6); weak blocky structure; clay nodules; no clay cutans; moderate root development down to 1 m, somewhat compact.

Analytical data of profile ZR007

horizon	depth (cm)	> 2 mm %	Coarse sand 0.25-2 mm	fine sand 0.05-0.25 mm	silt 0.05 - 0.002 mm	clay < 0.002 mm	tex-ture USDA
A	0-20	0.14	31.4	27.3	9.3	32.0	SCL

Bo	20-80	0.07	28.6	21.2	6.0	44.2	SC
cmol(+)/kg							
Ca	Mg	K	Na	H^+	Al^{3+}	Al sat. (m)	Base sat. %
6.02 2.71	0.49 0.04	0.08 0.03	0.07 0.02	0.02	0.05		93.0 79.3
cmol(+)/kg						bar	%
CEC_{soil} sum cat.	CEC_{soil} NH_4OAc	CEC_{soil} bases + Al	CEC_{soil} Effec-tive	pH H_2O	pH KCl	1/3	15
	7.16 3.53		6.73	5.5 6.0	5.0 5.0		
organic matter %	organ. C %	N %	free Fe_2O_3 %	avail. P ppm (o-d)	P. total mg/100g	$CaCO_3$%	EC sat. dS/m
	1.86 0.36	0.18 0.05		10 25			

Profile ZR008 (formerly 10)

Classification: Humic Acrisols, ACu (FAO, 1990)
Sombrihumults (USDA)

Source: Sys (1991)

Location: Butembo-Mushienene

Coordinates: 00°05’N; 29°15’E
00.08°; 29.25°

Terrain unit:	1210
Altitude:	1,600 m
Physiography:	rounded hill
Slope:	2-4 %
Drainage:	well drained
Parent material:	schists
Vegetation:	demonstration field

Profile description

Ah	0-45 cm	Clay; (5YR 4/2); weak, fine blocky structure, starting with fine granular; friable; many roots; distinct boundary.
Bt	45-100 cm	Clay; (5YR 4/4); crushed 5 YR 5/4); strong, coarse, blocky structure, with prismatic tendency; continuous clay cutans; firm; common roots; clear transition.
Bso	100-140 cm	Sombric horizon, clay; (5YR 3/4).

Analytical data of profile ZR008 (formerly 10)

horizon	depth (cm)	> 2 mm %	coarse sand 0.25-2 mm	fine sand 0.05-0.25 mm	silt 0.05 - 0.002 mm	clay < 0.002 mm	texture USDA
A	0-45	0.16	17.0	16.1	15.2	51.7	C
Bo	45-100	0.13	11.2	13.6	12.3	62.9	C

Bso	100-140	0.11	11.1	13.7	11.8	63.4	C
cmol(+)/kg							
Ca	Mg	K	Na	H^+	Al^{3+}	Al sat. (m)	Base sat. %
7.77 1.72 0.59	2.83 1.54 1.02	0.63 0.60 1.02	0.07 0.05 0.07	0.37 0.14 0.36	0.01 0.99 2.12		73.7 34.0 19.1
cmol(+)/kg						bar	%
CEC_{soil} sum of cat.	CEC_{soil} NH_4OAc	CEC_{soil} bases + Al	CEC_{soil} Effec-tive	pH H_2O	pH KCl	1/3	15
	15.33 11.50 14.12		11.68 5.04 5.18	5.3 5.2 5.2	4.7 4.2 4.2		
organic matter %	organ. C %	N %	free Fe_2O_3 %	avail. P ppm (o-d)	P. total mg/100 g	$CaCO_3$%	EC sat. dS/m
	3.61 0.90 1.54	0.34 0.12 0.13		225 123 118			

Profile ZR009 (formerly 199; 24 Series Zé U 3hE)

Classification: Mollic Andosols, ANm (FAO, 1990)
Brown sandy eutrophic humiferous recent tropical soils on volcanic ash, series ZE-U3hE (INEAC)

Source: Sys (1991), Pécrot (1960)

Location: Goma-Masisi, North Kivu

Coordinates: 01^o 25’S; 29^o 02’E

	-01.42°; 29.03°
Terrain unit:	1140, volcanic ash region
Altitude:	2,170 m
Physiography:	steep relief, top slope,
Slope:	10 % NE
Drainage:	well drained
Parent material:	volcanic ash
Climate:	Cf; mean annual temperature 14°C, mean annual rainfall 1,800 mm; 50 days of dry season
Vegetation:	fallow with *Pennisetum* in pyrethrum fields

Profile description

Ap	0-30 cm	Sandy clay loam; very dark brown (10YR 2/2); moderate, medium crumb; loose; abundant roots; gradual and smooth boundary.
AB	30-50 cm	Sandy loam; very dark greyish brown (10YR 3/2); weak, medium to coarse, blocky structure, with crumb pockets around roots; friable; common roots; gradual and smooth transition.
C1	50-80 cm	Loamy sand; dark brown (10YR 3/3); elementary structure; loose; few roots; distinct and smooth transition.
C2	80-170 cm	Sandy clay loam; dark brown (10YR 3/3-4); weak, coarse, blocky structure; friable; broken, very thin clay cutans; very few roots; distinct and smooth transition.
C3	170-230 cm	Fine gravelly sand, with pockets of black very coarse volcanic ash in the lower part of the horizon; dark brown (10YR 3/3).
C4	> 230 cm	Gravelly sand, with white spots when dry; dark brown (10YR 3/3).

Analytical data of profile ZR009 (formerly 24)

horizon	depth (cm)	> 2 mm %	coarse sand 0.25-2 mm	fine sand 0.05-0.25 mm	Silt 0.05 - 0.002 mm	clay < 0.002 mm	tex-ture USDA
Ap	0-30		51.5	10.5	11.4	26.6	SCL
AB	30-50		66.5	8.8	7.6	17.1	SL
C1	50-80		77.8	7.8	4.5	9.9	LS
C2	80-170		44.9	19.1	15.3	20.7	SCL
C3	170-210		58.7	14.2	11.0	16.1	SL

C3 C4	210-230 > 230		94.6 69.3	0.5 12.2	0.3 6.9	4.6 11.6	S LS
cmol(+)/kg							
Ca	Mg	K	Na	H^+	Al^{3+}	Al sat. (m)	Base sat. %
19.0 14.9 10.2 - - -		0.65 0.74 0.65 - - -					
cmol(+)/kg						bar	%
CEC_{soil} sum cat.	CEC_{soil} NH_4OAc	CEC_{soil} bases + Al	CEC_{soil} (Ca)	pH H_2O	pH KCl	1/3	15
			24.2 13.8 10.9 16.8 15.8 4.2	6.7 6.8 6.6 6.6 6.6 6.8			
organ. mat. %	organ. C %	N %	free Fe_2O_3 %	avail. P ppm Truogh	P. total mg/100 g	$CaCO_3$%	EC sat. dS/m
	4.70 2.38 1.51 - - -	0.756 0.461 0.252 - - -	5.2 5.4 5.4 7.5 5.7 3.5	21 24 40 21 34 18			

Profile ZR010 (formerly 201; 26 Series Za A 3 E)

Classification: Mollic Andosols, ANm (FAO)
Brown eutrophic, humiferous, sandy clay, tropical soils on volcanic ashes, series ZA-A3hE (INEAC)

Source: Sys (1991), Pécrot (1960)

Location: Masisi, North Kivu

Coordinates: 01° 20’S; 28° 40’E
-01.33°; 28.67°

Terrain unit:	1140, volcanic ash region
Altitude:	1,680 m
Physiography:	steep sloping region; summit of a convex slope (W)
Climate:	Cf; mean annual temperature 17°C, mean annual rainfall 2200 mm; 50 days of dry season
Drainage:	well drained
Parent material:	recent volcanic ash on older ashes
Vegetation:	former quinine plantation

Profile description

Ap1	0-13 cm	Sandy clay; very dark brown (10YR 2/2); strong, fine crumb structure; loose; abundant roots; gradual and smooth boundary.
Ap2	13-26 cm	Clay; very dark greyish brown (10YR 3/2); strong, fine crumb structure; loose; abundant roots; gradual and smooth transition.
AB	26-40 cm	Sandy clay loam to sandy clay; dark brown (10YR 3/3); moderate, fine to medium, blocky structure, with crumb pockets; friable; common roots; gradual and smooth transition.
BA	40-80 cm	Sandy clay loam; dark brown (10YR 3/3); moderate, fine blocky structure; thin, discontinuous cutans; friable; non plastic; common roots; diffuse transition.
Bw1	80-120 cm	Sandy clay loam; dark brown (9YR 3/3); strong, fine, angular blocky structure; continuous, very thin clay cutans; few roots; friable; very slightly plastic; diffuse transition.
Bw2	120-150cm	Sandy clay loam; dark brown (7.5YR 3/4); strong, fine, angular structure; continuous, very thin clay cutans; few roots; friable; slightly plastic; diffuse transition.
Bw3	150-175 cm	Clay; dark brown (9 YR 3/3); strong, fine angular structure; continuous, very thin clay cutans; friable; slightly plastic; diffuse and smooth transition.
C	> 175 cm	Clayey; brown (7.5 YR 4/2); strong, medium, angular

blocky structure; continuous clay cutans; no roots; friable; slightly plastic; locally firm; slightly plastic; this older volcanic ashes layer continues to > 3 m depth, and contains towards its base some pieces of very weathered mica schists.

Analytical data of profile ZR010 (26)

horizon	depth (cm)	> 2 mm %	coarse sand 0.25-2 mm	fine sand 0.05-0.25 mm	silt 0.05 - 0.002 mm	clay < 0.002 mm	texture USDA
Ap1	0-13		8.3	17.8	29.8	44.1	C
Ap2	13-26		8.2	19.9	18.7	53.2	C
AB	26-40		12.2	37.3	16.1	34.4	SCL
BA	40-80		16.2	42.4	13.8	27.6	SCL
Bw1	80-120		36.8	29.3	6.9	27.0	SCL
Bw2	120-150		45.7	24.4	4.6	25.3	SCL
Bw3	150-175		6.8	19.6	26.2	47.4	C
C	175-250		2.2	23.5	25.3	49.0	C
C	> 250		2.1	21.2	24.3	52.4	C
cmol(+)/kg							
Ca	Mg	K	Na	H^+	Al^{3+}	Al sat. (m)	Base sat. %
11.5		0.10					
7.4		0.07					
7.2		0.04					
12.8		0.04					
16.9		0.02					
13.6		0.03					
11.2		0.04					
8.2		0.05					
7.9		0.07					
cmol(+)/kg						bar	%

CEC_{soil} sum cat.	CEC_{soil} NH_4OAc	CEC_{soil} bases + Al	CEC_{soil} (Ca)	pH H_2O	pH KCl	1/3	15
			22.1	5.6			
			18.0	5.5			
			15.9	5.7			
			21.2	6.1			
			21.1	6.2			
			19.2	6.3			
			16.7	6.2			
			8.3	6.2			
			10.6	6.2			
organic matter %	**organ. C %**	**N %**	**free Fe_2O_3 %**	**avail. P ppm Truogh**	**P. total mg/100g**	**$CaCO_3$ %**	**EC sat. dS/m**
	5.40	0.689	6.8	20			
	3.96	0.607	7.5	18			
	2.84	0.363	8.5	18			
	1.95	0.316	9.3	25			
	1.04	0.150	11.2	92			
	0.92	0.137	10.8	11			
	0.54	0.077	11.2	8			
	-	-	8.8	8			
	-	-	8.3	12			

Profile ZR011 (formerly 1 Series Pî S 2 h)

Classification: Humic Nitosols, NTu (FAO, 1990)
Red Ferrisols (INEAC)

Source: Sys (1991), Pécrot (1960)

Location: E-W oriented mountain chain, W of the Kahuzi chain, Kivu

Coordinates: 02^o 15’S; 28^o 40’E
-02.25°; 28.67°

Terrain unit: 1210, eastern highlands

Altitude: 2,000 m

Physiography: elongated mountain chain, W-E oriented

Drainage: well drained

Parent material: slightly sandy clay; weathering product of the metamorphic complex

Vegetation: secondary mountain forest

Profile description

O 8-0 cm 1 cm thick layer of well-decomposed humus, on a thick layer of fine roots.

Ah1 0-10 cm Slightly sandy clay; dark reddish brown (5YR 3/2); strong, fine crumb structure; loose; abundant roots; gradual and smooth boundary.

Ah2 10-22 cm Slightly sandy clay; dark reddish grey (5YR 4/2); weak, medium crumb structure; friable; non plastic; abundant roots; gradual to diffuse and undulating transition.

Bt1 22-45 cm Slightly sandy clay; reddish brown (5YR 4/3); fine to medium, blocky structure; discontinuous, tiny cutans; firm in situ; slightly plastic; non sticky; common roots; diffuse transition.

Bt2 45-100 cm Slightly sandy clay; yellowish red (5YR 4/6); moderate, fine, blocky structure; thin, continuous cutans; firm in situ; slightly plastic; non sticky; common biological activity, getting weak deeper; distinct and smooth transition.

C > 100 cm Brown clay with quartz gravels.

Analytical data of profile ZR011

horizon	depth (cm)	> 2 mm %	coarse sand 0.25-2 mm	fine sand 0.05-0.25 mm	silt 0.05 - 0.002 mm	clay < 0.002 mm	texture USDA
Ah1	0-10		13.3	18.5	14.4	53.8	C
Ah2	10-22		11.0	21.5	15.6	51.9	C
Bt1	22-45		10.8	23.8	14.9	50.5	C
Bt2	45-100		12.1	14.0	16.1	49.3	C
cmol(+)/kg							
Ca	Mg	K	Na	H^+	Al^{3+}	Al sat.	Base sat.

						(m)	%
0.75 0.55 0.30 -		0.19 0.11 0.03 -					
cmol(+)/kg						bar	%
CEC_{soil} sum of cations	CEC_{soil} NH_4OAc	CEC_{soil} bases + Al	CEC_{soil} (Ca)	pH H_2O	pH KCl	1/3	15
			28.75 18.50 10.25 7.50	4.0 4.5 4.4 4.4			
organic matter %	organ. C %	N %	free Fe_2O_3 %	avail. P ppm Truogh	P. total mg/100g	$CaCO_3$ %	EC sat. dS/m
	9.02 4.44 1.33 -	0.932 0.404 0.107 -	5.9 7.0 7.5 7.1	2 1 tr. tr.			

