RIJKSUNIVERSITEIT GENT

INTERNATIONAL TRAINING CENTRE FOR POST-GRADUATE SOIL SCIENTISTS

CLASSIFICATIE VAN BODEMPROFIELEN UIT ALLUVIALE VLAKTEN VAN GRIEKENLAND (THESSALIE EN PELOPONNESUS) VOLGENS DE USDA EN FAO BODEMCLASSIFICATIE SYSTEMEN

CLASSIFICATION OF SOIL PROFILES FROM ALLUVIAL PLAINS OF GREECE (THESSALY AND PELOPENNESOS) ACCORDING TO THE USDA AND FAO SOIL TAXONOMY SYSTEMS

by

Ioannis Ala

Thesis submitted
to the State University of Ghent, Belgium in partial fulfilment
of the requirements for the degree of Master in Soil Science

Promoter : Dr. R. LANGOHR
Faculty of Sciences, Laboratory of General Pedology

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ABSTRACT

Fifty profiles are studied for reclassification according to the USDA Soil Taxonomy System. The data come from soil surveys and investigations carried out since 1977 by the Institute of Soil Classification and Mapping of Larissa and by the Agriculture Faculty of Athens.

According to the USDA Soil Taconomy Stystem (1975) the studied profiles are classified in five orders i.e. Mollisols, Entisols, Vertisols, Inceptisols and Alfisols, 7 suborders, 7 great groups, 20 subgroups. In the FAO-Unesco system they fall among the Gleysols, Fluvisols, Regosols, Luvisols, Vertisols, Cambisols and among 15 subunits.
There were not sufficient data for the classification purposes and this as well for the chemical analyses (base saturation, cation exchange capacity, extractable cations, sulfidic material, C/N ratio, sometimes organic matter content and amorphous material) as for the particle size analysis (fine sand, fine clay), the physical analyses (bulk density, water retension capacity, n-value, Cole), the mineralogical analyses (clay mineralogy, amorphous minerals, weatherable minirals of 20-200 micron size) and the field observations (designation of organic matter, rubbed, dry and moist colour, colour, quantity and size of mottles, depth of cracking pattern, presence of pyroclastic material, presence of ground water table, orientation, vegetation). Finally many of the chemical analysis should be considered as not accurate.

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This study is dedicated to my family.

CONTENTS

Chapter 1

INTRODUCTION

The aim of this research is to classify pedon data collected in the Thessaly and Peloponnessos areas of Greece according to the USDA Soil Taxonomy system. This should permit to find out in how far the USDA Soil Taxonomy system can be applied at present in Greece. The FAO Unesco soil classification system is tested as well.

Since the existence of a specific law concerning the Soil map of Greece (1977), soil scientists have tried to use the USDA and the FAO Soil Taxonomy systems more systematically. Before 1977, soil surveys and studies were carried out using different classification systems (e.g. the old American Classification, the 7th Approximation. There are also some old soil maps carried out by Svorykin. After 1977 two main depart ments, one belonging to the Agriculture sector and the other to the Forestry sector, were created in order to elaborate the Soil map of Greece. Both departments belong to the Ministry of Agriculture, the first one makes more detailed soil surveys (maps 1:5.000 - 1:20.000) for agricultural land and uses the Soil Taxonomy system. The second one works on semidetailed soil surveys in mountaineous forest land, and uses photointerpretation in combination with the FAO Unesco soil classification (maps 1:50.000).

All the studied profiles were selected from the agricultural sector, mainly from the Institute of Soil Classification and Mapping of Larissa and form one survey carried out by the Agricultural Faculty of Athens. The profile data were selected from the soil survey reports of two big districts of Greece : Thessaly and Peloponnesos.

In the Thessaly district 29 profiles from three different areas were selected : (1) Karditsa area, 122.707 ha, 8 profiles, (2) Kalipefki area, 531.4 ha, 12 profiles, (3) Nikea-Nea Letki area, 5 000 ha, 9 profiles.

In the Peloponnesos district 21 profiles were selected from the Argoliko pedio area with an extension of 24.500 ha.

Thessaly is situated at the center part of Greece. It is the more fertile and the most productive flood plain of Greece. Argoliko pedio is also a fertile area but more suitable for Citrus trees.

Chapter 2

LITERATURE REVIEW

21. THE SOIL SURVEY METHOD IN GREECE

211. Field work

Field teams of experienced surveyors examine a dense network of soil profiles and draw the boundaries of each mapping unit on aerial photographs or mostly on local maps at a scale of 1:5.000, 1:10.000 or 1:20.000. The morphological characteristics of each profile are examined for classification purposes, according to a system described below. The soils are further examined by about 1.50 m deep borings, made with a hand soil auger. The distance between the borings ranges from 50 to 200 m, depending upon the uniformity of the soils. For most soil types water infiltration rates are measured using the method of two concentric cylinders or a single cylinder with a shallow ditch around it. Hydraulic conductivity rates are measured with the auger hole method.

212. Laboratory methods

a. Mehanical analyses, are made by the use of Bouyoucos hydrometer or the pipette method.

b. Carbonates are determined by measuring the volume of CO_2 which evolved when the soil samples are treated with HCl, using a Bernard apparatus.

c. Ph is measured in a 1:1 or 1:5 soil to water suspension with a Beckman Ph-meter.

d. Organic Carbon is determined according to a modification of the Walkley-Black wet combustion method.

e. Total nitrogen (N) is determined with a nitrogen analyzer (Coleman Nitrogen Analyzer), or the Kjeldahl method.

f. Cation exchange capacity is determined by treatment with NH_4DAc, at Ph7.

g. Phosphorus (P) contents are determined after extraction with $NaHCO_3$ (Olsen method).

h. Extractable cations are determined with NH_4OAc or EDTA and with a Perkin-Elmer 303 Atomic Absorption Spectrometer (Ca, Mg, Mn, Zn, and Cn) and with a Beckman Au flame spectrometer (Na, K).

i. Bulk density is determined with the excavation method using a rubber balloon apparatus or with the method of undisturbed samples using a stable volume ring (100 cm^3).

j. Field capacity and permanent wilting point are determined using pressure cookers at 1/3 and 15 bar pressure or by the centrifugal method.

k. soluble salts are determined by conductivity measurements in soil cups.

l. Potassium (k) is determined with an extract by CO2 solution (Method Dirsks-Schelter).

213. Symbol Survey legend systems

A system of classification symbols was earlier developed by Yassoglov and Henrard. This system was ameliorated and completed by Yassoglou in order to cover the soil conditions met in Greece (Yassoglou et al, 1971). This system is based on the texture and the drainage classes of the whole profile, the degree and trend of soil genesis, the topography and the erosion of the soil surface, the presence of organic matter layers and gravels throughout the profile, the presence of carbonate salts, the presence of a calcic or a petrocalcic horizon, of soluble salts, (salinity - alkalinity) and the depth of salinity.
All these attributes are indicated with letters or numbers in the mapping unit the symbol (fig. 1). The whole of symbols corresponds to the Soil Phase. If the symbols of slope and erosion are dropped then the combination of symbols corresponds to the Soil Series.

Fig. 1 Mapping unit symbol

```
                                          Textural class (soil type)
                                          0-25 cm
                         Textural Class
                         75-150 cm                              Order
   Textural Class
   25-75 cm                                                     Great group
                    4     3      5
Drainage  C       ________________________________   I * O X V X    Subgroup
class
                    A     0      1     Ca     f     b                 Suborder
 Slope
      Erosion
              CaCO3
                   Calcic hor. presence
                                           Salinity
                                           Alkalinity
                                                    Depth of alkalinity
```

* E = Entisol, A = Alfisols, I = Inceptisol, V = Vertisols, M = Mollisols

I O X V X means : Inceptisol - Ochrept - Xerochrept - Vertic Xerochrept

A. Textural class

According to the system used, the soil profile is divided in three sections (a) surface, 0-25 cm, (b) subsoil, 25-75 cm and (c) substratum, 75-150 cm. Numerals from 0 to 5 are assigned to each section according to the texture as indicated in table 1. The textural classes are grouped in five, four and three groups for the sections A, B and C respectively.

Table A. Textural Classes

Mapping Symbol	Section A	Section B	Section C
	0-25 cm	25-75 cm	75-150 cm
0	Gravels 60 %	Gravels 60 %	Gravels 60 %
1	S, LS	S, LS, SL or statified	S, LS, SL
2	SL	Si, SiL, L or statified but predominantly L	L, Si, Sil, or stratified but predominantly medium textured
3	Si, SiL, fSL	CL, SiCL, SCL or stratified, but predominantly medium fine texture	Finer than loam, but predominantly fine textured.
4	SCL, CL, SiCL	SC, SiC, C or Stratified, but predominantly, fine texture	--
5	SC, SiC, C	--	--
P	Peat	Peat	Peat
M	Muck	Muck	Muck
X	Gravels 60 %	Gravels 60 %	Gravels 60 %

S = sand, L = loam, Si = silt, C = clay

B. Degree and direction of Soil genesis

For classification purpose, the USDA Soil Taxonomy System is used. Soils are classified up to the subgroup level and sometimes up to the family level. Taxa are symbolized with the initial letters i.e.

Axhmh means: Alfisol - Xeralf - Haploxeralf - mollic Haploxeralf

C. <u>Drainage Classes</u>

The drainage class is determined on the base of the colour throughout the soil profile, the presence of iron and manganese mottling as well as gleying, according to the following scheme.

Drainage class	characterization
A	Very well drained, soil profile dry, no mottling;
B	Well drained, limited mottling below 100 cm;
C	Moderately drained, obvious mottling below 50 cm;
D	Imperfectly drained, mottling starts at 25 cm below the surface;
E	Poorly drained, mottling starts in depths shallower than 25 cm;

When a permanent water table exists throughout the year in depths shallower than 150 cm, the following symbols are employed;

F	Permanent water table between 50 and 150 cm depth;
G	Soils with permanent water table in a depth shallower than 50 cm. The combination D/F or E/F etc. means that up to the water table depth the drainage class is indicated by the numerator.

According to SOIL TAXONOMY (SOIL SURVEY STAFF 1975) the soil series is defined as the smallest taxonomic group. The family contains soils within the subgroup with common physical and chemical properties which affect their reaction to management practices and land use. The various phases within the family are similar enough so that the interpretation of such reaction is possible.

The characteristics which are taken into account in order to define the families of mineral soils are the following, in the order of their appearance in the name of the family : 1 : Texture, 2 : Mineralogy, 3 : Calcium content and reaction, 4 : Temperature regime, 5 : Soil Depth, 6 : Slope, 7 : Consistence, 8 : Sand Coatings, 9 : Cracks.

In the present Greek system however, the series within a subgroup is defined on the basis of the drainage class and the texture of the subsurface and the subsoil. This way it is possible that a series includes more than one family as the textural classes are different here versus those used for the families in SOIL TAXONOMY. Despite their taxonomic antinomy, individual soil profiles can be and were classified into families.

It should be noted that all technical aspects and differentiating criteria for the establishment of a taxonomic unit at the level of the "family" for use in the Greek conditions are already being considered in the Greek system.

D. Soil Phases

1. Slope : Symbol/class

Symbol/class	Slope %	Phase
A	0-2	Flat
B	2-6	Slightly sloping
C	6-12	Moderately sloping
D	12-18	Strongly sloping
E	18-25	Extremely sloping
F	25-35	Slightly steep
G	35-50	Moderately steep
H	>50	Strongly steep

2. Erosion

symbol	Description	Phase
0	No erosion, no subsurface horizon or layer is present on the surface of the soil.	Not eroded
1	Slight erosion, subsurface horizon or layer is present in less than 30 % of the surface.	Slightly eroded
2	Moderate erosion, subsurface horizon is present in more than 30 % of the surface.	Moderately eroded
3	Strong erosion, deep lying subsurface horizons or layers are present on the surface.	Strangly eroded
4	Very strong erosion, a considerable part of the profile has been washed out, gullies are present in the area	Very strongly eroded

3. Carbonates ($CaCO_3$)

Symbols are employed according to the reaction of the soil material upon addition of a HCl solution, as follows :

Symbol	Description
0	No reaction to HCl
1	No reaction in the surface (A) but reaction evident in the subsurface (B) and/or substratum (C).
2	Weak reaction in section A, regardless of the reaction in B and C sections.

3   Strong reaction in section A, regardless of the reaction in B and C sections.

If a Calcic horizon exists it takes symbols according to its depth as follows

Symbol	Depth
Ca 2	40-60 cm
Ca 1	60-100 cm
Ca 0	100-150 cm

4. Alkalinity

For Alkalinity, symbols are used as follows.

Symbol	Description
f1	degree of Alkalinity 15-25
f2	degree of Alkalinity 25-50
f3	degree of Alkalinity 50

6. Salinity

Symbols for salinity description are used as follows :

Symbol	Description
S1	electrical conductivity 4- 8 mmhos/cm
S2	electrical conductivity 8-15 mmhos/cm
S3	electrical conductivity 15 mmhos/cm

Symbols for the depth of Salinity - Alkalinity

Symbol	depth cm
b1	0- 25
b2	25- 75
b3	75-150
b4	$>$150

7. Stoniness

As a criterion of stoniness, the existence of stones with diameter larger than 15 cm is used :

Symbol	Description	Phase
M1	Stones cover less than 15 % of the total surface of the soil.	Stony
M2	Stones cover 15 - 30 % of the surface of the soil.	Very stony

M3	Stones cover more than 30 % of the total surface of the soil	Extremely stony

The presense of less than 60 % stones in the three depth sections is indicated as follows :

Symbols	Section (Depth)
St 3	A (0-25cm)
St 2	B (25-75 cm)
St 1	C (75-150cm)

Also a star symbol can be used as follows :

*	* *	***
C 334 I,	B 225 E,	A 111 I
---	---	---
A01	B12	A01

214. Profile description Symbols

In the Greek Soil Survey Service (Agriculture department) and in this study symbols are used for profile description according to the Soil Survey Manual, Agriculture Handbook Nr. 18 " and the F.A.O. - UNESCO " Guidelines For Soil Profile Description, (Rome 1977).

1. Mottles

a. Abundance

F = Few, mottles occupy less than 2 % of surface;
C = Common, mottles occupy 2-20 % of surface;
M = Many, mottles occupy more than 20 % of the surface.

b. Size

1 = Fine : greatest dimension less than 5 mm.
2 = Medium : greatest dimension 5-15 mm.
3 = Coarse : greatest dimension larger than 15 mm.

c. Contrast

Fa : Faint, D : Distinct, P : Prominent.

d. Sharpeness of Mottle Boundaries

S = Sharp; Cl = Clear, Di = Diffuse.

2. Texture

S = Sand, C = Clay, Si = Silt, L : Loam, LS - Loamy sand, SL = Sandy loam, Sil = Silty loam, Cl = clay loam, SiCL : Silty clay loam, SCL = Sandy clay loam, SC = Sandy clay, SiC = Silty clay.

3. Structure

a. Grade :

M = Massive, SG = Single grain, 1 = Weak, 2 = Moderate, 3 = Strong.

b. Size :

VF = Very Fine, F = fine, M = Medium, C = Coarse, VC = Very coarse.

c. Form :

Gr = Granular, Cr = Crumb, Pl = Platy, Pr = Prismatic, Cpr = Columnar; Abk = Angular Blocky, Sbk = Subangular blocky.

4. Consistence

a. Dry soil :

LO : Loose, SO : Weakly coherend, SH : Slightly hard, H : hard, VH : Very hard, E H : Extremely hard.

b. Moistsoil :

LO : Loose, VFR : Very friable, Fr : Friable, FI : Firm, VFI : Very firm, EFI : Extremely firm.

c. Wet soil :

SO : Not Sticky, SS : Slightly Sticky, S : Sticky, VS : Very Sticky.

d. Plasticity :

PO : Not plastic, SP : Slightly plastic, P : Plastic, VP : Very plastic.

5. Carbonates (CaC03)

VSE : Very slight effervescence
E : Slight effervescence
ES : Strong effervescence
EV : Very strong effervescence

6. Horizon Boundaries

a. Width of boundary

VA : Very abrupt = boundary less than 1 cm
A : Abrupt = boundary less than 2,5 cm
C : Clear = boundary 2.5 - 6.5 cm
G : Gradual = boundary 6.5 - 12.5 cm
D : Diffuse = boundary more than 12.5 cm

b. Topography of Boundary

S : Smooth = boundary is nearly a plane surface
W : Wavy = pockets are wider than their depth
IR : Irregular = pockets are deeper than their width
B : Broken = horizon boundary is not continuous.

7. Clay fims (Cutans)

a. Frequency

1. Very few : less than 5 % of aggregates or pores surface is covered by clay films.
2. Few : 5 - 25 % of aggregates or pores surface is covered by clay films.
3. Moderate : 25 - 50 % of aggregate surface is covered by clay films.
4. Many : 50 - 90 % of aggregates or pores surfaces is covered by clay films.
5. Continual : 90 % of aggregate or pores surface is covered by clay films.

b. Thickness

n : thin, MK : Moderately thick, K : Thick,

c. Form

a : clay films on the faces
b : clay films inside of pores
c : clay films as links

i.e. 4 MKa means : Clay films cover 50 - 90 % of the aggregate surface, they are moderately thick and they cover the faces of the aggregates.

8. Cracks

+ : there are cracks, - : no cracks

9. Slickensides :

+ : there are slickensides, - : no slickensides

10. Gilgai

+ yes, - no

Remark : a blank column means no information.

215. Maps

The following Soil and soil interpretation maps are made :

1. Detailed soil maps, a scale of 1 : 5 000 or 1 : 10,000 or 1 : 20,000 etc.

2. Map of soil series and soil types, based on the detailed soil map, with the same scale and indications the soil types (textural class of section A, 0-25 cm). According to the Greek classification system the textural class of sections B and C and the drainage class make up the soil series.

3. Maps of cultivation groups or soil managment maps, showing the areas with similar soil and water properties, as far as concerning the management practises that can be applied.

4. Irrigability classes map : six classes are used on the basis of soil, topography and drainage limitations.

22 GENERAL PRINCIPLES OF SOIL GENESIS IN MEDITERRANEAN AREAS.

Mediterranean soils are soils which, by definition, occur and evolve under mediterranean climatic conditions. These are characterized by a winter rainfall and a dry and warm summer period.

Mediterranean soils have dominantly a xeric moisture regime and a thermic temperature regime. Areas with aquic moisture regime and those with mesic temperature regime are not uncommon. Studying the role of different soil forming factors it is evident that in mediterranean areas probably even more than in any other region, the substratum (= soil below 75 cm depth) and the biological activity (including Man) may be considered as the most important pedogenetic factors (Verheye W.). Of course, the influence of the other factors of pedognesis (topography, climate, time) should not be neglected.

The parent materials are mainly derived from Carboniferons rocks, less frequently marbles, granites, shales (shists), gneisses, flysh, ect. and interferes in the pedogenesis through : 1) mineralogical composition, 2) coherence or hardness, 3) permeability. The more permeable is the substratum the more intensively weathered is the material and the more evolved is the profile.

The Present day climate has a special impact on the physico-chemical processes.

- Dissolution and leaching of easily weatherable minerals;
- Limited leaching (in time and intensity) : causing saturated soils and limited clay migration;
- Liberation of free iron.

