Soil Reference Profiles of Costa Rica

Field and Analytical Data

Centro Agronomico Tropical de Investigacion y Enseñanza
International Soil Reference and Information Centre

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July 1994
Compiled by D.L. Kass (CATIE), J.H. Kauffman (ISRIC) and A. Nieuwenhuyse (LUW)

Based upon fieldwork of

<table>
<thead>
<tr>
<th>W. Campos A.</th>
<th>E. Veldkamp</th>
</tr>
</thead>
<tbody>
<tr>
<td>M. Jimenez Hernandez</td>
<td>G.J. Weerts</td>
</tr>
<tr>
<td>D.L. Kass</td>
<td>A. Weitz</td>
</tr>
<tr>
<td>(CATIE)</td>
<td>(LUW)</td>
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</table>

J.H. Kauffman
A. Nieuwenhuijse
(ISRIC)

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Reference citation


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FOREWORD

National Soil Reference Collection and Database of Costa Rica

The objective of this Country Report is to provide comprehensive field and analytical data of a number of reference soils representative for the major soils of Costa Rica. The sites were carefully selected, described and sampled by CATIE and ISRIC, and analyzed in their respective soil laboratories. Additional information on the reference soils is provided in a series of Soil Briefs, comprising information about the environment and soils, such as characterization, classification and an assessment of soil/land qualities. For Costa Rica such Soil Briefs are in preparation.

The major part of the sites are located in the Atlantic Region and the Central Highlands. The sites were selected on a number of criteria, such as major soil type, extension, advanced stage of weathering and production potential.

At present the collection comprises 12 soil reference profiles. From each reference soil two or three undisturbed profiles were taken, specially preserved and prepared into monoliths, ready for exposition. The monolith expositions of Costa Rica is housed in CATIE (Centro Agronomico Tropical de Investigacion y Enseñanza) in Turrialba. Duplicate monoliths are included in ISRIC’s world soil collection in The Netherlands.

The plan for a national soil reference collection was formulated in 1988 and it could be realized in the period 1990 to 1994 within the framework of ISRIC’s National Soil Reference Collection Programme (NASREC).

The establishment of the soil reference collection, comprising exposition and accompanying documentation has been made possible with the support of many persons, some are specially mentioned here: Dr. D.L. Kass (coordinator), M. Jimenez Hernandez and W. Campos A. (field programme), Dr. E. Veldkamp, Ir. J.H. Kauffman (coordinator NASREC programme) and Ir. A. Nieuwenhuijse.

.........................., director CATIE
International Soil Reference Collection an Database

The International Soil Reference and Information Centre (ISRIC), founded in 1966 as an initiative of the International Society of Soil Science (ISSS), has a mandate to collect and disseminate scientific knowledge about soils for the purpose of a better understanding of their formation, characterization, classification, distribution and capability for sustained land use at local, national, and global scales. One of ISRIC’s main objectives is to assemble soil profiles, soil samples and associated information to illustrate the units of the FAO-Unesco Soil Map of the World. To date, the world soil collection consists of about 800 reference soils from 60 countries, accompanied by soil and environmental data. The collection is supported by a soil map collection, soil reports library, a thin section collection and a slide collection.

The National Soil Reference Collection Programme (NASREC), supported by the Directorate General of International Cooperation of the Netherlands within the Action Plan of National Soil Policies of UNEP, and through ISRIC’s own budget has been instrumental to achieve this objective. ISRIC greatly appreciates the cooperation of the Centro Agronomico Tropical de Investigacion y Enseñanza (CATIE) in its efforts to bring together a Central American Soil Reference Collection (CASREC).

The collected information of the reference soil profiles is stored in ISRIC’s Soil Information System (ISIS), a database management system for storing and retrieving data on geology, geomorphology, hydrology, soil morphology, soil chemical and physical characteristics, and climate.

To disseminate its data, ISRIC has combined the different types of information into several publication series. Each series aims to address the needs of those working in one of the many fields of research using soil data and soil related data. One of these series is the Country Report.

The Country Reports, containing all ISRIC held data on soils and associated information of a specific country are generated by ISIS. Additional information on literature references, small scale maps, and a list of slides available in the ISRIC Slide Database is included. The country reports are jointly published by the national institution involved in the collection and ISRIC. A list of country reports (in press) is given on the back cover of this report. We are very pleased to release the draft Costa Rica Country Report at the occasion of the XVth World Congress of Soil Science.

Any comments on the Country report in general or on the presentation of the data in particular is highly appreciated and may be communicated to the directors of either CATIE or ISRIC.

Dr. L.R. Oldeman, Director ISRIC

Country Reports can be pursued through ISRIC or the national institution of the country concerned. Publications based on the Country Reports should always explicitly indicate the information source. To order Country Reports please contact ISRIC:

ISRIC
9 Duivendaal
P.O.Box 353
6700 AJ Wageningen
The Netherlands

Telephone (31) (0)8370 71718
Fax (31) (0)8370 24460
E-mail ISRIC@RCL.WAU.NL

or

CATIE
Apartado Postal 187
7170 Turrialba
Costa Rica

Telephone (506) 566431
Fax (506) 561533
Telex 8005 catie cr
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SOIL INFORMATION SHEETS

Generated by the ISRIC Soil Information System (ISIS, version 4.0)
FAO/UNESCO (1988) : 
USDA/SCS SOIL TAXONOMY (1992) : loamy, halloysitic, isothermic
LOCAL CLASSIFICATION : Serie Instituto

DIAGNOSTIC CRITERIA
USDA/SCS (1992) : Soil moisture regime : udic
 : Soil moisture regime : udic

LOCATION
Cartago, Turrialba, Exp. station CATIE, experiment 170
Latitude : 10°55'00" N
Longitude : 83°39'55" W
Altitude : 610 (m.a.s.l.)
Date (mm.yy) : 3.91

AUTHOR(S)
Kauffman/Kass/Campos

GENERAL LANDFORM
: intermontane basin
Topography : flat or almost flat

PHYSIOGRAPHIC UNIT
: old terrace Reventazón river

SLOPE
Gradient : 25
Aspect : upper slope

POSITION OF SITE
Kind :

SURFACE CHAR.
Rock outcrop : nil
Stoniness : nil
Cracking : nil
Slaking/crusting : nil
Salt : nil
Alkali : nil

SLOPE PROCESSES
Soil erosion : nil

PARENT MATERIAL
: alluvium
Texture :

Depth lithological boundary (cm) : 150
Remarks : partly colluvial?

EFFECTIVE SOIL DEPTH(cm) : 150

WATER TABLE
Depth(cm) : moderately well to well
Kind : no watertable observed

DRAINAGE
Permeability :

MOISTURE CONDITIONS PROFILE : 0 - 150 cm moist
Slow permeable layer from : 114 to 150 cm

LAND USE
: high level arable farming; improvements : draining
Landuse/vegetation remarks : experimental fields CATIE (see remarks)

ADDITIONAL REMARKS:
Crops in experimental fields: mais, beans, palm (Bactis gasipae), Coral tree (Erythrina poepiggiana), coffee (Caffea arabica), Macadamia (Macadamia fytotigrillia).

Brief soil description:
Very deep, moderately well to well drained, dark brown gravelly sandy clay loam. Mainly in the subsoil some larger stones.

Soil was occasionally saturated/flooded before installation of drains.
Colour determination is difficult due to composite character.
The lower horizons show smooth shiny ped surface, however, presence of cutans is not so convincing.

Note: "halloysite" in clay mineralogy is mixture of 0.7 and 1.0 mm material.

Topsoil may be enriched with volcanic ash.