Profile ZR012 (formerly 2)

Classification: Ferralic Arenosols, ARo (FAO, 1990)
Yellow hygro-xero-arenoferrals on Kalahari sands, series HE-Z13 (INEAC)

Source: Sys (1972), description in 1956

Location: Kwango-Kwilu, Kiyaka station, SE of Kikwit

Coordinates: 05° 30'S; 19° 20'E
-05.50°; 19.33°

Terrain unit: 830/2, sand-covered plateaux

Altitude: 660 m

Topography: 3 % slope, plateau limit

Drainage: excessively well drained, groundwater deep

Parent material: Kalahari sands

Vegetation: wooded savannah, near to dense forest

Profile description

Ah 0-10 cm Humiferous sand; very dark brown (10YR 2/2, moist); weak, fine, granular structure; loose; abundant grass roots; gradual and smooth transition.

AC1 10-25 cm Humiferous sand; dark greyish brown (10YR 3/2, moist); some darker organic matter spots; single grain; loose; common roots; gradual and smooth boundary.

AC2 25-60 cm Slightly humiferous sand; dark greyish brown (10YR 4/2, moist); weak, medium, subangular blocky; slightly firm in situ, but friable after removal; common roots; gradual and smooth transition.

C1 60-85 cm Slightly humiferous sand; dark greyish brown (10YR 4/2, moist); single grain; gradual transition.

C2 85-120 cm Sand; yellowish brown (10YR 5/4, moist); single grain; loose; a few dark organic matter spots; gradual and smooth transition.

C3 120-170 cm Sand, brown (7.5YR 5/6, moist); loose.

Analytical data of profile ZR012

horizon	depth (cm)	> 2 mm %	coarse sand 0.25-2 mm	fine sand 0.05-0.25 mm	silt 0.05 - 0.002 mm	clay < 0.002 mm	texture USDA
Ah	0-10		31.9	58.0	2.5	7.6	S
AC1	10-25		32.1	59.1	1.9	6.9	S
AC2	25-60		25.9	65.7	1.6	6.8	S
C1	60-85		26.0	65.2	2.4	6.4	S
C2	85-120		26.9	64.1	2.2	6.8	S
C3	120-170		24.0	66.8	2.2	7.0	S
cmol(+)/kg							
Ca	Mg	K	Na	H^+	Al^{3+}	Al	Base

(HCl N/20)		(HCl N/20)				sat. (m)	sat. %
0.5 0.4 0.4 0.4 0.4 0.5		0.8 0.8 0.4 0.6 0.4 0.4					
cmol(+)/kg						bar	%
CEC_{soil} sum cat.	CEC_{soil} NH_4OAc	CEC_{soil} bases + Al	CEC_{soil} (Ca)	pH H_2O	pH KCl	1/3	15
			3.9 2.8 2.4 2.1 1.8 1.6	5.5 5.7 5.9 6.0 5.9 5.8			
organ. matter %	organ. C %	N %	free Fe_2O_3 (%)	avail. P ppm Truogh	P. total mg/100g	$CaCO_3$ %	EC sat. dS/m
	0.73 0.50 0.36 0.28 0.16 0.14	0.065 0.037 0.026 0.021 0.017 0.013	0.62 0.67 0.75 0.74 0.84 1.06				

Profile ZR013 (formerly 9)

Classification: Xanthic Ferralsols, FRx (FAO, 1990)
Yellow hygro-xero-ferralsols, on Kalahari sands, with a clayey sand texture, series HU-F13 (INEAC)

Source: Sys (1972), description in 1957

Location: Kundelungu plateau, Central Katanga

Coordinates: $10^o00'$S; 28^o $00'$E
-10.00°; 28.00°

Terrain unit: 1040, Kundelungu plateau

Altitude: 1,550 m

Topography: subhorizontal plateau

Drainage: well drained, groundwater very deep

Parent material: Kalahari sands, influenced by Kundelungu sandstone

Vegetation: savannah

Profile description

Ah 0-12 cm Loamy sand; dark greyish brown (10YR 4/2, moist); single grain, friable; abundant roots; clear and smooth transition.

AB 12-30 cm Loamy sand; bright brown (10YR 5/3, moist); single grain; loose; common roots; gradual and smooth boundary.

Bo1 30-60 cm Sandy loam; yellowish brown (10YR 5/4, moist); weak, subangular blocky structure; slightly firm in situ, but very friable after removal; few roots; gradual and smooth transition.

Bo2 60-110 cm Sandy clay loam; yellowish brown (10YR 5/6, moist); single grain; very loose; gradual transition.

Bo3 110-200 cm Sandy clay loam; yellowish brown (10YR 5/6, moist); single grain.

Analytical data of profile ZR013

horizon	depth (cm)	> 2 mm %	coarse sand 0.25-2 mm	fine sand 0.05-0.25 mm	silt 0.05 - 0.002 mm	clay < 0.002 mm	texture USDA
Ah	0-12		34.5	47.3	6.5	11.7	LS
AB	12-30		23.4	59.8	6.1	10.7	LS
Bo1	30-60		23.1	50.2	11.6	15.1	SL
Bo2	60-110		20.9	42.5	16.5	20.1	SCL
Bo3	110-200		19.8	39.4	17.7	23.0	SCL
Cmol(+)/kg							
Ca (HCl N/20)	Mg	K (HCl N/20)	Na	H^+	Al^{3+}	Al sat. (m)	Base sat. %

0.7 0.8 0.7 0.5 0.7		0.09 0.06 0.05 0.09 0.08					
cmol(+)/kg						bar	%
CEC_{soil} sum of cations	CEC_{soil} NH_4OAc	CEC_{soil} bases + Al	CEC_{soil} (Ca)	pH H_2O	pH KCl	1/3	15
			3.1 2.2 2.2 2.1 2.2	5.2 5.2 5.3 5.3 5.4			
organic matter %	organ. C %	N %	free Fe_2O_3 (%)	avail. P ppm Truogh	P. total mg/100g	$CaCO_3$ %	EC sat. dS/m
	0.65 0.38 0.23 0.17 0.10	0.055 0.035 0.024 0.018 0.016	3.1 3.6 3.2 3.6 3.6				

Profile ZR014 (formerly 27)

Classification: Haplic Ferralsols, FRh (FAO, 1990)
Yellowish red hygro-ferralsols, on clayey sand Yangambi deposits, series YA-F2 (INEAC)

Source: Sys (1972), description in 1957

Location: Gazi, 80 km WNW of Kisangani

Coordinates: 01^o 00’N; 24^o 30’E
01.00°; 24.50°

Terrain unit: 430, Yangambi deposits plateaux

Altitude: 530 m

Topography: top of a large plateau

Drainage: well drained, groundwater very deep

Parent material: Yangambi deposits

Vegetation: dense humid forest

Climate: Af, mean annual temperature 24°C, mean annual rainfall 1,875 mm

Profile description

O 0.5-0 cm Very weak developed litter layer

Ah 0-7 cm Sand clay loam; dark brown (7.5YR4/2, moist); strong, fine to medium, crumb structure; friable; abundant roots; distinct and smooth transition.

AB 7-17 cm Sandy clay loam; reddish brown (5YR4/4, moist); moderate, medium, crumb structure; friable; less roots; gradual boundary.

Bo1 17-30 cm Sandy clay loam; reddish brown (5YR4/4, moist); weak, medium, subangular blocky; friable to firm; less roots; diffuse transition.

Bo2 30-70 cm Sandy clay; yellowish red (5YR 4/6-8, moist); moderate, medium to coarse, subangular blocky; firm; few roots; diffuse transition.

Bo3 70-150 cm Sandy clay; yellowish red (5YR 5/8, moist); strong, fine crumb (floury); few roots.

Analytical data of profile ZR014

horizon	depth (cm)	> 2 mm %	coarse sand 0.25-2 mm	fine sand 0.05-0.25 mm	silt 0.05 - 0.002 mm	clay < 0.002 mm	texture USDA
Ah	0-7		39.0	27.8	1.9	31.3	SCL
AB	7-17		35.9	30.2	2.2	31.7	SCL
Bo1	17-30		37.6	26.3	2.7	33.4	SCL
Bo2	30-70		32.5	23.9	2.6	41.0	SC
Bo3	70-150		32.1	25.0	2.4	40.5	SC
Cmol(+)/kg							
Ca (HCl N/20)	Mg	K (HCl N/20)	Na	H^+	Al^{3+}	Al sat. (m)	Base sat. %
0.4		0.09					

0.3 0.2 0.4 0.5		0.08 0.06 0.10 0.05					
cmol(+)/kg						bar	%
CEC_{soil} sum of cations	CEC_{soil} NH_4OAc	CEC_{soil} bases+Al	CEC_{soil} (Ca)	pH H_2O	pH KCl	1/3	15
			5.3 4.7 4.1 3.9 3.4	4.0 4.0 4.1 4.2 4.2			
organic matter %	organ. C %	N %	free Fe_2O_3 (%)	avail. P ppm Truogh	P. total mg/100g	$CaCO_3$ %	EC sat. dS/m
	1.52 0.93 0.62 0.35 0.19	0.122 0.080 0.060 0.037 0.021	3.3 2.9 3.3 3.9 4.8				

Profile ZR015 (formerly 32)

Classification: Xanthic Ferralsols, FRx (FAO, 1990)
Yellow hygro-ferralsols, on deposits of the low plateaux, series DA-F3 (INEAC)

Source: Sys (1972), description in 1958

Location: S of Bolomba, E of Mbandaka (Equator)

Coordinates: 00°05’N; 19°10’E
00.08°; 19.17°

Terrain unit: 410, low plateaux of the Central Congo Basin

Altitude: 370 m

Topography: plateau

Drainage: well drained, groundwater very deep

Parent material: low plateaux deposits

Vegetation: disturbed, old secondary forest

Climate: Af, mean annual temperature 25°C, mean annual rainfall 2,100 mm

Profile description

O Very weak developed litter layer

Ah 0-7 cm Sandy loam; dark brown (10YR 3/3, moist); locally weak, crumb structure; loose; moist; abundant roots, diffuse and smooth transition.

AB 7-27 cm Sandy clay loam; dark yellowish brown (10YR 4/4, moist); weak granular structure; loose to friable; common roots and faunal activity; clear boundary.

Bo1 27-45 cm Sandy clay loam; yellowish brown (10YR 5/4-6, moist); moderate, fine, granular structure; moist; friable; common roots; clear transition.

Bo2 45-87 cm Sandy clay loam; yellowish brown (10YR 5/6, moist); weak, fine, subangular blocky structure; moist; friable to firm; few roots; some traces of mottling; clear transition.

Bo3 87-107 cm Sandy clay loam; yellowish brown (10YR 5/6, moist); moist; strong, fine, granular structure; friable; strong reduction of roots; gradual boundary.

Bo4 107-180 cm Sandy clay loam; yellowish brown (10YR 5/6, moist); moist; strong, fine granular structure; friable.

Analytical data of profile ZR015

horizon	depth (cm)	> 2 mm %	coarse sand 0.25-2 mm	fine sand 0.05-0.25 mm	silt 0.05 - 0.002 mm	clay < 0.002 mm	texture USDA
Ah	0-7		41.3	38.9	1.9	17.9	SL
AB	7-27		34.3	39.8	2.9	23.0	SCL
Bo1	27-45		30.7	32.8	2.9	33.6	SCL
Bo2	45-87		35.5	30.2	2.2	32.1	SCL
Bo3	87-107		30.3	32.7	2.2	34.8	SCL
Bo4	107-180		36.6	28.9	2.0	32.2	SCL
Cmol(+)/kg							
Ca (HCl N/20)	Mg	K (HCl N/20)	Na	H^+	Al^{3+}	Al sat. (m)	Base sat. %

1.15		0.10					
1.65		0.05					
1.8		0.04					
1.65		0.04					
1.7		0.04					
1.8		0.05					
cmol(+)/kg						bar	%
CEC_{soil} sum of cations	CEC_{soil} NH_4OAc	CEC_{soil} bases+Al	CEC_{soil} (Ca)	pH H_2O	pH KCl	1/3	15
			5.50	4.2			
			3.35	4.3			
			3.45	4.4			
			3.15	4.7			
			2.80	4.8			
			2.90	4.8			
organic matter %	organ. C %	N %	free Fe_2O_3 (%)	avail. P ppm Truogh	P. total mg/100g	$CaCO_3$ %	EC sat. dS/m
	1.26	0.133	5.4				
	0.40	0.044	6.6				
	0.27	0.033	8.7				
	0.22	0.032	7.8				
	0.19	0.027	9.0				
	0.16	0.023	8.6				

Profile ZR016 (formerly 39)

Classification:	Haplic Nitosols, NTh (FAO, 1990) Yellow hygro-xeroferrisols, on Mesozoic rocks, series KO-S13 (INEAC)
Source:	Sys (1972), description in 1958
Location:	Mushie, between the Congo and Lower Kasai (Kwa)
Coordinates:	02° 40’S; 16° 50’E -02.67°; 16.83°
Terrain unit:	810/5, lower Kasai sand-covered plateaux
Altitude:	400 m
Topography:	recent incision in the plateau, moderate slope
Drainage:	well drained

Parent material: sandy clay, weathering product of Karroo rocks

Vegetation: savannah

Climate: (Aw)s, mean annual temperature 25.5°C, mean annual rainfall 1,500 mm, 3 months of dry season

Profile description

Ah 0-4 cm Sandy clay; dark brown (10YR 4/3, moist); strong, fine, angular blocky structure; firm; abundant roots, abrupt transition.

AB 4-14 cm Sandy clay, brown to dark brown (10-7.5YR 4/4, moist); moderate to strong, angular blocky structure; firm when dry; common roots; gradual boundary.

Bt1 14-31 cm Sandy clay; brown (10-7.5YR 5/4, moist); strong, medium, angular blocky structure; thick, continuous clay cutans on ped faces; firm; few roots; diffuse transition.

Bt2 31-54 cm Sandy clay; dark brown (10YR 5/6, moist); weak, fine to medium, angular blocky structure; discontinuous clay cutans, on about 60 % of the ped surfaces; loose; few roots; diffuse transition.

Bt3 54-150 cm Sandy clay; strong, angular, blocky structure; clay stains; loose.