A soil profile in equilibrium with the present day climate is characterized by :

- an argillic horizon
- free iron accumulation with consequent red colours
- an almost completely saturated cation enchange complex

The factor time in relation to climate and parent rock activities determines the intensity of the weathering processes plus the maturity stage of the profile. According to absolute age 1) Soils on slopes and on impermeable substrata (marls) are continuously rejuvenated and are thus young soils (A - C profiles or ENTISOLS), 2) Soils on permeable substrata and on flat, non eroded landscape, are older soils, with A-Bt-C profiles (ALFISOLS, 3) soils on flat areas developed over impermeable substratum have a limited development and reach a VERTIC or INCEPTISOL STAGE. For the soils on sloping areas developed over permeable substrata the rejuvenation limits the profile development to the INCEPTISOL STAGE.

The factor Topography orients the profile development within the range determined by the climate and the parent material.

On slopes and on impermeable substrata (marls) :

- important erosion - rejuvenation of the profile : SKELETAL, SHALLOW SOILS (A - C profiles)
- On slopes and on permeable substrata (hard limestones) : irregular soil depth = dissolution holes + moderate erosion : RUPTIC SUBGROUPS (B-C profiles)

Flat areas

- impermeable substrata : temporary stagnating water, hydromorphy and VERTIC properties (A-B-C profiles).
- permeable substrata : maximal profile development without erosion : DEEP ALFISOLS (A-B-C profiles)

The soil formation in Mediterranean areas includes three phases

a. Grayish-white phase
b. reddish-brown phase
c. Red phase

Fig. 2

	soft, marly and almost impermeable limestone	Hard, compact, pure and very permeable limestone
First stage Grayish-white phase	shallow, skeletal very calcareous soils (ENTISOLS)	very thin, almost invisisble calcareous, weathering pelicula
Second stage, Brown to reddish phase	Moderately deep, calcareous to reddish brown soils (XEROCHREPT)	very thin calcareous, brown to reddish brown weathering pelicula.

Evolution under hydromorphic conditions : (VERTIC XEROCHREPTS)

Under restricted drainage conditions :(REDDISH -BROWN XEROCHREPTS)

Evolution under intensive and continuous erosion : profile rejuvenation (ENTISOLS)

Temporarily restrained evolution due to local obstacles in the profile (BROWN CALREOUS PATCHES IN B-C HORIZONS OF ALFISOLS)

in well drained conditions and little erosion (REDDISCH_ BROWN XEROCHREPTS)

Third stage Red phase	Rather deep, completely decalcified red soils with prominent argillic horizon : (HAPLOXERALFS and RHODOXERALFS)

(W. Verheye)

The Biological activity can influence the pedogenesis as follows :

1) Forest vegetation produces more CO_2 and provides thus more H_2CO_3 as an active dissolution agent in the soil material (W. VERHEYE).

2) Deforestation in ancient times :

   - affects changes in weathering activity due to change, in microclimate and microbiological activity;

- increases the surface erosion and thus affects the A - horizons,

3) Present-day climate is alternatively moist (vertical water movement and leaching) and dry (capillary rise and precipitation). This seasonal variation affects the soil PH and thus the neoformation of clay minerals.

In Creece there are furthermore Vertisols, Mollisols and Histosol

Vertisols develop on basic rocks. 2:1 clay minerals (montmorillonite, Vermiculite) dominate. These soils have very wide up to one meter deep cracks during the dry summer, they have slickensides and where the soil is not cultivated the have gilgai. Mostly they have very dark colours and very often present hydromorphic characteristics.

Some Histosols are also found in small patches. They are purely organic soils and were formed under water or under very poor drainage conditions.
Finally, some areas, as in this study, have been dominated by Mollisols. These last three orders do not represent the main pedogenetic processes typical for the Mediterranean areas. The most representative orders are in fact ENTISOLS, INCEPTISOLS and ALFISOLS.

chapter 3

PHYSICAL ENVIRONMENT OF THE STUDIED AREAS

31. LOCATION AND ELEVATION

Table B. Location and Elevation of the studied areas

Area	Surface (ha)	Latitude (N)	Longitude (E)	Altitude
a. Drained Ascorida lake of Kallipefki	531 ha	35° 59'	22°28'-22°29'	1005 m
b. Karditsa district	122.707 ha	39°12'-39°30'	21°43'-22°13'	100-200 m
c. Argoliko Pedio district	24.500 ha	37°33'-37°45'	22°40'-22°51'	0-100 m
d. Nikea-Nea Lefki areas	5.000 ha	39°32'-39°36'	22°23'-22°29'	110-180 m

32. GEOLOGY-GEOMORPOLOGY

a. Drained Ascordida Lake of Kallipefki

In the area the following rocks occur : Tertiary limestone and marbl or older gneiss; Mesozoic ophiolite and Quaternary alluvial deposits. Holocrystaline Peridotite without Serpentine have been found in some places. In the whole area there is a folded system of alternating synclines and anticlines with a general NE to NW direction.
The area of Kallipefki, at an elevation of 1.000 m is a tectonic depression surrounded by mountains composed of gneisses, limestones, marbles and ophiolites. It has now a completely flat surface and the surrounded relief is related to the nature of the rocks as well as to the tectonic and karstic processes. The lake was drained in 1911.

b. Karditsa district

The subbasin of Karditsa is in the western part of Thessaly. It is a large alluvial plain with a very thin cover of Plio-Pleistocene alluvial deposits. The intensity of the streams depends strongly on the season and so there are big textural differences among the Quaternary deposits as well in horizontal as in vertical direction. In some places silty deposits are dominating. A great part of the Karditsa area was covered by a lake which has been drained in the recent past. Afterwards drainage of the alluvial deposits took place. In some areas tectonic horns emerge from under the Plio-Pleistocene deposits as a result of strong erosion.

The Karditsa's area is strongly influenced by some rivers which erode, transport and deposit sediments, from shists, hornsteins, ophiolites, psammites, clayshists, limestones, marls, flyshes, arkoses and graywackes. The whole area of Thessaly is drained by the river Pinios.

c. Argoliko pedio district.

The geomorphology of this area has been influenced by tectonic movements. On the lower parts of the plain Quaternary alluvial deposits from gravels, sands, red soils and clays are dominating. On the higher parts lacustrine deposits from the Upper Pleistocene are dominating. They are mainly marls, psammitic marls and a mixture of marl and psammite gravels.
On the hilly areas limestones of the Upper Cretaceous are dominating, alternating with marls. In some part there are old Quaternay torential and marine compacted gravels as well as Flysh from Neo Cretaceous-Paleocene age.

d. Nikea-Nea Lefki area

This area has an anticline character. It is mainly composed of metamorphic rocks. In some parts of the regions the old rocks are covered by Pliocene or Quaternary deposits.
Around the villages of Nikea, Nea Lefki and close to the Larissa city, the area is slightly folded (hilly area) and consists of river-torrential depostis of Plio-pleistocene age. These deposits contain lacustrine sediments in the deeper layers (marls and marl-limestones).

34. CLIMATE

341. General

There is a limited amount of complete data for all the studied areas. Generally the climatic conditions are mediterranean; i.e. dry and hot in summer and rainy and cold in winter. According to the Köppen classification we have the Csa and Cfb climatic types where C means warm temperate rainy climate (average temperature of the coldest month is between -3°C and +18 °C), S means the presence of a dry season during the summer with less than 30 mm precipitation in the dryest month, f means that in the dry season the driest month receives more than 30 mm precipitation, a means hot summer (hottest month t° > 22°C) and 6 means cool summer (hottest month t° < 22°C).

342. Temperature

a. Drained Ascorida Lake of Kallipefki

The temperatures (table 1) have been calculated from the mean temperatures of Larissa using the adiabatic (impassable, testable) scale (0.6°C/100 m) (elevation of the Kallipefki village : 1.050 m). During the winter months snow, frost, and hoarfrost (rime) occur but there are no precise data available. There are also no data about the relative humidity, cloudiness, sun radiation and wind. The area of Kallipefki corresponds to the Cfb climate type of the Köppen Classification.

Table 1. Average monthly and yearly temperatures for Kallipefki, Kapditsa, Argoliko Pedio and Nikea Nea Lefki (in °C).

Month	Kallipefki	Kapditsa district					Argoliko Pedio	Nikea-Nea Lefki
		Kapditsa	Palamas	Kallifoni	Pedino	Kalyvakia		
January	0.5	4.1	4.1	4.0	4.1	5.0	10.0	5.8
February	1.0	6.8	6.3	5.8	6.3	8.1	9.7	7.4
Mardi	3.0	10.7	9.3	10.5	10.8	10.6	11.0	9.2
April	7.0	13.7	14.3	11.8	14.5	14.2	14.2	13.7
May	13.5	19.6	20.1	17.7	19.5	20.6	21.5	19.7
June	19.0	25.1	25.4	25.5	24.7	26.5	26.7	25.4
July	21.5	27.1	27.5	26.2	26.5	26.5	28.0	28.0
August	21.5	26.3	26.7	25.0	25.1	25.6	24.3	27.8
September	16.0	21.8	22.5	22.0	21.5	21.9	23.0	24.4
October	10.0	16.4	16.6	16.7	15.8	17.3	21.0	16.2
November	5.0	10.6	10.5	10.0	10.0	10.8	17.5	11.4
December	1.0	6.8	5.8	7.7	6.7	7.4	12.5	7.4
Mean Annual	9.9	15.8	15.7	15.3	15.5	16.2	19.9	16.2
		M : 15.7 °C						
Köppen Classification	Cfb	Csa					Csa	Csa
Data		1962-1992	1962-1982	1979-1982	1975-1982	1975-1982		

b. Karditsa district (table 1)

The absolute minimum for the winter months is -2,0°C (January) and the absolute maximum during summer months approaches 42,0°C. Often frost occurs but there are no data just as there are no data for snow, hoarfrost, relative humidity, sun radiation, cloudiness and wind. According to the Köppen classification the climate is of the Csa type.

c. Argoliko Pedio district

Table 1 gives the mean monthly and year temperatures. The absolute minimum for the winter months is -1.1°C (January) and for the summer months 15,5° (August). The absolute maximum for the same months are 20,0° and 37,8°C. Often frost and hoarfrost occur during winter months but there are no data. Just as there are no data for snow, relative humidity, sun radiation, cloudiness, wind and even for average monthly temperature. The Köppen climatic classification is Csa.

d. Nikea-Nea Lefki area

The climatological data of the Larissa station are used. The absolute minimum for the winter months is -14.0°C and for the summer months, is 10,6°C. The absolute maximum for the summer months is 45,0°C and for the winter months is 24,0°C. According to the Köppen classification the climate type is Csa. The average annual windspeed is 0.7 m/sec. The entirely frost free period is 6.2 months.

343. Rainfall

Table 2. Average monthly and yearly rainfall data for Kallipefki, Karditsa, Argoliko Pedio and Nikea-Nea Lefki (in mm).

Month	Kallipefki 1970-1983	Karditsa 1962-1982	Argoliko Pedio	Nikea - Nea Lefki
January	47.4	100.0	67.0	51.0
February	63.5	94.0	40.0	40.0
March	65.8	84.5	52.0	49.0
April	90.6	55.0	48.0	35.0
May	82.1	50.0	27.0	45.0
June	53.7	30.0	12.0	30.0
July	33.9	12.0	3.0	15.0
August	41.7	20.0	5.0	13.0
September	61.1	40.5	21.0	31.0
October	113.0	116.0	60.0	88.0
November	91.2	81.0	70.0	64.0
December	69.8	104.0	75.0	61.0
Total	813.8	787.0	480.0	522.0

a. Drained Ascorida lake of Kallipefki (table 2)

The mean annual rainfall is about 810 mm. This amount is distributed of follows : 265 mm (33 %) in autumn, 238 mm (30 %) in spring, 188 mm (22 %) in winter and 129 mm (18 %) in summer.

b. Karditsa district

From the 6 stations of the area, the data of Karditsa itself are represented in table 2.

c. Argoliko Pedio district

The mean annual rainfall is 480 mm. 40 % falls in winter while during the summer months there are very rarely rains. So, during winter season there is excess of water creates run off and leaching conditions which are reflected in the relief and the soil type.
On the contrary, during the summer period the evapotranspiration is high, the rainfall very low and so there is a water deficit. The potential evapotranspiration of the area is reported to be 175-180 mm in July while the rainfall is only about 3.0 mm in that month.

d. Nikea-Nea Lefki area

Table 2 gives the mean annual precipitation of the area. The mean annual precipitation is 522 mm. This is distributed as follows : winter 152 mm (29 %), spring 129 mm (24,7 %), summer 58 mm (11,1 %), autumn 183 mm (35,1 %). There are 86 days with precipitation 0.1 mm. The mean maximum precipitation in 24 hours is 86 mm. The potential evopotranspiration is 891 mm per year. The leaching rainfall (excess of precipitation P over potential evapotranspiration E' for the period that P E) is 207 mm. The P/E ratio (average annual precipitation/ditto potential evapotranspiration) is 0.59.

344. Dry period

Table 3 gives various aspects of the degree of dryness (wittness) of the climate of the 4 studied areas.

The dry period is defined as the number of continuous months, in which the numerical value of the mean monthly rainfall in mm is smaller or equal to the double numerical value of the mean monthly temperature in degrees Celsius (C°) (Unesco/FAO, 1963).

The dryness index of de Martone is calculated by the formula :

$$a = \frac{P}{T + 10}$$

where P is the mean annual rainfall and T is the mean annual temperature (MARTONE de, 1929).

35. VEGETATION AND LAND USE

351. Vegetation

The studied areas are mainly agricultural areas and very rarely one can find some "natural" vegetation.

Table 3. The dry period, the climatic type and the dryness index of de Martone for the four studied areas.

	Kallipefki	Karditsa	Argoliko Pedio	Nikea-Nea Lefki
Dry period	2 months July, August	4 months June, July August, September	5 months May, June, July, August September	4 months June, July, August, September
Dryness Index of De Martone $(Ia = \frac{P}{T + 10}$	40.90	28.79	17.20	19.9
Hygrometric character of the climate (de Martone	Very moist	Semimoist/ moist	Semidry	Semidry

The Hygrometric Character of the Climate according to de Martone is given in follwing table 4.

Appellation or Climatic type	Dryness Index Ia
Dry	10
Semidry	10 - 20
Mediterranean	20 - 24
Semimoist	24 - 28
Moist	28 - 35
Very moist	35

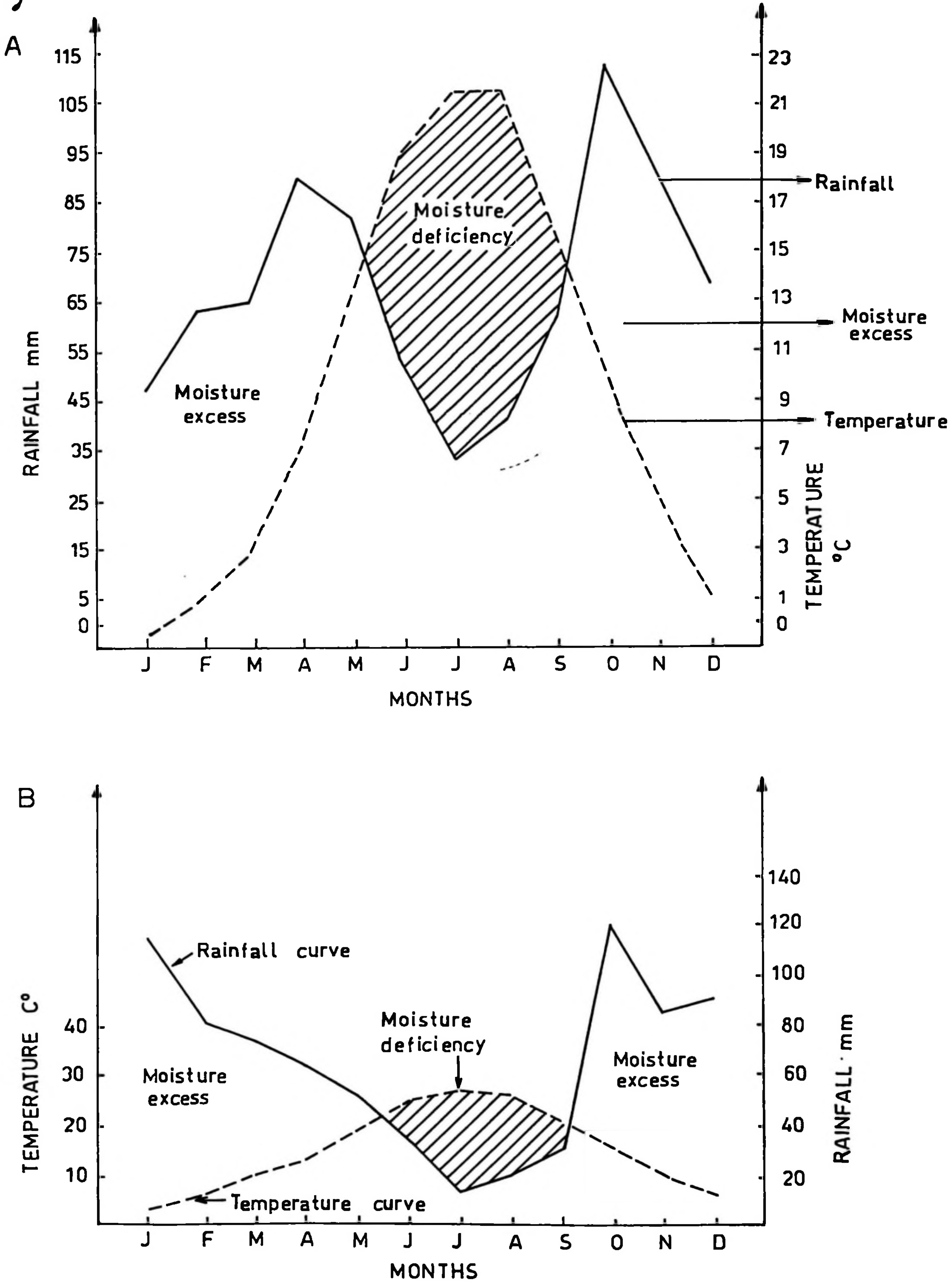
The area of Kallipefki is surrounded by forests consisting of Pine (Pinus nigra), Fir (Abies hybritogenus), Oak (Quercus sessiliflora, Quercus coccifera) etc.
In the other areas there are few trees, such as Poplars (Populus alba, Populus nigra), Elm (Ulmus campestris), Plane (Platanus orientalis), Willows (Salix alba, Salix fragilis), Cypress (Cupressus sempervirens), Pines (Pinus halepensis), Holm oak (Quercus, coccifera), wild pears, wild olive trees, wild fig-trees etc.

The mean agricultural crops are wheat, barley, maize, fruit trees, vinyards, cotton, sugar beets, melons, water melons, tobbaco, potatoes, tomatoes, lentils, beans etc.
All these kinds of trees and plants can show a high, a medium, or a low biological activity, this influencing the structure, the porosity, the infiltration rate, the permeability and the available water content of the soils.

352 Land use

The studied areas are used mainly for agriculture purposes.