CLIMATE :
Köppen: Af
Station: 9°53' N / 83°38' W 602 m a.s.l. 1 km E of site
CATE-TURrialba
Relevance: very good

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### PROFILE DESCRIPTION:

- **Ap**: 0 - 20 cm. very dark grayish brown (10YR 3.0/2.0, moist) slightly gravelly loam; moderate very fine subangular blocky structure; slightly sticky, slightly plastic, very friable; many fine pores and few medium pores; many very fine roots throughout and many fine roots throughout; clear wavy boundary to

- **Bw1**: 20 - 56 cm. dark brown (7.5YR 3.0/4.0, moist) slightly gravelly sandy clay loam; moderate very fine subangular blocky and moderate very fine crumb structure; slightly sticky, slightly plastic, very friable; many fine pores; many very fine roots and common fine roots; gradual wavy boundary to

- **Bw2**: 56 - 78 cm. dark brown (7.5YR 3.0/4.0, moist) gravelly loam; weak fine subangular blocky structure; non sticky, non plastic, very friable; many fine pores and common medium pores; abrupt wavy boundary to

- **C**: 78 - 114 cm. dark yellowish brown (10YR 3.0/4.0, moist) very gravelly loam; weak fine subangular blocky structure; non sticky, non plastic, very friable; many fine pores and common medium pores; gradual smooth boundary to

- **ICg1**: 114 - 142 cm. dark gray (10YR 4.0/1.0, moist) sandy clay loam; moderate medium angular blocky and moderate medium subangular blocky structure; slightly sticky, slightly plastic, friable; common medium MOTTES (5YR 4.0/0.0); many fine pores and common medium pores; gradual smooth boundary to

- **ICg2**: 142 - 150 cm. dark grayish brown (10YR 4.0/2.0, moist) silty clay loam; moderate medium angular blocky and moderate medium subangular blocky structure; slightly sticky, slightly plastic, firm; common fine pores and few medium pores; few coarse andesite fragments;

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**CLAY MINERALOGY** (1 very weak, ... 8 very strong) / EXTRACTABLE Fe Al Si Mn (by AMM. OXALATE(o), Na DITHIONITE(d) & PYROPHO(p))

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ISIS 4.0 data sheet of monolith CR002  Country: COSTA RICA**

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<td>Kauffman</td>
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<td><strong>GENERAL LANDFORM</strong></td>
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<tr>
<td>PHYSIOGRAPHIC UNIT</td>
<td>Terrace of Reventazon river</td>
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<tr>
<td>SLOPE</td>
<td>Gradient: 1%</td>
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<td>80 - 170 cm moist</td>
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<td>A 'raised bed' technique was applied some years ago, with the result that about 30 cm soil was put on top of the original profile. At present the site is drained with drain ditches.</td>
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<tr>
<td>Brief description of the soil:</td>
<td>Very deep, moderately well to well drained, dark brown sandy clay soil. Stratification of alluvial deposits well visible throughout the profile.</td>
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<td>The soil horizons (thickness and gravel content) varies at short distance. The four walls of the pit show different sequences. The wall from which the monoliths were taken, was described. Other walls had higher gravel content.</td>
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<td>Actual classification FAO (1988): Umbric Cambisol</td>
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**CLIMATE**

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**PROFILE DESCRIPTION:**

Ap  0 - 30 cm. dark brown (7.5YR 3.0/2.0, moist) sandy clay loam; very fine subangular blocky structure; sticky, slightly plastic, very friable, slightly hard; many very fine pores and few medium pores; many clear smooth boundary to

Ahb  30 - 45 cm. very dark brown (7.5YR 2.0/2.0, moist) sandy clay loam; subangular blocky structure; sticky, slightly plastic, firm, hard; common very fine pores and few fine pores; common fine roots throughout; clear smooth boundary to

Bw1  45 - 80 cm. 6.2YR 3.0/4.0, moist sandy clay; subangular blocky structure; sticky, plastic, friable, hard; many very fine pores; few fine roots throughout; gradual smooth boundary to

Bw2  80 - 110 cm. dark brown (7.5YR 4.0/3.0, moist) sandy clay loam; very fine subangular blocky structure; sticky, slightly plastic, friable; many very fine pores and few fine pores; few fine roots throughout; gradual wavy boundary to

Bg 110 - 135 cm. dark yellowish brown (10YR 4.0/4.0, moist) sandy clay; subangular blocky structure; sticky, slightly plastic, friable; many medium distinct mottles; many very fine pores; abrupt smooth boundary to

Cg 135 - 170 cm. dark yellowish brown (10YR 4.0/4.0, moist) clay; subangular blocky structure; sticky, plastic, friable; many medium mottles; many very fine pores;

**ANALYTICAL DATA:**

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<th>mm 1000 500 250 100 TOT 50 20 TOT &lt;2 DISP BULK</th>
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**CLAY MINERALOGY (1 very weak, ... 8 very strong) / EXTRACTABLE Fe Al Si Mn (by AMM. OXALATE(o), Na DITHIOGONITE(d) & PYROPHOS(p))**

| Hor. | pH | CaCO3 | ORG- | MAT. | EXCH CAT. | C | N | Ca | Mg | K | Na | sum | H+Al | Al | soil clay OrgC | EC | SAT | SAT | BASE | Al | EC 2.5 |
|------|----|-------|------|------|----------|---|---|---|---|---|---|-----|-----|-----|-----|-------|-----|-----|-----|------|-----|-------|
| 1    | 5.3 | 4.2   | 2.54 | 0.23 | 5.5      | 1.0| 0.7| 0.0| 7.2| 1.0| 0.7| 18.6| 55 | 8.9 | 8.2 | 39   | 4   | 0.04 |
| 2    | 5.7 | 4.6   | 2.45 | 0.23 | 9.2      | 1.4| 0.4| 0.0| 11.0| -  | -   | 19.4| 58 | 8.6 | 11.0| 57   | -   | 0.03 |
| 3    | 5.8 | 4.7   | 0.78 | 0.06 | 6.3      | 1.1| 0.5| 0.1| 8.0| -  | -   | 13.9| 44 | 2.7 | 8.0 | 58   | -   | 0.04 |
| 4    | 5.9 | 4.8   | 0.33 | 0.04 | 6.5      | 1.1| 0.1| 0.1| 7.8| -  | -   | 13.1| 40 | 1.2 | 7.8 | 60   | -   | 0.03 |
| 5    | 6.0 | 4.9   | 0.22 | 0.03 | 6.7      | 0.7| 0.2| 0.1| 7.7| -  | -   | 13.1| 43 | 0.8 | 7.7 | 59   | -   | 0.03 |
| 6    | 5.9 | 4.9   | 0.26 | 0.06 | 6.9      | 2.1| 0.3| 0.2| 9.5| -  | -   | 13.5| 29 | 0.9 | 9.5 | 70   | -   | 0.02 |

**CLAY MINERALOGY (1 very weak, ... 8 very strong) / EXTRACTABLE Fe Al Si Mn (by AMM. OXALATE(o), Na DITHIOGONITE(d) & PYROPHOS(p))**

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FAO/UNESCO (1988) : clayey loamy, kaolinitic, isohyperthermic

DIAGNOSTIC CRITERIA
USDA/SCS (1992) : Soil moisture regime : ustic
: Diagnostic properties : hydromorphic properties
: Soil moisture regime : ustic

LOCATION
Guantanamo, Cuba, Reserve Ecologico Pocosol [No. PCH1]
Latitude : 10°53'30" N
Longitude : 85°36'20" W
Altitude : 250 (m.a.s.l.)
Date (mm.yy) : 3.91

AUTHOR(S)
Kauffman

GENERAL LANDFORM : plain
PHYSIOGRAPHIC UNIT : Interfluve
SLOPE : 2%
POSITION OF SITE : middle slope
MICRO RELIEF : Rock outcrop : nil
Cracking : nil
Salt : nil
SLOPE PROCESSES : Soil erosion : slight sheet

Topography : undulating
Aspect : Form : straight
Stoniness : nil
Slaking/crusting : partly slaked
Alkali : nil

PARENT MATERIAL : residual material
Texture : Ignimbrite
Remarks : derived from : pyroclastic, consolidated

WATER TABLE : Depth(cm) :

DRAINAGE : imperfect-moderately well
PERMEABILITY : slow
MOISTURE CONDITIONS PROFILE : 0 - 120 cm dry

LAND USE : (semi)natural vegetation
VEGETATION : Type :
Landuse/vegetation remarks : Formerly grazing land

ADDITIONAL REMARKS :
Site is located about 14 km west of the Orosi volcano.
The site is at present used for reforestation experiments.

Brief soil description:
Moderately deep, imperfectly drained very dark gray clay soil, having a black topsoil. The soil has a poor structure (coarse blocky and prismatic) and is very hard when dry. The underlying ignimbrite is penetrated by tree roots through a few cracks till probably great depth.

The underlying ignimbrite is slowly permeable for water. However fragments emersed in water, absorb water easily. The ignimbrite has about 10% available water capacity. When penetrated by roots the ignimbrite may contribute to the moisture supply for trees.

The thickness of the solon is considerably at short distance, it varies from about 20 till 70cm. [estimated from a few observations]. Rock and Ignimbrite outcrops are observed at a distance of a few 100 meters.