Analytical data of profile ZR016

horizon	depth (cm)	> 2 mm %	coarse sand 0.25-2 mm	fine sand 0.05-0.25 mm	silt 0.05 - 0.002 mm	clay < 0.002 mm	tex-ture USDA
Ah, AB	0-14		4.3	36.3	22.2	37.2	CL
Bt1	14-31		4.0	35.5	23.4	37.1	CL
Bt2	31-54		3.0	32.5	22.8	41.7	C
Bt3	54-150		2.5	28.8	22.6	46.1	C
cmol(+)/kg							
Ca (HCl N/20)	Mg	K (HCl N/20)	Na	H^+	Al^{3+}	Al sat. (m)	Base sat. %
1.3		0.10					
1.2		0.03					
0.8		0.03					

0.7		0.02					
cmol(+)/kg						bar	%
CEC_{soil} sum of cations	CEC_{soil} NH_4OAc	CEC_{soil} bases+Al	CEC_{soil} (Ca)	pH H_2O	pH KCl	1/3	15
			4.7 3.6 3.45 3.05	4.8 4.3 4.3 4.5			
organic matter %	organ. C %	N %	free Fe_2O_3 (%)	avail. P ppm Truogh	P. total mg/100 g	$CaCO_3$%	EC sat. dS/m
	1.03 0.62 0.42 0.29	0.093 0.063 0.054 0.051	10.3 8.1 9.8 10.5				

Profile ZR017 (formerly 42)

Classification:	Haplic Acrisols, ACh (FAO, 1990) Red hygro-ferrisols, on Mesozoic sandstones, intergrades to recent tropical soils; series KE-(s)1 (INEAC)
Source:	Sys (1972), description in 1956
Location:	Kikwit-Gungu, Kwango-Kwilu rivers
Coordinates:	05° 30’ S; 19° 00’E -05.50°; 19.00°
Terrain unit:	840, dissected valleys in sand covered plateaux
Altitude:	560 m
Topography:	steep relief, slope of 50 % in the Kwilu valley
Drainage:	well drained

Parent material: clayey sand, weathering product of Karroo sandstone

Vegetation: dense humid forest

Climate: (Aw)S, mean annual temperature 24.5°C, mean annual rainfall 1,650 mm, 3 months of dry season

Profile description

Ah 0-14 cm Loamy sandy; greyish reddish brown (2.5YR 4/2, moist); moderate, coarse, crumb structure; loose; abundant roots; gradual transition.

AB1 14-23 cm Loamy sand, reddish brown (2.5YR 4/4, moist); weak, Medium, blocky structure; loose; many roots; diffuse boundary.

AB2 23-56 cm Sandy loam; reddish brown (2.5YR 4/4, moist); weak, medium, blocky structure; slightly firm in situ; many roots; diffuse transition.

BA 56-80 cm Sandy loam; reddish brown to dark red (2.5YR 4/3-3/6, moist); massive; loose; diffuse transition.

Bt1 80-130 cm Sandy clay loam; dark red (2.5YR 3/6, moist); weak structure; slightly mottled; diffuse transition.

Bt2 130-200 cm Sandy clay loam; dark red (2.5YR 3/6, moist).

Analytical data of profile ZR017

horizon	depth (cm)	> 2 mm %	coarse sand 0.25-2 mm	fine sand 0.05-0.25 mm	Silt 0.05 - 0.002 mm	Clay < 0.002 mm	tex-ture USDA
Ah	0-14		29.8	54.5	2.9	12.8	LS
AB1	14-23		26.5	55.7	3.4	14.4	SL
AB2	23-56		30.1	50.4	3.8	15.9	SL
BA	56-80		28.5	52.0	4.0	15.5	SL
Bt1	80-130		24.7	50.4	4.4	20.5	SCL
Bt2	130-200		22.8	50.5	4.8	21.9	SCL
cmol(+)/kg							
Ca (HCl N/20)	Mg	K (HCl N/20)	Na	H^+	Al^{3+}	Al sat. (m)	Base sat. %
0.7		0.18					
0.6		0.14					

0.3 0.5 0.3 0.4		0.19 0.20 0.25 0.15					
cmol(+)/kg						bar	%
CEC_{soil} sum of cations	CEC_{soil} NH_4OAc	CEC_{soil} bases+Al	CEC_{soil} (Ca)	pH H_2O	pH KCl	1/3	15
			4.5 4.2 4.0 3.6 4.4 4.2	4.6 4.8 5.1 5.2 5.2 4.9			
organic matter %	organ. C %	N %	free Fe_2O_3 (%)	avail. P ppm Truogh	P. total mg/100 g	$CaCO_3$%	EC sat. dS/m
	0.75 0.44 0.26 0.16 0.18 0.12	0.087 0.067 0.052 0.036 0.041 0.039	1.5 1.8 1.8 1.8 1.9 2.3				

Profile ZR018 (formerly 45)

Classification: Ferralic Cambisols, CMo (FAO, 1990) Hygro-xeroferrisols, intergrades to brown tropical soils, on Mesozoic sandstone; series KY-s12 (INEAC)

Source: Sys (1972), description in 1959

Location: Maniema

Coordinates: 04° 30’S; 27°30’ E
-04.50°; 27.50°

Terrain unit: 910, Lueki-Lukuga plateaux

Altitude: 620 m

Topography: slightly E sloping relief

Drainage: well drained

Parent material: sandy clay, weathering product of Karroo sandstone: Lukuga deposits

Vegetation: savannah with *Imperata cylindrica*

Climate: (Aw)S, mean annual temperature 23°C, mean annual rainfall 1,450 mm, 3 months of dry season

Profile description

Ah1 0-10 cm Sandy loam; dark brown (7.5YR 3/2, moist); moderate, fine, crumb structure; loose; moist; abundant roots; distinct and smooth transition.

Ah2 10-27 cm Sandy clay loam; dark brown (7.5YR 4/2, moist); moderate medium, crumb structure; loose; moist; many roots; gradual and smooth boundary.

BA 27-56 cm Sandy clay loam; reddish brown (5YR 4/4, moist); weak, medium, subangular blocky structure; friable; moist; gradual and smooth transition.

Bw 56-80 cm Sandy clay; reddish brown (5YR 4/4, moist); weak, coarse, blocky structure; friable; moist; fine rounded gravel fragments; gradual and smooth transition.

C 80-120 cm Sandy clay; reddish brown (5YR 4/4, moist) to yellowish red (5YR 4/4, moist); stone layer of schists and fine sandstones, with a few rounded pebbles and dispersed ironstone concretions; friable to firm.

Analytical data of profile ZR018

horizon	depth (cm)	> 2 mm %	coarse sand 0.25-2 mm	fine sand 0.05-0.25 mm	silt 0.05 - 0.002 mm	clay < 0.002 mm	texture USDA
Ah1	0-10		4.4	34.6	42.0	19.0	L
Ah2	10-27		4.5	28.3	43.9	23.3	L
BA	27-56		4.8	25.3	38.2	31.9	CL
Bw	56-80	38	5.4	21.2	38.2	35.2	CL
C	80-120	63	5.2	20.4	37.7	36.7	CL
Cmol(+)/kg							
Ca (HCl N/20)	Mg	K (HCl N/20)	Na	H^+	Al^{3+}	Al sat. (m)	Base sat. %
2.4		0.30					
1.2		0.10					
1.3		0.08					
1.3		0.09					

1.3		0.12					
cmol(+)/kg						bar	%
CEC_{soil} sum of cations	CEC_{soil} NH_4OAc	CEC_{soil} bases+Al	CEC_{soil} (Ca)	pH H_2O	pH KCl	1/3	15
			5.7 5.5 5.5 5.7 5.8	6.0 5.3 5.2 5.4 5.2			
organic matter %	organ. C %	N %	free Fe_2O_3 (%) clay	avail. P ppm Truogh	P. total mg/100 g	$CaCO_3$%	EC sat. dS/m
	0.94 0.53 0.29 0.20 0.20	0.095 0.069 0.059 0.054 0.055	7.3 7.7 8.3 8.9 8.1				

Profile ZR019 (formerly 52)

Classification: Xanthic Ferralsols, FRx (FAO, 1990)
Yellow typic hygro-xeroferralsols, on the Schisto-Calcaire System, series IO-F13 (INEAC)

Source: Sys (1972), description in 1958

Location: Mbanza Ngungu, Lower Congo

Coordinates: 05° 20’S; 14°30’ E
-05.33°; 14.50°

Terrain unit: 710, Schisto-Calcaire depression

Altitude: 410 m

Topography: widely undulating to flat

Drainage: well drained

Parent material: clay, weathering product of the Schisto-Calcaire

Vegetation: savannah

Climate: (Aw)s, mean annual temperature 24°C, mean annual rainfall 1,275 mm, 130-140 days of dry season

Profile description

Ah 0-14 cm Clay; very dark greyish brown (10YR 3/2, moist); dark greyish brown (10YR 4/2 dry); fine, blocky structure, with crumb pockets around roots; loose; moist; abundant roots; gradual transition.

AB 14-29 cm Clay; dark brown (10YR 4/3, moist); dark yellowish brown (10YR 4/4, dry); moderate, fine, subangular blocky structure; firm; common roots; gradual transition.

Bo1 29-56 cm Clay; yellowish brown (10YR 5/4, moist and dry); weak, fine and very fine, subangular blocky structure; friable; few roots; diffuse transition.

Bo2 56-12O cm Clay; yellowish brown (10YR 5/6, moist and dry); weak, fine and medium, subangular blocky structure; very friable.

Analytical data of profile ZR019

horizon	depth (cm)	> 2 mm %	coarse sand 0.25-2 mm	fine sand 0.05-0.25 mm	silt 0.05 - 0.002 mm	Clay < 0.002 mm	tex-ture USDA
Ah1	0-14		4.5	21.4	18.5	55.6	C
AB	14-29		4.2	20.1	17.7	58.0	C
Bo1	29-56		3.9	19.0	18.0	59.1	C
Bo2	56-120		3.3	18.0	17.4	63.1	C
Cmol(+)/kg							
Ca (HCl N/20)	Mg	K (HCl N/20)	Na	H^+	Al^{3+}	Al sat. (m)	Base sat. %
1.3		0.17					
1.3		0.07					
1.6		0.04					
0.9		0.02					
cmol(+)/kg						bar	%

CEC_{soil} sum of cations	CEC_{soil} NH_4Oac	CEC_{soil} bases+Al	CEC_{soil} (Ca)	PH H_2O	pH KCl	1/3	15
			6.10 5.15 4.45 3.95	4.9 4.8 4.9 5.1			
organic matter %	organ. C %	N %	free Fe_2O_3 (%)	avail. P ppm Truogh	P. total mg/100 g	$CaCO_3$%	EC sat. dS/m
	1.40 0.96 0.71 0.53	0.129 0.102 0.086 0.053	5.8 5.7 6.9 6.6				

Profile ZR020 (formerly 56)

Classification: Haplic Ferralsols, FRh (FAO, 1990)
Yellowish red, clayey, hygro-xeroferralsols, on the Schisto-Greseux System, series IO-F12 (INEAC)

Source: Sys (1972), description in 1958

Location: Mbanza Ngungu, Lower Congo

Coordinates: 05° 20’S; 14°30’E
-05.33°; 14.50°

Terrain unit: 720, Schisto-Greseux plateaux

Altitude: 585 m

Topography: undulating

Drainage: well drained

Parent material: clay, weathering product of the Schisto-Greseux

Vegetation: wooded savannah

Climate: (Aw)S, mean annual temperature 24°C, mean annual rainfall 1,275 mm, 130-140 days of dry season

Profile description

Ah 0-10 cm Sandy clay; dark brown (7.5YR 3/2, moist), (75YR 4/2 dry); strong, medium, crumb and fine, blocky structure; firm; abundant roots; gradual and smooth transition.

AB 10-22 cm Sandy clay; dark brown (7.5YR 4/2, moist); reddish brown (5YR 4/4, dry); strong, fine, subangular blocky structure; firm; many roots; gradual and undulating transition

BA 22-45 cm Sandy clay to clay; reddish brown (5YR 4/4, moist), yellowish red (5YR 4/6, dry); strong, fine, subangular blocky structure; firm; few roots; diffuse and smooth transition.

Bo1 45-76 cm Clay; reddish brown (5YR 5/4, moist), yellowish red (5YR 4/6, dry); strong, fine, subangular blocky structure; compact when dry; diffuse transition.

Bo2 76-150 cm Sandy clay to clay; yellowish red (5YR 5/6, moist), (5YR 4/6, dry); weak, coarse, subangular blocky structure falling apart into fine granules; friable; no roots.

Analytical data of profile ZR020

horizon	depth (cm)	> 2 mm %	coarse sand 0.25-2 mm	fine sand 0.05-0.25 mm	silt 0.05 - 0.002 mm	Clay < 0.002 mm	tex-ture USDA
Ah	0-10		13.9	33.6	7.9	44.6	SC
AB	10-22		12.8	32.5	8.8	45.9	SC
BA	22-45		10.8	27.5	8.6	53.0	C
Bo1	45-76		9.7	26.8	9.5	54.0	C
Bo2	76-150		11.0	28.1	9.5	51.4	C
cmol(+)/kg							
Ca (HCl N/20)	Mg	K (HCl N/20)	Na	H^+	Al^{3+}	Al sat. (m)	Base sat. %
1.05		0.11					
0.6		0.06					
0.5		0.05					
0.5		0.04					
0.5		0.04					
cmol(+)/kg						bar	%

CEC_{soil} sum of cations	CEC_{soil} NH_4OAc	CEC_{soil} bases+Al	CEC_{soil} (Ca)	pH H_2O	pH KCl	1/3	15
			6.9 5.9 4.7 4.2 3.8	4.6 4.6 4.8 5.0 5.0			
organic matter %	organ. C %	N %	free Fe_2O_3 (%)	avail. P ppm Truogh	P. total mg/100g	$CaCO_3$%	EC sat. dS/m
	1.72 1.30 0.69 0.54 0.36	0.115 0.111 0.102 0.056 0.047	3.0 4.1 3.6 3.4 3.4				

Profile ZR021 (formerly 58)

Classification: Haplic Ferralsols, FRh (FAO, 1990)
Dark red, clayey, hygro-xeroferralsols, on schists of the laterised Plio-Pleistocene pediplain, series ILI-F10 (INEAC)

Source: Sys (1972), description in 1955

Location: ENE of Gemena (Equator)

Coordinates: 03° 35’N; 20°25’E
03.58°; 20.42°

Terrain unit: 930, Lindi plateaux

Altitude: 460 m

Topography: plateau with termite hills

Drainage: well drained

Parent material: weathering products of schists of the Lower Ubangi (Lindian)

Vegetation: savannah

Climate:	(Aw)N, mean annual temperature 24°C, mean annual rainfall 1,700 mm, 60-65 days of dry season

Profile description

Ah1	0-05 cm	Clay; greyish reddish brown (2.5YR 4/2, moist); firm; moist; abundant roots; diffuse transition.
Ah2	05-18 cm	Clay; greyish reddish brown (2.5YR 4/2, moist); firm; moist; crumb structure; abundant roots; clear transition.
AB	18-28 cm	Clay with some coarse sand; greyish reddish brown (2.5YR 4/2, moist); subangular blocky structure; firm; moist; weak biological activity; many roots; gradual transition.
BA	28-48 cm	Clay; light purplish red (10R 4/4, moist); moderate, subangular blocky structure; firm; moist; many roots; clear transition.
Bo1	48-83 cm	Clay (10R 4/6, moist); strong, angular blocky structure; few cutans; weak biological activity; many roots; firm; moist; clear transition.
Bo2	83-90 cm	Clay; red (10R 4/6, moist); weak, subangular blocky; firm; moist; few roots; diffuse transition.
Bo3	90-140 cm	Clay; red (10R 4/6 to 2.5YR 4/8, moist); massive; firm; few roots; abrupt transition.
IIBo4 cs	140-200cm	Gravelly layer composed of ironstone concretions and clay.