Fig. 3

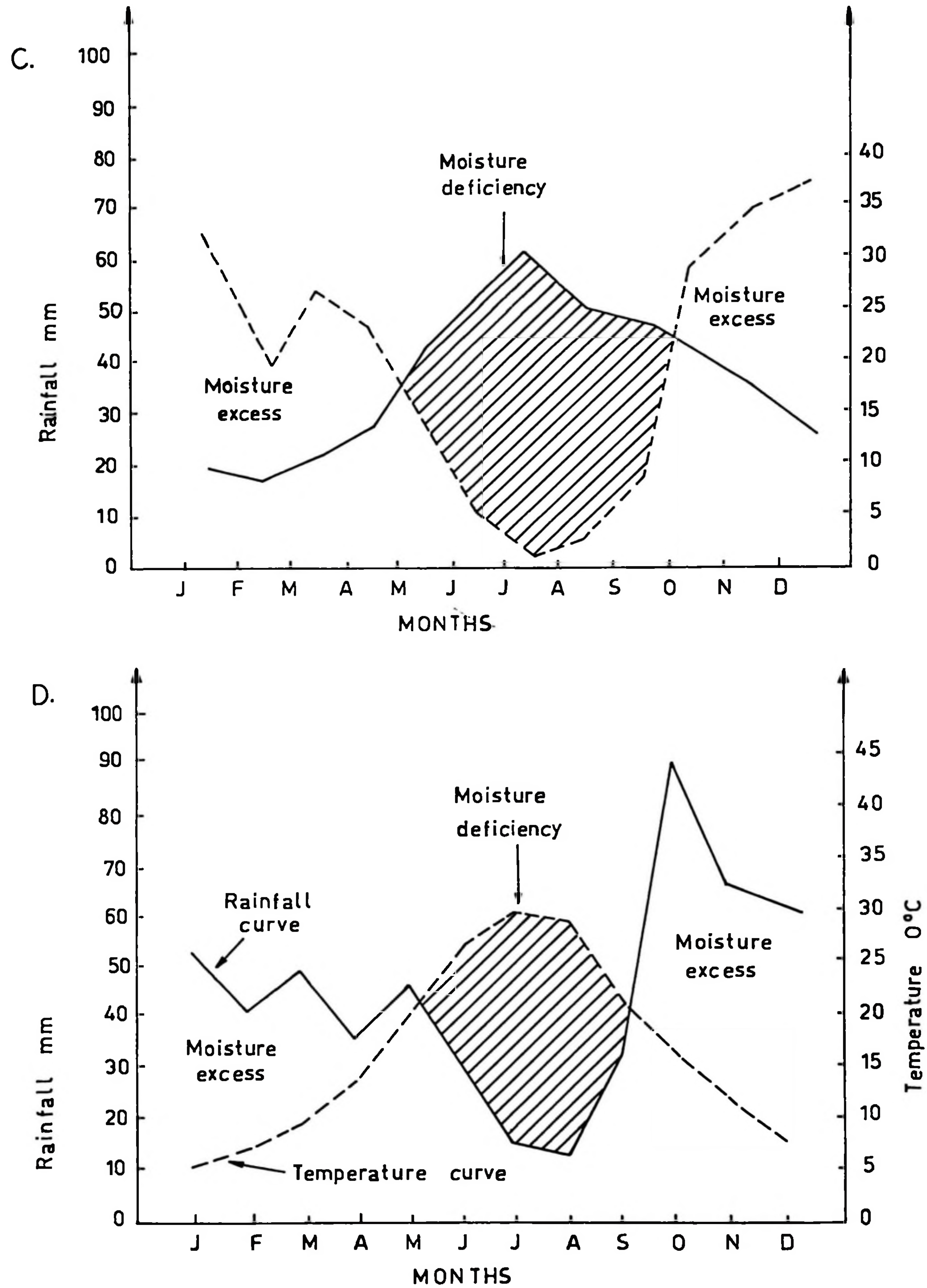


Rainfall and Temperature diagram

A. Kallipefki

B. Karditsa

Fig. 3



Rainfall and Temperature diagram

C. Argoliko pedio district

D. Nikea Nea Lefki area

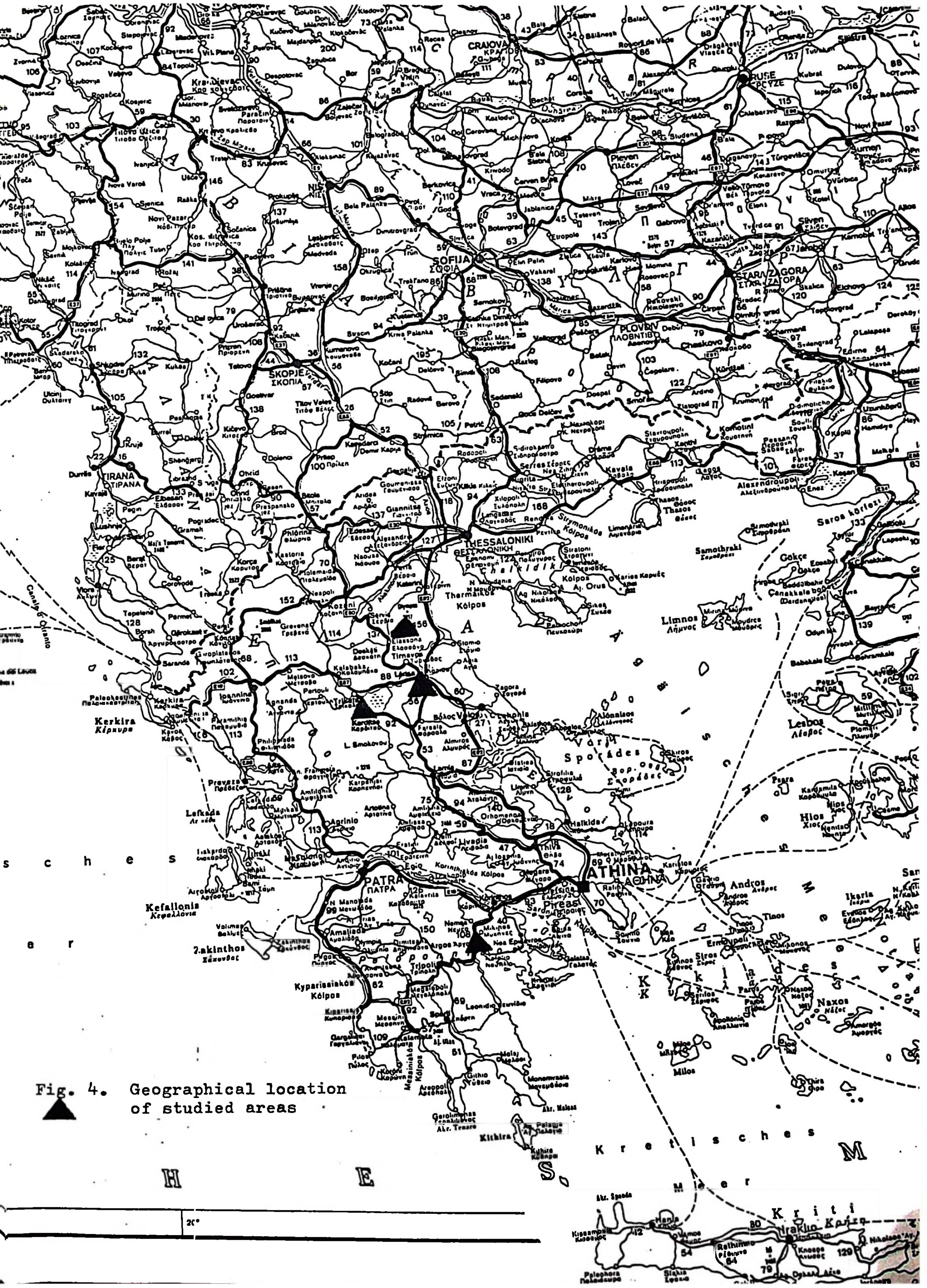
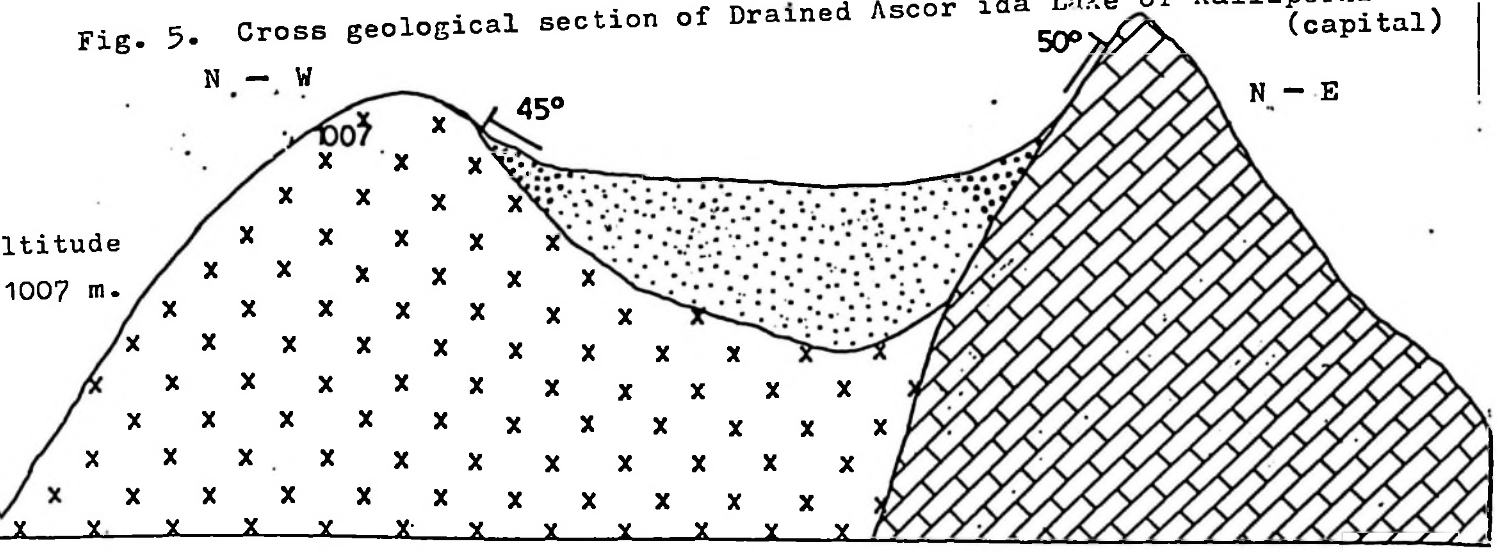


Fig. 4. Geographical location of studied areas

Fig. 5. Cross geological section of Drained Ascor ida Lake of Kallipefki (capital)



SCHEMATIC REPRESENTATION OF DRAINED ASCORIDA LAKE OF KALLIPEFKI

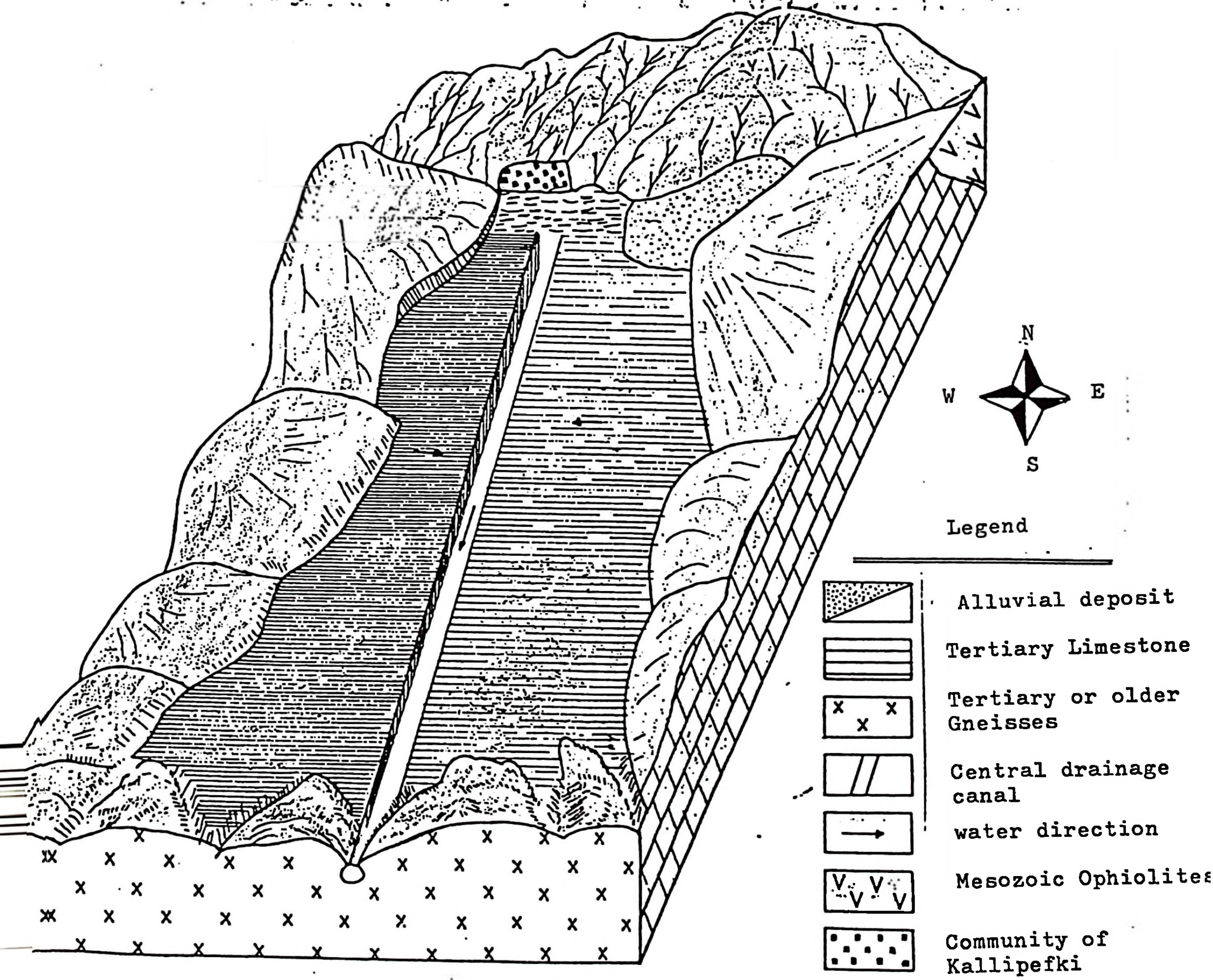
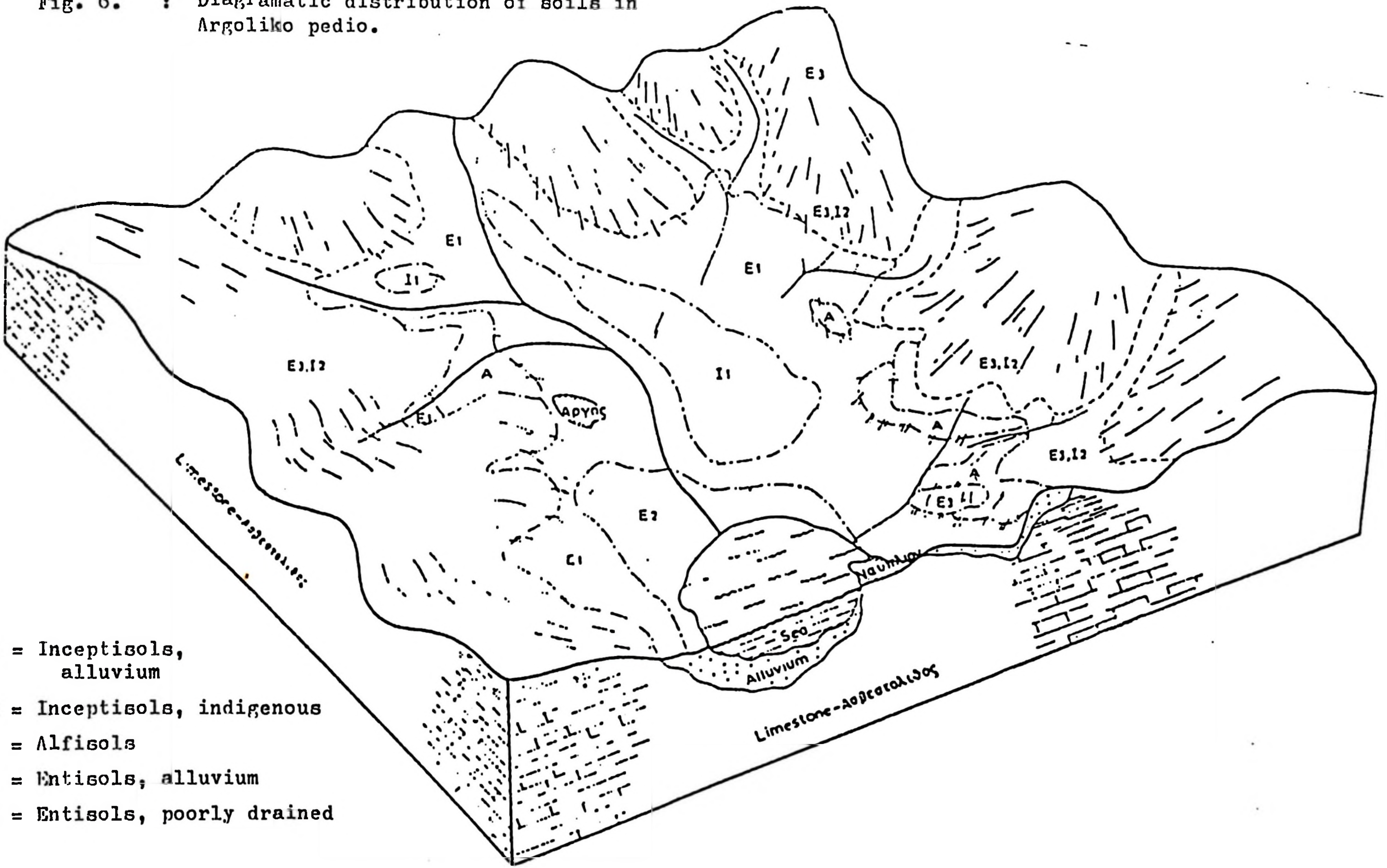


Fig. 6. : Diagramatic distribution of soils in Argoliko pedio.



I 1 = Inceptisols, alluvium

I 2 = Inceptisols, indigenous

A = Alfisols

E 1 = Entisols, alluvium

E 2 = Entisols, poorly drained

Chapter 4

MATERIAL AND METHODS

41. MATERIAL

Fifty soil profiles are studied according to the USDA Soil Taxonomy system. These profile data are taken from the soil survey and investigation reports published either by the Institute of Soil Classification and Mapping of Larissa or by the Agriculture School (Facaulty) of Athens. Most of them were collected since 1977 the profiles of Argoliko Pedio were collected earlier than 1977 but they were restudied after 1980 again.

Each profile was already classified according to the USDA Soil Taxonomy system. Most of them until the subgroup level, others up to the family level and others only at the order level.

42. METHODS

The system of the USDA Soil Taxonomy is applied as strictly as possible. The taxonomic position of a specific soil is then checked after the definition of the particular taxon. An effort is made to classify up to the family level. Soil moisture and soil temperature regimes are determined firstly. These data are taken from the general data given in §52.11-52.12. Next the epipedon and the diagnostic subsurface horizons are determined. Other characteristics which may be needed for classification are checked as well. Then the profiles are classified according to the USDA key system up to the family level using physical, chemical and profile description data. Classifying correctly a profile is not always easy. Often, because of missing data, or vague definitions, several taxa are possible for a given profile, and this may occur at any level of the classification. Whenever doubt arises because of missing or vague data, the various options are mentioned and the cause of difficulty in classification is mentioned. A list of frequently missing or vague morphological, chemical, physical and/or mineralogical data will be provided in a way that in the future the quality of the basic data for classifying profiles can be improved.

Table 5 Studied profiles, mapping intensity, scale of maps and reference of the publications.