Parent material is early Pleistocene ignimbrite of the Bacoac Formation. It seems likely that the soil has received volcanic ash additions.
Concretions in the Bg horizon are composed of iron & manganese.
CLIMATE:
Station: LIBERIA
10 36 N / 85 32 W
85 m a.s.l.
31 km SSE of site
Relevance: poor

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<th>Feb</th>
<th>Mar</th>
<th>Apr</th>
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PROFILE DESCRIPTION:
Ah 0 - 20 cm. black (10YR 2.0/1.0, moist) dark gray (10YR 3.5/1.0, dry) silty clay; strongly coherent porous massive to medium subangular blocky structure; sticky, plastic, friable, hard; many very fine to fine pores; many fine roots; clear smooth boundary to
Bw 20 - 40 cm. very dark gray (10YR 3.0/1.0, moist) gray (10YR 5.0/1.0, dry) clay; strong medium to coarse angular blocky structure; sticky, plastic, firm, very hard; few fine faint mottles (7.5YR 5.0/0.0); many very fine pores; common fine roots; clear smooth boundary to
Bg 40 - 60 cm. dark gray (10YR 4.0/1.0, moist) gray (10YR 6.0/1.0, dry) sandy clay loam; very coarse prismatic and strongly coherent porous massive structure; slightly sticky, slightly plastic, firm, very hard; many medium to prominent mottles (7.5YR 6.0/0.0); many very fine pores; few fine roots; few medium to coarse ferrigenous concretions; abrupt smooth boundary to
R/C 60 - 67 cm. gray (10YR 6.0/1.0, moist) light gray (10YR 7.0/1.0, dry) sandy loam; strongly coherent massive structure; extremely firm, extremely hard; many coarse prominent mottles (7.5YR 6.0/0.0); abrupt smooth boundary to
R 67 - 120 cm. gray (10YR 8.0/1.0, dry) massive structure; extremely firm, extremely hard;

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CLAY MINERALOGY (1 very weak, 8 very strong) / EXTRACTABLE Fe Al Si Mn (by AMM. OXALATE(o), Na DITHIONITE(d) & PYROPHOS(p) Hor. no. MI VE CH SM KA HA ML QU FE GI GO HE Fe(o) Al(o) Si(o) Fe(d) Al(d) Fe(p) Al(p) Pret pHNaF

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FAO/UNESCO (1988): 
USDA/SCS SOIL TAXONOMY (1992): clayey, mixed, isothermic
LOCAL CLASSIFICATION: Serie Birrisito

DIAGNOSTIC CRITERIA

(CLASSIFICATIONS ARE FIELD CLASSIFICATIONS)

LOCATION
Carthagena, Turrialba, CATIE exp.station San Juan Sur
Latitude: 10°52'50" N
Longitude: 83°41'50" W
Altitude: 900 (m.a.s.l.)
Date (mm-yy): 3.91

AUTHOR(S)
Kauffman

GENERAL LANDFORM
Mountain
Topography: mountainous

PHYSIOGRAPHIC UNIT
Low mountain
Aspect: Form: convex

SLOPE
Gradient: 25%

POSITION OF SITE
Upper slope

MICRO RELIEF
Kind:

SURFACE CHAR.
Rock outcrop: nil
Cracking: nil
Salt: nil
Alkali: nil
Stoniness: nil
Slaking/crusting: nil

SLOPE PROCESSES
Soil erosion: nil

PARENT MATERIAL
1: volcanic ejecta
Texture: derived from: unconsol. pyroclastic rocks

PARENT MATERIAL
2: residual material
Texture: Derived from: fine-intermediate igneous
Weathering degree:
Depth lithological boundary (cm): 75

Remarks: see remarks
Resistence:

EFFECTIVE SOIL DEPTH(cm)
180

WATER TABLE
Depth(cm):
Kind: no watertable observed

DRAINAGE
well

PERMEABILITY:

MOISTURE CONDITIONS PROFILE
0 - 180 cm moist

LAND USE
arable farming
Landuse/vegetation remarks: exp. station, see remarks

ADDITIONAL REMARKS:
1. Name of site 'Huerto Latino America Clonal de AFN'
2. Erosion plots recently installed, no significant sediment transport was recorded till today
3. Site is in pasture plot, in the surroundings small holders with sugar cane, coffee (coffee Arabica) and pastures

Brief soil description:
Very deep, well drained, darkbrown clay soil with a very thick A horizon.

Parent material of the subsoil > 75 cm is probably derived from the underlying andesitic rock. The thick A horizon was derived or influenced by volcanic ashes. However, the first 35cm of the topsoil is strongly deviating from the buried A horizon, the latter having more convincing andic properties. After preparing the monolith, the upper 35 cm can be subdivided in an darker Ah1 and a more grayish Ah2 horizon. High biological activity throughout the soil.

Actual classification:
FAO (1988): Umbric Andosol
Soil Taxonomy (1992): Acruodic Melanudand
**CLIMATE:**

Köppen: Af  
Station: CATIE-TURRIALBA  
602 m a.s.l. 5 km S of site  
Relevance: good

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**PROFILE DESCRIPTION:**

Ah1 0 - 35 cm. very dark brown (10YR 2.0/2.0, moist) clay; moderate to strong very fine subangular blocky structure; sticky, plastic, firm; many very fine pores and common fine pores; many fine roots; gradual smooth boundary to

Ahb 35 - 60 cm. black (10YR 2.0/1.0, moist) sandy clay loam; weak medium subangular blocky into moderate fine crumb structure; slightly sticky, slightly plastic, very friable; many micro to very fine pores and common fine pores; many fine roots; gradual wavy boundary to

BC 60 - 75 cm. dark yellowish brown (10YR 3.0/4.0, moist) clay; moderate fine subangular blocky structure; slightly sticky, plastic, friable; many very fine to fine pores; common fine roots; gradual wavy boundary to

2Bw1 75 - 115 cm. dark yellowish brown (10YR 4.0/4.0, moist) clay; moderate medium subangular blocky structure; sticky, plastic, friable; broken moderately thick clay cutans; many very fine to fine pores and common medium pores; few fine roots; diffuse smooth boundary to

2Bw2 115 - 180 cm. 8.5YR 4.0/4.0, moist clay; moderate medium subangular blocky and moderately coherent porous massive structure; sticky, plastic, very friable; broken moderately thick clay cutans; many very fine to fine pores;

**ANALYTICAL DATA:**

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<th>Top - Bot</th>
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**CLAY MINERALOGY:**

(1 very weak, ... , 8 very strong) / EXTRACTABLE Fe Al Si Mn (by AMM. OXALATE(o), Na DITHIONITE(d) & PYROPHOF(p))

Hor.  
no. 1 NI VE CH SM KA HA ML QU FE G1 GO HE Fe(o) Al(o) Si(o) Fe(d) Al(d) Fe(p) Al(p) Pret pHNAF

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DIAGNOSTIC CRITERIA
USDA/SCS (1992) : Soil moisture regime: aquic

LOCATION
Latitude : 10°34'.0'' N
Longitude : 83°42'.30'' W
Altitude : 10 (m.a.s.l.)

AUTHOR(S)
Nieuwenhuyze

Date (mm.yy) : 3.91

GENERAL LANDFORM
: floodplain

PHYSIOGRAPHIC UNIT
: Floodplain of Zapote river

SLOPE
Gradient : 1%
Aspect :
Form :

POSITION OF SITE
: open depression

MICRO RELIEF
: level

SURFACE CHAR.
Rock outcrop : nil
Cracking : nil
Salt : nil
Alkali : nil

SLOPE PROCESSES
Soil erosion : nil
Aggradation : nil

PARENT MATERIAL
: alluvium

Texture : derived from : fine-intermediate igneous

WATER TABLE
Depth(cm) :
Estimated highest level : 0
Kind :
Estimated lowest level : 150

DRAINAGE
: imperfectly

PERMEABILITY
: moderate

FLOODING
Frequency : irregular, fresh water
Run off : medium

MOISTURE CONDITIONS PROFILE
: 0 - 130 cm moist

LAND USE
: cultivated pasture; no irrigation; Rotation: not relevant; Improvements: none

ADDITIONAL REMARKS:
presence of cutanas is not so convincing.

Clay mineralogy: halloysite is a mixture of 0.7 and 1.0 nm material.