Analytical data of profile ZR021

horizon	depth (cm)	> 2 mm %	coarse sand 0.25-2 mm	fine sand 0.05-0.25 mm	silt 0.05 - 0.002 mm	Clay < 0.002 mm	tex-ture USDA

Ah1	0-5		10.5	21.4	22.3	45.8	C
Ah2	5-18		22.0	21.6	18.4	38.0	SC
AB	18-28		22.4	16.1	8.8	52.7	C
BA	28-48		17.7	12.5	5.0	64.8	C
Bo1	48-83		14.1	10.0	4.3	71.6	C
Bo2	83-90		13.8	8.8	3.8	73.6	C
Bo3	90-140		13.8	8.6	4.0	73.6	C
IIBo4	140-200	67	17.8	7.1	5.4	69.7	C
cmol(+)/kg							
Ca (HCl N/20)	Mg	K (HCl N/20)	Na	H^+	Al^{3+}	Al sat. (m)	Base sat. %
10.5		0.80					
7.4		0.62					
3.1		0.38					
2.5		0.23					
2.3		0.34					
2.2		0.29					
2.2		0.25					
1.9		0.32					
cmol(+)/kg						bar	%
CEC_{soil} sum of cations	CEC_{soil} NH_4OAc	CEC_{soil} bases+Al	CEC_{soil} (Ca)	pH H_2O	pH KCl	1/3	15
			14.1	6.5			
			9.7	6.3			
			6.7	6.2			
			6.1	6.2			
			5.6	6.1			
			5.2	6.1			
			5.1	6.2			
			4.8	6.2			
organic matter %	organ. C %	N %	free Fe_2O_3 (%)	avail. P ppm Truogh	P. total mg/100 g	$CaCO_3$%	EC sat. dS/m
	2.3	0.190	7.5				
	1.84	0.155	8.2				
	0.86	0.099	7.0				
	0.55	0.054	7.8				
	0.29	0.040	5.3				
	0.24	0.034	8.5				
	0.24	0.037	6.1				
	0.27	0.026	11.5				

Profile ZR022 (formerly 62)

Classification:	Haplic Ferralsols, FRh (FAO, 1990) Yellowish red clayey hygro-ferralsols, on gravels of the Plio-Pleistocene pediplain, series ILO-F2 (INEAC)
Source:	Sys (1972), description in 1957
Location:	Isiro, Uele, Higher Congo
Coordinates:	02° 15’N; 27°37’E 02.25°; 27.62°
Terrain unit:	980, Kibali plateaux
Altitude:	820 m
Topography:	isolated relief overlooking the end-Tertiary pediplain
Drainage:	well drained
Parent material:	clay, weathering product of the schists of the Kibali Group
Vegetation:	equatorial forest
Climate:	(Aw)N, mean annual temperature 23-24°C, mean annual rainfall 1,850 mm

Profile description

Ah	0-04 cm	Clay; reddish brown (5YR 4/4, moist); crumb structure.
AB	04-14 cm	Clay; yellowish red (5YR 4/6, moist); strong fine blocky and crumb structure.
BA	14-27 cm	Clay; yellowish red (5YR 4/6, moist); moderate, fine, blocky structure; firm.
Bo1	27-51 cm	Clay; yellowish red (5YR 5/6, moist); moderate to strong, medium, blocky structure; firm.
Bo2	51-80 cm	Clay; yellowish red (5YR 4/6, moist); weak, blocky structure; loose.
IIBo3 cs	80-160 cm	Heterogeneous gravelly layer, composed of dominantly ironstone concretions, mixed with slightly red-coloured schist gravels.

Analytical data of profile ZR022

horizon	depth (cm)	> 2 mm %	coarse sand 0.25-2 mm	fine sand 0.05-0.25 mm	silt 0.05 - 0.002 mm	clay < 0.002 mm	texture USDA
Ah	0-4	20	5.2	12.6	21.3	60.9	C
AB	4-14	5	5.0	17.0	18.9	59.1	C
BA	14-27		5.6	15.6	16.7	62.1	C
Bo1	27-51		5.7	13.0	18.2	63.1	C
Bo2	51-80	25	4.1	15.5	18.9	62.2	C
IIBo3cs	80-160	43	6.5	14.5	17.1	59.8	C
cmol(+)/kg							
Ca (HCl N/20)	Mg	K (HCl N/20)	Na	H^+	Al^{3+}	Al sat. (m)	Base sat. %
8.1		0.68					
1.9		0.16					
1.6		0.15					
1.6		0.12					
1.1		0.14					
1.3		0.24					
cmol(+)/kg						bar	%
CEC_{soil} sum of	CEC_{soil} NH_4OAc	CEC_{soil} bases+Al	CEC_{soil} (Ca)	pH H_2O	pH KCl	1/3	15

cations							
			9.4 7.9 6.8 6.1 5.6 5.4	5.4 4.9 4.7 4.7 5.2 5.4			
organic matter %	organ. C %	N %	free Fe_2O_3 (%)	avail. P ppm Truogh	P. total mg/100 g	$CaCO_3$%	EC sat. dS/m
	2.84 1.13 0.86 0.68 0.59 0.54	0.281 0.117 0.102 0.076 0.071 0.057	7.8 8.9 8.8 9.6 9.1 8.9				

Profile ZR023 (formerly 71)

Classification: Humic Ferralsols, FRu (FAO, 1990)
Red clayey ferralsols, with a sombric horizon, on schists, series IO-FR21 (INEAC)

Source: Sys (1972), description in 1958

Location: Higher Ituri, N of Nioka, Higher Congo

Coordinates: 02° 18’N; 30°32’E
02.30°; 30.53°

Terrain unit: 1230, Aru highlands

Altitude: 1,750 m

Topography: top of a large hill

Drainage: well drained

Parent material: clay, weathering product of schists

Vegetation: grass savannah

Climate: Cf, mean annual temperature 18.1°C, mean annual rainfall 1,400 mm, 70 days of dry season

Profile description

Ah 0-20 cm Clay; dark reddish brown (5YR 2/2, moist); strong, fine and medium, crumb structure; friable; slightly moist; abundant roots; gradual transition.

AB 20-32 cm Clay; dark reddish brown (5YR 3/2, moist); strong, medium, crumb structure; firm in situ; slightly moist; common roots; gradual transition.

BA 32-54 cm Clay; dark reddish brown to dark brownish red (2.5YR 3/4 to 5YR 3/4, moist); moderate, medium, subangular blocky structure; hard; moist; very few roots; diffuse transition.

Bo1 54-80 cm Clay; dark red (2.5YR 3/6, moist); moderate, fine, subangular blocky structure; firm; moist; few roots; diffuse transition.

Bo2 80-150 cm Clay; dark red (2.5YR 3/6, moist); massive; very friable; presence of some dark reddish brown nodules (5YR 3/3).

Analytical data of profile ZR023

horizon	depth (cm)	> 2 mm %	coarse sand 0.25-2 mm	fine sand 0.05-0.25 mm	silt 0.05 - 0.002 mm	clay < 0.002 mm	tex-ture USDA
Ah	0-20		11.0	14.7	16.1	60.2	C
AB	20-32		12.2	14.5	13.4	60.9	C
BA	32-54		10.0	15.3	13.8	60.9	C
Bo1	54-80		8.0	14.3	13.5	64.2	C
Bo2	80-150		7.3	14.2	12.3	66.4	C
cmol(+)/kg							
Ca (HCl N/20)	Mg	K (HCl N/20)	Na	H^+	Al^{3+}	Al sat. (m)	Base sat. %
5.4		0.25					
1.0		0.05					
0.6		0.05					
0.5		0.02					
—		—					
cmol(+)/kg						bar	%
CEC_{soil} sum of cations	CEC_{soil} NH_4OAc	CEC_{soil} bases+Al	CEC_{soil} (Ca)	pH H_2O	pH KCl	1/3	15
			15.2	5.4			
			10.8	4.9			

			8.0	5.1			
			6.0	5.2			
			7.2	5.2			

organic matter %	organ. C %	N %	free Fe_2O_3 (%)	avail. P ppm Truogh	P. total mg/100 g	$CaCO_3$%	EC sat. dS/m
	3.30	0.285	12.0				
	2.10	0.167	7.8				
	1.37	0.116	7.8				
	0.76	0.084	13.4				
	-	-	13.4				

Profile ZR024 (formerly 79)

Classification: Haplic Nitisols, NTh (FAO, 1990)
Yellow clayey hygro-ferrisols, on schists, series IO-S3 (INEAC)

Source: Sys (1972), description in 1965
Location: N of Kasongo, Kisamba, Maniema

Coordinates: 04° 05'S; 26°32'E
-04.08°; 26.53°

Terrain unit: 990, Rusizian-Burundian plateaux at medium altitude

Altitude: 660 m
Topography: undulating plateau, slope 1-2 %
Drainage: well drained

Parent material: clay, weathering product of schists

Vegetation: cleared forest

Climate: (Aw)S, mean annual temperature 24°C, mean annual rainfall 1,550 mm, 80 days of dry season

Profile description

O 0.5 cm litter layer

Ah1 0-05 cm Fine clayey; dark brown (7.5YR 4/4, moist); moderate, fine, crumb structure; loose; moist; abundant roots; strong biological activity; gradual and smooth transition.

Ah2 05-10 cm Fine clayey; dark brown to brown (7.5YR 4.5/4, moist); strong, fine, granular structure; loose to friable; moist; abundant roots; strong biological activity; gradual and smooth transition.

BA 10-30 cm Fine clayey; brown (7.5YR 5/4, moist); moderate, fine, subangular to angular blocky structure; friable; moist; many roots; discontinuous, fine, clay cutans cover 20-30 % of the ped surfaces; distinct and smooth transition.

Bt1 30-50 cm Fine clayey; brown (7.5YR 5/4, moist); strong, very fine, angular blocky structure; friable to firm; moist; many roots; continuous, fine, clay coatings cover 50-60 % of the ped surfaces; gradual and smooth transition.

Bt2 50-90 cm Fine clayey; brown (7.5YR 5/4, moist); strong, very fine, angular blocky structure; friable to firm; moist; few roots; almost continuous, fine, clay coatings cover 40-50 % of the peds; gradual and smooth transition.

Bt3 90-160 cm Fine clayey; brown (7.5YR 5/4, moist); strong, very fine to very fine, angular to subangular blocky structure; friable; moist; few roots; 20-30 % clay cutans on the peds.

Analytical data of profile ZR024

horizon	depth (cm)	> 2 mm %	coarse sand 0.25-2 mm	fine sand 0.05-0.25 mm	silt 0.05 - 0.002 mm	clay < 0.002 mm	texture USDA
Ah1	0-5		5.0	14.7	36.4	43.9	C
Ah2	5-10		4.7	16.6	35.0	43.7	C
BA	10-30		4.5	14.2	31.5	49.8	C
Bt1	30-50		3.8	11.8	28.5	55.9	C
Bt2	50-90		4.0	11.0	27.6	57.4	C
Bt3	90-150		4.0	10.5	26.2	59.3	C
cmol(+)/kg							
Ca (HCl N/20)	Mg	K (HCl N/20)	Na	H^+	Al^{3+}	Al sat. (m)	Base sat. %
1.3		0.39					
0.9		0.28					
0.8		0.19					
0.6		0.13					
0.5		0.12					
0.7		0.11					
cmol(+)/kg						bar	%
CEC_{soil} sum of	CEC_{soil} NH_4OAc	CEC_{soil} bases+Al	CEC_{soil} (Ca)	pH H_2O	pH KCl	1/3	15

cations							
			8.0	4.5			
			6.5	4.4			
			5.9	4.5			
			5.9	4.9			
			6.1	4.9			
			6.0	4.8			
organic matter %	organ. C %	N %	free Fe_2O_3 (%)	avail. P ppm Truogh	P. tot.mg /100g	$CaCO_3$%	EC sat. dS/m
	0.88	0.138	8.1				
	0.54	0.084	8.1				
	0.29	0.067	8.9				
	0.19	0.053	9.4				
	0.19	0.056	10.4				
	0.14	0.055	9.2				

Profile ZR025 (formerly 86)

Classification: Haplic Ferralsols, FRh (FAO, 1990)
Yellowish red, clayey, hygro-xeroferralsols, on schists on the Plio-Pleistocene pediplain, series ILO-F12 (INEAC)

Source: Sys (1972), description in 1956
Location: Lubumbashi, High Katanga

Coordinates: 11° 38’S; 27°25’E
-11.63°; 27.45°

Terrain unit: 1030, High plateaux of Katanga

Altitude: 1,250 m
Topography: flat plateau
Drainage: well drained
Parent material: clay, weathering product of schists

Vegetation: degraded open forest

Climate: Cw, mean annual temperature 20.1°C, mean annual rainfall 1,244 mm, 180 days of dry season

Profile description

Ah1 0-02 cm Clay; dark brown (7.5YR 4/2, moist); strong, fine, crumb structure; loose; abundant roots; clear transition.

Ah2 02-06 cm Clay; dark brown (7.5YR 4/4, moist); strong, coarse, crumb structure; many roots; termite activity; gradual and smooth transition.

AB 06-15 cm Clay; reddish brown (5YR 4/4, moist); moderate, medium, blocky structure; firm; diffuse and smooth transition.

BA 15-24 cm Clay; reddish brown (5YR 4/4, moist); moderate, coarse, blocky structure; firm; good root penetration; diffuse transition.

Bo1 24-41 cm Clay; yellowish red (5YR 4/6-5/6, moist); weak, coarse, blocky structure; very firm; many roots; diffuse transition.

Bo2 41-72 cm Clay; yellowish red (5YR 4/6, moist); as above, but somewhat less firm; diffuse transition.

Bo3 72-100 cm Clay; yellowish red (5YR 4/6-2.5YR 5/8, moist); massive; very friable; very few roots; diffuse transition.

Bo4 100-150 cm Same as above.