No	Profile number	Mapping degree/scale		Published by	Publication number
1	1 a	Detail	1:5.000	I.S.C.M. Larissa	256297/
2	2 a	"	"	"	13-04-83
3	3 a	"	"	"	"
4	4 a	"	"	"	"
5	5 a	"	"	"	"
6	6 a	"	"	"	"
7	7 a	"	"	"	"
8	8 a	"	"	"	"
9	9 a	"	"	"	"
10	10 a	"	"	"	"
11	11 a	"	"	"	"
12	12 a	"	"	"	"
13	69 a	"	1:20.000	"	EDX 77-100
14	67 a	"	"	"	"
15	23 a	"	"	"	"
16	56	"	"	"	"
17	61	"	"	"	"
18	13	"	"	"	"
19	15	"	"	"	"
20	91	"	"	"	"
21	7 b	"	"	A.Sch.Athens	1354/
22	10 b	"	"	"	22-08-84
23	12 b	"	"	"	"
24	18	"	"	"	"
25	20	"	"	"	"
26	22	"	"	"	"
27	23 b	"	"	"	"
28	25	Detail	1:20.000	A.Sch.Athens	1354/
29	28	"	"	"	22-08-84
30	29	"	"	"	"
31	31	"	"	"	"
32	48	"	"	"	"
33	49	"	"	"	"
34	50	"	"	"	"
35	67 b	"	"	"	"
36	69 b	"	"	"	"
37	82	"	"	"	"
38	95	"	"	"	"
39	96	"	"	"	"
40	97	"	"	"	"
41	98	"	"	"	"
42	1 b		1:20.000	I.S.C.M.Larissa	276742/
43	2 b		"	"	16-05-83
44	3 b	"	"	"	"
45	4 b	"	"	"	"
46	5 b	"	"	"	"
47	6 b	"	"	"	"
48	8 b	"	"	"	"
49	12	"	"	"	"
50	14	"	"	"	"

chapter 5

CLASSIFICATION OF THE STUDIED PROFILES AND ITS PROBLEMS

51. INTRODUCTION

As written in Soil Survey Staff (1975) Soil Taxonomy is a sorting system. A small number at order level (10 order) means that each order is very heterogenous with respect to the properties that are not used for sorting. Next, a successive sorting must be carried out further down. The great group level is considered as a set of already meaningfull grouping. The soil series level is a group of "soils" (polypedons), which are considered very homogenous in that their range of properties is small and can be readily understood (Soil Survey Staff, 1975).

The differentiating characteristics accumulate as a pyramid from the higher levels of generalization to the lower level. In fact, classes at the lower levels are defined and differentiated not only by the differentiating characteristics used at the given categorical level but also by those which have been used as differentia at higher levels. Consequently a large number of differentiating characteristics are considered in the lowest category, such that the classes are quite narrowly and completely defined (Buol et al., 1973)

52. PROBLEMS IN CLASSIFICATION

521. Identification of soil moisture and soil temperature regimes

5211. Soil moisture regime

In Greece the SMR is closely related to both the rainfall distribution and the physiographical position. Aquic and xeric SMRs are recognized within the studied area.

The aquic SMR implies a reducing regime that is virtually free of dissolved oxygen because the soil is saturated by ground water or by water of the capillary fringe. An aquic regime is a reducing one (Soil Survey Staff 1975). From the 50 profiles only 4 profiles (Nrs 3, 6, 10, 12) have an aguic SMR (table 6). The area with aquic SMR is situated 70 km north of Larissa, in a closed basin of the low Olympus, at 1005 m altitude. These profiles belong to the E,F drainage classes of the Greek classification system. Soil colour is considered as a good indication of such moisture regime. There are 46 profiles which are considered to have a xeric SMR, typical for Mediterranean areas, i.e. the soil moisture control section is dry in all parts for 45 or more consecutive days withing 4 months that follow the summer solstice in 6 or more years out of 10.

Table 6 : Profiles defined to have an aguic soil moisture regime (drained Ascorida Lake) and their moist soil colour.

Prof. Nr.	Depth (m)	Horizon	Colour
3	0 - 25	Ap	10YR 2.5/1
	25 - 50	A12g	2.5Y 2.5/0
	50 - 90	C1 g	5Y 4/2
	90 - 150	C2 g	5Y 4/2
	150 +	C3 g	5Y 4/2
6	0 - 25	Ap	10YR 2.5/1
	25 - 70	A12 g	2.5Y 2.5/0
	70 - 170	A13 g	2.5Y 4/2
	170 - 210	A14	2.5Y 3/2
	210 +	A15	5Y 4/1
10	0 - 27	Ap	10YR 2.5/1
	27 - 62	C1 g	5Y 5/2
	62 - 87	II C2 g	5Y 4/2
	87 - 107	III C3 g	5Y 6/2
	107 - 150	IV C4 g	5Y 5/1
12	0 - 18	Ap	10YR 4/2
	18 - 37	A12 g	5Y 4/1
	37 - 54	II C1 g	5Y 3/1
	54 - 100	C2 g	5Y 4/3
	100 - 130	C3 g	5Y 5/1
	130 - 170	gley	2.5Y 6/0

5212. Soil temperature regime (STR)

According to the meteorological data of the studied areas (§34) the following table can be constructed :

Area	Mean ann. air t°	Mean winter air t°	Mean summer air t°	Soil t° regime
	°C			
Kallipefki	16.9			mesic
Karditsa	16.7			thermic
Nikea	17.5			thermic
Argoliko Pedio	17.9			thermic

522. <u>Identification of the diagnostic horizons</u>

The summaries of properties of the epipedon and the subsurface horizons as they are mentioned in Soil Taxonomy, have been followed there.

5221. Epipedon determination

Two kinds of epipedon, ochric and mollic, were identified. However, most epipedons are ochric. However for the determination of a mollic epipedon some of the data are missing (table 7)

5222. Subsurface diagnostic horizon determination

Two kinds of subsurface horizon, argillic and cambic, are determined. Some of the studied profiles have an argillic or a cambic horizon. Some have no diagnostic subsurface horizons, some have vertic characteristics. One can consider the presence of three groups of soils as refering to the subsurface horizon : (1) argillic (8 profiles), (2) Cambic (14 profiles) (3) no diagnostic horizons (19 profiles). It should be added that there are 9 profiles with mollic epipedon and without other diagnostic horizons; these are Mollisols. Table 12 shows the proposed subsurface horizons and the summary of the missing information.

Table 7. Information about the studied profiles as to the requirements of the mollic epipedon.

1	2	3	4	5	6	7	8	9	10	11	12	Eipedon
1	+	+	(+)	+	(+)	+	+	+	+	+	(+)	Mollic
2	+	+	(+)	+	(+)	+	+	+	+	+	(+)	"
3	+	+	(+)	+	(+)	+	+	+	+	+	(+)	"
4	+	+	(+)	+	(+)	+	+	+	+	+	(+)	"
5	+	+	(+)	+	(+)	+	+	+	+	+	(+)	"
6	+	+	(+)	+	(+)	+	+	+	+	+	(+)	"
7	+	-	(-)	-	-	+	+	-	+	-	(+)	Ochric
8	+	+	(+)	-	(-)	-	+	+	+	-	(+)	"
9	+	+	(+)	+	(+)	+	+	+	+	+	(+)	Mollic
10	+	+	(+)	+	(+)	+	+	+	+	+	(+)	"
11	+	+	(-)	+	(-)	-	+	+	+	-	(+)	Ochric
12	+	+	(+)	+	(+)	+	+	+	+	+	(+)	Mollic
13	+	-	+	-	+	(-)	+	+	+	-	(+)	Ochric
14	-	+	+	+	+	+	+	-	(+)	-	(+)	"
15	+	-	-	+	+	+	(+)	+	(+)	-	(+)	"
16	-	-	+	+	+	(+)	+	+	+	-	(+)	"
17	-	-	-	+	+	(+)	+	+	+	-	(+)	"
18	+	-	+	-	-	(+)	+	+	+	-	(+)	"
19	+	+	+	+	+	(+)	+	+	(+)	-	(+)	"
20	+	-	+	+	+	(+)	+	+	+	-	(+)	"
21	+	+	+	+	+	(+)	+	+	(+)	-	(+)	"
22	+	(+)	+	(+)	+	(+)	+	+	(+)	-	(+)	"
23	+	(+)	+	(+)	+	(+)	+	-	(+)	-	(+)	"
24	+	(+)	+	(+)	+	(+)	+	+	+	-	(+)	"
25	+	(+)	+	(+)	+	(+)	+	+	(+)	-	(+)	"

26	+	(+)	+	(+)	+	(+)	+	+	(+)	-	(+)	"
27	+	-	+	+	+	(+)	+	+	+	-	(+)	"
28	+	-	+	+	+	(+)	+	+	+	-	(+)	"
29	+	-	-	+	+	(+)	+	+	(+)	-	(+)	"
30	+	(+)	+	(+)	+	(+)	+	-	(+)	-	(+)	"
31	+	-	+	+	+	(+)	+	+	+	-	(+)	"
32	+	(+)	+	(+)	+	(+)	+	+	+	-	(+)	"
33	+	(+)	+	(+)	+	(+)	+	-	(+)	-	(+)	"
34	+	(+)	+	(+)	+	(+)	+	+	+	-	(+)	"
35	+	(+)	+	(+)	+	(+)	+	-	(+)	-	(+)	"
36	+	(+)	+	(+)	+	(+)	+	+	(+)	-	(+)	"
37	+	(+)	+	(+)	+	(+)	+	-	(+)	-	(+)	"
38	+	(+)	+	(+)	+	(+)	+	-	+	-	(+)	"
39	+	(-)	+	(+)	+	(+)	+	-	+	-	(+)	"
40	+	(-)	+	(-)	+	(+)	+	-	+	-	(+)	"
41	+	(+)	+	(+)	+	(+)	+	+	+	-	(+)	"
42	-	(+)	+	(+)	+	+	+	+	(+)	-	(+)	"
43	+	(+)	+	(+)	+	+	+	-	(+)	-	(+)	"
44	+	+	(+)	+	(+)	+	+	-	(+)	-	(+)	"
45	+	(+)	+	(+)	+	+	+	+	(+)	-	(+)	"
46	+	+	(+)	+	(+)	+	+	+	(+)	-	(+)	"
47	+	+	(+)	-	(+)	+	+	+	(+)	-	(+)	"
48	+	+	(+)	+	(+)	+	+	+	(+)	-	(+)	"
49	+	+	(+)	+	(+)	+	+	+	(+)	-	(+)	"
50	+	+	(+)	+	(+)	(+)	+	-	(+)	-	(+)	"

Legend :

1 : Number of the profile
2 : Not both massive and hard or very hard when dry.
3 : Colour value moist les than 3.5.
4 : Colour value dry less than 5.5.
5 : Colour chroma moist less than 3.5.
6 : Colour chroma dry less than 5.5.
7 : Base saturation is 50 % or more (by NH4Oc).
8 : Organic carbon content is 0.6 % or more
9 : Thicknes of more than 18 cm.
10 : P205 of less than 250 ppm.
11 : Moist 3 months or more of the year (cumulative) in more than 7 out of 10 years at times when the soil temperature at a depth of 50 cm is 5°C or higher.
12 : The n-value is less than 0.7.
+ : Fulfil the requirement
(+) : Missing data but according to other data one can consider that the requirement is fulfilled.
- : Does not fulfil the requirement
(-) : Missing data and seems not to fulfil the requirement.

Table 8. Information about the diagnostic subsurface horizons of the studied profiles as to the requirements of the argillic and cambic horizons.

1	2	3	4	5	6	7	8	9	10	Subsurface	Order
1	-	-	0	+	+	0	+	+	+	-	Mollisol
2	+	-	0	+	+	0	+	+	+	-	"
3	+	-	0	+	+	0	+	+	+	-	"
4	-	-	0	+	+	0	+	+	+	-	"
5	+	-	0	+	+	0	+	+	+	-	"
6	+	-	0	+	+	0	+	+	+	-	"
7	+	-	0	+	+	0	+	+	+	-	Entisol
8	+	-	0	+	+	0	+	+	+	-	"
9	-	-	0	+	+	0	+	+	+	-	Mollisol
10	-	-	0	+	+	0	+	+	+	-	"
11	-	-	0	+	-	0	+	+	+	-	Entisol
12	+	-	0	+	+	0	+	+	+	-	Mollisol
13	+	+	+	+	+	0	+	+	+	Argillic	Alfisol
14	-	-	0	+	+	0	+	+	+	- *	Vertisol
15	+	+	+	+	+	0	+	+	+	Argillic	Alfisol
16	+	-	0	+	+	0	+	+	-	- *	Vertisol
17	+	+	+	+	+	0	+	+	+	Argillic	Alfisol
18	+	+	+	+	-	0	+	+	+	"	"
19	+	-	0	+	+	0	+	+	+	- *	Vertisol
20	+	+	+	+	+	0	+	+	-	Argillic	Alfisol
21	+	-	+	+	+	(+)	+	+	+	Cambic	Inceptisol
22	+	-	+	+	+	(+)	+	+	+	"	"
23	-	-	0	+	+	0	+	+	+	-	Entisol
24	+	-	0	+	+	0	+	+	+	-	"
25	+	-	0	+	+	0	+	+	+	-	"
26	+	-	0	+	+	0	+	+	+	-	"
27	+	-	0	+	-	0	+	+	+	-	"
28	-	-	0	+	+	0	+	+	+	-	"
29	+	-	+	+	+	(+)	+	+	+	Cambic	Inceptisol
30	+	-	+	+	+	(+)	+	+	+	"	"
31	+	-	+	+	+	0	+	+	+	-	Entisol
32	+	-	+	+	+	(+)	+	+	+	Cambic	Inceptisol
33	+	-	+	+	+	(+)	+	+	+	"	"
34	-	-	+	+	+	(+)	+	+	+	"	"
35	+	-	+	+	(+)	(+)	+	+	+	"	"
36	+	-	0	+	(+)	0	+	+	+	-	Entisol
37	+	-	0	+	(+)	0	+	+	+	-	"
38	-	-	0	+	-	0	+	+	+	-	"
39	+	-	0	+	-	0	+	+	+	-	"
40	+	+	+	+	+	0	+	+	+	Argillic	Alfisol
41	+	+	+	+	-	0	+	+	+	"	"
42	+	-	+	+	+	(+)	+	+	+	Cambic	Inceptisol
43	+	-	0	+	+	0	+	+	+	-	Entisol
44	+	-	+	+	+	(+)	+	+	+	Cambic	Inceptisol
45	+	-	+	+	+	(+)	+	+	+	"	"
46	+	-	+	+	+	(+)	+	+	+	"	"
47	+	-	0	+	+	0	+	+	+	-	Entisol
48	-	-	+	+	+	(+)	+	+	+	Cambic	Inceptisol
49	+	-	+	+	+	(+)	+	+	+	"	"
50	+	+	+	+	+	0	+	+	+	Argillic	Alfisol

Notes : Requirements for the argillic horizon.

1 : Number of the profile
2 : Increase in clay
3 : Presence of clay coatings (cutans)
4 : Thickness of Bt (>7.5 cm, >15 cm)

Requirements for the cambic horizon.

5 : Very fine sand, loamy very fine sand or finer
6 : Soil structure or absense of rock structure in at least half of the volume or C.E.C. (NH4OAc) > 16 meg per 100 gr. clay
7 : Significant amounts of weatherable minerals
8 : Does not meet the requirements of an argillic or a spodic horizon.
9 : No cementation or induration.
10 : Its base is at least 25 cm below the soil surface
+ : Fulfils the requirements.
- : Does not fulfil the requirements.
(+) : Assumed to fultfil the requirements (based on other data)
(-) : Assumed not to fulfil the requirements (based on other data)
0 : Missing data * Vertic character

Remarks : a : The studied Mollisols have no B horizon at all
b : The studied Vertisols have no B horizon at all
c : The studied Entisols have stratified layers

Table 9 : Subsurface horizons and properties of the studied profiles expressed in totals and percentages.

Proposed diagnostic subsurface horizons and properties	Number of Studied profiles		Properties			Profile numbers
	Total	%	(1)	(2)	(3)	
Argillic	8	16 %	+	+	-	13, 15, 17, 18, 20, 40, 41, 50.
Cambic	1.5	30 %	+	-	(+)	21, 22, 29, 30, 32, 33, 34, 35, 42, 43, 44, 45, 46, 48, 49.
No diagnostic horizon (Mollisols)	9	18 %				1, 2, 3, 4, 5, 6, 9, 10, 13.
No diagnostic horizon (Entisols)	15	30 %				7, 8, 11, 23, 24, 25, 26, 27, 28, 31, 36, 37, 18, 39, 47.
Cracking properties (Vertisols)	3	6 %				14, 16, 19.

Notes : (1) = Clay increase
(2) = Presence of clay coatings based on field description
- C.E.C. (NH4OAc) > 16 meq per 100 g. clay
- Very fine sand, loamy very fine sand or finer
(3) = Significant amount of weatherable minerals.
\+ = Fulfils the requirement
\- = Does not fulfil the requirement
o = Missing information
(+) = Assumed to fulfil the requirements (based on other data)

523. Order, suborder and great group

In the USDA Soil Taxonomy system, the studied profiles are classified among 5 orders, 7 suborders and 7 great groups. The representative profiles of each great group are indicated in table 10.

The following paragraphs explain mainly the problems in classification for each taxon by showing one example of the studied profiles related to the taxon. Some remarks of missing data or not accurate laboratory data are noted including, the missing information. Also the FAO system is checked .

Table 10 : Classification of the studied profiles according to the USDA Soil Taxonomy system.

No	Order	Suborder	Great group	Profile numbers
1	Mollisols	Xerolls	Haploxerolls	1, 2, 4, 5, 9.
		Aquolls	Haploquolls	3, 6, 10, 12.
2	Entisols	Fluvents	Xerofluvent	7, 8, 23, 24, 25, 26, 27, 28, 31, 36, 37, 38, 39.
		Orthents	Xerothents	11, 43, 47.
3	Vertisols	Xererts	Chromoxererts	14, 16, 19.
4	Inceptisols	Ochrepts	Xerocherepts	21, 22, 29, 30, 32 35, 42, 44, 45, 46, 48, 49.
5	Alfisols	Xeralfs	Haploxeralfs	13, 15, 17, 18, 20,

5231. Mollisols

5231. a.Classification of the studied profiles

Profiles 1, 2, 3, 4, 5, 6, 9, 10, 12, (table 20) represent the soils classified as Mollisols. All these soils formed in a closed basin at 1005 m altitude after draining an old lake (Ascordida Lake of Kallipefki) filled with sediments from limestone, marble, gneiss and ophyolite. After drainage the soils were Histosols but in order to cultivate them, the farmers of the area burnt the peat (telmatic peat).

The studied profiles have a mollic epipedon and no subsurface diagnostic horizon. They have only C horizons with lithological discontinuities and according to their SMR are classified as Xerolls (A, B, C, D drainage class) and Aquolls (E, F drainage class). In the FAO system, they are Mollic Gleysols.

Example 1

USDA : Fluvaquenatic Haploxeroll, fine, mixed, mesic.
FAO : Mollic Gleysol
Profile nr : 1a (1)* (* : number of profile in this study)
Publication : I.S.C.M. - Larissa 1984.
Location : drained Ascorida Lake of Kallipefki.
Altitude : 1005 m
Relief : flat (slope 0.2 % - A).
Physiography : closed basin, tectonic sinking, surrounded by mountains - tertiary folded.
Parent material : alluvium from limestone, marble, gneiss, ophyolite, sepentine, etc.
Vegetation/land use : wheat, agricultural use.
Drainage class : D
Climate type : Cfb of Köppen.