CLIMATE
Köppen: AF
Station: FINCA MOLA
10°21' N / 83°47' W
75 m a.s.l.
25 km NNE of site
Relevance: good

No. of days
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Annual
relative humidity %
7
85
83
82
81
83
87
87
85
84
86
87
86
85

precipitation
mm
11
250
160
130
180
350
360
460
440
270
350
380
350
3690

T mean °C
2
23.3
24.7
25.7
25.6
25.9
26.2
25.3
25.5
26.2
25.3
25.6
24.5
25.4

PROFILE DESCRIPTION:

A 0 - 7 cm. dark grayish brown (10YR 4.0/2.0, moist) silty clay loam; wood fragments, moderately decomposed; weak to moderate medium angular blocky; weak to moderate medium subangular blocky structure; slightly sticky, slightly plastic, firm; common fine distinct clear mottles (7.5YR 5.0/6.0); no cutans; common fine to coarse pores; moderately porous; many very fine roots in mat at top of horizon and common fine roots throughout; no inclusions; no fragments; non cemented continuous massive petrified; non calcareous (HCL); abrupt smooth boundary to

Bw 7 - 17 cm. dark yellowish brown (10YR 4.0/4.0, moist) silty clay loam; moderate fine to medium subangular blocky; moderate fine to medium angular blocky structure; slightly sticky, slightly plastic, friable; common fine distinct clear mottles (10YR 5.0/6.0); common very fine to fine pores; moderately porous; common very fine roots throughout; non calcareous (HCL); clear smooth boundary to

Bw2 17 - 24 cm. dark brown (10YR 4.0/3.0, moist) silty clay loam; moderate fine to medium subangular blocky, moderate fine to medium angular blocky structure; slightly sticky, slightly plastic, friable; common medium distinct clear mottles (10YR 5.0/6.0) and common medium distinct clear mottles (10YR 5.0/2.0); many very fine pores and few medium pores; moderately porous; common very fine roots throughout; non calcareous (HCL); clear smooth boundary to

Bw3 24 - 40 cm. dark brown (10YR 4.0/3.0, moist) silty clay loam; moderate very fine subangular blocky, moderate very fine angular blocky structure; slightly sticky, slightly plastic, friable; common medium distinct clear mottles (10YR 5.0/6.0) and common medium distinct clear mottles (10YR 5.0/2.0); many very fine to fine pores and few medium pores; highly porous; very fine very roots throughout; non calcareous (HCL); clear smooth boundary to
### Analytical Data

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CLAY MINERALOGY (1 very weak, ... B very strong) / EXTRACTABLE Fe Al Si Mn (by AMM. OXALATE(o), Na DITHIONITE(d) & PYROPHOS(p)

Hor. no. MI VE CH SM KA HA ML QU FE GI GO HE MX Fe(o) Al(o) Si(o) Fe(d) Al(d) Fe(p) Al(p) Pret pH NaF

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USDA/SCS SOIL TAXONOMY (1992) : Vitric Hapludand, coarse loamy o.sandy (sk), isohyperthermic (1975 : typic dystrandept)
LOCAL CLASSIFICATION : Suelo Los Diamantes

DIAGNOSTIC CRITERIA
USDA/SCS (1992) : Soil moisture regime : perudic
 : Diagnostic properties : thixotropy
 : Soil moisture regime : perudic

(CLASSIFICATIONS ARE FIELD CLASSIFICATIONS)

LOCATION
 : Costa Rica, Guapiles, Los Diamantes, 200m N of cow-shed.
 : Latitude: 10°13'15" N
 : Longitude: 83°46'45" W
 : Altitude: 250 (m.a.s.l.)
 : Date (mm.yyyy): 3.91

AUTHOR(S)
 : Veldkamp, E./A. Weitz

GENERAL LANDFORM
 : alluvial fan
Topography: undulating

PHYSIOGRAPHIC UNIT
 : river terrace on alluvial fan
Form: straight

SLOPE
 : Gradient: 3%
Aspect: E

POSITION OF SITE
 : middle slope

MICRO RELIEF
 : Kind:

SURFACE CHAR.
 : Rock outcrop: nil
Stoniness: very few stones
 : Form: (sub)rounded
Av.Size (cm): 50
 : Crackling: nil
Slaking/crusting: nil
 : Salt: nil
Alkali: nil

SLOPE PROCESSES
 : Soil erosion: nil

PARENT MATERIAL
 : 1: alluvium
Texture: sandy
Remarks: derived from: fine-intermediate igneous
 : Andesitic origin

EFFECTIVE SOIL DEPTH(cm)
 : 100

WATER TABLE
 : Depth(cm): Kind: no watertable observed

DRAINAGE
 : well

PERMEABILITY
 : high
No slow permeable layer(s) cm

FLOODING
 : Frequency: nil

MOISTURE CONDITIONS PROFILE
 : 0 - 130 cm moist

LAND USE
 : cultivated pasture; no irrigation; Rotation: not relevant; Improvements: none
Landuse/vegetation remarks: Forest cut approximately in 1963

ADDITIONAL REMARKS:
Brief soil description:
Moderately deep, well drained, dark brown to brown coarse loamy over sandy soil, well structured.

Some pot splinters were found at about 30 cm depth indicating former Indian activity at site. Between 30 and 60 cm abunden small balls of dung (?) were found originating from dung beetles.

CLIMATE:
Köppen: af
Station: 10 13 N/ 83 46 W 249 m a.s.l. 1 km SSE of site
Relevance: very good

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<th>Jun</th>
<th>Jul</th>
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<td>245</td>
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<td>482</td>
<td>428</td>
<td>358</td>
<td>446</td>
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</table>
PROFILE DESCRIPTION:

Ah1 0 - 7 cm. very dark grayish brown (10YR 3.0/2.0, moist) loam; strong fine subangular blocky structure; non sticky, non plastic, friable, slightly hard; none mottles; no cutans; common very fine continuous expelled tubular pores and common fine vertical continuous expelled interstitial pores; many very fine roots throughout and many fine roots throughout; no inclusions; no fractures; gradual smooth boundary to

Ah2 7 - 20 cm. dark brown (10YR 3.0/3.0, moist) loam; moderate fine subangular blocky and moderate fine angular blocky structure; non sticky, non plastic, friable, slightly hard; none mottles; no cutans; common very fine continuous expelled tubular pores and common fine vertical continuous expelled interstitial pores; many very fine roots throughout and many fine roots throughout; no inclusions; no fragments; gradual smooth boundary to

Ah3 20 - 70 cm. dark brown (10YR 3.0/3.0, moist) sandy loam; weak medium angular blocky structure; non sticky, non plastic, very friable, soft; none mottles; no cutans; common very fine continuous expelled tubular pores; few very fine roots throughout and few fine roots throughout; no inclusions; no fragments; frequent esoprogenic elements; clear smooth boundary to

B 70 - 100 cm. dark brown (10YR 4.0/3.0, moist) loamy sand; weak medium angular blocky structure; non sticky, non plastic, very friable, loose; few very fine continuous expelled tubular pores; few very fine roots and few fine roots; clear smooth boundary to

C 100 - 115 cm. dark brown (10YR 3.0/3.0, moist) sand; structureless structure; non sticky, non plastic, loose; few very fine continuous interstitial pores; highly porous; nil roots; clear smooth boundary to

2b 115 - 140 cm. dark yellowish brown (10YR 4.0/4.0, moist) loamy sand; weak medium angular blocky structure; non sticky, non plastic, friable, slightly hard; common very fine continuous expelled tubular pores and common fine random continuous expelled tubular pores; moderately porous; nil roots;

ANALYTICAL DATA:

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<th>&gt;2</th>
<th>2000</th>
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CLAY MINERALOGY (1 very weak, 2... B very strong) / EXTRACTABLE Fe Al Si Mn (by AMM. OXALATE(o), Na DITHIONITE(d) & PYROPHO(p))

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USDA/SCS SOIL TAXONOMY (1992): Acrudoxic Hapludand, coarse loamy o.sandy (sk), isohyperthermic(1975: typic dystrandept)
LOCAL CLASSIFICATION: Suelo Los Diamantes

DIAGNOSTIC CRITERIA

: Soil moisture regime: perudic

(CLASSIFICATIONS ARE FIELD CLASSIFICATIONS)

LOCATION
: Costa Rica Guapiles, on west bank of Rio Diamantes, colegio agropec.
Latitude: 10°13'40" N
Longitude: 83°46'30" W
Altitude: 240 (m.a.s.l.)
Date(mm. yy) : 3.91

AUTHOR(S)
: Veldkamp, E.GJ. Weer

GENERAL LANDFORM
: alluvial fan

PHYSIOGRAPHIC UNIT
: river terrace on alluvial fan

SLOPE
: Gradient: 3%
Aspect: S
Form: straight

POSITION OF SITE
: middle slope

MICRO RELIEF
: Rock outcrop: nil
Stoniness: nil

SURFACE CHAR.
: Cracking: nil
Slaking/crusting: nil
Salt: nil
Alkali: nil

SLOPE PROCESSES
: Soil erosion: nil

PARENT MATERIAL
: alluvium
Texture: sandy
Weathering degree: slight

Remarks
: Andesitic origin

derived from: fine-intermediate igneous

EFFECTIVE SOIL DEPTH(cm)
: 90

WATER TABLE
: Depth(cm)
Kind: no watertable observed

DRAINAGE
: somewhat excessive

PERMEABILITY
: No slow permeable layer(s) cm

FLOODING
: Frequency: nil

MOISTURE CONDITIONS PROFILE
: 0 - 150 cm moist

LIFE USE
: (semi)natural vegetation; no irrigation; Rotation: not relevant; Improvements: none

VEGETATION
: Type: closed forest
Status: cut over

Landuse/vegetation remarks: forest strip of 50 m width along river

ADDITIONAL REMARKS:
Brief soil description:
Moderately deep, well drained, dark brown to brown loamy over sandy soil, well structured.