Analytical data of profile ZR025

horizon	depth (cm)	> 2 mm %	co.sand 0.25-2 mm	f.sand 0.05-0.25mm	Silt 0.05 - 0.002mm	clay < 0.002 mm	tex-ture USDA
Ah1	0-2		5.0	15.6	23.6	55.8	C
Ah2	2-6		4.1	15.9	21.6	58.4	C
AB	6-15		4.1	14.9	22.3	58.7	C
BA	15-24		2.7	11.3	20.5	65.5	C
Bo1	24-41		2.4	8.9	16.8	71.9	C
Bo2	41-72		1.6	8.0	15.2	75.2	C
Bo3	72-100		1.7	8.8	17.2	72.3	C
Bo4	100-150		1.6	9.8	18.9	69.7	C
cmol(+)/kg							
Ca(HCl N/20)	Mg	K (HCl N/20)	Na	H^+	Al^{3+}	Al sat. (m)	Base sat. %
15.3		2.6					
6.3		1.2					
4.1		0.9					
2.7		0.8					
2.4		0.8					
2.1		0.6					
2.3		0.7					
2.0		0.5					
cmol(+)/kg						bar	%
CEC_{soil} sum cat	CEC_{soil} NH_4OAc	CEC_{soil} bases+Al	CEC_{soil} (Ca)	pH H_2O	pH KCl	1/3	15
			-	5.5			
			-	5.3			
			-	5.0			

			-	5.2			
			5.8	5.4			
			5.0	5.6			
			4.9	5.9			
			4.9	5.9			
organic mat. %	organ. C %	N %	free Fe_2O_3(%)	avail. P ppm	P.tot. mg/100g	$CaCO_3$%	EC dS/m
	3.3	0.216	4.0				
	1.91	0.157	5.0				
	1.32	0.125	5.0				
	0.82	0.088	6.2				
	0.55	0.065	6.0				
	-	-	6.6				
	-	-	6.4				
	-	-	7.0				

Profile ZR026 (formerly 92)

Classification: Haplic Ferralsols, FRh (FAO, 1990)
Yellow, sandy clayey, hygro-xeroferralsols, on sandstone, series QA-F13 (INEAC)

Source: Sys (1972), description in 1959

Location: Mayombe highlands, Lower Congo

Coordinates: 05° 30'S; 13°00'E
-05.50°; 13.00°

Terrain unit: 600/2, Mayombe highlands

Altitude: 265 m

Topography: undulating, slope 4 %

Drainage: well drained

Parent material: sandy clay, weathering product of sublitoral sandstone.

Vegetation: grazing savannah

Climate: (Aw)S, mean annual temperature 22°C, mean annual rainfall 1,225 mm, 140 days of dry season

Profile description

Ah 0-07 cm Sand; dark grey (10YR 4/1, moist); moderate, fine and medium, crumb structure; loose; many roots; distinct and smooth transition.

AB 07-23 cm Loamy sand; light brown (10YR 5/3, moist); moderate, medium, subangular blocky structure; loose; common roots; gradual and smooth transition.

BA 23-36 cm Sandy clay loam; brown (7.5YR 5/5, moist); strong to moderate, medium, subangular blocky structure; firm; common roots; gradual and smooth transition.

Bo1 36-50 cm Sandy clay; strong brown (7.5YR 5/6, moist); moderate, medium, blocky structure; firm; common roots; diffuse and smooth transition.

Bo2 50-65 cm Sandy clay; same as above.

Bo3 65-107 cm Sandy clay loam; yellowish brown to light yellowish red (6.5YR 6/6, moist); moderate, medium, blocky structure; firm; few roots; diffuse transition.

Bo4 107-150 cm Sandy clay; yellowish red (5YR 5/6, moist).

Analytical data of profile ZR026

horizon	depth (cm)	> 2 mm %	co.sand 0.25-2 mm	fine sand 0.05-0.25 mm	silt 0.05 - 0.002 mm	clay < 0.002 mm	tex-ture USDA
Ah	0-7		39.7	43.2	7.5	9.6	LS
AB	7-23		35.4	43.8	8.5	12.3	LS
BA	23-36		27.7	33.2	7.2	31.7	SCL
Bo1	36-50		25.8	31.2	7.7	35.3	SC
Bo2	50-65		29.1	29.5	7.1	34.2	SCL
Bo3	65-107		28.3	30.7	7.6	33.3	SCL
Bo4	107-150		30.2	32.9	9.0	27.6	SCL
cmol(+)/kg							
Ca (HCl N/20)	Mg	K (HCl N/20)	Na	H^+	Al^{3+}	Al sat. (m)	Base sat. %
1.4		0.34					
0.7		0.20					
0.6		0.28					
0.6		0.29					
0.7		0.28					
0.7		0.32					
-		-					
cmol(+)/kg						bar	%
CEC_{soil} sum cat	CEC_{soil} NH_4OAc	CEC_{soil} bases+Al	CEC_{soil} (Ca)	pH H_2O	pH KCl	1/3	15
			3.9	6.6			
			3.1	5.6			
			4.8	5.1			

			5.5 5.0 4.7 4.6	5.0 5.2 5.2 4.9			
organ. matter %	organ. C %	N %	free Fe_2O_3(%)	avail. P ppm	P.tot. mg/100 g	$CaCO_3$%	EC sat. dS/m
	0.55 0.31 0.42 0.38 0.25 0.16 -	0.059 0.043 0.069 0.070 0.061 0.057 -					

Profile ZR027 (formerly 125)

Classification: Rhodic Ferralsols, FRr (FAO, 1990)
Red clayey hygro-xeroferralsols, on dolomite, series CO-F11 (INEAC)

Source: Sys (1972), description in 1955

Location: Lubumbashi, Katanga

Coordinates: 11° 42’S; 27°25’E
-11.70°; 27.42°

Terrain unit: 1030, S Katanga high plateaux

Altitude: 1,250 m

Topography: large well drained depression

Drainage: well drained

Parent material: clay, weathering product of Kakontwe limestone

Vegetation: open forest with *Brachystegia*

Climate: Cw, mean annual temperature 20°C, mean annual rainfall 1,250 mm, 180-190 days of dry season

Profile description

Ah 0-03 cm Clay; dark red (2.5YR 3/2, moist); strong, fine crumb structure; loose; many roots; clear and smooth transition.

AB 03-10 cm Clay; reddish brown (2.5YR 4/4, moist); strong, coarse, crumb structure; loose; abundant roots; gradual transition.

BA 10-19 cm Clay; reddish brown (2.5YR 3/4, moist); moderate, medium, blocky structure; firm; many roots; diffuse transition.

Bo1 19-63 cm Clay; dark red (2.5YR 3/6, moist); slightly structured; few, weakly developed, blocky aggregates in a massive mass; firm; many roots; diffuse transition.

Bo2 63-90 cm Clay; dark red (10R 3/6, moist); massive; very friable; few roots; diffuse transition.

Bo3 90-150 cm Same as above.

Analytical data of profile ZR027

horizon	depth (cm)	> 2 mm %	co.sand 0.25-2 mm	fine sand 0.05-0.25 mm	silt 0.05 - 0.002 mm	clay < 0.002 mm	tex-ture USDA
Ah	0-3		21.8	16.8	11.6	49.8	C
AB	3-10		20.6	15.6	11.7	51.2	C
BA	10-19		18.0	16.7	11.7	53.6	C
Bo1	19-63		18.0	16.6	11.7	53.7	C
Bo2	63-90		16.3	16.6	12.5	54.6	C
Bo3	90-150		16.5	15.9	11.7	55.9	C
cmol(+)/kg							
Ca (HCl N/20)	Mg	K (HCl N/20)	Na	H^+	Al^{3+}	Al sat. (m)	Base sat. %
7.1		0.90					
0.9		0.33					
0.7		0.28					
0.7		0.24					
0.9		0.27					
0.5		0.30					
cmol(+)/kg						bar	%
CEC_{soil} sum of cations	CEC_{soil} NH_4OAc	CEC_{soil} bases+Al	CEC_{soil} (Ca)	pH H_2O	pH KCl	1/3	15
			11.9	5.8			
			6.1	5.0			
			5.9	5.0			
			5.3	5.1			

			4.8 4.2	4.8 4.5			
organic matter %	organ. C %	N %	free Fe_2O_3(%)	avail. P ppm	P.tot. mg/100 g	$CaCO_3$%	EC sat. dS/m
	5.6 2.24 1.63 0.84 - -	0.455 0.202 0.131 0.078 - -					

Profile ZR028 (formerly 135)

Classification: Rhodic Ferralsols, FRr (FAO, 1990)
Dark red, clayey, hygro-xeroferralsols, on the Plio-Pleistocene pediplain, series BLO-F1Oe (INEAC)

Source: Sys (1972), description in 1960

Location: Gemena, Ubangi, Equator

Coordinates: 03° 50'N; 20°22'E
03.83°; 27.37°

Terrain unit: 950, Liki-Bembe plateaux

Altitude: 530 m

Topography: widely undulating

Drainage: well drained

Parent material: clay, weathering product of gabbro and diabases

Vegetation: savannah

Climate: (Aw)N, mean annual temperature 24°C, mean annual rainfall 1,675 mm, 60-70 days of dry season

Profile description

Ah1 0-15 cm Clay; (2.5YR 2/4, moist); strong, crumb structure; earth worm activity; abundant roots; firm and moist; clear transition.

Ah2 15-27 cm Clay; (2.5YR 3/4, moist); moderate crumb and angular blocky; firm and moist; many roots; clear transition.

Bo1 27-53 cm Clay; (10R 3/4, moist); moderate, subangular blocky structure; firm and moist; common roots; diffuse transition.

Bo2 53-72 cm Clay; (10R 3/4, moist); weak, subangular blocky structure; few roots; firm and moist; diffuse transition.

Bo3 72-150 cm Clay; (10R 3/4, moist); massive; firm and moist; rare roots.

Analytical data of profile ZR028

horizon	depth (cm)	> 2 mm %	coarse sand 0.25-2 mm	fine sand 0.05-0.25 mm	silt 0.05 - 0.002 mm	clay < 0.002 mm	tex-ture USDA
Ah	0-15		16.3	17.7	7.7	58.3	C
Ah2	15-27		20.7	9.2	5.8	64.3	C
Bo1	27-53		10.5	12.9	5.2	71.4	C
Bo2	53-72		11.3	13.8	5.4	69.5	C
Bo3	72-150		11.7	15.0	5.8	67.5	C
Cmol(+)/kg							
Ca (HCl N/20)	Mg	K (HCl N/20)	Na	H^+	Al^{3+}	Al sat. (m)	Base sat. %
4.1		0.50					
1.9		0.15					
1.5		0.13					
1.4		0.13					
1.0		0.15					
cmol(+)/kg						bar	%
CEC_{soil} sum of cations	CEC_{soil} NH_4OAc	CEC_{soil} bases+Al	CEC_{soil} (Ca)	pH H_2O	pH KCl	1/3	15
			8.1	6.4			
			5.0	5.3			
			3.1	5.6			
			3.4	5.6			
			3.0	5.3			
organic matter	organ. C %	N %	free Fe_2O_3	avail. P ppm	P.tot. mg/100	$CaCO_3$%	EC sat.

%			(%)clay		g		dS/m
	1.58	0.126	5.3				
	0.87	0.081	11.9				
	0.60	0.056	16.2				
	0.40	0.035	17.5				
	0.33	0.023	16.6				

Profile ZR029 (formerly 151)

Classification: Humic Nitisols, NTu (FAO, 1990)
Yellowish red clayey humiferous Ferrisols, on basalt, series BO-S22 (INEAC)

Source: Sys (1972), description in 1960
Location: Bukavu, Kivu

Coordinates: 02° 30’S; 28°45’E
-02.50°; 28.75°

Terrain unit: 1130, Basalt plateaux
Altitude: 2,370 m
Topography: top in an area of gullied relief

Drainage: well drained

Parent material: clay, weathering product of basalt

Vegetation: bamboo forest

Climate: Cf, mean annual temperature 16°C, mean annual rainfall 1,850 mm, < 50 days of dry season

Profile description

0 2-0 cm litter layer

Ah1 0-17 cm Clay; black (7.5YR 2/1-2/2, moist); moderate, granular structure, with coarse elements; dense fine root network; friable to loose; gradual and smooth transition.

Ah2 17-30 cm Clay; very dark brown (7.5YR 2/2-3/2, moist); moderate blocky structure, with crumb pockets; abundant roots; friable; plastic; gradual and smooth transition.

AB 30-45 cm Clay; (7.5 YR 4/4, moist).

Bt1 45-80 cm Clay; reddish brown (5YR 4/5, moist); moderate, blocky structure; discontinuous, thin cutans; common roots; friable, plastic, slightly sticky; diffuse transition.

Bt2 80-120 cm Clay; yellowish red (5YR 4/6, moist); moderate, blocky structure; continuous, thin cutans; formation of very coarse prisms when drying; few roots; friable; plastic, slightly sticky; diffuse transition.

Bt3 120-170 cm Clay; reddish brown (5YR 4/4, moist); moderate, fine, blocky structure; continuous cutans of the same colour; firm in situ, slightly plastic, non-sticky; rare roots.

Analytical data of profile ZR029

horizon	depth (cm)	> 2 mm %	coarse sand 0.25-2 mm	fine sand 0.05-0.25 mm	silt 0.05 - 0.002 mm	clay < 0.002 mm	texture USDA
Ah	0-17		2.5	1.6	17.2	78.7	C
Ah2	17-30		1.4	1.4	14.8	82.4	C
AB	30-45		1.1	1.5	13.7	83.7	C
Bt1	45-80		0.7	1.7	13.3	83.9	C
Bt2	80-120		0.8	1.5	13.9	83.5	C
Bt3	120-170		1.0	1.6	13.3	83.6	C
cmol(+)/kg							
Ca (HCl N/20)	Mg	K (HCl N/20)	Na	H^+	Al^{3+}	Al sat. (m)	Base sat. %
0.9		0.25					
0.4		0.13					
0.6		0.05					
0.5		0.03					
0.4		0.03					
-		-					
cmol(+)/kg						bar	%
CEC_{soil} sum of cations	CEC_{soil} NH_4OAc	CEC_{soil} bases+Al	CEC_{soil} (Ca)	pH H_2O	pH KCl	1/3	15
			26.65	5.1			
			19.00	5.0			
			13.55	4.6			
			12.90	4.6			
			12.20	4.5			

			13.10	4.5			
organic matter %	organ. C %	N %	free Fe_2O_3 (%)clay	avail. P ppm	P.tot. mg/100 g	$CaCO_3$%	EC sat. dS/m
	8.12	0.855	9.4				
	4.84	0.500	9.4				
	2.98	0.308	11.6				
	2.01	0.215	11.9				
	1.60	0.206	11.1				
	-	-	-				

Profile ZR030 (formerly 157)

Classification: Haplic Nitisols, NTh (FAO, 1990)
Yellowish red, clayey, hygro-xeroferrisols, on gneiss, series NI-S12 (INEAC)

Source: Sys (1972), description in 1959

Location: S of Tshela, Mayombe, Lower Congo

Coordinates: 05° 15'S; 12°50'E
-05.25°; 12.83°

Terrain unit: 600/1, Mayombe highlands

Altitude: 400 m ?