Horizon	Ap	A12g	II C1g	III C2g	IV C3g	V C4g	
Depth (cm)	0 - 23	23 - 58	58-95	95 - 110	110-150	150+	
Color moist	10 YR 3/2	5 Y 3/1	5 Y 5/3	5 Y 6/2	5 Y 4/3	5 Y 5/2	
Fe, Mn oxides	-	+ F	+ C	+ C	+ M	+ M	
Mottles Color							
Texture	CL	C	SL	SiCL	SL	SiC	
Structure	2 M Sbk	2 M Sbk	S.g.	Massive	S.g.	Massive	
Consistency	V FR	FI	LO	FI	LO	FI	
CaCO3	–	–	–	–	–	–	
Boundary	C - S	G - S	C - S	G - S	G - S		
Clay films	–	–	–	–	–	–	
Cracks	–	–	–	–	–	–	
Slickensides	–	–	–	–	–	–	
Sand %	32	30	68	19	75	19	
Silt %	25	23	15	44	14	32	
Clay %	43	47	17	37	11	49	
Texture	C	C	SL	SiCL	SL	C	
pH(H2O 1/5)	6.3	6.9	7.3	7.7	7.5	8.3	
O.M. (%)	3.83	1.94	0.13	0.15	0.10	0.39	
N total (%)	258						
CaCo3 (%)	–	–	–	–	–	–	
C/N	9						
P (Olsen ppm)	15.5	4.5	3.5				
K2O (%)	1.7	0.1	0.5				
Extr. Na	0.2	0.2					
Cat. Ca	14.1	19.2	4.8				
Meq/ Mg	4.9	8.6	3.4				
100 g. K	1.0	0.3	0.1				
CEC (meq/ 100 g. soil)	24.7	33.0	8.2				
Base sat.	81.0	81.0	100.0				
B.D. (g/cm3)	1.46	1.71	2.04				
Color Dry							

Example 2

USDA : Fluvaquentic Haplaquoll, fine, mixed, mesic level
FAO : Mollic Gleysol
Profile number : 10a (10)
Publication : I.S.C.M - Larissa 1984
Location : drained Ascordida Lake of Kallipefki
Altitude : 1005 m
Relief : flat (slope 0 %-A)
Physiography : closed basin, tectonic sinking surrounded by mountains - tertiary folded.
Parent material : alluvium from limestone, marble, gneis, ophyolites (serpentine etc).
Vegetation/land use : wheat, agriculture use
Drainage class : E
Climate type : Cfb of Köppen.

Horizon	Ap	C1g	II C2g	III C3g	IV C4g		
Depth (cm)	0 - 27	27 - 62	62 - 87	87 - 107	107 - 150		
Color moist	10 YR 2.5/1	5 Y 5/2	5 Y 4/2	5 Y 6/2	5 Y 5/1		
Fe, Mn oxides	+ F	+ C	+ C	+ M	+ M		
Mottles colour		5 Y 4/3	7.5 YR 5/6		5 Y 3/2		
Texture	CL	CL	SiC	SL	SC		
Structure	2M Gr	2 M abk	2 M abk	S.g.	2 M abk		
Consistency	V FR	FI	FI	LO	V FI		
CaCO3	–	–	ES	–	ES		
Boundary	A - S	G - W	A - S	A - S			
Clay films	–	–	–	–	–		
Cracks	–	–	–	–	–		
Slickensides	–	–	–	–	–		
Sand %	28	20	10	56	12		
Silt %	36	46	40	22	34		
Clay %	36	34	50	22	54		
Texture	CL	CL	C	SCL	C		
pH(H20 1/5)	6.7	7.6	8.2	7.7	7.1		
O.M. (%)	6.55	0.94	1.82	0.30	1.43		
N total (%)	361						
CaCo3 (%)	–	–	6.1	–			
C/N	11						
P (Olsen ppm)	27.5	7.0	2.5				
K20 (%)	1.7	2.3	2.3				
Extr. Na	0.3	0.3	0.2				
Cat. Ca	21.1	8.6	14.0				
Meq/ Mg	8.6	8.6	1.9				
100 g. K	0.6	0.2	0.2				
CEC (meq/ 100 g. soil)	40.1	20.9	20.9				
Base sat.	76.0	86.0	78.0				
B.D. (g/cm3)	0.94	1.44	1.35				

Example 3

USDA : Vertic Haplaquoll, fine, mixed, mesic, level.
FAO : Mollic Gleysol.
Profile number : 12 a (12)
Publication : I.S.C.M - Larissa 1984
Location : drained Ascordida Lake of Kallipefki
Altitude : 1005 m
Relief : flat (slope 1%-A)
Physiography : closed basin, tectonic sinking surrounded by mountains - Tertiary folded.
Parent material : alluvium from limestone, marble, gneiss, ophyolite (serpentine ect.)
Vegetation/land use : wheat, agriculture use
Drainage class : D/F
Climate type : Cfb of Köppen

Horizon	AP	A12g	II C1g	Cag	C3g	gley	gley
Depth (cm)	0 - 18	18 - 37	37 - 54	54-100	100-130	130-170	170-200
Color moist	10YR 4/2	5Y 4/1	5Y 3/1	5Y 4/3	5Y 5/1	5Y 6/1	2.5Y 6/0
Fe, Mn oxides		+F	+C	+C	+M		
Mottles colour		10YR 5/6	10YR 5/6	5Y 5/1			
Texture	C	C	SL	SiC	SiC	SiC	SiCL
Structure	1 M sbk	2 C abk	1 M sbk	2 M sbk	—	—	—
Consistency	FR	VFI	FR	FI	FI	FI	FI
CaCO3	—	—	—	—	—	—	—
Boundary	C - S	A - S	A - S	A - W	D - S	D - S	
Clay films	—	—	—	—	—	—	—
Cracks	+	+	+	—	—	—	—
Slickensides	—	—	—	—	—	—	—
Sand %	16	12	54	14	12	20	18
Silt %	32	32	24	40	36	42	34
Clay %	52	56	22	46	52	42	34
Texture	C	C	SC	C/SiC	C	C	SiCL
pH(H2O 1/5)	5.7	6.0	6.7	7.3	8.1	7.6	8.4
O.M. (%)	4.15	2.25	0.42	0.38	0.53	0.35	0.34
N total (%)							
CaCo3 (%)	—	—	—	—	—	—	—
C/N							
P (Olsen ppm)	21.5	10.5	6.0				
K2O (%)	0.7	0.9	1.5				
Extr. Na	0.2	—	—				
Cat. Ca	12.0	5.2	6.6				
Meq/ Mg	7.8	18.8	10				
100 g. K	0.3	0.3	0.1				
CEC (meq/ 100 g. soil)	40.7	41.8	7.1				
Base sat.	50.0	58.0					
B.D. (g/cm3)	0.80	0.97	1.51				

5231. b. Classification problems of the Mollissols

Nine profiles were classified as Mollisols (table 20). Three subgroups Fluvaquentic Haplaquoll, Fluvaquentic Haploxeroll and Vertic Haplaquoll fit best with respect ot the studied profiles. Table 11. gives the missing information for each taxa for the field observations and the laboratory data.

Table 11. Classification problems for the Mollisols.

Level	Taxa	Missing information	
		Observations	Analytical data
USDA System			
Order	Mollisols	Value dry chroma dry	Base saturation>50% (NH4OAc) at 125 cm or 180 cm; Exchange complex not dominated by amorphous material; BD at 1/3-bar moisture tension is ≥0.85 g/cm3; < 60% vitric volcanic ash cinders or other vitric pyroclastic material; n-value 0.7.
Suborder	Aquolls	--	--
	Xerolls	--	--
Great group	Haplaquolls	No duripan within 1 m of the surface	--
		--	B.D. at 1/3 bar water tension ≥0.95 g/cm3; A ratio of measured clay to 15-bar water of 1.25 or less; A ratio of C.E.C. (at Ph near 8) to 15-bar water of >1.5; A coefficient of linear extensibility (COLE) of 0.09 or more.
	Haploxerolls	No duripan within 1 m of the surface No mottles with chroma of 2 or less within 75 cm of the surface	A coefficient of linear extensibility (COLE) of 0.05 or more No accurate chemical analytical data (C.E.C.extractable cations)
FAO-unesco system			
Unit	Gleysol	--	--
Subunit	Mollic	--	--

5232. Entisols

5232. a. Classification of the studied profiles.

Profiles 7, 8, 11, 23, 24, 25, 26, 27, 28, 31, 36, 37, 38, 39, 43, 47 represent the soils classified as Entisols (table 20). They represent about 30 % of the studied profiles. According to the USDA classification system they are Orthents (11, 43, 47) and Fluvents. Both suborders are classified as Xerorthents and Xerofluvents because of the SMR (Xeric). The Xerorthents are typic Xerorthents and are represented by profiles 11, 43, 47. The Xerofluvents are Xerofluvents (7, 23, 24, 26), Mollic and Xerofluvent (8 profiles) and Typic Xerofluvents (25, 27, 28, 31, 36, 37, 38, 39). According to the FAO classification system they are Regosols and Fluvisols. The studied profiles have an Ochric epipedon, no subsurface diagnostic horizons at all. They present stratified layers with lithological discontinuities and are calcareous except profiles 7,8,11.

Example 1

USDA	: Aguic Xerofluvent, fine, mixed, non acid, mesic
FAO	: Eutric Fluvisol
Profile number	: 7a (7)
Publication	: I.S.C.M. - Larissa 1984
Location	: drained Ascorida Lake of Kallipefki
Altitude	: 1005 m
Relief	: slightly sloping (slope 4 % -B)
Physiography	: closed basin, tectonic sinking surrounded by mountains - tertiary folded
Parent material	: alluvium from limestones, marbles, gneisses, ophylites (serpentines etc)
Vegetation/land use	: wheat, agricultural use
Drainage class	: C
Climate type	: Cfb of Köppen

Horizon	Ap	IIC1g	IIC2g	IIIC3g	IVC4g	A11bg	A12bg
Depth (cm)	0 - 17	17 - 47	47 - 73	73 - 80	80 - 90	90 - 110	110 - 135
Color moist	10YR 4/4	2.5 Y 4/2	2.5 Y 5/2	2.5 Y 5/4	2.5 Y 5/2	2.5 Y 5/2	5 Y 4/1
Fe, Mn oxides			+ F	+ C		+ C	
Mottles Color			7.5 YR 5/6	7.5 YR 4/4		5 YR 3/3	
Texture	L	SiCL	SiCL	L	SiCL	SiCL	SiCL
Structure	1M sbk	1C sbk	Massive	—	—	—	—
Consistency	FR	FI	FI	LO	FI	FI	FI
CaCO3	—	—	—	—	—	—	—
Boundary	A - S	D - S	D - S	C - S	D - S	D - S	D - S
Clay films	—	—	—	—	—	—	—
Cracks	—	—	—	—	—	—	—
Slickensides	—	—	—	—	—	—	—
Sand %	36	6	6	33	8	14	26
Silt %	45	65	58	44	51	53	37
Clay %	19	29	36	23	41	53	37
Texture	L	SiCL	SiCL	L	SiCL	C	CL
pH(H2O 1/5)	5.4	5.7	5.5	6.0	5.4	4.9	5.6
O.M. (%)	1.95	1.56	1.73	1.37	1.92	4.81	1.88
N total (%)	1 22						
CaCo3 (%)	—	—	—	—	—	—	—
C/N	11						
P (Olsen ppm)	30.5	14.0	4.5				
K2O (%)	4.5	1.1	2.0				
Extr. Na	0.25	—	—	0.20			
Cat. Ca	13.2	25.9	22.0	17.3			
Meq/ Mg	10.9	10.1	5.0	13.2			
100 g. K	0.7	0.33	0.32	0.17			
CEC (meq/ 100 g. soil)	30.2	41.2	29.7	30.3			
Base sat.	83.0	88.0	92.0				
B.D. (g/cm3)	1.65	1.61	1.42				
Color Dry							

Example 2

USDA	: Aquic Xerofluvent, fine, mixed, calcareous, thermic
FAO	: Calcaric Fluvisol
Profile number	: 22 (26)
Publication	: Agriculture school of Athens - Ministry of Agriculture 1983
Location	: Argoliko pedio, Peloponnessos
Altitude	: 10 m
Relief	: flat (slope 0.5 % - A)
Physiography	: alluvial plain
Parent material	: alluvial quaternary deposits from limestone, flysh, marble, shist etc.
Vegetation/land use	: maize, agricultural use
Drainage class	: 0
Climate type	: Csa of Köppen

Horizon Depth (cm)	Ap 0 - 18	IIg 18 - 43	III 43 - 56	IV 56 - 72	V1 72 - 130	V2 130 - 150	
Color moist Fe, Mn oxides Mottles Color		+F 10YR 4/4	+M 10YR 4/4	+C 10YR 4/4			
Texture Structure Consistency CaCO3 Boundary	CL-C 2C sbk FI EV C-IR	C 1C sbk VFI EV C-IR	SiCL 2C sbk FI ES C-S	SiL massive FR VSE D-IR	L massive FR VSE D-IR	L 1C abk FR —	
Clay films Cracks Slickensides	— — —	— — —	— — —	— — —	— — —	— — —	
Sand % Silt % Clay % Texture pH(H2O 1/5)	9.4 26.6 64.0 C 7.4	7.4 25.8 66.8 C 7.6	14.4 30.4 55.2 C 7.2	26.8 31.6 41.6 Muck 6.3	39.2 37.0 23.8 Peat 5.0	— — — Peat 2.3	
O.M. (%) N total (%) CaCo3 (%) C/N P (Olsen ppm) K2O (%)	5.4 0.32 20.1 16.8	3.7 0.23 22.2 16.0	12.0 0.67 5.1 17.9	29.5 1.37 0.8 21.5	28.3 — 0.4	27.1 — 0.0	
Extr. Na Cat. Ca P.P.M. Mg K	168 11250 175 170	154 9750 151 160	126 110	210 100	98 90	70 50	
CEC (meq/ 100 g. soil) Base sat.	32.0	32.0	42.0				
B.D. (g/cm3)							
Color Dry	2.5Y 4/2	5Y 5/2	10YR 3/1	10YR 2/1	5YR 2/2	10YR 2/1	

Example 3

USDA	: Mollic Xerofluvent, fine, silty, non acid, mesic
FAO	: Dystric Fluvisol
Profile number	: 8a (8)
Publication	: I.S.C.M - Larissa 1984
Location	: drained Ascordida lake of Kallipefki
Altitude	: 1005 m
Relief	: slightly sloping (slope 4 % - B)
Physiography	: closed basin, tectonic sinking, surrounded by mountains - Tertiary folded
Parent material	: alluvial from limestones, marbles, gneises, ophyolites (serpentines etc.)
Vegetation/land use	: wheat, agricultural use
Drainage class	: C
Climate type	: Cfb of Köppen

Horizon	Ap	A12	A13g	II C1g	II C2g	III C3g	
Depth (cm)	0 - 18	18 - 38	38 - 59	59 - 78	78 - 105	105 - 150	
Color moist	10 YR 3/3	10 YR 4/3	5 Y 3/1	5 Y 4/1			
Fe, Mn oxides			+ F	+ C	+ C	+ C	
Mottles Color			7.5 YR 5/6	7.5 YR 5/6	7.5 YR 5/6	7.5 YR 5/6	
Texture	L	L	CL	L	SCL	SL	
Structure	1 M sbk	1 M sbk	Massive	—	—	—	
Consistency	V FI	FR	SH	FI	FR	LO	
CaCO3	—	—	—	—	—	—	
Boundary	C - S	A - S	C - S	C - S	G - S		
Clay films	—	—	—	—	—	—	
Cracks	—	—	—	—	—	—	
Slickensides	—	—	—	—	—	—	
Sand %	30	23	34	39	44	65	
Silt %	41	38	37	38	33	20	
Clay %	29	39	29	23	23	15	
Texture	CL	CL	CL	L	L	SL	
pH(H2O 1/5)	4.8	4.3	5.4	5.9	6.1	6.1	
O.M. (%)	3.76	10.37	1.74	0.68	0.71	0.28	
N total (%)	302						
CaCo3 (%)	—	—	—	—	—	—	
C/N	7						
P (Olsen ppm)	26.5	—	3.5				
K2O (%)	3.8	0.8	0.3				
Extr. Na	0.1	0.2	0.2	0.3			
Cat. Ca	0.96	0.48	3.36	2.40			
Meq/ Mg	1.44	1.42	1.44	2.88			
100 g. K	0.61	0.27	0.12	0.12			
CEC (meq/ 100 g. soil)	16.5	40.1	15.4	9.9			
Base sat.	19.0	6.0	33.0	6.0			
B.D. (g/cm3)							
Color Dry							

Example 4

USDA	: Typic Xerofluvent, very fine, mixed calcareous, thermic
FAO	: Calcaric Fluvisol
Profile number	: 31 (31)
Publication	: Agriculture School of Athens - Ministry of Agricultural 1983
Location	: Argoliko pedio - Peloponnessos
Altitude	: 50 m
Relief	: flat (slope 0 % - A)
Physiography	: alluvial plain
Parent material	: alluvial Quaternary deposits from limestone, flysh, shist, marbles etc.
Vegetation/land use	: citrus, fruits, agricultural use
Drainage class	: A
Climate type	: Csa of Köppen

Horizon	Ap	I2	I3C			
Depth (cm)	0-23	23-81	81-150			
Color moist	10YR 4/2	—	10YR 4/2			
Fe, Mn oxides						
Mottles Color						
Texture	SiC	C	C			
Structure	2M sbk	2M sbk	3F abk			
Consistency	FI	FI	FI			
CaCO3	EV	EV	EV			
Boundary	C-IR	D-IR				
Clay films	—	—	—			
Cracks	—	—	—			
Slickensides	—	—	—			
Sand %	2.6	1.6	3.9			
Silt %	54.0	36.8	37.1			
Clay %	43.4	61.6	59.0			
Texture	SiC	C	C			
pH(H2O 1/5)	8.2	8.2	8.1			
O.M. (%)	2.9	1.7	1.3			
N total (%)	0.16	0.09	0.07			
CaCo3 (%)	20.1	18.1	16.2			
C/N	18.1	18.8	18.5			
P (Olsen ppm)	14.3	5.7	3.3			
K2O (%)						
Extr. Na	134	172	152			
Cat. Ca	10400	10600	10800			
P.P.M. Mg	880	620	560			
K	360	220	220			
CEC (meq/ 100 g. soil)	24.0	24.6	24.6			
Base sat.						
B.D. (g/cm3)						
Color Dry	10YR 4/3	10YR 4/3	10YR 3/3			

Example 5

USDA : Typic Xerofluvent, fine, mixed, calcareous, thermic
FAO : Calcaric Fluvisol
Profile number : 82 (37)
Publication : Agriculture School of Athens - Ministry of Agricultural 1983
Location : Argoliko pedio - Peloponnessos
Altitude : 65 m
Relief : flat (slope 0,5 % - A)
Physiography : alluvial plain
Parent material : alluvial Quaternary deposits from limestone, flysh, shist, marbles etc.
Vegetation/land use : praire, agricultural use
Drainage class : A
Climate type : Csa of Köppen