On the boundary of Ah1 to Ah2 a 'panlike structure' is found although no compaction was found. The structure can be recognized as a grey band with rust coloured edges. Abundant soil fauna: ants, earthworms, termites, jumptails, beetles.

CLIMATE:
Köppen: Af
Station: 10 13 N/ 83 46 W
249 m a.s.l
1 km SSE of site
Relevance: very good

LOS DIAMANTES

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<th>Mar</th>
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20
PROFILE DESCRIPTION:

Ah1  0 - 25 cm. very dark brown (10YR 2.0/2.0, moist) sandy loam; strong medium crumb structure; non sticky, non plastic, very friable; many fine to coarse continuous exped-imped tubular pores; highly porous; many very fine to coarse roots throughout; clear smooth boundary to

Ah2  25 - 80 cm. dark brown (10YR 3.0/3.0, moist) sandy loam; weak medium to coarse angular blocky structure; non sticky, non plastic, very friable; many very fine continuous exped-imped tubular pores and many fine random continuous exped-imped tubular pores; highly porous; many very fine to coarse roots throughout; gradual smooth boundary to

B  80 - 90 cm. dark brown (10YR 3.0/3.0, moist) loamy sand; weak medium to coarse angular blocky structure; non sticky, non plastic, loose, loose; many fine continuous intersitial pores; highly porous; few fine roots throughout; abrupt smooth boundary to

C  90 - 135 cm. very dark brown (10YR 2.0/2.0, moist) sand; structureless structure; non sticky, non plastic, common very fine continuous exped-imped tubular pores and many fine random continuous exped-imped tubular pores; moderately porous; nil roots;

2Bb 135 - 150 cm. dark brown (10YR 3.0/3.0, moist) loamy sand; weak medium angular blocky structure; non sticky, non plastic, very friable; common very fine continuous exped-imped tubular pores and common fine random continuous exped-imped tubular pores; moderately porous; nil roots;

ANALYTICAL DATA:

| Hor. | Top - Bot | mm 1000 | 1000 | 500 | 250 | 100 | TOT | 50 | 20 | TOT | <2 | DISP | BULK | pH | DENS | 0.0 | 1.0 | 1.5 | 2.0 | 2.3 | 2.7 | 3.4 | 4.2 |
|------|-----------|---------|------|-----|-----|-----|-----|-----|-----|-----|------|-----|------|------|------|------|------|------|------|------|------|------|------|------|------|
| 1    | 0 - 25    | 0 2 6 16 26 9 59 10 18 28 13 | 3.1 | 0.75 | 65 | 60 | 51 | 46 | 44 | 43 | 38 | 36 |
| 2    | 25 - 80   | 0 2 7 16 30 13 68 11 16 27 | 5 2.1 | 0.69 | 69 | 65 | 69 | 40 | 38 | 37 | 32 | 31 |
| 3    | 80 - 90   | 0 3 9 22 34 10 77 8 12 20 | 3 3.0 | 0.77 | 65 | 63 | 53 | 45 | 43 | 40 | 38 | 36 |
| 4    | 90 - 135  | 0 2 20 46 25 4 96 0 3 3 | 2.4 | - | - | - | - | - | - | - | - | - | - |

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CLAY MINERALOGY (1 very weak, ... 8 very strong) / EXTRACTABLE Fe Al Si Mn (by AMM. OXALATE(o), Na DITHIONITE(d) & PYROPHO(p)

| Hor. | MI | VE | CH | SM | KA | HA | ML | QU | FE | GI | GO | HE | Fe(o) Al(o) Si(o) Fe(d) Al(d) Fe(p) Al(p) | Pret pHNaF |
|------|----|----|----|----|----|----|----|----|----|----|----|----|------|------|------|------|------|------|------|
| 1    | -  | -  | 1  | 1  | -  | 1  | -  | 0.69 | 2.01 | 0.18 | -  | -  | -    | -    | -    | -    | -    | -    | -    |
| 2    | -  | -  | 1  | 1  | -  | 1  | -  | 0.62 | 2.26 | 0.18 | -  | -  | -    | -    | -    | -    | -    | -    | -    |
| 3    | -  | -  | 1  | 1  | -  | 1  | -  | 0.42 | 1.52 | 0.26 | -  | -  | -    | -    | -    | -    | -    | -    | -    |
| 4    | -  | -  | 1  | 1  | -  | 1  | -  | 0.61 | 0.42 | 0.12 | -  | -  | -    | -    | -    | -    | -    | -    | -    | -    |
USDA/SCS SOIL TAXONOMY (1992): Andic Maploprox, clayey, kaolinitic, isohyperthermic
LOCAL CLASSIFICATION: Suelo Neguev

DIAGNOSTIC CRITERIA
- Soil moisture regime: perudic

(Classifications are field classifications)

LOCATION
- Prov. de Limon Asentamiento Neguev, Parcela 252
- Latitude: 10°11' 00" N
- Longitude: 83°32'30" W
- Altitude: 30 (m.a.s.l.)
- Date (mm.yy): 2.91

GENERAL LANDFORM: alluvial terrace
PHYSIOGRAPHIC UNIT: Flat top Pleistocene terrace

Slope
- Gradient: -%
- Aspect: Form:

POSITION OF SITE
- Kind: level
- Pattern: none

MICRO RELIEF
- Rock outcrop: nil
- Stoniness: nil
- Cracking: nil
- Slaking/crusting: nil
- Salt: nil
- Alkali: nil

SLOPE PROCESSES
- Soil erosion: nil

PARENT MATERIAL
- Texture: alluvium
- Derived from: fine-intermediate igneous

Remarks: see general remarks

EFFECTIVE SOIL DEPTH (cm)
- 150

WATER TABLE
- Depth (cm):

DRAINAGE
- Kind: no watertable observed

PERMEABILITY
- Frequency: nil

FLOODING
- Kind: nil
- No slow permeable layer(s) cm

MOISTURE CONDITIONS PROFILE
- 0 - 140 cm moist

LAND USE
- (semi)natural vegetation; no irrigation; Rotation: not relevant; Improvements: none

VEGETATION
- Type: evergreen forest
- Status: cut over

LANDSCAPE/VEGETATION REMARKS
- Remaining forest island of about 6ha

ADDITIONAL REMARKS:
- Brief soil description:
  - Very deep, well drained, brown clay soil, strongly acid and having a very low sum of exchangeable bases.

Parent material is of fluvio-laharic origin. The original texture is not known. Composition of parent material is probably andesitic. The pan has a black color and occurs at about 140cm depth.

Actual classification:
- FAO (1988): Haplic Ferralsol
- USDA (1992): Andic Maploprox

PROFILE DESCRIPTION:

**Ah**
- 0 - 15 cm. Dark brown (10YR 3.0/3.0, moist) silty clay; moderate fine to medium crumb structure; slightly sticky, slightly plastic, very friable; many fine to coarse continuous expedit-imped interstitial pores and many fine to coarse random continuous exped-imped tubular pores; highly porous; many very fine to coarse roots; non calcareous; clear wavy boundary to

**Bu1**
- 15 - 60 cm. Dark yellowish brown (10YR 3.0/4.0, moist) silty clay; weak porous massive structure; slightly sticky, slightly plastic, very friable; many fine to coarse continuous expedit-imped tubular pores; highly porous; few very fine to coarse roots; clear smooth boundary to

**Bu2**
- 60 - 140 cm. Dark yellowish brown (10YR 3.0/4.0, moist) silty clay; weak porous massive structure; slightly sticky, slightly plastic, very friable; many fine to coarse continuous expedit-imped tubular pores; few very fine to coarse roots; weakly cemented discontinuous massive iron pan

ANALYTICAL DATA:

22
| no. | mm 1000 | 500 | 250 | 100 | 50 | SAND | 20 | 2 SILT | μm | DENS | 0.0 | 1.0 | 1.5 | 2.0 | 2.3 | 2.7 | 3.4 | 4.2 |
| 1 | 0 - 15 | 0 | 0 | 0 | 1 | 3 | 2 | 6 | 6 18 | 24 | 69 | 14.2 | 0.95 | 64 | 62 | 59 | 57 | 56 | 53 | 42 | 40 |
| 2 | 15 - 60 | 0 | 0 | 0 | 1 | 3 | 2 | 7 | 7 22 | 29 | 64 | 2.1 | 0.95 | 61 | 59 | 54 | 49 | 48 | 45 | 44 | 43 |
| 3 | 60 - 140 | 0 | 0 | 0 | 1 | 3 | 2 | 6 | 5 21 | 26 | 68 | 2.0 | 0.87 | 62 | 60 | 53 | 47 | 45 | 43 | 38 | 37 |
| Hor. pH  | CaCO3 | ORG  | MAT. | EXCH CAT. | ---- | --- | --- | --- | EXCH AC. | ---- | CECP | ---- | --- | BASE | AL | EC 2.5 |
| no.     | H2O  | KCl  | C    | N    | Ca Mg | K Na | sum H+Al | Al | soil clay OrgC | ECEC | SAT | SAT | --- | mS/cm |
| 1  | 3.9  | 3.6  | 3.84 | 0.44 | 0.4  | 0.3 | 0.4 | 0.0 | 1.1 | 6.4 | 5.2 | 19.4 | 28 | 13.4 | 7.5 | 6 | 27 | 0.34 |
| 2  | 4.3  | 4.0  | 0.94 | 0.16 | 0.0  | 0.0 | 0.0 | 0.1 | 0.1 | 3.8 | 3.2 | 10.0 | 16 | 3.3 | 3.9 | 1 | 32 | 0.03 |
| 3  | 4.4  | 4.0  | 0.55 | 0.10 | 0.0  | 0.0 | 0.0 | 0.1 | 0.1 | 3.1 | 2.4 | 9.2 | 14 | 1.9 | 3.2 | 1 | 26 | 0.03 |

CLAY MINERALOGY (1 very weak, ... 8 very strong) / EXTRACTABLE Fe Al Si Mn (by AMM, OXALATE(o), Na DITHIONITE(d) & PYROPHD(p))

| Hor. | MI VE CH SM KA ML QU FE GI GO HE Fe(o) Al(o) Si(o) Fe(d) Al(d) Fe(p) Al(p) Pret pHNaF |
| no.  | 1  | 2  | 3  | 4  | 1  | 2  | 3  | 2  | 0.70 | 0.50 | 0.05 | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| 4  | 1  | 2  | 3  | 2  | 0.73 | 0.70 | 0.06 | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| 4  | 1  | 2  | 3  | 2  | 0.73 | 0.65 | 0.06 | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |

23
Draft
ISIS 4.0 data sheet of monolith CR009 Country: COSTA RICA

LOCAL CLASSIFICATION : Suelo Neguev

DIAGNOSTIC CRITERIA
USDA/SCS (1992) : Soil moisture regime : perudic
: Soil moisture regime : perudic

(CLASSIFICATIONS ARE FIELD CLASSIFICATIONS)

LOCATION
: Prov. de Limón, Asentamiento Neguev, parcela 255.
Latitude : 10°10'15" N
Longitude : 83°32'30" W
Altitude : 30 (m.a.s.l.)
Date (mm.yy) : 4.91

AUTHOR(S)
: Veldkamp

GENERAL LANDFORM
: alluvial terrace
: flat top of dissected terrace
Topography : flat or almost flat

PHYSIOGRAPHIC UNIT
: alluvial terrace
: flat top of dissected terrace

Slope
: Gradient : -%
: Aspect :
Form :

POSITION OF SITE
: flat

MICRO RELIEF
: Kind : level
Pattern : none

SURFACE CHAR.
: Rock outcrop : nil
Stoniness : nil

Cracking : small cracks
Slaking/crusting : nil
Salt : nil
Alkali : nil

SLOPE PROCESSES
: Soil erosion : nil

PARENT MATERIAL
: 1 : alluvium
: derived from : fine-intermediate igneous

Texture :
Remarks :
: see general remarks

EFFECTIVE SOIL DEPTH(cm)
: 140

WATER TABLE
: Depth(cm) :
Kind : no watertable observed

DRAINAGE
: well

PERMEABILITY
: high
No slow permeable layer(s) cm

MOISTURE CONDITIONS PROFILE
: 0 - 25 cm dry
25 - 140 cm moist

LAND USE
: cultivated pasture; no irrigation; Rotation : not relevant; Improvements : none

Landuse/vegetation remarks :
deforested approximately in 1975

ADDITIONAL REMARKS :
Brief soil description:
Very deep, well drained, brown clay soil, strongly acid and having a very low sum of exchangeable bases.

In the lower part of the soil monolith cemented remains of the parent material can be observed. Cementing material is probably silica. Parent material is of fluvo-laharic origin. The original texture is not known with certainty, but appear to be andesitic sand.

Topsoil (0-23) is severely compacted. Profile was described in extremely dry period. Therefore cracks were visible which normally don't occur.
PROFILE DESCRIPTION:

A 0 - 8 cm. very dark grayish brown (10YR 3.0/2.0, moist) silty clay; strong medium prismatic into moderate fine subangular blocky structure; slightly sticky, slightly plastic, firm, very hard; common fine continuous exped interstitial pores and common very fine random continuous exped-ined tubular pores; highly porous; many very fine roots in cracks and many fine roots in cracks; clear smooth boundary to

Bu1 8 - 23 cm. dark brown (10YR 4.0/3.0, moist) silty clay; moderate medium prismatic into moderate medium angular blocky structure; slightly sticky, slightly plastic, friable, hard; common fine continuous exped interstitial pores and common very fine random continuous exped-ined tubular pores; few very fine roots in cracks and few fine roots in cracks; clear smooth boundary to

Bu2 23 - 110 cm. dark yellowish brown (10YR 3.0/4.0, moist) silty clay; weak fine subangular blocky to weak porous massive structure; slightly sticky, slightly plastic, very friable; many very fine continuous exped-ined tubular pores and many fine random continuous exped-ined tubular pores; few very fine roots throughout and few fine roots throughout; boundary to

Bu3 110 - 140 cm. dark brown (10YR 3.0/3.0, moist) silty clay; weak fine subangular blocky to weak porous massive structure; slightly sticky, slightly plastic, very friable; many very fine continuous exped-ined tubular pores and many fine random continuous exped-ined tubular pores; highly porous; few very fine roots throughout and few fine roots throughout;

ANALYTICAL DATA:

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<thead>
<tr>
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<th>Top 2000</th>
<th>1000</th>
<th>500</th>
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CLAY MINERALOGY (1 very weak..., 8 very strong) / EXTRACTABLE Fe Al Si Mn (by AMM, OXALATE(o), Na DITHIONITE(d) & PYROPHO(p)

Hor.
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<th>no.</th>
<th>M1 VE CH SM KA HA ML QU FE GI GO HE Fe(o) Al(o) Si(o) Fe(d) Al(d) Fe(p) Al(p)</th>
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<td>- - 1 4 - - 1 - - 7 - - 0.93 0.54 0.01 - - - -</td>
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<td>- - 1 4 - - 1 - - 6 - - 0.62 0.61 0.03 - - - -</td>
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<tr>
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<td>- - 1 2 - - 1 - - 6 - - 0.88 0.72 0.07 - - - -</td>
<td>- - - - - -</td>
</tr>
</tbody>
</table>

- Sandy, isohyperthermic
  
**USDA/SCS SOIL TAXONOMY (1992)**

- Udic Arenosols (1976: Aquic tropopsamment)
  
**DIAGNOSTIC CRITERIA**

- Soil moisture regime: udic
- Diagnostic horizons: ochric
- Diagnostic properties: mottles with chroma <2
- Soil moisture regime: udic

**LOCATION**

- Latitude: 10°24' 0" N
- Longitude: 83°53' 0" W
- Altitude: 65 (m.a.s.l.)
- Date (mm.y): 3, 91

**GENERAL LANDFORM**

- Alluvial plain

**PHYSIOGRAPHIC UNIT**

- Channel fill of Chirripó river

**SLOPE**

- Gradient: 1%

**POSITION OF SITE**

- Kind: level

**MICRO RELIEF**

- Pattern: none

**SURFACE CHAR.**

- Rock outcrop: nil
- Cracking: nil
- Salt: nil
- Alkali: nil

**SLOPE PROCESSES**

- Soil erosion: nil
- Aggradation: nil

**PARENT MATERIAL**

- 1: alluvium
- Texture: sandy
- Weathering degree: slight
- Derived from: fine-intermediate igneous
- Resistance: 

**EFFECTIVE SOIL DEPTH(cm)**

- 28

**WATER TABLE**

- Depth(cm): 100

**DRAINAGE**

- Estimated highest level: 100
- Kind: no water table observed
- Estimated lowest level: 250
- Somewhat excessive

**PERMEABILITY**

- High
- No slow permeable layer(s) cm

**FLOODING**

- Frequency: irregular, fresh water

**MOISTURE CONDITIONS PROFILE**

- 0 - 100 cm moist

**LAND USE**

- Cultivated pasture; no irrigation; Rotation: not relevant; Improvements: none

**ADDITIONAL REMARKS**

- Presence of cutans is not so convincing.