Topography: undulating, near a hill top, slope 6 %

Drainage: well drained

Parent material: clay, weathering product of gneiss

Vegetation: forest clearing

Climate: (Aw)S, mean annual temperature 23.5°C, mean annual rainfall 1,000 mm, 150-160 days of dry season

Profile description

0 0.5-0 cm decomposing organic matter layer

Ah 0-21 cm Sandy clay; reddish brown (2.5YR 4/4, moist); strong, fine, angular blocky structure; friable to firm; many roots; distinct and smooth transition.

AB 21-46 cm Clay; reddish brown (2.5YR 5/4, moist); strong, medium, angular blocky; firm; many roots; gradual and smooth transition.

Bt1 46-76 cm Clay; red (2.5 YR 5/6, moist); strong, medium, angular blocky; thick and continuous cutans on the ped surfaces; firm to compact; common roots; diffuse and smooth transition.

Bt2 76-97 cm Same as above, but with coarser structural elements.

Bt3 97-120 cm Clay; red (2.5YR 5/6, moist); strong, medium, subangular blocky structure; continuous, thick cutans on the ped surfaces; few roots; friable; diffuse transition.

Bt4 120-200 cm Clay; red (2.5YR 5/6, moist); weak, coarse, blocky structure; discontinuous, thin cutans; friable.

Analytical data of profile ZR030

horizon	depth (cm)	> 2 mm %	co.sand 0.25-2 mm	fine sand 0.05-0.25 mm	silt 0.05 - 0.002 mm	clay < 0.002 mm	texture USDA
Ah	0-21		26.1	22.5	9.1	42.3	SC
AB	21-46		25.8	16.9	7.3	50.0	C
Bt1	46-76		20.0	16.5	6.9	56.6	C
Bt2	76-97		20.8	13.5	7.4	58.3	C
Bt3	97-120		17.5	13.5	8.1	60.9	C
Bt4	120-200		14.4	11.3	9.0	65.3	C
cmol(+)/kg							
Ca (HCl N/20)	Mg	K (HCl N/20)	Na	H^+	Al^{3+}	Al sat. (m)	Base sat. %
5.9		0.34					
2.1		0.28					
1.4		0.26					
1.3		0.24					
1.3		0.22					
-		-					
cmol(+)/kg						bar	%
CEC_{soil} sum of cations	CEC_{soil} NH_4OAc	CEC_{soil} bases+Al	CEC_{soil} (Ca)	pH H_2O	pH KCl	1/3	15
			11.3	6.5			
			6.5	6.4			
			4.8	6.3			
			4.7	6.2			
			4.9	6.2			
			4.7	6.2			

organic matter %	organ. C %	N %	free Fe_2O_3 (%)clay	avail. P ppm	P.tot. mg/100 g	$CaCO_3$%	EC sat. dS/m
	0.63	0.133	10.8				
	0.40	0.058	12.7				
	0.28	0.050	12.9				
	0.22	0.047	11.8				
	0.19	0.039	12.6				
	-	-	12.7				

Profile ZR031 (formerly 161)

Classification: Haplic Ferralsols, FRh (FAO, 1990) Yellowish red, clayey, hygro-ferralsols, slightly ferralsolic, on granite, on the Plio-Pleistocene pediplain, series NLI-(F)2 (INEAC)

Source: Sys (1972), description in 1960

Location: Bambesa, Uele

Coordinates: 03° 21’N; 25°45’E
03.35°; 25.75°

Terrain unit: 510, NE Congo granite plateaux

Altitude: 500 m ?

Topography: upper slope of a large plateau

Drainage: well drained

Parent material: clay, weathering product of granite

Vegetation: dense forest

Climate: (Am)N, mean annual temperature 24°C, mean annual rainfall 1,775 mm, 60 days of dry season

Profile description

Ap 0-18 cm Sandy clay; reddish brown (5YR 4/3, moist);

		moderate, fine and medium, crumb structure; friable in situ; moist to humid; many roots; intense biological activity; distinct and undulating transition.
AB	18-29 cm	Humiferous sandy clay (5YR 3/4); and yellowish red clay (5YR 4/6, moist); moderate, medium, subangular blocky; firm in situ; moist; many roots; gradual and smooth transition.
Bo1	29-43 cm	Clay; yellowish red (5 YR 4/6, moist); moderate, medium, subangular blocky, few discontinuous cutans; firm in situ; moist; important biological activity; common roots; gradual and smooth transition.
Bo2	43-65 cm	Clay; yellowish red (5YR 4/6, moist); moderate, medium and coarse, subangular blocky structure, thin cutans on 30 % of the ped surfaces; intense biological activity; few roots; firm in situ; moist; gradual and smooth transition.
Bo3	65-98 cm	Same as above, but the structure is less developed; there are also less cutans; gradual and smooth transition.
Bo4	98-138 cm	Clay; yellowish red (5YR 4/6, moist); weak to moderate, medium to coarse, blocky structure; rare cutans; few roots; rare nodules; reduced biological activity; slightly firm to friable in situ; gradual and smooth transition.
Bo5	138-200 cm	Clay; yellowish red (5YR 4/6, moist) to red (2.5YR 4/6); massive tendency; weak, medium, subangular blocky structure, no cutans; friable in situ; moist; rare, slightly firm, nodules; distinct and smooth transition.

Analytical data of profile ZR031

horizon	depth (cm)	> 2 mm %	coarse sand 0.25-2 mm	fine sand 0.05-0.25 mm	silt 0.05 - 0.002 mm	clay < 0.002 mm	tex-ture USDA
Ap	0-18		30.6	27.3	11.3	30.8	SCL
AB	18-29		29.5	19.5	10.6	40.4	SC
Bo1	29-43		21.5	17.8	8.7	52.0	C
Bo2	43-65		20.2	15.3	7.9	56.6	C
Bo3	65-98		18.1	14.9	7.5	59.5	C
Bo4	98-138		22.8	13.6	7.6	56.0	C
Bo5	138-200		25.2	12.6	9.4	52.6	C
cmol(+)/kg							
Ca (HCl N/20)	Mg	K (HCl N/20)	Na	H^+	Al^{3+}	Al sat. (m)	Base sat. %
3.4		2.4					
1.7		3.25					
1.3		2.60					
1.1		1.30					
1.1		0.25					
1.1		0.10					
-		-					
cmol(+)/kg						bar	%
CEC_{soil} sum of cations	CEC_{soil} NH_4OAc	CEC_{soil} bases+Al	CEC_{soil} (Ca)	pH H_2O	pH KCl	1/3	15
			9.6	7.2			
			8.4	6.6			
			8.1	4.8			
			7.4	4.7			
			6.3	4.8			
			6.9	4.7			

			5.3	4.9			
organic matter %	organ. C %	N %	free Fe_2O_3 (%)clay	avail. P ppm	P.tot. mg/100 g	$CaCO_3$%	EC sat. dS/m
	0.77	0.076	7.6				
	0.66	0.058	7.6				
	0.56	0.045	7.3				
	0.53	0.046	7.7				
	0.44	0.032	7.9				
	-	-	8.5				
	-	-	8.3				

Profile ZR032 (formerly 193)

Classification: Humic Nitosols, NTu (FAO, 1990)
Humiferous, clayey, xeroferrisols, intergrades to brown tropical soils, on mica schists, series MO-s11hE (INEAC)

Source: Sys (1972), description in 1958

Location: Ituri, Mahagi, Angal zone, Higher Congo

Coordinates: 02° 25’N; 30°58’E
02.42°; 30.97°

Terrain unit: 1240, Bunia or Lake Albert Highlands

Altitude: 1,345 m

Topography: top of a rounded hill in Kakot valley, slope 2 %.

Drainage: well drained

Parent material: micaceous clay, weathering product of mica schists

Vegetation: cassava field

Climate: (Am)N, mean annual temperature 21°C, mean annual rainfall 1,200 mm, 70-80 days of dry season

Profile description

Ap 0-25 cm Micaceous silty clay; (7.5YR 3/2, moist); strong, medium and fine, angular blocky structure; friable; dry; many roots; distinct transition.

AB   25-42 cm Micaceous silty clay (5YR 3/2); strong, fine and medium, angular blocky; firm; some weathered mica schist dispersed in the horizon; gradual transition.

BA   42-60 cm Micaceous silty clay; (5 YR 3/4, moist); strong, fine and medium, angular blocky, firm to compact; few, thin cutans on the ped surfaces; gradual transition.

Bt1   60-150 cm Micaceous silty clay; (2.5YR 3/4, moist); strong, fine, angular blocky structure; thick cutans on the ped surfaces; hard; few roots; distinct and undulating transition.

IIBt2 150+ cm Gravel layer of quartz and weathered rock fragments, mixed with silty clay.

Analytical data of profile ZR032

horizon	depth (cm)	> 2 mm %	coarse sand 0.25-2 mm	fine sand 0.05-0.25 mm	silt 0.05 - 0.002 mm	clay < 0.002 mm	tex-ture USDA
Ap	0-25		9.5	16.5	17.0	57.0	C
AB	25-42		7.9	14.8	15.0	62.3	C
BA	42-60		7.9	15.3	15.3	61.4	C
Bt1	60-150		7.2	13.0	15.8	64.0	C
IIBt2	150+	78.5	14.5	7.8	14.9	62.8	C
cmol(+)/kg							
Ca (HCl N/20)	Mg	K (HCl N/20)	Na	H^+	Al^{3+}	Al sat. (m)	Base sat. %
9.9		0.38					
6.9		0.10					
6.5		0.08					
6.3		0.08					
-		-					
cmol(+)/kg						bar	%
CEC_{soil} sum of cations	CEC_{soil} NH_4OAc	CEC_{soil} bases+Al	CEC_{soil} (Ca)	pH H_2O	pH KCl	1/3	15
			17.6	5.7			
			14.6	5.6			
			13.9	5.6			
			14.6	5.7			
			13.0	5.9			
organic matter %	organ. C %	N %	free Fe_2O_3 (%)clay	Avail. P ppm	P.tot. mg/100 g	$CaCO_3$%	EC sat. dS/m

	2.17 1.34 0.88 0.53 -	0.173 0.147 0.091 0.072 -	10.7 10.5 10.9 10.7 10.2				

Profile ZR033 (formerly 207)

Classification: Eutric Fluvisols, FLe (FAO, 1990)
Imperfectly drained, humiferous, eutrophic, tropical brown soil soils, series FO-B6hE (INEAC)

Source: Sys (1972), description in 1958

Location: Mateba, Lower Congo

Coordinates: 05° 50’S; 12°55’E
-05.83°; 12.92°

Terrain unit: 201/1, Congo estuarine plain

Altitude: 0-5 m

Topography: alluvial swamps

Drainage: imperfect, groundwater at 1 m

Parent material: recent alluvium with shells

Vegetation: fallow

Climate: (Aw)S, mean annual temperature 25°C, mean annual rainfall 1,050 mm, 140-150 days of dry season

Profile description

Ap1 0-15 cm Loam to clay loam; dark grey (10YR 4/1, moist); moderate crumb structure; many roots; firm; many shells; distinct and smooth transition.

Ap2 15-30 cm Clay loam ; dark grey (10YR 4/1); moderate, fine and very fine, angular blocky; firm; many roots; distinct and smooth transition.

C1g 30-52 cm Clay loam; olive brown (2.5Y 5/3, moist), with mottles; strong, fine, angular blocky, compact when dry; common roots; gradual and smooth transition.

C2g 52-81 cm Clay loam; olive brown (2.5Y 5/3, moist), with grey spots (2.5Y 5/1) and mottles; strong, coarse, prismatic structure; compact when dry; few roots; distinct and smooth transition.

C3r 81-100 cm Clay; pale grey (2.5Y 7/2); massive; plastic; few roots.

Analytical data of profile ZR033

horizon	depth (cm)	> 2 mm %	coarse sand 0.25-2 mm	fine sand 0.05-0.25 mm	silt 0.05 - 0.002 mm	clay < 0.002 mm	tex-ture USDA
Ap	0-15		2.6	23.6	43.7	30.1	CL
Ap2	15-30		2.0	23.0	40.9	34.1	CL
C1g	30-52		0.8	20.6	41.7	36.9	CL
C2g	52-81		0.4	17.7	44.3	37.6	SiCL
C3r	81-100		0.4	17.8	37.1	44.7	C
cmol(+)/kg							
Ca (HCl N/20)	Mg	K (HCl N/20)	Na	H^+	Al^{3+}	Al sat. (m)	Base sat. %
24.7		0.40					
25.5		0.41					
24.2		0.33					
12.1		0.43					
6.8		0.52					
cmol(+)/kg						bar	%
CEC_{soil} sum of cations	CEC_{soil} NH_4OAc	CEC_{soil} bases+Al	CEC_{soil} (Ca)	pH H_2O	pH KCl	1/3	15
			19.3	7.2			
			19.8	7.4			
			16.2	7.7			
			12.7	7.9			
			12.8	7.6			
organic matter %	organ. C %	N %	free Fe_2O_3 (%)clay	avail. P ppm	P.tot. mg/100 g	$CaCO_3$%	EC sat. dS/m

	1.72 1.39 0.74 0.18 0.10	0.149 0.120 0.071 0.038 0.033					

Profile ZR034 (formerly 210)

Classification:	Eutric Gleysols, FLe (FAO, 1990) Poorly drained, hydro-ferralsols, on clayey sand alluvium, series FÊ-F8 (INEAC)
Source:	Sys (1972), description in 1966
Location:	Lisala, Bolamba zone, Congo river
Coordinates:	01° 55'N; 21°20' E 01.92°; 21.33°
Terrain unit:	202, Central Congo basin alluvial plain
Altitude:	400 m ?
Topography:	alluvial valley
Drainage:	very poor
Parent material:	clayey sand alluvium
Vegetation:	temporary inundated forest
Climate:	(Am)N, mean annual temperature 24°C, mean annual rainfall 1,800 mm

Profile description

O	3-0 cm	Decomposing organic matter
Ah1	0-11 cm	Sandy clay loam; (10YR 3/3, moist); massive; loose; moist; abundant roots; clear transition.
Ah2	11-40 cm	Sandy clay loam; (2.5YR 4/1); massive; loose; moist;

		abundant roots; few localised mottles; gradual transition.
ACg	40-74 cm	Sandy clay loam; (2.5Y 5-6/2, moist); massive; loose; moist; common mottles; many roots; gradual transition.
C1g	74-120 cm	Sandy clay loam; (2.5Y 6/2, moist); massive; loose; moist; no roots; intense mottling; clear transition.
C2r	120+ cm	Sandy clay loam; (2.5Y 7/0); massive; loose; humid; reduced substratum.