Horizon	AP	I	II	III	IV	V	VI
Depth (cm)	0 - 16	16 - 32	32 - 50	50 - 72	72 - 110	110 - 128	128 - 150
Color moist							
Fe, Mn oxides							
Mottles Color							
Texture	CL	C	C	CL-C	CL	CL-C	C
Structure	3M sbk	2M sbk	2M-C sbk	1C abk	1C sbk	2M sbk	2M abk
Consistency	FI	FI	FI	FI	FR	FI	FI
CaCO3	VSE	ES	EV	EV	EV	EV	EV
Boundary	C - S	A - S	A - S	D - S	D - S	D - S	
Clay films	—	—	—	—	—	—	—
Cracks	—	—	—	—	—	—	—
Slickensides	—	—	—	—	—	—	—
Sand %	28.8	28.6	29.6	23.8	28.6	32.6	28.6
Silt %	40.2	28.6	30.2	37.8	34.2	33.2	33.8
Clay %	31.0	42.8	40.2	38.4	37.2	34.2	37.6
Texture	CL	C	C	CL	CL	CL	CL
pH(H2O 1/5)	8.2	8.2	8.2	8.2	8.2	8.3	8.2
O.M. (%)	1.1	1.3	1.1	0.4	0.3	0.2	0.2
N total (%)	0.07	0.11	0.08	0.03	0.03	0.04	0.04
CaCo3 (%)	1.2	5.5	22.4	31.2	22.2	20.1	21.4
C/N	15.7	11.8	13.7	13.3	10.0	5.0	5.0
P (Olsen ppm)							
K2O (%)							
Extr. Na	60	66	62	62	68	74	64
Cat. Ca	—	—	8250	9500	7500	6750	8500
P.P.M. Mg	—	90	120	80	130	100	60
K	182	148	122	110	92	88	100
CEC (meq/ 100 g. soil)							
Base sat.							
B.D. (g/cm3)							
Color Dry	5YR 3/4	5YR 3/4	5YR 3/4	5YR 4/4	5YR 4/4	5YR 3/4	5YR 4/6

Example 6

USDA	: Typic Xerofluvent, fine, loamy, mixed, non acid, mesic
FAO	: Eutric Regosol
Profile number	: 11 (11)
Publication	: I.S.C.M. Larissa 1984
Location	: drained Ascordida Lake of Kallipefki
Altitude	: 1005 m
Relief	: slightly sloping (slope 4 % - 8)
Physiography	: closed basin, tectonic sinking surrounded by mountains - Tertiary folded
Parent material	: alluvial from limestones, marbles, gneisses, ophyolites (serpentines etc.)
Vegetation/land use	:
Drainage class	: A
Climate type	: Cfb of Köppen

Horizon	Ap	A12	C1	C2	C3	
Depth (cm)	0 – 19	19 - 30	30 - 62	62 - 100	100 - 150	
Color moist	10 YR 3/3	10 YR 4/3	10 YR 3/2	10 YR 3/3	10 YR 4/3	
Fe, Mn oxides						
Mottles Color						
Texture	L	L	SL	SL	L	
Structure	1M sbk		1M sbk			
Consistency	VFR	FI	VFR	LO	LO	
CaCO3	—	—	—	—	—	
Boundary						
Clay films	—	—	—	—	—	
Cracks	—	—	—	—	—	
Slickensides	—	—	—	—	—	
Sand %	52	53	72	77	80	
Silt %	27	26	9	8	7	
Clay %	21	21	19	15	13	
Texture	SCL	SCL	SL	SL	SL	
pH(H2O 1/5)	5.2	5.2	5.9	5.6	5.9	
O.M. (%)	1.77	1.26	0.78	0.21	0.16	
N total (%)	118					
CaCo3 (%)	—	—	—	—	—	
C/N	9					
P (Olsen ppm)	26.5	16.5	33.0			
K2O (%)	2.9	2.8	1.1			
Extr. Na	0.1	—	—			
Cat. Ca	—	4.8	3.3			
Meq/ Mg	0.48	0.90	1.50			
100 g. K	0.32	0.30	0.17			
CEC (meq/ 100 g. soil)	10.7	9.35	8.25			
Base sat.	8.0	64.0	60.0			
B.D. (g/cm3)						
Color Dry						

Example 7

USDA	: Typic Xerofluvent, fine, mixed, calcareous thermic
FAO	: Calcaric Regosol
Profile number	: 6b (47)
Publication	: I.S.C.M. Larissa 1984
Location	: Nikea, Larissa, Thessaly
Altitude	: 150 m
Relief	: moderately sloping (slope 7 % - C)
Physiography	: slightly folding, alluvial fluvial plain (mixed)
Parent material	: alluvial, Quaternary, river torrential depostits from limestones, marbles, gneisses, shists, flyshes (clay stones, siltstones, sandstones)
Vegetation/land use	: straw/agricultural use
Drainage class	: A
Climate type	: Csa of Köppen

Horizon	Ap	C1	C2
Depth (cm)	0 - 20	20 - 65	65 - 120
Color moist	10 YR 3/4	7.5 YR 5/6	7.5 YR 5.5/6
Fe, Mn oxides			
Mottles Color			
Texture	CL	C	C
Structure	1 M gr	Massive	2M abk
Consistency			
CaCO3	EV	EV	EV
Boundary	C - S	C - S	
Clay films	–	–	–
Cracks	–	–	–
Slickensides	–	–	–
Sand %	46	31	19
Silt %	19	24	32
Clay %	35	45	49
Texture	SC/SCL	C	C
pH(H2O 1/5)	7.7	8.0	7.9
O.M. (%)	1.54	0.73	0.27
N total (%)			
CaCo3 (%)	37.4	39.1	52.1
C/N			
P (Olsen ppm)			
K2O (%)			
Extr. Na	0.20	0.15	
Cat. Ca	16.3	16.9	
Meq/ Mg	5.2	1.9	
100 g. K	0.67	0.53	
CEC (meq/ 100 g. soil)	22.5	19.8	
Base sat.	99.4	98.4	
B.D. (g/cm3)			
Color Dry			

5232. b. Classification problems of Entisols.

Classification problems of Entisols concerning the missing information : see table 12.

Table 12. Classification problems of Entisols

Level	Taxa	Missing information: Field observations	Missing information: Analytical data
USDA system			
Order	Entisols	n-value 0.7 between 20-50 cm depth	N-value calculation : water retention at field capacity and bulk density requirements for - sulfuric horizon - calcic horizon - salic horizon - sodium saturation
suborder	Fluvents	--	--
	Orthents	--	--
great group	Xerofluvents	Value dry Value moist Durinodes content	Coefficient of linear extensibility (COLE)
	Xerorthents	Durinodes content	Conductivity of saturation extract 2 mmhos per cm at 25°C Base saturation
FAO system			
Unit	Fluvisol	Sulfuric horizon	--
	Regosol	--	--
Subunit	- Calcaric Fluvisol	-- --	Base saturation 50% (by NH4 OAc) at least in some parts between 20-50 cm.
	- Dystric Fluvisol	-- --	
	- Calcaric Regosol	-- --	--
	- Eutric Regosol	--	--

5233. Vertisols

5233. a. Classification of the studied profiles

Profiles 14, 16, 19 are the only profiles considered to be Vertisols (6% of the studied profiles). Profile 14 is classified as an Aguic Entic Chromoxerert because of the aquic SMR and the colour characteristics. Profiles 16, 19 are classified as Entic Chromoxererts. According to the FAO-

Unesco classification system all profiles are Chromic Vertisols. The cracking character is the most important feature in these soils. It should be added that in Greece these are very productive soils for many crops and particularly for cotton.

Example 1

USDA : Aguic, Entic, Chromoxert, fine, mixed, thermic
FAO : Chromic Vertisol
Profile number : 67a (14)
Publication : I.S.C.M. Larissa 1984
Location : Agii Theodori (Saints Theodores) Karditsa
Altitude : 130 m
Relief : flat (slope 0-2% - A)
Physiography : alluvial plain
Parent material : basic rocks
Vegetation/land use : cotton/agricultural use
Drainage class : D
Climate type : Csa of Köppen

Horizon	Ap	A12	C1	C2	C3	
Depth (cm)	0 - 15	15 - 55	55- 85	85 -108	108-150	
Color moist	10 YR 3/2	10 YR 3/1	10 YR 4/3	10 YR 4/3	10 YR 6/3	
Fe, Mn oxides	–	+ F	+ F	+ C	+ C	
Mottles Color						
Texture	CL	C	CL	L	C	
Structure	Massive	2M sbk	1M sbk	1M gr	1M gr	
Consistency	FI	V FI	FI	FR	FI	
CaCO3	–	–	–	–	ES	
Boundary						
Clay films	–	–	–	–	–	
Cracks	+	+	+	+	–	
Slickensides	–	+	+	+	–	
Sand %	26	4	30	52	22	
Silt %	34	28	34	24	28	
Clay %	40	48	36	24	50	
Texture	C	C	CL	SCL	C	
pH(H2O 1/5)	6.5	7.5	9.0	8.8	8.4	
O.M. (%)	1.04	0.40	0.17	0.06	0.12	
N total (%)						
CaCo3 (%)	–	–	–	–	11.7	
C/N	6.40	9.66	5.27	2.63		
P (Olsen ppm)						
K2O (%)	11	0.5	0.6	0.6	0.3	
Extr. Cat. Meq/100 g. Na	0.90	1.70	1.65	1.10		
Ca	22.8	28.4	33.0	27.3		
Mg	4.6	9.6	11.0	3.6		
K	0.20	0.1	0.1	0.07		
CEC (meq/100 g. soil)	31.2	32.7	18.3	17.6		
Base sat.	91.3					
B.D. (g/cm3)						
Color Dry	10YR 4/2	10YR 3/1	10 YR 5/4	10YR 5/3	10 YR 7/3	

Example 2

USDA : Entic, chromoxerert, fine, mixed, thermic
FAO : Chromic Vertisol
Profile number : 56 (16)
Publication : I.S.C.M. Larissa 1984
Location : Marko-Karditsa
Altitude : 120 m
Relief : flat (slope 0-2% - A)
Physiography : alluvial plain
Parent material : basic rocks
Vegetation/land use : wheat/agricultural use
Drainage class : C
Climate type : Csa of Köppen

Horizon Depth (cm)	AP 0-21	A12 21-40	A13 40-66	A14 66-118	C1 118-134	C2 134-150	
Color moist Fe, Mn oxides Mottles Color	10 YR 4/3 – –	10 YR 3/2 – –	10 YR 3/2 – –	10 YR 4/2 – –	10 YR 5/3 – –	10 YR 5/4 – –	
Texture Structure Consistency CaCO3 Boundary	SiCL Structureless LO – G-S	SiC Structureless LO – G-S	C 1M Pr FR – G-S	C 2M Pr FI – G-S	CL Structureless FI VSE G-S	CL Structureless FI ES G-S	
Clay films Cracks Slickensides	– + –	– + –	– + +	– + +	– – –	– – –	
Sand % Silt % Clay % Texture pH(H2O 1/5)	14 42 44 SiC 6.6	10 44 46 SiC 6.9	18 36 46 C 7.1	24 28 48 C 8.0	30 34 36 CL 8.4	36 34 30 CL 8.6	
O.M. (%) N total (%) CaCo3 (%) C/N P (Olsen ppm) K2O (%)	3.1 0.184 – 16.8 18.5 1.1	14 0.112 – 12.5 4.0 0.9	1.0 0.073 – 13.6 1.0 0.8	0.4 – – 0.6	0.3 traces – 0.5	0.2 9.0 – 0.3	
Extr. Na Cat. Ca Meq/ Mg 100 g. K	0.9 23.2 24.4 0.77	0.9 22.2 15.0 0.25	0.6 21.0 18.4 0.20	0.9 24.0 36.8 0.26			
CEC (meq/ 100 g. soil) Base sat.	28.5	28.5	27.9	27.0			
B.D. (g/cm3)							
Color Dry	10YR 5/3	10YR 4/2	10YR 4/2	10YR 5/2	10YR 6/3	10YR 6/4	

5233. b. Classification problems of Vertisols.

At the order level, the information about cracks seems to be satisfied. Some additional requirements such as intersecting slickensides and wedge shaped structural aggregates are missing. Some of the missing information is indicated in table 13.

table 13. Classification problems of Vertisols

Level	Taxa	Missing information: Field observations	Missing information: Analytical data
USDA system			
Order	Vertisol	Wedge shaped structural aggregates at some depth between 25-100 cm	Coefficient of line arextensibility (COLE)
		Intersecting slickensides	Bulk density Base saturation
		Presence of gilgai Colour of mottles	CEC Extractable cations Non-accurate chemical data
Suborder	Xererts	Duration of open cracks (less than 60 consecutive days).	
Great group	Chromoxererts	--	--
FAO system			
Unit	Vertisol	idem as USDA system	--
Subunit	Chromic Vertisols	--	--

5234. Inceptisols

5234. a. Classification problems of the studied profiles

15 profiles were classified as Inceptisols. (28 % of the studied profiles). They are all Xerochrepts. Profiles 42, 44, 45, 46, 48 are Calcixerollic Xerochrepts. Profile 49 is a Vertic Calcixerollic Xerochrept. Profile 43 has a double classification : Typic Xerorthent and Typic Xerochrept. This is because of the presence of fragments of a petrocalcic horizon even on the surface, after deep plowing. So it is considered to be an Inceptisol but the deep plowed areas are considered to be Entisols (this soil could be a "ruptic" subgroup). Profiles 22, 29, 30, 34 are classified as Typic Xerochrept. There is also a double classification for profile 49 which is a calcixerollic and a Vertic Xerochrept. As table 20 shows the classification for profiles 22,

29, 30, 33, 34 was wrong at the subgroup level.
According to the FAO-Unesco classification profiles 21, 22, 29, 30, 32, 33, 34, 42, 44, 45, 46 are Calcic Cambisols. Profiles 35, 48 are Calcic or Chromic Cambisols. Profile 49 is a Calcic or a Vertic Cambisol

Example 1

USDA : Calcixerollic Xerochrept, fine, mixed, thermic
FAO : a) Calcic b)Chromic Cambisol
Profile number : 8b (48)
Publication : I.S.C.M. Larissa 1985
Location : Nikea, Nea Lefki-Larissa
Altitude : 150 m
Relief : flat (slope 0-2% - A)
Physiography : alluvial, fluvial plain.
Parent material : Quaternary river-torrential deposits, from limestones, gneiss, phyllites, gneis, ophyolites, flysh (sand-silt-claystones)
Vegetation/land use : straw of harvested wheat, agricultural use
Drainage class : A
Climate type : Csa of Köppen

Horizon	Ap	(B)	C1ca	C2ca	C3ca	
Depth (cm)	0 - 19	19 - 45	45 - 60	60 - 105	105 - 150	
Color moist	7.5YR 3/3	5YR 4/4	5YR 4/8	5YR 4/6	5YR 5/8	
Fe, Mn oxides						
Mottles color						
Texture	C	C	C	C	CL	
Structure	2 C gr	2 M abk	2 M abk	2 M abk	Massive	
Consistency						
CaCO3	ES	ES	EV	EV	EV	
Boundary	C - S	C - S	C - S	C - S		
Clay films	—	—	—	—	—	
Cracks	—	—	—	—	—	
Slickensides	—	—	—	—	—	
Sand %	31	23	21	29	39	
Silt %	19	22	22	14	24	
Clay %	50	45	56	56	36	
Texture	C	C	C	C	CL	
pH(H2O 1/5)	7.7	7.9	8.0	8.0	8.1	
O.M. (%)	1.40	0.87	0.47	0.43	0.33	
N total (%)						
CaCo3 (%)	8.8	19.7	27.3	39.5	41.6	
C/N						
P (Olsen ppm)						
K2O (%)						
Extr. Cat. Meq/ 100 g. Na	0.20	0.15				
Ca	22.8	25.5				
Mg	10.5	7.8				
K	0.83	0.67				
CEC (meq/ 100 g. soil)	35.2	34.6				
Base sat.	97.5	98.6				
B.D. (g/cm3)						
Color Dry						

Example 2

USDA	: a) Calcixerollic Xerochrept or b) Vertic Xerochrept fine, mixed, thermic
FAO	: a) Vertic b) Calcic Cambisol
Profile number	: 12b (49)
Publication	: I.S.C.M. Larissa 1985
Location	: Nikea-Larisssa
Altitude	: 150 m
Relief	: slightly sloping (slope 5% - B)
Physiography	: alluvial fluvial plain
Parent material	: Quaternary river-torrential deposits from limestone, marble, shist, gneis, phyllites, ophiolytes, flysh (sand-silt-claystones).
Vegetation/land use	: wheat/agricultural use
Drainage class	: A
Climate type	: Csa of Köppen

Horizon	Ap	(B)	C1	C2			
Depth (cm)	0 - 20	20-53	53-85	85-120			
Color moist	10YR 3/3	10YR 3/2	7.5YR4/4	7.5YR4/6			
Fe, Mn oxides							
Mottles color							
Texture	C	C	C	C			
Structure	1F gr	2C abk	2M abk	2M sbk			
Consistency							
CaCO3	traces	—	ES	EV			
Boundary	G-S	G-S	G-S				
Clay films	—	—	—	—			
Cracks	+	+	+	—			
Slickensides	—	—	—	—			
Sand %	23	23	23	23			
Silt %	31	23	23	23			
Clay %	46	54	54	54			
Texture	C	C	C	C			
pH(H2O 1/5)	7.7	7.7	8.0	8.1			
O.M. (%)	1.38	0.67	0.37	0.34			
N total (%)							
CaCo3 (%)	traces	—	4.2	18.9			
C/N							
P (Olsen ppm)							
K2O (%)							
Extr. Na	0.20	0.18					
Cat. Ca	19.3	23.7					
Meq/ Mg	10.2	6.5					
100 g. K	0.72	0.54					
CEC (meq/ 100 g. soil)	31.4	31.4					
Base sat.	96.9	98.5					
B.D. (g/cm3)							
Color Dry							

Example 3

USDA	: Typic Xerochrept, fine, mixed, thermic
FAO	: Calcic Cambisol
Profile number	: 10b (22)
Publication	: Agriculture School of Athens - Ministry of Agriculture 1983
Location	: Argoliko pedio - Peloponnessos
Altitude	: 60 m
Relief	: flat (slope 0,5% - A)
Physiography	: alluvial plain
Parent material	: alluvial quaternary deposits from limestone, shists, marble etc.
Vegetation/land use	: citrus, fruit/agricultural use.
Drainage class	: B
Climate type	: Csa of Köppen

Horizon Depth (cm)	Ap 0-21	I1 B1 21-43	I2 B2 43-80	I3 C 80-150			
Color moist Fe, Mn oxides Mottles Colour			7.5 YR 3/2 +F 10YR 3/2	7.5YR 4/2 +F 7.5YR 5/6			
Texture Structure Consistency CaCO3 Boundary	C 2F sbk FI EV A-S	C 3F-M sbk VFI EV D-IR	C 2M sbk VFI EV	C 2M abk VFI EV D-IR			
Clay films Cracks Slickensides	– – –	– – –	– – –	– – –			
Sand % Silt % Clay % Texture pH(H2O 1/5)	16.6 31.6 51.8 C 8.4	15.6 30.2 54.2 C 8.4	18.6 30.2 51.2 C 8.4	25.2 29.2 45.2 C 8.5			
O.M. (%) N total (%) CaCo3 (%) C/N P (Olsen ppm) K2O (%)	1.95 0.11 27.9 17.2	1.24 0.07 29.6 17.7	0.97 0.06 32.1 16.1	0.84 – 31.0			
Extr. Na Cat. Ca P.P.M. Mg K	94 8500 1070 164	136 7450 810 216	140 7900 1150 196	162 7800 1490 188			
CEC (meq/ 100 g. soil) Base sat.	30.8	28.1	19.8	24.2			
B.D. (g/cm3)							
Colour Dry	7.5 YR 4/3	7.5 YR 4/2.5	7.5YR 4/4	7.5 YR 4/4			

Example 4

USDA	: Fluventic Xerochrept, fine, illitic, thermic
FAO	: Calcic Cambisol
Profile number	: 48 (32)
Publication	: Agriculture School of Athens - Ministry of Agriculture 1983
Location	: Argoliko pedio-Peloponnessos
Altitude	: 55 m
Relief	: flat (slope 0,5% - A)
Physiography	: alluvial plain
Parent material	: alluvial quaternary deposits from limestone, shist, flysh, marble etc.
egetation/land use	: citrus, fruit/agricultural use
Drainage class	: B
Climate type	: Csa of Köppen

Horizon	Ap	II1 B1	II2 B2	III Bs	IV C	
Depth (cm)	0 - 24	24 - 46	46 - 95	95 - 130	130 - 150	
Color moist	–	7.5 YR 4/2	7.5 YR 4/3	7.5 YR 4/3	7.5 YR 4/3	
Fe, Mn oxides						
Mottles color						
Texture	CL	C	C	C	CL	
Structure	2C sbk	3M sbk	2M sbk	3F sbk	3M sbk	
Consistency	FI	V FI	V FI	V FI	V FI	
CaCO3	EV	EV	EV	EV	EV	
Boundary	D - IR	D - IR	D - IR	D - IR	D - IR	
Clay films	–	–	–	–	–	
Cracks	–	–	–	–	–	
Slickensides	–	–	–	–	–	
Sand %	15.4	12.6	13.4	16.4		
Silt %	46.6	43.2	42.6	34.6		
Clay %	38.0	44.2	44.0	49.0		
Texture	SiC	SiC	SiC	C		
pH(H2O 1/5)	8.2	8.1	8.2	8.2		
O.M. (%)	2.2	1.3	0.7	0.9		
N total (%)	0.13	0.08	0.05	0.05		
CaCo3 (%)	22.6	21.6	28.2	27.1		
C/N	16.9	16.2	14.0	18.0		
P (Olsen ppm)	17.3	3.3	3.3	3.0		
K2O (%)						
Extr. Cat. P.P.M. Na	118	148	128	128		
Ca	800	9050	8600	10160		
Mg	390	260	275	620		
K	234	130	96	136		
CEC (meq/100 g. soil)	13.3	12.5	12.5	16.7		
Base sat.						
B.D. (g/cm3)						
Color Dry	10 YR 4/3	7.5 YR 4/3	7.5 YR 4/4	7.5 YR 4/4	5 YR 4/4	

5234. b. Classification problems of the Inceptisols

The main problem concerns missing information and this at all levels, as well as the high amount of calcium carbonate. Table 14 gives the details about the classification problems of the Inceptisols.