**CLIMATE**

- Köppen: Af
- Station: FINCA MOLA 10 21 N/ 83 47 W
- 75 m a.s.l.
- 11 km ESE of site
- Relevance: good

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<tr>
<td>Ac</td>
<td>0 - 10</td>
<td>Very dark grayish brown (10YR 3.0/2.0, moist) slightly gravelly; weak medium subangular blocky and weakly coherent structure; non sticky, non plastic, very friable; none mottles; no cutans; few to common, fine pores and few coarse pores; slightly porous; common fine roots throughout; no inclusions; no fragments; non cemented; few worm channels; non calcareous (HCL); gradual smooth boundary to</td>
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<tr>
<td>Cg1</td>
<td>10 - 28</td>
<td>Dark yellowish brown (10YR 3.0/4.0, moist) slightly gravelly medium sand; structureless single grain structure; non sticky, non plastic, loose; few fine distinct clear mottles (10YR 5.0/8.0) and few fine distinct clear mottles (10YR 6.0/2.0); no cutans; few medium to coarse pores; slightly porous; few fine roots throughout; no inclusions; no fragments; non cemented; few biological activity; non calcareous (HCL); abrupt smooth boundary to</td>
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<td>C2</td>
<td>28 - 70</td>
<td>Dark brown (10YR 3.0/3.0, moist) slightly gravelly coarse sand; structureless single grain structure; non sticky, non plastic, loose; none mottles; no cutans; none pores; nil roots; no inclusions; no fragments; non cemented; no biological activity; non calcareous (HCL); abrupt smooth boundary to</td>
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<tr>
<td>Cg3</td>
<td>70 - 100</td>
<td>Dark yellowish brown (10YR 3.0/4.0, moist) medium sand; structureless single grain structure; non sticky, non plastic, loose; few fine distinct clear mottles (10YR 5.0/6.0) and few fine distinct clear mottles (10YR 6.0/2.0); no cutans; none pores; nil roots; no inclusions; no fragments; non cemented; no biological activity; non calcareous (HCL);</td>
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</table>
Mineuse Anadous, loamy over sandy(skel), isohyperthermic (1975: entic dystrandept)

SOIL CLASSIFICATION: USDA/SOS (1992)

DIAGNOSTIC CRITERIA

FAO/UNESCO (1988)

USDA/SOS SOIL TAXONOMY (1992)

LOCAL CLASSIFICATION: Suelo Montelmar


: Soil moisture regime: perudic

: Diagnostic properties: thixoconvulc, weatherable minerals

: Soil moisture regime: perudic

CLASSIFICATIONS ARE FIELD CLASSIFICATIONS)

LOCATION:

South of MOLA 2 banana plantation, community of Esperanza, Guácimo.

AUTHOR(S):

Lat. 10°19' 00'' N

Long. 83°37'30'' W

Alt. 30 (m.a.s.l.)

Date (mm. yyyy): 3.91

GENERAL LANDFORM

PHYSIOGRAPHIC UNIT

Slope

POSITION OF SITE

MICRO RELIEF

SURFACE CHAR.

Slope Processes

Topography: flat or almost flat

Aspect:

Form:

Gradient: 1%

Kind: level

Rock outcrop: nil

Salt: nil

Aggradation: nil

Parent Material

Texture: sandy

Weathering degree: slight

Remarks:

derived from: fine-intermediate igneous

EFFECTIVE SOIL DEPTH(cm):

90

WATER TABLE

Depth(cm): 200

Estimated highest level: 150

DRAINAGE

PERMEABILITY

FLOODED

MOISTURE CONDITIONS PROFILE:

Run off: very rapid

0 - 150 cm moist

LAND USE:

: cultivated pasture; no irrigation; Rotation: not relevant; Improvements: none

ADDITIONAL REMARKS:

influenced by volcanic ashes. However, the first 35cm of the topsoil is strongly deviating from the buried A horizon, the latter having more convincing andic properties.

High biological activity throughout the soil.

CLIMATE:

Köppen: AF

Station: FINCA MOLA 10 21 W 83 47 W

75 m a.s.l

16 km W of site

Relevance: good

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28
### PROFILE DESCRIPTION:

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<th>Layer</th>
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<tr>
<td>A</td>
<td>0 - 10 cm.</td>
<td>dark brown (10YR 3.0/3.0, moist) slightly gravelly loam; moderate fine angular blocky and subangular blocky structure; slightly sticky, slightly plastic, friable; none mottles; no cutans; common fine to coarse pores and few coarse pores; moderately porous; many fine roots throughout and few medium roots throughout; no inclusions; no fragments; very frequent worm channels; non calcareous (HCL); clear wavy boundary to</td>
</tr>
<tr>
<td>AB</td>
<td>10 - 25 cm.</td>
<td>dark brown (10YR 4.0/3.0, moist) slightly gravelly loam; weak fine subangular blocky structure; slightly sticky, slightly plastic, very friable; none mottles; no cutans; many fine to coarse pores and few coarse pores; common fine roots throughout and few medium roots throughout; no inclusions; no fragments; frequent worm channels; non calcareous (HCL); gradual wavy boundary to</td>
</tr>
<tr>
<td>Bw</td>
<td>25 - 56 cm.</td>
<td>dark yellowish brown (10YR 4.0/4.0, moist) slightly gravelly medium sands loam; weak subangular blocky structure; slightly sticky, slightly plastic, very friable; none mottles; no cutans; many fine to coarse pores and few coarse pores; highly porous; common fine roots throughout and few medium roots throughout; no inclusions; no fragments; frequent worm channels; non calcareous (HCL); clear wavy boundary to</td>
</tr>
<tr>
<td>CB</td>
<td>56 - 113 cm.</td>
<td>very dark grayish brown (10YR 3.0/2.0, moist) slightly gravelly coarse sand; structureless structure; non sticky, non plastic, loose; mottles; cutans; few very fine roots; inclusions; very few fine strongly weathered PUMICE fragments; no biological activity; non calcareous (HCL); clear wavy boundary to</td>
</tr>
<tr>
<td>C2</td>
<td>113 - 150 cm.</td>
<td>very dark grayish brown (10YR 3.0/2.0, moist) coarse sand; structureless structure; non sticky, non plastic, loose; none mottles; no cutans; nil roots; no inclusions; no fragments; no biological activity; non calcareous (HCL);</td>
</tr>
</tbody>
</table>
USDA/SCS SOIL TAXONOMY (1992) : loamy, isothermic

**DIAGONISTIC CRITERIA**
- Diagnostic properties: exc. compl. dom. by amorph., thixotropy
- Soil moisture regime: peridic

**LOCATION**
- Finca O.Casanosa, 2.5 km W of Santa Cruz de Turrialba, 75 m E of house
- Latitude: 9°57'150'' N
- Longitude: 83°45' 8'' W
- Altitude: 1650 (m.a.s.l.)
- Date (mm.yy): 11.95

**GENERAL LANDFORM**
- Volcano

**PHYSIOGRAPHIC UNIT**
- SE slope of Turrialba volcano

**SLOPE**
- Gradient: 5%
- Kind: level

**SURFACER CHAR.**
- Rock outcrop: nil
- Cracking: nil
- Salt: nil
- Stoniness: nil
- Slaking/crusting: nil
- Alkali: nil

**SLOPE PROCESSES**
- Soil erosion: slight sheet
- Aggradation: nil

**PARENT MATERIAL**
- Derived from: ejecta ash
- Texture: sandy
- Kind: andesitic ash

**EFFECTIVE SOIL DEPTH(cm)**
- 150

**WATER TABLE**
- Depth(cm): nil
- Kind: no watertable observed

**DRAINAGE**
- Frequency: nil
- Run off: rapid

**PERMEABILITY**
- High

**MOISTURE CONDITIONS PROFILE**
- 0 - 150 cm moist

**LAND USE**
- Cultivated pasture; no irrigation; Rotation: crop - grass rotation, ley; Improvements: none

**ADDITIONAL REMARKS**
- Brief soil description:
  - Very deep, well drained, brownish black over yellowish brown loamy soil. The upper 50 cm have a very high organic matter content.
  - The soil has been formed in various superimposed volcanic ash deposits of the Turrialba volcano.