Analytical data of profile ZR034

horizon	depth (cm)	> 2 mm %	coarse sand 0.25-2 mm	fine sand 0.05-0.25 mm	silt 0.05 - 0.002 mm	clay < 0.002 mm	tex-ture USDA
Ah1	0-11		39.0	37.3	2.7	21.0	SCL
Ah2	11-40		39.5	35.5	3.0	22.0	SCL
ACg	40-74		33.6	41.3	2.8	22.3	SCL
C1g	74-120		43.9	33.7	2.2	20.3	SCL
C2r	120+		47.7	30.0	1.9	19.9	SL
cmol(+)/kg							
Ca (HCl N/20)	Mg	K (HCl N/20)	Na	H^+	Al^{3+}	Al sat. (m)	Base sat. %
1.0		0.15					
1.65		0.10					
1.9		0.07					
1.7		0.06					
1.9		0.06					
cmol(+)/kg						bar	%
CEC_{soil} sum of cations	CEC_{soil} NH_4OAc	CEC_{soil} bases+Al	CEC_{soil} (Ca)	pH H_2O	pH KCl	1/3	15
			5.3	4.4			
			3.15	4.8			
			2.3	5.3			
			1.9	5.2			
			1.85	4.9			
organic matter %	organ. C %	N %	free Fe_2O_3 (%)clay	avail. P ppm	P.tot. mg/100 g	$CaCO_3$%	EC sat. dS/m
	1.89	0.187					

	1.82 0.49 0.15 0.09	0.090 0.052 0.024 0.014					

Profile ZR035 (formerly 211)

Classification: Eutric Vertisols, VRe (FAO, 1990)
Tropical black clays on alluvium, series FI-N3 (INEAC)

Source: Sys (1972), description in 1958

Location: Ituri, Ishwa plain

Coordinates: 02° 10'N; 31°05' E
02.17°; 31.08°

Terrain unit: 1220, Rift valley floor

Altitude: 700 m ?

Topography: flat

Drainage: well drained

Parent material: clayey alluvium

Vegetation: savannah with *Imperata*

Climate: (Aw)N, mean annual temperature 20°C, mean annual rainfall 1,300 mm, 70 days of dry season

Profile description

Ah1 0-12 cm Micaceous sandy clay loam; black (10YR 2/1, moist); moderate, medium and coarse, crumb structure; very friable; moist to dry; abundant roots; gradual transition.

Ah2 12-39 cm Slightly micaceous clay; black (10YR 2/1); strong, angular blocky structure; very hard to extremely firm; dry; common roots; gradual transition.

AC 39-75 cm Clay; very dark greyish brown (10YR 3/2, moist); some slickensides; massive; very hard when dry; diffuse transition.

C 75-120 cm Clay; very dark greyish brown (10YR 3/2, moist); same as above.

Analytical data of profile ZR035

horizon	depth (cm)	> 2 mm %	coarse sand 0.25-2 mm	fine sand 0.05-0.25 mm	silt 0.05 - 0.002 mm	clay < 0.002 mm	tex-ture USDA
Ah1	0-12		25.2	31.2	15.2	28.4	SCL
Ah2	12-39		16.9	24.3	13.4	45.4	C
AC	39-75		17.5	24.5	13.0	45.0	C
C	75-120		14.9	13.2	14.9	47.0	C
cmol(+)/kg							
Ca (HCl N/20)	Mg	K (HCl N/20)	Na	H^+	Al^{3+}	Al sat. (m)	Base sat. %
8.8		0.63					
10.0		0.30					
9.8		0.12					
10.3		0.15					
cmol(+)/kg						bar	%
CEC_{soil} sum of cations	CEC_{soil} NH_4OAc	CEC_{soil} bases+Al	CEC_{soil} (Ca)	pH H_2O	pH KCl	1/3	15
			14.7	6.0			
			20.2	6.0			
			19.8	6.4			
			20.8	6.8			
organic matter %	organ. C %	N %	free Fe_2O_3 (%)clay	avail. P ppm	P.tot. mg/100 g	$CaCO_3$%	EC sat. dS/m
	0.97	0.104					
	0.53	0.071					
	0.23	0.042					
	0.27	0.048					

Profile ZR036 (formerly KIN25)

Classification:	Geric Ferralsols, FRg (FAO, 1990) Fine-loamy siliceous isohyperthermic Acrustoxic Kandiustult (USDA), Phonzo Series (PH)
Source:	Marcelino (1995) descript. in 1988 by Baert G.
Location:	road Kinshasa-Kikwit, between 3.2 to 3.6 km after Menkau, 200 m before the first depression on the right.
Coordinates:	04° 11'S; 15°43'E -04.18°; 15.72°
Terrain unit:	820, Batéké plateau, dissected towards the N
Altitude:	705 m
Topography:	plateau, slope < 1 %, numerous mushroom termite hills
Drainage:	well drained
Parent material:	Ocre Sand Series, Kalahari
Vegetation:	shrub savannah
Climate:	Aw4

Profile description

Ah1	0-15 cm	Loamy sand; very dark grey (10YR 3/1, moist); weak, fine to medium, subangular blocky structure; very friable; non sticky; non-plastic; abundant very fine and medium, tubular pores; abundant roots throughout; gradual and smooth transition.
Ah2	15-50 cm	Sandy loam; very dark greyish brown (10YR 3/2, moist); weak, medium to coarse, subangular blocky structure; slightly sticky, non plastic, very friable; common, very fine to fine, tubular pores; common fine roots throughout; gradual and smooth transition (note: termite nests).
ABh	50-88 cm	Sandy clay loam; yellowish brown (10YR 5/6, moist); weak, coarse, subangular blocky; slightly plastic, slightly sticky, friable; common, very fine and fine

pores; common, very fine to fine roots throughout; diffuse and smooth transition (note: organic matter infiltration).

Bws1 88-137 cm Sandy clay loam; yellowish brown (10YR 5/8, moist); weak, medium to coarse, subangular blocky; slightly sticky, slightly plastic, very friable; common, very fine and fine tubular pores; few, very fine and fine roots throughout; diffuse and smooth transition (note: organic matter infiltration).

Bws2 137-185 cm Sandy clay loam; yellowish brown (10YR 6/8, moist); weak, coarse, subangular blocky structure; slightly sticky, slightly plastic, very friable; common, very fine and fine, tubular pores; very few, very fine and fine roots throughout (note: little organic matter infiltration).

Analytical data of profile ZR036

horizon	depth (cm)	> 2 mm %	coarse sand 0.25-2 mm	fine sand 0.05-0.25 mm	silt 0.05 - 0.002 mm	clay < 0.002 mm	tex-ture USDA
Ah1	0-15	0	12.4	70.0	1.9	15.7	SL
Ah2	15-50	0	9.7	66.6	5.8	17.9	SL
ABh	50-88	0	9.8	60.1	6.2	23.9	SCL
Bws1	88-137	0	8.8	62.0	6.8	22.4	SCL
Bws2	137-185	0	9.3	57.1	4.1	29.5	SCL
by NH_4Oac, in cmol(+)/kg							
Ca	Mg	K	Na	Exchan. Acidity	Al^{3+}	Al sat. (m)	Base sat. %
0.18	0.05	0.08	0.41	0.83	0.46	30	11
0.05	0.02	0.05	0.02	0.86	0.60	60	3
0.10	0.02	0.03	0.03	0.24	0.19	45	6
0.06	0.01	0.02	0.05	0.41	0.39	71	4
0.07	0.01	0.01	0.03	0.38	0.32	64	5
cmol(+)/kg						bar	%
CEC_{soil} sum of bases + acidity	CEC_{soil} NH_4OAc	$ECEC_{soil}$ sum of bases + Al	CEC_{soil} (Ca)	pH H_2O	pH KCl	1/3	15
1.55	6.86	1.18		5.2	4.1		
1.00	5.22	0.74		4.7	4.2		
0.42	2.92	0.37		4.7	4.3		
0.55	3.30	0.53		4.7	4.4		
0.50	2.62	0.44		4.9	4.5		

organic matter %	organ. C %	N %	free Fe_2O_3 (%)clay	avail. P mg/kg (Bray2)	P.tot. mg/100 g	$CaCO_3$%	EC sat. dS/m
	1.36	0.088		98.78			
	0.93	0.059		20.99			
	0.67	nd		nd			
	0.23	nd		nd			
	nd	nd		nd			

Profile ZR037 (formerly MA4)

Classification: Luvic Arenosols, ARl (FAO, 1990)
Siliceous isohyperthermic Ustic Quartzipsamment (USDA), Mpese series (Mp)

Source: Marcelino (1995), descrip. in 1988 by Baert G.

Location: road Boma-Moanda, beside the Kitona military base

Coordinates: 05° 53’S; 12°24’E
-05.88°; 12.40°

Terrain unit: 300, coastal plateau

Altitude: 120 m

Topography: dissected plateau, with deep valleys (> 100 m), with swampy flat bottoms; slope < 1 %

Drainage: somewhat excessive
Parent material: Cirques Sand Series
Vegetation: steppe to open shrub savannah, burned beans and cassava field

Climate: Aw5

Profile description

Ah1 0-24 cm Sand; dark brown (10YR 3/3, moist); weak, medium, subangular blocky structure; very friable; non sticky; non plastic; many very fine and fine, tubular pores; abundant fine roots throughout; gradual and smooth transition (note: few bleached sand grains).

Ah2 24-70 cm Sand; dark yellowish brown (10YR 3/2, moist); weak, medium, subangular blocky structure; non sticky, non plastic, very friable; common, very fine and fine, tubular pores; many very fine and fine roots throughout; gradual and smooth transition (note: few bleached sand grains).

Bws1 70-103 cm Loamy sand; yellowish brown (10YR 4/6, moist); single grain to weak, coarse, subangular blocky; non sticky, non plastic, very friable; common, very fine, tubular pores; few, very fine and fine roots throughout; diffuse and smooth transition (note: organic matter infiltration in spots and pockets).

Bws2 103-145 cm Loamy sand; yellowish brown (10YR 5/6, moist); single grain, non-sticky, non-plastic, very friable; few, very fine, tubular pores; few, very fine roots throughout; diffuse and smooth transition (note: organic matter infiltration in spots and pockets).

Bws3 145-200 cm Loamy sand; yellowish brown (10YR 5/8, moist); single grain; non-sticky, non-plastic, very friable; few, very fine tubular pores; very few, very fine and fine roots throughout (note: organic matter infiltration in spots and pockets).

Analytical data of profile ZR037

horizon	depth (cm)	> 2 mm %	coarse sand 0.25-2 mm	fine sand 0.05-0.25 mm	silt 0.05 - 0.002 mm	clay < 0.002 mm	tex-ture USDA
Ah1	0-24	0	75.8	15.2	4.5	4.5	S
Ah2	24-70	0	73.8	14.2	6.5	5.5	S
Bws1	70-103	0	63.0	22.4	5.8	8.8	LS
Bws2	103-145	0	68.1	20.4	3.5	8.0	LS
Bws3	145-200	0	61.7	24.1	4.7	9.5	LS
by NH_4Oac, in cmol(+)/kg							
Ca	Mg	K	Na	Exchan. Acidity	Al^{3+}	Al sat. (m)	Base sat. %
0.26	0.23	0.03	0.03	-	-	-	30
0.05	0.01	0.01	0.01	0.45	0.39	74	5
0.03	0.01	0.01	0.01	0.40	0.32	70	4
0.05	0.01	0.01	0.01	0.17	0.15	60	6
0.04	0.01	0.02	0.01	0.22	0.20	67	5
cmol(+)/kg						bar	%
CEC_{soil} sum of bases + acidity	CEC_{soil} NH_4OAc	$ECEC_{soil}$ sum of bases + Al	CEC_{soil} (Ca)	pH H_2O	pH KCl	1/3	15
0.55	1.82	0.55		5.8	4.5		
0.53	1.66	0.47		5.2	4.3		
0.46	1.68	0.38		5.3	4.3		
0.25	1.40	0.23		5.5	4.5		
0.30	1.50	0.28		5.4	4.5		
organic matter	organ. C %	N %	free Fe_2O_3	avail. P mg/kg	P.tot. mg/100	$CaCO_3$%	EC sat.

%			(%)clay	(Bray2)	g		dS/m
	0.39	0.026		112.43			
	0.18	0.019		47.48			
	0.14	nd		nd			
	0.11	nd		nd			
	nd	nd		nd			

Profile ZR038 (formerly KIN22)

Classification: Carbic Podzols, PZc (FAO, 1990) Sandy siliceous isohyperthermic Typic Haplohumod (USDA), Lingezi Series (Li)

Source: Marcelino (1995), description in 1988 by Baert G. and Embrechts J.

Location: road Kinshasa-Kikwit, 3.6 km after Menkau, 200 m before the first depression on the right

Coordinates: 04° 11’S; 15°43’E
-04.18°; 15.72°

Terrain unit: 820, Batéké plateau, dissected towards the N

Altitude: 696 m

Topography: Lower slope of minor closed depression in the Batéké plateau, slope %

Drainage: imperfectly drained

Parent material: Ocre Sand Series, Kalahari

Vegetation: Slightly shrub-covered steppe with *Loudetia simplex*

Climate: Aw4

Profile description

Ah 0-20 cm Sand; very dark grey (2.5YR 3/0, moist); weak, medium to coarse, subangular blocky structure; non sticky; non plastic; loose; common, fine and medium, tubular pores; many, fine roots throughout; distinct to gradual, smooth transition (note: bleached sands and termite activity).

AE 20-35 cm Sand; dark greyish brown (2.5Y 4/1, moist); single grain, non-sticky, non-plastic, loose; common, fine, tubular pores; few to common fine roots throughout;

gradual and smooth transition (note: bleached sand and termite activity).

E 35-50/70 cm	Sand; light grey (10YR 7/1, moist); single grain; non plastic, non sticky, loose; common, fine tubular pores; few, very fine to fine roots throughout; distinct to abrupt and undulating transition (note: humus in pockets and sheets in the lower part of the horizon, few prehistoric arrow points).
Bh 50/70-53/75 cm	Sand to loamy sand; black (10YR 2/1, moist) and light grey (10YR 7/1, moist); single grain; non-sticky, non-plastic, very friable; few, very fine and fine tubular pores; few, very fine roots throughout; distinct and undulating transition.
Bhsm1 53/75-60/110 cm	Sand to loamy sand; black (2.5Y 2/0, moist); massive; very firm, extremely hard; moderately cemented; gradual and undulating transition.
Bhsm2 60/110-100/125	Loamy sand; strong brown (7.5YR 4/6, moist); massive; extremely firm, extremely hard; moderately cemented; abrupt and undulating transition.
BC 100/125-145cm+	Loamy sand to sandy loam; dark brown (10YR 4/3, moist); massive; slightly sticky, non-plastic, very friable; common, very fine and fine, tubular pores (note: between the Bhsm2 and the BC occurs a lens of very loose white sand, with visible sedimentary structure).