Table 14. Classification problems for inceptisols

Level	Taxa	Missing information: Field observations	Missing information: Analytical data
USDA system			
Order	Inceptisols	No sulfidic material within 50 cm of the soil surface N-value between 20 - 50 cm depth Data for calcic, petrocalcic, sali, sulfuric horizons	Data for sulfidic material Data for n-value calculation A SAR $\geq$ 13
Suborder	Ochrepts	Moist colour	Bulk density a+1/3 bar water retention >0.85 in all horizons Amorphous material in the exchange complex Less than 60 % vitric volcanic ash, cinders or other vitric pyroclastic materials
Great group	Xerochrepts	Colour of mottles Do not have a duripan Data for Calcic horizon	Base Saturation (by NH4,OAc) of 60 % or more between 25-75 depth Coefficient of linear extensibility (COLE) of 0.05 or more. Bulk density at 1/3 bar water retention <0.95 g/cm3 Ratio of meansured clay to 15 bar water (% / of 1.25 or less. Ratio of C.E.C at PH near 8) to 15 bar water of $\geq$15 and more exchange acidity than the sum of bases Amorphous clay Extractable cations
FAO system			
Unit Submit	Cambisol Vertic Cambisol Calcic Cambisol Chromic Cambisol	--	--

5235 Alfisols

5235. a. Classification problems of the studied profiles

Profiles 13, 15, 17, 18, 20, 40, 41, 50 (tables 10 and 20) are classified as Alfisols (16% of the studied profiles). All are Haploxeralfs. Profiles 13, 15, 17, 40, 41 are Typic Haploxeralfs. Profile 18 is a Calcic Natric Vertic Haploxeralf. Profile 20 is an Aquic Calcic Natric Haploxeralf and profile 50 is a Calcic Mollic Vertic Haploxeralf. These profiles come from 3 areas : Karditsa, Larissa and Argoliko Pedio. It has to be stated here that for some of these soils up to three different taxa are proposed.
According to the FAO-Unesco classification system (table 20) they are Orthic Luvisols (13, 15, 17), Vertic Luvisols or Calcic Luvisols, Calcic Luvisol, Calcic Luvisol or Chromic Luvisol or Orthic Luvisol (40), Luvisol or Chromic Luvisol (41), Vertic Luvisol or Calcic Luvisol or Chromic Luvisol (50).

Example 1

USDA : Typic Haploxeralf, fine, mixed, thermic
FAO : Orthic Luvisol
Profile number : 23 (15)
Publication : I.S.C.M - Larissa 1984
Location : Karditsomagonla, Karditsa
Altitude : 120 m
Relief : flat (slope 0-2% - A)
Physiography : alluvial plain
Parent material : mainly flysh (sand, silt, claystone).
Vegetation/land use : cereals/agricultural use
Drainage class : B
Climate type : Csa of Köppen

Horizon	Ap	A12	B1	B2t	B3	C	
Depth (cm)	0 - 21	21 - 44	44 - 67	67 - 90	90 - 125	125 - 150	
Color moist	10 YR 4/3	10 YR 4/3	10 YR 4/3	10 YR 4/3	10 YR 4/3	10 YR 5/3	
Fe, Mn oxides							
Mottles Color							
Texture	L	CL	C	C	SiC	SiC	
Structure	1 M gr	2 M sbk	2 M sbk	2 M abk	2 M sbk	Massive	
Consistency	FR	FR	VFI	VFI	VFI	VFI	
CaCO3	–	–	–	–	–	VSE	
Boundary	D - S	C - S	G - S	G - S	G - S		
Clay films	–	–	1 M ka	2 ka	1 M ka	–	
Cracks	–	–	–	–	–	–	
Slickensides	–	–	–	–	–	–	
Sand %	28	19	11	17	13	11	
Silt %	46	50	44	36	44	48	
Clay %	26	31	43	47	43	48	
Texture	L	SiCL	SiC	C	SiC	SiC	
pH(H2O 1/5)	6.2	6.1	6.0	6.3	7.0	8.3	
O.M. (%)							
N total (%)							
CaCo3 (%)	–	–	–	–	–	1.9	
C/N							
P (Olsen ppm)	6.5	7.5	7.0	6.5	6.0	4.5	
K2O (%)							
Extr. Na	0.3	0.6	0.3	0.6	0.6	1.8	
Cat. Ca	13.0	16.0	21.0	22.0	12.0	13.0	
Meq/ Mg	8.6	5.0	1.4	12.4	20.6	12.0	
100 g. K	6.4	0.4	0.5	0.3	0.1	0.08	
CEC (meq/ 100 g. soil)	24.6	22.8	30.0	39.0	33.9	27.3	
Base sat.	90.6	96.7	77.3	90.7	98.0	98.5	
B.D. (g/cm3)							
Color Dry	10YR 6/3	10YR 6/3	10YR 5/3	10YR 5/3	10YR 5/3	10YR 6/3	

Example 2

USDA : Natric, Vertic, Haploxeralf, fine, mixed, thermic
FAO : a) Vertic or b) Calcic Luvisol
Profile number : 13 (18)
Publication : I.S.C.M - Larissa 1984
Location : Myrini, Karditsa
Altitude : 120 m
Relief : flat (slope 0-2% - A)
Physiography : alluvial plain
Parent material : mainly flysh (sand, silt, claystone).
Vegetation/land use : Pasture/agricultural use
Drainage class : C
Climate type : Csa of Köppen

Horizon Depth (cm)	Ap 0 - 25	A12 25 - 37	B1 37 - 51	B21t 51-110	B22t 110-135	C 135-150	
Color moist Fe, Mn oxides Mottles Color	10YR 4/4	10 YR 4/3	10YR 5/3	10YR 5/6 + F	10YR 5/6 + M	10YR 5/6 + M	
Texture	CL	CL	C	C	C	CL	
Structure	1 M gr	1 M gr	2 M sbk	3 M abk	2 M sbk	Massive	
Consistency	FR	FR	FI	FI	FI	FR	
CaCO3	—	VSE	VSE	VSE	VSE	ES	
Boundary	G - S	C - S	C - S	C - S	G - S		
Clay films	—	—	1 na	3 M ka	3 ka		
Cracks	+	+	+	+	—	—	
Slickensides	—	—	—	—	—	—	
Sand %	28	28	28	28	26	34	
Silt %	38	38	30	30	28	34	
Clay %	34	34	42	42	46	32	
Texture	CL	CL	C	C	C	CL	
pH(H20 1/5)	8.8	8.6	9.5	9.4	8.6	8.4	
O.M. (%)	1.09	2.02	0.62	0.59	0.62	0.53	
N total (%)	0.067	0.109	0.045	0.042			
CaCo3 (%)	—	traces	traces	traces	traces	15.5	
C/N	17.0	18.5	13.7	14.0			
P (Olsen ppm)	4.0	12.5	3.5	1.5	0.02	4.5	
K20 (%)	0.7	0.7	0.6	0.3	0.3	0.2	
Extr. Na	13.8	12.9	20.1	11.4	2.4		
Cat. Ca	2.5	2.0	6.5	8.5			
Meq/ Mg	6.0	5.5	4.5	3.5			
100 g. K	0.12	0.08	0.14	0.12	0.16		
CEC (meq/ 100 g. soil)	14.0	16.0	18.5	14.5			
Base sat.							
B.D. (g/cm3)							
Color Dry	10YR 5/3	10YR 5/3	10YR 5/4	10YR 6/4	10YR 6/4	10YR 6/4	

Example 3

USDA	: (Aquic ?), (Vertic ?), Calcic Haploxeralf, fine, mixed, thermic
FAO	: Calcic Luvisol
Profile number	: 91 (20)
Publication	: I.S.C.M - Larissa 1984
Location	: Sofades, Karditsa
Altitude	: 120 m
Relief	: flat (slope 0-2% - A)
Physiography	: alluvial plain
Parent material	: mainly flysh (sand, silt, claystone).
Vegetation/land use	: cereals/agricultural use
Drainage class	: D/c
Climate type	: Csa of Köppen

Horizon	Ap	B21t	B22t	C1ca	C2ca	C3	
Depth (cm)	0 - 23	23-44	44-71	71-90	90-122	122-165	
Color moist	10 YR 4/3	10 YR 4/3	10 YR 4/3	10 YR 5/3	10 YR 5/4	10 YR 5/6	
Fe, Mn oxides	—	—	+ F	+ C	+ C	+ M	
Mottles color							
Texture	L-CL	C	C	C	CL	SCL	
Structure	1 M gr	2C sbk	3C sbk	2 M sbk	2 M sbk	Massive	
Consistency	FR	V FI	V FI	V FI	FI	FR	
CaCO3	—	—	—	EV	ES	E	
Boundary	G - S	D - S	G - S	D - S	G - S		
Clay films	—	3 MKa	4 Ka	—	—	—	
Cracks	—	—	—	—	—	—	
Slickensides	—	—	—	—	—	—	
Sand %	43	39	30	30	37	51	
Silt %	25	17	20	28	25	21	
Clay %	32	44	50	42	38	28	
Texture	CL	C	C	C	CL	SCL	
pH(H2O 1/5)	7.0	7.8	8.3	9.1	9.0	8.9	
O.M. (%)	1.40	0.90	0.73	0.57	0.40	—	
N total (%)	0.078	0.048	0.039	0.034			
CaCo3 (%)	—	—	—	20.1	17.0	2.5	
C/N	17.9	18.7	18.7	16.7			
P (Olsen ppm)	12.0	12.0	6.0	6.0	3.0	3.0	
K2O (%)	0.3	0.3	—	—	0.1		
Extr. Na	1.65	3.75	5.30	3.25	2.50	1.0	
Cat. Ca							
Meq/ Mg							
100 g. K	0.21	0.21	0.12	0.10	0.07	—	
CEC (meq/ 100 g. soil)	28.5	30.8	32.3	28.4	27.6	24.0	
Base sat.							
B.D. (g/cm3)							
Color Dry	10 YR 5/3	10 YR 5/3	10 YR 5/3	10 YR 5/4	10 YR 5/6	10 YR 3/6	

Example 4

USDA	: Typic Haploxeralf, fine, mixed, thermic
FAO	: a) Calcic or b) Chromic Luvisol
Profile number	: 97 (40)
Publication	: Agriculture School of Athens, Ministry of Agriculture 1983
Location	: Argoliko pedio, Peloponnessos
Altitude	: 30 m
Relief	: flat (slope 1% - A)
Physiography	: alluvial plain
Parent material	: alluvial quaternary deposits from limestone, shist, flysh, marble etc.
Vegetation/land use	: citrus, fruits/agricultural use
Drainage class	: A
Climate type	: Csa of Köppen

Horizon Depth (cm)	Ap 0 - 5	B1 5 - 22	Bt 22 - 45	II1 45 - 70	III1 70 - 103	III2 103+	
Color moist Fe, Mn oxides Mottles Color		5 YR 4/3.5	7.5 YR 4/4	7.5YR 4/3.5	7.5 YR 5/5	7.5 YR 5/5	
Texture	SL	SCL	C	SCL	C	C	
Structure	3 F gr	2 M sbk	2C abk	2 M sbk	3F-M sbk	3 F sbk	
Consistency	FR	FI	FI	FI	FI	FI	
CaCO3	—	VSE	VSE	EV	ES	ES	
Boundary	C - S	C - S	C - S	D - S	D - S		
Clay films	—	2MKa	3 Ka				
Cracks	—	—	—	—	—	—	
Slickensides	—	—	—	—	—	—	
Sand %	66.3	58.0	31.5	39.3	27.8	23.2	
Silt %	20.5	22.1	21.9	24.0	32.4	34.2	
Clay %	13.2	19.9	46.6	36.7	39.8	42.6	
Texture	SL	SL	C	CL	CL	C	
pH(H20 1/5)	7.4	7.5	7.6	8.4	8.3	8.2	
O.M. (%)	2.2	0.5	0.6	0.3	0.2	0.2	
N total (%)	0.12	0.03	0.04	0.04	0.04		
CaCo3 (%)	1.6	2.1	2.3	9.5	8.0	9.0	
C/N	18.3	16.6	15.0	7.5	5.0		
P (Olsen ppm)	10.1	3.0	2.0	2.7	1.0	1.2	
K20 (%)							
Extr. Cat. P.P.M. Na	52	80	106	90	116	124	
Ca	2750	2920	4350	7920	8250	9400	
Mg	168	155	405	275	358	460	
K	260	118	200	156	186	206	
CEC (meq/ 100 g. soil)	6.7	8.7	21.7	15.4	17.5	17.5	
Base sat.							
B.D. (g/cm3)							
Color Dry	7.5YR 5/5	7.5 YR 4/4	7.5YR 4.5/4	7.5 YR 4/5	7.5 YR 4/4	7.5 YR 5/4	

Example 5

USDA	: a) Calcic, or b) Mollic, or c) Vertic Haploxeralf, fine, mixed, thermic
FAO	: a) Vertic or b) Cal. or c) Chromic Luvisol
Profile number	: 14 (50)
Publication	: I.S.C.M. - Larissa 1985
Location	: Nikea Larissa
Altitude	: 150 m
Relief	: flat (slope 0% - A)
Physiography	: alluvial, fluvial plain (mixed)
Parent material	: alluvial Quaternary, river, torrential deposits from limestone, shist,gneis, marble etc.
Vegetation/land use	: Cereals, Agriculture use
Drainage class	: B
Climate type	: Csa of Köppen

Horizon Depth (cm)	Ap 0 - 17	B21t 17 - 35	B22t 35 - 61	B3 61 - 88	Cca 88+	
Color moist Fe, Mn oxides Mottles Color	7.5 YR 3/2	5 YR 3/3	5YR 4/3	5YR 4/6	5 YR 4/8	
Texture Structure Consistency CaCO3 Boundary	C 2 M sbk — G - S	C 2 M sbk — G - S	C 3 M sbk — G - S	C 3 M sbk ES G - S	C 2 M sbk ES	
Clay films Cracks Slickensides	— + —	3 M ka + —	4 ka + —	— — —	— — —	
Sand % Silt % Clay % Texture pH(H2O 1/5)	31 24 45 C 7.0	31 18 51 C 7.5	31 18 51 C 7.9	29 22 49 C 7.9	33 20 47 C 8.1	
O.M. (%) N total (%) CaCo3 (%) C/N P (Olsen ppm) K2O (%)	1.80 —	0.88 —	0.65 —	0.54 2.52	0.32 25.2	
Extr. Na Cat. Ca Meq/ Mg 100 g. K						
CEC (meq/ 100 g. soil) Base sat.		29.7	29.7			
B.D. (g/cm3)						
Color Dry						

5235. b. Classification problems of Alfisols.

As table 15 shows, missing information is the most important problem from order to subgroup level.

Table 15 . classification problems of Alfisols.

Level	Taxon	Missing information: Field observations	Missing information: Analytical data
USDA system			
Order	Inceptisols	About fragipan, duripan. Tongues of albic material of 50 cm or more in the Argillic horizon. Do not have plinthite that forms a continuous phase within 30 cm of the surface.	Water is held at <15-bar tension during at least 3 months >10% weatherable minerals Base saturation by sum of cations is 35 % or more.
Suborder	Xeralfs	--	--
Subgroup	Haploxeralfs	Presence of mottles with a hue of 7.5 YR or redder or chroma greater than 5. Should have less than 5% plinthite	Have an Argillic horizon that has base saturation (by sum of cations) of 75% or more throughout the upper 75 cm. A coefficient of linear extensibility (COLE) of 0.05 or more. Organic matter content. Extractable cations. Non-accurate analytical data. Bulk density.
FAO-System			
Unit	Luvisol	--	--
Subunit	Orthic	--	--
	vertic	--	--
	Calcic	--	--
	Chromic	--	--
	Orthic	--	--

Chapter 6

GENERAL DISCUSSION

61. INTRODUCTION

Fifty profiles distributed over an area of 1527 km2 are studied. Five orders are recognized, Mollisols, Entisols, Vertisols, Inceptisols and Alfisols (table 20). The soil moisture and soil temperature regime determination can be considered as satisfactory for the purpose of the study. Physiographical position, elevation and climatological data were useful and did help in this determination. In the studied areas the soils have a Xeric or an Aquic SMR and a Mesic or Thermic STR.

Many data are missing for a precise identification of the diagnostic horizons. For the epipedon identification there are not too many problems as compared to the identification of the subsurface diagnostic horizons.
9 profiles have a mollic epipedon and 41 have an ochric epipedon.

The subsurface horizon identification was more difficult. Often one or two diagnostic horizons are possible, especially argillic and cambic horizons. However by using non-direct by required properties, the subsurface horizon of the profiles could often be identified. 8 profiles are considered to have an argillic horizon (Alfisols), 14 have a cambic horizon (inceptisols), 25 have no diagnostic horizon (Entisols, Mollisols) and finally 3 have cracking characteristics (Vertisols) (table 9).

In general, each profile has already at order level weak aspects in the information. Missing analytical and field data are common. The classification problems at great group level of the USDA Taxonomy System are more or less identical to those met for the FAO-Unesco system.
Consequently, a complete site and profile description besides correct analytical data are the main problems for classification purposes, as dealed within the following paragraphs.

62. SITE DESCRIPTION

Description of the site and the surrounding land close to the studied profiles can be considered as satisfactory for classification purposes. There is some missing information for elevation, date of description, orientation (aspect), physiographic position and the name of the surveyor.

63. PROFILE DESCRIPTION

The most common missing data concern the symbol of the horizons, soil colour (dry and moist, rubbed), mottles and their colour, consistence, cracking pattern, gilgai, n-value, designation of organic matter, clay coatings, roots and pore description, horizon boundary, soil profile depth, pyroclastic material.