The site has been used for many years for pasture, which has caused compaction of the upper 30 cm, as evidenced by slight mottling. At time of description, the land was being prepared for growing potatoes and later on beans, after which pasture will probably be reestablished.

In the subsoil some very large pores are present, partly filled up which material from the A horizon.
### PROFILE DESCRIPTION:

<table>
<thead>
<tr>
<th>Depth (cm)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - 26</td>
<td>very dark grayish brown (10YR 3.0/2.0, moist) loam; moderate very fine subangular blocky, moderate fine to very fine crumb structure; slightly sticky, slightly plastic, friable, moderately smearable; common fine distinct clear mottles (7.5YR 4.0/6.0); no cutans; common very fine to fine pores and few medium pores; highly porous; many fine roots throughout; no inclusions; no fragments; non cemented; frequent worm channels; (HCL); clear wavy boundary to</td>
</tr>
<tr>
<td>26 - 53</td>
<td>very dark brown (10YR 2.0/2.0, moist) loam; moderate very fine subangular blocky, moderate fine crumb structure; slightly sticky, slightly plastic, very friable, moderately smearable; mottles; no cutans; many very fine to fine pores and few medium pores; highly porous; many fine roots throughout; no inclusions; very few medium fresh andesitic fragments; non cemented; few worm channels; (HCL); clear wavy boundary to</td>
</tr>
<tr>
<td>53 - 100</td>
<td>dark yellowish brown (10YR 4.0/4.0, moist) loam; moderate very fine subangular blocky structure; slightly sticky, slightly plastic, friable, moderately smearable; mottles; no cutans; many very fine to fine pores and few medium pores; highly porous; common fine roots throughout; no inclusions; very few medium fresh andesitic fragments; non cemented; (HCL); diffuse smooth boundary to</td>
</tr>
<tr>
<td>100 - 150</td>
<td>dark yellowish brown (10YR 4.0/4.0, moist) loam; moderate very fine angular blocky, moderate very fine subangular blocky structure; slightly sticky, slightly plastic, firm, moderately smearable; mottles; no cutans; many very fine to fine pores and few medium pores; highly porous; few fine roots throughout; no inclusions; very few medium fresh andesitic fragments and very few very fine strongly weathered pumice/ash fragments; non cemented; (HCL);</td>
</tr>
</tbody>
</table>
APPENDIX 1  REFERENCES AND LITERATURE


APPENDIX 2  FIELD METHODS

The soils are described in the field according to ISRIC’s Guidelines for the description and coding of soil data (van Waveren & Bos, 1988; 1994). These guidelines follow closely those for soil description given by FAO (1977) and FAO-ISRIC (1990). Soil colours are determined using either the Munsell Soil Color Charts or the Revised Standard Soil Color Charts (Oyama & Takehara, 1967).

Soil columns are taken for monolith preparation using the methods described by van Baren & Bommer (1979). In addition, disturbed and undisturbed samples are collected for physical, chemical and mineralogical analyses and for thin section preparation, where possible using the guidelines for the sampling of soil horizons for a soil reference collection (NASREC Newsletter no. 1 (March, 1991).

Of all sites slides and photographs are taken showing the landscape, vegetation, land use, soil profile and important profile details. Furthermore, data are collected with each pedon on climate, land use history, crops and crop yields, soil management practices, etc.

Soils are classified according to the FAO-Unesco Legend of the Soil Map of the World (1974) and its Revised Legend (FAO, 1988). Soil subunit modifiers (“third level”) were added using the proposals given by Nachtergaele et al. (1994). In addition soil were given their classification according to Soil Taxonomy (Soil Survey Staff, 1975; 1992), and, if available, the local classification.

All data are stored in ISIS version 4.0 (ISRIC, 1994), ISRIC’s soil pedon data management system for micro computers. The information given on the soil data sheets in this publication have been generated from the ISIS files.
APPENDIX 3  ANALYTICAL METHODS

Preparation
Each sample is air-dried, cleaned, crushed (not ground), passed through 2 mm sieve, homogenized. Moisture content is determined at 105°C.

pH H₂O
(1:2.5): 20 g of soil is shaken with 50 ml of deionised water for 2 hours, electrode in upper part of suspension.

pH-KCl
Likewise but shaken with 1M KCl.

EC
(1:2.5): Conductivity of pH-H₂O suspension.

Particle-size distribution
Soil is treated with 15% hydrogen peroxide overnight in the cold, then on waterbath at about 80°C. Then boiled on hot plate for 1 hour. Washings until dispersion. Dispersing agent is added (20 ml solution of 4% Na-hexametaphosphate and 1% soda) and suspension shaken overnight. Suspension sieved through 50 μm sieve. Sand fraction remaining on sieve dried and weighed. Clay and silt determined by pipetting from sedimentation cylinder.

Water-dispersible clay
Pipetting after shaking 20 g of soil overnight (16 hours) with deionized water.

Specific surface area
Saturation with ethylene glycol monoethyl ether (EGME), excess removal by vacuum suction. Mass of retained monomolecular layer of EGME is measure for surface area.

Exchangeable bases and CEC
Percolation with 1M ammonium acetate pH7 using automatic extractor.
(If EC>0.5mS pre-leaching with ethanol 80%). Cations are determined in the leachate by AAS.
CEC: saturation with sodium acetate 1M pH7; washed with ethanol 80% and then leached with ammonium acetate 1M pH7. Na determined by FES.

Exchangeable acidity and aluminium
The sample is extracted with 1M KCl solution and the exchange acidity (H+Al) titrated with NaOH. Al is measured by AAS.

Carbonate
Piper's procedure. Sample is treated with dilute acid and the residual acid is titrated.

Organic carbon
Walkley-Black procedure. The sample is treated with a mixture of potassium dichromate and sulphuric acid at about 125°C. The residual dichromate is titrated with ferrous sulphate. The result expressed in % carbon (because of incomplete oxidation a correction factor of 1.3 is applied).

Total nitrogen
Micro-Kjeldahl. Digested in H₂SO₄ with Se as catalyst. Then ammonia is distilled, trapped in boric acid and titrated with standard acid.

P-Bray 1
Phosphate is extracted with a mixture of 0.025M HCl + 0.03M NH₄F and determined colorimetrically.
P-Olsen
Phosphate is extracted with 0.5M NaHCO₃ solution pH 8.5 and determined colorimetrically.

P-retention
Blakemore et al. Shaken with (KH₂PO₄ + NaAc) solution, 1000 mg/L P
pH 4.6 for 16 hours.
Determination of residual P colorimetrically after centrifuging.

pH-NaF
To 1g of soil 50 ml of NaF 1M is added and stirred for 1 minute.
Reading pH by continuous stirring exactly 2 minutes after adding NaF solution.

Extractable iron, aluminium, manganese and silicon
All determinations by AAS.
1. "Free" (Fe, Al, Mn): Holmgren Shaken with sodium citrate (17%) + sodium dithionite (1.7%) solution
   for 16 hours.
2. "Active" (Fe, Al, Si): Shaken with acid ammonium acetate 0.2M pH 3 for 4 hours in the dark.
3. "Organically bound" (Fe, Al): Shaken with sodium pyrophosphate 0.1M for 16 hours.

Clay mineralogy
Clay is separated as indicated for particle-size analysis.
about 10-20 mg of clay is brought on porous ceramic tile by suction and analyzed using a Philips
diffractometer.

Soluble salts
Measuring pH, EC, cations and anions in water extracts.
1. 1:5 extract. Shaking 30 g of fine earth + 150 ml of water for 2 hours.
2. saturation extract. Adding to 200-1000 g fine earth just enough water to saturate the sample.
Standing overnight.
After filtration Ca, Mg, Na, K are measured by AAS. Cl with the Chlorocounter and SO₄ turbidimetrically.

Gypsum
To 10 g of fine earth 100 ml of water is added, shaken overnight and centrifuged.
Precipitation by adding acetone. Precipitate redissolved in water and determination of Ca by AAS.

Elemental composition
The fine earth is dried, ignited and fused with lithium tetraborate.
The formed bead is analyzed by X-ray fluorescence spectroscopy.

Moisture retention
Moisture determinations on undisturbed core samples in silt box (pF1.0; 1.5; 2.0) and kaolinite box (pF2.3;
2.7) respectively and on disturbed samples in high pressure pan (pF3.4; 4.2).
Bulk density obtained from dry weight of core sample.
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<th>Country</th>
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1 as of June 1995