Analytical data of profile ZR038

hori-zon	depth (cm)	> 2 mm %	coarse sand 0.25-2 mm	fine sand 0.05-0.25 mm	silt 0.05 - 0.002 mm	clay < 0.002 mm	tex-ture USDA
Ah	0-20	0	11.2	81.5	4.6	2.7	S
AE	20-35	0	12.0	80.7	6.8	0.5	S
E	35-50/70	0	13.0	81.3	5.0	0.7	S
Bh	50/70-53/75	0	10.5	79.2	5.6	4.7	S
Bhsm1	53/75-60/110	0	10.9	76.3	6.6	6.2	S
Bhsm2	60/110-100/125	0	10.4	67.2	3.7	18.7	SL
BC	100/125-145+	0	10.6	70.8	4.1	14.5	SL

by NH_4Oac, in cmol(+)/kg							
Ca	Mg	K	Na	Exchan. Acidity	Al^{3+}	Al sat. (m)	Base sat. %
0.57	0.15	0.06	0.02	2.04	1.60	56	8
0.15	0.03	0.01	<0.01	0.43	0.25	40	9
0.14	0.04	0.01	0.01	-	-	-	27
0.20	0.04	0.02	0.02	2.80	2.25	73	1
0.08	0.03	0.01	0.01	4.18	3.50	81	<1
0.12	0.03	<0.01	0.01	2.47	2.10	80	<1
0.21	0.04	0.01	0.01	1.85	1.45	68	2

cmol(+)/kg						bar	%
CEC_{soil} sum of bases + acidity	CEC_{soil} NH_4OAc	$ECEC_{soil}$ sum of bases + Al	CEC_{soil} (Ca)	pH H_2O	pH KCl	1/3	15
2.84	9.48	2.40		4.4	3.3		
0.62	2.08	0.44		5.3	4.3		
0.20	0.74	0.20		5.6	4.4		
3.08	19.68	2.53		5.0	3.9		
4.31	34.74	3.63		4.2	3.6		
2.63	30.66	2.26		4.7	3.9		
2.12	12.24	1.72		5.0	4.1		

organic matter %	organ. C %	N %	free Fe_2O_3 (%)clay	avail. P mg/kg (Bray2)	P.tot. mg/100 g	$CaCO_3$%	EC sat. dS/m
	2.70	0.076		38.72			

	0.74	0.012		6.95			
	0.23	nd		nd			
	5.08	nd		nd			
	7.50	nd		nd			
	4.04	nd		nd			
	3.06	nd		nd			

Profile ZR039 (formerly SO13)

Classification: Xanthic Ferralsols, FRx (FAO, 1990)
Typic Haplustox (USDA)
Hygro-xeroferrisols, intergrades to Ferralsols (INEAC)

Source: Baert (1995), description in 11/1988

Location: road Matadi-Kinshasa, at the bridge over the Kwilu river, at 34 km from Songololo towards Kimpese

Coordinates: 05° 38’S; 14°16’E
-05.63°; 14.27°

Terrain unit: 710, Schisto-Calcaire depression

Altitude: 270 m
Topography: summit of rounded hill, slope < 1 %; surroundings: steeply dissected landscape, maximal slopes > 30 %.

Drainage: well drained

Parent material: calcareous schists and limestone
Vegetation: shrub savannah
Climate: Aw4

Profile description

Ah 0-12 cm Clay; black (10YR 2/1, moist) and very dark grey (10YR3/1, dry); weak to moderate, medium, subangular blocky structure; friable, sticky, slightly plastic; common, fine and medium, tubular and vesicular pores; frequent, fine and medium roots, throughout the horizon; clear and wavy transition.

ABh 12-30 cm Clay; dark brown (10YR 4/3, moist) and brown (10YR 5/3); weak to moderate, medium to coarse, subangular blocky structure; sticky, slightly plastic, firm to friable; common, very fine and fine, tubular pores; common, very fine and fine roots, throughout the horizon; gradual and wavy transition (note: termite nests).

Bt1	30-66 cm	Clay; yellowish brown (10YR 5/6, moist), brownish yellow (10YR 5/8, dry); weak, medium to coarse, subangular blocky; sticky, slightly plastic, firm; common patchy clay coatings, with iron-oxides and hydroxides on ped surfaces and in root channels and pores; common, very fine and fine, tubular pores; few, very fine roots, throughout the horizon; clear to diffuse and smooth transition (note: organic matter infiltration in between aggregates).
Bt2	66-104 cm	Clay; yellowish brown (10YR 5/8, moist), brownish yellow (10YR 6/6, dry); weak, coarse, subangular blocky; sticky, slightly plastic, firm; common, patchy clay coatings, with iron-oxides and hydroxides, on ped surfaces; common, very fine, tubular pores; few, very fine roots, throughout the horizon; diffuse and smooth transition (note: organic matter infiltration in between aggregates).
Bt3	104-152 cm	Clay; yellowish brown (10YR 5/8, moist) and brownish Yellow (10YR 6/7, dry); weak, medium to coarse, subangular blocky; sticky, slightly plastic, firm to friable; common patchy clay coatings, with iron-oxides and hydroxides, on ped surfaces; few to common, very fine, tubular pores; very few, very fine roots, throughout the horizon; abrupt and wavy transition (note: organic matter infiltration in between aggregates).
2St.L	152-164cm	Clay; brownish yellow (10YR 6/8, moist) and yellow (10YR 7/6, dry); weak, fine, subangular blocky structure; sticky, slightly plastic, friable; few patchy clay coatings, with iron-oxides and hydroxides, in root channels, pores and on iron nodules; few, very fine, tubular pores; abundant, small, spherical, hard and irregular, red iron nodules; very few, very fine roots throughout the horizon; abrupt and wavy transition.
3BSA	164-210 cm	Clay to silty clay; light yellowish brown (2.5Y 4/8, moist), with many red (2.5YR 4/8), fine and medium, prominent, sharp mottles; massive to weak, coarse, subangular blocky; sticky, slightly plastic, friable; few, very fine, tubular pores; few, fresh to slightly weathered chert fragments, gravel size; few to common, small, soft, irregular, red iron nodules; very few, very fine roots throughout the horizon; gradual and smooth transition (note: thin layer of weathered chert at the base of the horizon).
3SA	210-290 cm	Silty loam; yellow (10YR 7/8, moist), with common, red (2.5YR 4/8), fine, clear, distinct mottles; stratified; slightly sticky, slightly plastic, very friable; few, very fine, tubular pores; fine layers of parallel, non weathered chert in the horizon; clear, wavy transition.
R	290+ cm	Shallow transition of weathered limestone (< 5 cm) over non weathered rock.

Analytical data of profile ZR039

horizon	depth (cm)	> 2 mm %	co.sand 0.25-2 mm	f.sand 0.05-0.25 mm	silt 0.05 - 0.002 mm	cl. < 0.002 mm	tex-ture USDA
Ah	0-12		1.2	7.1	28.4	63.3	C
ABh	12-30		0.9	5.1	32.7	61.3	C
Bt1	30-66		0.8	4.0	25.7	69.5	C
Bt2	66-104		0.8	3.7	24.0	71.5	C
Bt3	104-152		0.6	3.7	27.2	68.5	C
2St.L.	152-164	60	1.0	4.8	26.9	67.3	C
3BSA	164-210		1.3	5.9	35.3	57.3	C-SiC
3SA	210-290		1.6	9.3	71.5	19.0	SiL
CR	460-490		2.6	7.5	72.9	17.8	SiL
by NH_4Oac, in cmol(+)/kg							
Ca	Mg	K	Na	Exchan. Acidity	Al^{3+}	Al s. (m)	Base s. %
1.07	0.39	0.39	0.02	4.65	4.45	70	13
0.18	0.07	0.08	0.01	4.60	4.45	93	7
0.15	0.05	0.11	0.01	4.10	3.85	92	7
0.15	0.04	0.11	0.01	4.13	3.75	92	6
0.17	0.04	0.10	0.01	3.58	3.90	92	2
0.46	0.13	0.23	0.02	3.53	2.95	78	9
0.35	0.11	0.05	0.01	2.42	3.10	86	11
0.42	0.11	0.10	0.03	-	-	-	5
3.65	3.00	0.16	0.07	-	-	-	53
cmol(+)/kg						bar	%
CEC_{soil} bases+ acidity	CEC_{soil} NH_4OAc	$ECEC_{soil}$ sum of bases+Al	CEC_{soil} (Ca)	pH H_2O	pH KCl	1/3	15
	14.02	6.32		4.6	3.8		
	5.24	4.81		4.6	3.8		
	4.94	4.17		5.3	3.8		
	5.08	4.06		5.2	3.9		
	13.84	4.22		5.2	3.8		
	9.90	3.79		4.3	3.8		
	4.86	3.62		5.1	3.8		
	15.24	0.66		5.6	4.3		
	12.96	6.88		6.3	5.2		
organic	organ.	N %	free	avail.	P.tot.	$CaCO_3$%	EC

matter%	C %		Fe_2O_3(%)	P ppm			dS/m
	2.27 0.98 0.38 0.28	0.201 0.130 nd nd		23 6 nd nd			

Profile ZR040 (formerly BO52)

Classification: Haplic Lixisols, LXh (FAO, 1990)
Fine clayey, mixed-kaolinitic, isohyperthermic Kanhaplic Rhodustalfs (USDA)
Typic xeroferrisols (INEAC)

Source: Baert (1995), description in 03/1989

Location: Boma, road to Bralima, 900 m before the factory

Coordinates: 05° 51'S; 13°06'E
-05.85°; 13.10°

Terrain unit: 600/2, Mayombe, main sector

Altitude: 150 m

Topography: strongly dissected area; slightly convex upper slope; slope 15 %; irregular micro-topography due to stoniness and erosion.

Drainage: well drained

Parent material: biotite mica schists

Vegetation: open shrub savannah

Climate: Aw4-5

Surface stoniness: abundant angular and subangular quartz gravels and stones, many rock outcrops

Erosion: sheet erosion, often rill and gully erosion

Profile description

Ah 0-12 cm Sandy clay loam, extremely gravelly; dark reddish brown (5YR 2/2, moist; 5YR 3/2, dry); moderate, fine, subangular blocky structure; hard, friable to firm, slightly sticky, slightly plastic; many, very fine and fine, tubular pores; abundant fresh angular quartz gravels; many, fine roots throughout the horizon and around stones; clear and smooth transition (note: many mica flakes).

Bt1	12-43 cm	Clay, very gravelly; dark reddish brown (2.5YR 3/4, moist) and dark red (2.5YR 3/6, dry); moderate, fine to medium, subangular blocky structure; sticky, slightly plastic, hard, firm; common patchy clay cutans, with iron-oxides and hydroxides on ped surfaces; common, very fine and fine, tubular pores; abundant fresh angular quartz gravels; common, very fine and fine roots throughout the horizon; clear to gradual and smooth transition (note: many mica flakes).
Bt2	43-82 cm	Light clay, slightly gravelly; dark red (10R 3/6) and light yellowish brown (10YR 6/4) moist; with common, medium, faint, diffuse, red (7.5R 4/6) mottles; moderate, medium, subangular blocky; sticky, slightly plastic, firm; common discontinuous clay coatings, with iron-oxides and hydroxides, on ped surfaces; few to common, very fine and fine, tubular pores; few fresh angular quartz gravels; few, very fine roots throughout the horizon; gradual and smooth transition (note: many mica flakes).
BtSA	82-115 cm	Clay loam, slightly gravelly; dark red (10R 3/6, moist), with many, medium, faint, diffuse, red (7.5R 4/6) mottles; weak to moderate, coarse subangular blocky; sticky, slightly plastic, firm; common, discontinuous clay coatings, with iron-oxides and hydroxides, on ped surfaces; few, very fine and fine, tubular pores; few fresh angular quartz gravels and many strongly weathered and iron-impregnated rock fragments; few, very fine roots throughout the horizon; clear and smooth transition (note: many mica flakes).
SA1	115-185 cm	Sandy loam; red (7.5R 4/6, moist); massive; stratified; sticky, slightly plastic, friable; few, very fine tubular pores; very few, very fine roots all throughout the horizon; gradual and smooth transition (note: many mica flakes).
SA2	185-230 cm	Sandy loam to loamy sand; red (7.5R 4/6, moist); massive; stratified; sticky, slightly plastic, friable to firm; few very fine, tubular pores; very few, very fine roots throughout the horizon; gradual and wavy transition (note: many mica flakes).

Analytical data of profile ZR040

horizon	depth (cm)	> 2 mm %	coarse sand 0.25-2 mm	fine sand 0.05-0.25 mm	silt 0.05 - 0.002 mm	clay < 0.002 mm	tex-ture USDA
Ah	0-12	70	32.2	28.6	11.9	27.3	SCL
Bt1	12-43	26	16.4	10.5	17.6	55.5	C
Bt2	43-82	6	8.2	11.0	33.5	47.3	C
BtSA	82-115	5	12.9	19.8	30.8	36.3	CL
SA1	115-185	-	28.5	45.1	19.9	6.5	SL
SA2	185-230	-	40.8	35.2	20.2	3.8	SL-LS
by NH_4Oac, in cmol(+)/kg							
Ca	Mg	K	Na	Exchan. Acidity	Al^{3+}	Al sat. (m)	Base sat. %
1.32	2.31	0.33	0.03				64
0.31	3.68	0.39	0.02				52
0.20	4.66	0.45	0.04				59
0.20	4.23	0.42	0.05				68
0.31	2.75	0.29	0.03				100
0.10	3.25	0.18	0.01				84
cmol(+)/kg						bar	%
CEC_{soil} sum of bases + acidity	CEC_{soil} NH_4OAc	$ECEC_{soil}$ sum of bases + Al	CEC_{soil} (Ca)	pH H_2O	pH KCl	1/3	15
	6.24	3.99		6.3	5.0		
	8.50	4.40		6.1	5.2		
	9.02	3.35		6.2	5.7		
	7.24	4.90		6.2	5.7		
	3.24	3.38		6.4	5.6		
	4.24	3.54		6.4	5.0		
organic matter %	organ. C %	N %	free Fe_2O_3(%)	avail. P ppm	P.tot. g/100g	$CaCO_3$%	EC sat. dS/m
	1.28	0.087		10			
	0.92	0.071		10			
	0.28	nd		nd			
	0.50	nd		nd			
	nd	nd		nd			

	nd	nd		nd			