631. Soil colour

Soil colour determination is important, starting from the epipedon determination untill the great group level. There is missing information about as well dry as moist colours as for the rubbed soil hue (table 16).

Table 16 : Problems about soil colour determination.

Missing information	Requirements for...
Value less than 5,5 (dry) and chroma less than 5,5 (dry) or value less than 3.5 (moist) and chroma less than 3.5 (moist).	Mollic epipedon
Rubbed hue 7.5 YR and a chroma of more than 4, or a hue redder than 7.5 YR.	Chromic Cambisol
Rubbed hue 7.5 YR and a chroma of more than 4, or a hue redder than 7.5 YR.	Chromic Luvisol
An argillic horizon that, in all parts, has a hue redder than 5 YR and a value, dry, no more than one unit higher than the value moist	Rhodoxeralfs

632. Mottles and their colour

Information about the presence of mottles and their colour is missing. We can estimate the depth of mottles from the drainage class but this is not accurate enough. The depth and the chroma of the mottles is also needed to determine if a subgroup is Aquic or not, i.e. the Aquic Haploxeralfs have up to a depth of 75 cm mottles with chroma of 2 or less.

633. Consistence

In many profiles this information is missing.

634. Cracking pattern-Gilgai

The Vertisols have, by definition, a particular cracking pattern. Missing information associated to this characteristic are intersecting slickensides, wedge shaped structural aggregates and period length during which cracks up to at least 1 cm width occur at 50 cm depth. In the Xererts, cracks should be open 60 consecutive days or more in more than 7 out of 10 years. This feature can only be observed in the field. There is also no information about gilgai. Yet, as the fields are cultivated intensively one can consider that gilgai have levelled and that they cannot form again.

635. Determination of the n-value in the field

The critical n-value of 0.7 can be approximated closely in the field by a simple test of squeezing the water-saturated soil in the hand. If the soils flows with difficulty between the finger, the n-value is between 0.7 and 1.0. If the soil flows easily between the fingers, the n-value is 1 or more (Soil Survey Staff, 1975). The studied profiles have no data concerning the n-value (table 17). Yet as all these soils are under agriculture one can consider that the n-value is everywhere below 0.7.

Table 17 : some problems about n-value identification

Missing information	Requirements
N-value of < 0.7	Mollic epipedon
N-value of ≤ 0.7 at 20-50 cm below the mineral soil surface	Inceptisols
N-value of > 0.7 between a depth of 20-50 cm	Entisols

636. Designation of organic matter

The kind of organic matter must be described in the field, especially for soils with a histic epipedon or for the Histosols. The degree of decomposition (fibric, hemic or sapric) can only be identified in the field. There is no information about this feature even not for the Mollisols which orginated from Histosols. However the C/N ratio can help to predict this information.

637. Clay coatings

Field identification of clay coatings is very important for classification purposes. In some soils the only field identification without further examination by micromorphology is not enough to be sure about the presence of an argillic horizon. There is a lot of information about clay skins in the studied profiles namely about frequency, thickness and form but no information at all from the micromorphological point of view.

638. Horizon boundary

The information about the horizon boundaries was largely sufficient for the classification purposes.

639. Symbol of the horizon

Identification of horizons by symbols in the field helps the classification, particularly when other data are missing. In all studied profiles there were horizon symbols.

640. Roots and pores description

There was no information at all about roots and pores. Yet, these data can help to interpret the information about for example clay illuviation, plow pan, fragipan, duripan, biological activity.

641. Soil profile depth

Almost all the studied profiles are deep enough for classification purposes either by the USDA Soil Taxonomy or the FAO-Unesco System.

642. Pyroclastic materials

There is no information about vitric volcanic ashes, cinders and other pyroclastic materials which can be observed in the field. But this is not so important as there are no Andosols in the study areas.

65. CHEMICAL ANALYSIS

There were many missing data (table 18). They include base saturation, CEC, extractable cations, O.M., SAR, amorphous material in the exchange complex, total N, C/N ratio, P content.

Table 18. Problems of chemical analytical data for the studied profiles

Missing information	Requirements
Base saturation of >50% (NH4OAC) at 125 cm or 180 cm...	Mollisols
Base saturation (by NH4OAc) of 60% or more between 25-75 cm depth.	Xerochrepts
Base saturation of <50% (NH4OAC) in at least some part between 20-50 cm.	Dystric Fluvisols
Base saturation by sum of cations is 35% or more at 125 cm or 180 cm...	Alfisols

Table 19. Problems of physical analysis of the studied profiles

Missing information	Adapted to the requirement of
N-value of < 0.7.	Mollic epipedon
N-value of ≤ 0.7 between 20-50 cm below the mineral soil surface.	Inceptisols
N-value of > 0.7 between 20-50 depth.	Entisols
A ratio of measured clay to 15-bar water of 1.25 or less.	Haplaquolls, Xerochrepts,
A ratio of C.E.C. (at PH near 8) to 15-bar water of >1.5.	Haplaquolls, Xerochrepts,
Water is held at < 15-bar tension during at least 3 months per year.	Alfisols
Analytical data with respect to the N-value calculations such as water retention at field capacity and B.D.	Entisols, Inceptisols
Bulk density (at 1/3-bar water retention) >0.85 gr/cm3 in all horizons.	Mollisols, Ochrepts
Bulk density (at 1/3 bar water retention) 0.95 gr/cm3.	Xerochrepts
Bulk density (at 1/3 bar water retention in≤0.95 gr/cm3 or more.	Haplaquolls
Bulk density (whole soil).	Vertisols, Inceptisols, Alfisols and mostly in Entisols
A coefficient of linear extensibility (COLE) of 0.09 or more.	Haplaquolls
A coefficient of linear extensibility (COLE) of 0.05 or more.	Haploxerolls, Xerochrepts, Haploxeralfs
A coefficient of linear extensibility (whole soil).	Vertisols, Entisols
Argillic horizon that has base saturation (by sum of cations) of 75% or more throughout the upper 75 cm.	Haploxeralfs
Base saturation missing entirely	Inceptisols, Vertisols, Xerochrepts

Missing information	Adapted to the requirement of
CEC (NH4AC) missing entirely	Vertisols
Extractable cations	Vertisols, Inceptisols, Alfisols
SAR of ≥13 (or Sodium Saturation of 15% or more)	Inceptisols
Amorphous material in the exchange complex	Mollisols, Ochrepts, Xerochrepts
No sulfidic material within 50 cm of the mineral soil surface (sulfidic analysis).	Inceptisols
No accurate chemical analytical data (C.E.C., extractable cations).	Mollisols, Vertisols, Alfisols
$<$60% vitric volcanic ash, cinders or other vitric pyroclastic materials.	Mollisols, Ochrepts
Conductivity of saturation extract $<$2 mmhos per cm at 25°C.	Xerochrepts
Organic matter content whole soil	Haploxeralf

66. PHYSICAL ANALYSIS

In Table 19 are indicated some missing date met during this study. They include the determination of the n-value, water retention capacity, bulk density, coefficient of linear extensibibity (COLE), ratio of measured clay to 15-bar water, ratio of C.E.C. (at pH near 8) to 15-bar water retention etc.

67. MINERALOGICAL ANALYSIS

There are no mineralogical data at all. Yet, they are very important in order to know the weatherable minerals in the 20-200 micron fraction. Also the gibbsite and the clay mineralogy data are important, mainly for the family level determination.

Chapter 7

CONCLUSIONS

71. FIELD OBSERVATIONS AND LABORATORY ANALYSIS

Problems met within this study concern especially missing information about both field and laboratory data.
Missing field data include soil colours (dry, moist and rubbed), mottles and their colour, consistence, cracking pattern, gilgai, n-value data, nature of organic matter, clay coatings, horizon boundaries, symbols of horizons, root and pore description, soil profile depth and presence of pyroclastic materials. The use of precise guidelines for profile descriptions is suggested. The correct use of the Soil Survey Manual (Soil Survey Staff, 1951) or the Guidelines for Soil Profile Description of FAO (FAO, 1977) may be sufficient. Missing data about chemical analysis include base saturation, effective C.E.C, apparent C.E.C., extractable cations, organic matter, SAR, amorphous material in the exchange complex, total N, C/N ratio, P content, sulfidic material.

It has to be noticed that some of the profile data such as P6 (Fluvaguentic Haplaquoll), P12 (Vertic Haplaquoll), P13 (Typic Haploxeralf), P14 (Aguic Entic Chromoxerert), P16 (Entic Chromoxerert), P17 (Typic Haploxeralf), P18 (Calcic-Natric-Vertic Haploxeralf), P19 (Entic Chromoxerert) have been found to contain wrong chemical data. These are mostly related to base saturation, C.E.C. and extractable cations. They represent 16% of the studied profiles.

Missing data about physical analysis are water retention capacity, bulk density, n-value and the coefficient of linear extensibility (COLE). Water retention capacity and bulk density are needed for the determination of the hydraulic conductivity and the ratio of water to clay.

Data about mineralogy are missing completely. This is very important for the classification at the levels of orders i.e. Alfisols, Inceptisols. For mineralogical analyisis it is suggested to use the 20-200 micron particle size class.

72. RECLASSIFICATION OF THE STUDIED PROFILES

Table 20 gives the classification of the profiles firstly according to published reports and secondly according to this study (USDA Soil Taxonomy (up to the family level) and to FAO-Unesco system). Some of the profiles have double or triple classification at the subgroup level. This is to remain correct with the quanlity of the field and laboratory data.

Table 20. Classification according to the USDA Taxonomy (1975) and FAO-Unesco System (1974).

Prof Nr.	Classification in report or publication	Great group	Subgroup	Family	FAO-UNESCO subunits
1	Fluvaquentic Haploxeroll	Haploxeroll	Fluvaquentic	fine, mixed, mesic	Mollic Gleysol
2	Fluvaquentic Haploxeroll	Haploxeroll	a)Fluvaquentic b) Ultic	fine, mixed, mesic	Mollic Gleysol
3	Fluvaquentic Haplaquoll	Haplaquoll	Fluvaquentic	fine, mixed, mesic, level	Mollic Gleysol
4	Fluvaquentic Haploxeroll	Haploxeroll	a)Fluvaquentic b) Ultic	fine, mixed, mesic	Mollic Gleysol
5	Fluvaquentic Haploxeroll	Haploxeroll	Fluvaquentic	fine, mixed, mesic	Mollic Gleysol
6	Fluvaquentic Haplaquoll	Haplaquoll	Fluvaquentic	fine, mixed, mesic, level	Mollic Gleysol
7	Aguic Xerofluvent	Xerofluvent	Aguic	fine, mixed, non acid, mesic	Eutric Fluvisol
8	Mollic Xerofluvent	Xerofluvent	Mollic	fine, silty, non acid, mesic	Dystric Fluvisol
9	Fluvaquentic Haploxeroll	Haploxeroll	Fluvaquentic	fine, mixed, thermic	Mollic Gleysol
10	Fluvaquentic Haplaquoll	Haplaquoll	Fluvaquentic	fine, mixed, mesic, level	Mollic Gleysol
11	Typic Xerorthent	Xerorthent	Typic	fine, loamy, mixed, non acid, mesic	Eutric Regosol
12	Vertic Haplaquoll	Haplaquoll	Vertic	fine, mixed, mesic, level	Mollic Gleysol
13	Typic Haploxeralf fine, mixed, thermic	Haploxeralf	Typic	fine, mixed, thermic	Orthic Luvisol
14	Aguic Chromoxerert fine, montmorillonitic, thermic	Chromoxerert	a) Aguic b) Entic	fine, mixed, thermic	Chromic Vertisol
15	Typic Haploxeralf fine, mixed, thermic	Haploxeralf	Typic	fine, mixed, thermic	Orthic Luvisol
16	Entic Chromoxerert fine, mixed, thermic	Chromoxerert	Entic	fine, mixed, thermic	Chromic Vertisol

Prof Nr.	Classification in report or publication	Great group	Subgroup	Family	FAO-UNESCO subunits
17	Typic Haploxeralf fine, mixed, thermic	Haploxeralf	Typic	fine, mixed, thermic	Orthic Luvisol
18	Vertic Haploxeralf fine, mixed, thermic	Haploxeralf	a) Natric b) Vertic	fine,mixed,thermic	a) Vertic Luvisol b) Calcic Luvisol
19	Entic Chromoxerert fine, mixed, thermic	Chromoxerert	Entic	fine, mixed, thermic	Chromic Vertisol
20	Vertic Haploxeralf fine, mixed, thermic	Haploxeralf	a) Aquic b) Calcic c) Natric	fine, mixed, thermic	Calcic Luvisol
21	Fluventic Xerochrept fine, mixed, thermic, calcareous	Xerochrept	Fluventic	fine, mixed, thermic	Calcic Cambisol
22	Fluventic Xerochrept fine, mixed, thermic, calcareous	Xerochrept	Typic	fine, mixed, thermic	Calcic Cambisol
23	Aquic Xerofluvent very fine, mixed, thermic, calcareous	Xerofluvent	Aquic	very fine, mixed, calcareous, thermic	Calcaric Fluvisol
24	Aquic Xerofluvent Very fine, mixed, thermic, calcareous	Xerofluvent	Aquic	very fine, mixed, calcareous, thermic	Calcaric Fluvisol
25	Typic Xerofluvent fine, mixed, thermic, calcareous	Xerofluvent	Typic	very fine, mixed, calcareous, thermic	Calcaric Fluvisol
26	Aguic Xerofluvent	Xerofluvent	Aguic	fine, mixed, calcareous, thermic	Calcaric Fluvisol
27	Typic Xerofluvent fine, silty, mixed, thermic, calcareous	Xerofluvent	Typic	fine, mixed, calcareous, thermic	Calcaric Fluvisol
28	Typic Xerofluvent fine, mixed, thermic, calcareous	Xerofluvent	Typic	fine, mixed, thermic, calcareous	Calcaric Fluvisol
29	Fluventic Xerochrept fine, mixed, thermic, calcareous	Xerochrept	Typic	fine, mixed, thermic	Calcic Cambisol

Prof Nr.	Classification in report or publication	Great group	Subgroup	Family	FAO-UNESCO subunits
30	Fluventic Xerochrept fine, mixed, thermic, calcareous	Xerochrept	Typic	fine, mixed, thermic	Calcic Cambisol
31	Typic Xerofluvent very fine, mixed, thermic, calcareous	Xerofluvent	Typic	very fine, mixed, calcareous, thermic	Calcaric Fluvisol
32	Fluventic Xerochrept fine, mixed, thermic, calcareous	Xerochrept	Fluventic	fine, illitic, thermic	Calcic Cambisol
33	Fluventic Xerochrept fine, mixed, thermic, calcareous	Xerochrept	Typic	fine, mixed, thermic	Calcic Cambisol
34	Fluventic Xerochrept fine, mixed, thermic, calcareous	Xerochrept	Typic	fine, mixed, thermic	Calcic Cambisol
35	Fluventic Xerochrept fine, mixed, thermic, calcareous	Xerochrept	Fluventic	fine, mixed, thermic	a)Calcic Cambisol b)Chromic Cambisol
36	Typic Xerofluvent fine, mixed, thermic, calcareous	Xerofluvent	Typic	fine, mixed, thermic, calcareous	Calcaric Fluvisol
37	Typic Xerofluvent fine, thermic, carbonatic	Xerofluvent	Typic	fine, mixed, thermic calcareous	Calcaric Fluvisol
38	Typic Xerofluvent fine, loamy, thermic, carbonatic	Xerofluvent	Typic	fine, loamy, thermic calcareous	Calcaric Fluvisol
39	Typic Xerofluvent fine, thermic, carbonatic	Xerofluvent	Typic	fine, thermic, carbonatic	Calcaric Fluvisol
40	Typic Haploxeralf fine, loamy, mixed, thermic, calcareous	Haploxeralf	Typic	fine, mixed, thermic	a)Calcic Luvisol b)Chromic Luvisol
41	Typic Haploxeralf fine, loamy, mixed, thermic, calcareous	Haploxeralf	Typic	fine, loamy, mixed,	a) Calcic Luvisol b) Chromic Luvisol
42	Inceptisol	Xerochrept	Calcixerollic	fine, mixed, thermic	Calcic Cambisol

Prof Nr.	Classification in report or publication	Great group	Subgroup	Family	FAO-UNESCO subunits
30	Fluventic Xerochrept fine, mixed, thermic, calcareous	Xerochrept	Typic	fine, mixed, thermic	Calcic Cambisol
31	Typic Xerofluvent very fine, mixed, thermic, calcareous	Xerofluvent	Typic	very fine, mixed, calcareous, thermic	Calcaric Fluvisol
32	Fluventic Xerochrept fine, mixed, thermic, calcareous	Xerochrept	Fluventic	fine, illitic, thermic	Calcic Cambisol
33	Fluventic Xerochrept fine, mixed, thermic, calcareous	Xerochrept	Typic	fine, mixed, thermic	Calcic Cambisol
34	Fluventic Xerochrept fine, mixed, thermic, calcareous	Xerochrept	Typic	fine, mixed, thermic	Calcic Cambisol
35	Fluventic Xerochrept fine, mixed, thermic, calcareous	Xerochrept	Fluventic	fine, mixed, thermic	a)Calcic Cambisol b)Chromic Cambisol
36	Typic Xerofluvent fine, mixed, thermic, calcareous	Xerofluvent	Typic	fine, mixed, thermic, calcareous	Calcaric Fluvisol
37	Typic Xerofluvent fine, thermic, carbonatic	Xerofluvent	Typic	fine, mixed, thermic calcareous	Calcaric Fluvisol
38	Typic Xerofluvent fine, loamy, thermic, carbonatic	Xerofluvent	Typic	fine, loamy, thermic calcareous	Calcaric Fluvisol
39	Typic Xerofluvent fine, thermic, carbonatic	Xerofluvent	Typic	fine, thermic, carbonatic	Calcaric Fluvisol
40	Typic Haploxeralf fine, loamy, mixed, thermic, calcareous	Haploxeralf	Typic	fine, mixed, thermic	a)Calcic Luvisol b)Chromic Luvisol
41	Typic Haploxeralf fine, loamy, mixed, thermic, calcareous	Haploxeralf	Typic	fine, loamy, mixed,	a) Calcic Luvisol b) Chromic Luvisol
42	Inceptisol	Xerochrept	Calcixerollic	fine, mixed, thermic	Calcic Cambisol

Prof Nr.	Classification in report or publication	Great group	Subgroup	Family	FAO-UNESCO subunits
43	Inceptisol	Xerochrept Xerorthent	a) Typic b) Typic	a) fine, mixed, calcareous,thermic b) fine,mixed,thermic	a)Calcaric Regosol b)Calcic Cambisol
44	Inceptisol	Xerochrept	Calcixerollic	fine, mixed, thermic	Calcic Cambisol
45	Xerochrept	Xerochrept	Calcixerollic	fine, mixed, thermic	Calcic Cambisol
46	Xerochrept	Xerochrept	Typic	fine, mixed, thermic	Calcic Cambisol
47	Xerorthent	Xerorthent	Typic	fine, mixed, thermic calcareous	Calcaric Regosol
48	Xerochrept	Xerochrept	Calcixerollic	fine, mixed, thermic	a) Calcic Cambisol b)Chromic cambisol
49	Xerochrept	Xerochrept	a)Calcixerollic b) Vertic	fine, mixed, thermic	a) Vertic cambisol b) Calcic Cambisol
50	Alfisol	Haploxeralf	a) Calcic b) Mollic c) Vertic	fine, mixed, thermic	a) Vertic Luvisol b) Calcic Luvisol

Chapter 8

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