Morphological characteristics and pedogenesis of the soils in the Elbistan Basin Eastern Anatolia

Mater, Baris

MORPHOLOGICAL CHARACTERISTICS AND PEDOGENESIS OF THE SOILS IN THE ELBISTAN BASIN, EASTERN ANATOLIA

By

BARIS MATER Dip. Univ. (Istanbul)

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CONTENTS

LIST OF FIGURES

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ABSTRACT

The thesis comprises two parts. The first part describes the physical environments, past and present, under which the soils of eastern Anatolia and the Elbistan Basin have been formed. Geology and relief are discussed briefly in relation to soil development. In the case of climate, both past and present conditions are discussed in considerable detail and particular attention is paid to changes during the Pleistocene, which are believed to have played an important role in pedogenesis in the Elbistan basin. The possible effects of glacial and periglacial activity are also discussed.

In the second part, attention is focussed on soil characteristics and an attempt is made to classify and interpret the various soil profiles and to fit these into existing classification schemes. A soil map at a scale of 1:80,000 is introduced. Individual soils profiles are discussed in detail and particular attention is paid to pedogenesis, which is the major aspect of the present research. Each soil group was investigated both in the field and in the laboratory, the latter on the basis of representative samples, the physical and chemical characteristics of which are given in considerable detail. The various pedogenic factors are discussed individually and their relative influences on soil formation are assessed.

C H A P T E R O N E

INTRODUCTION

INTRODUCTION

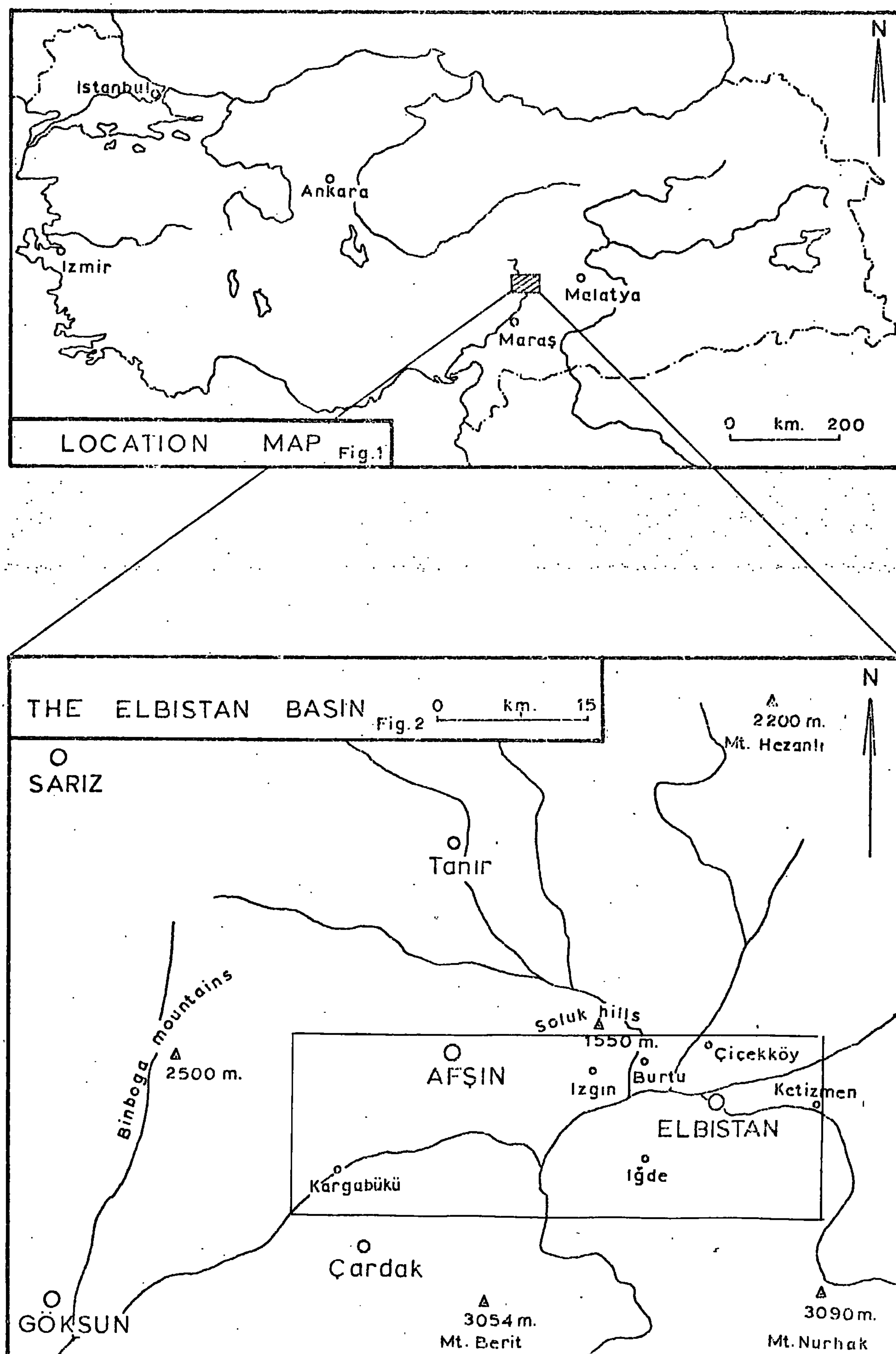
1.1 Location of the area:

The Elbistan basin lies in the extreme south west corner of eastern Anatolia. (Fig. 1). It is situated roughly equal distance from Malatya and Maras. The basin is surrounded on all sides by mountain ranges which rise abruptly to heights of 2000-3000 metres. Its long axis extends 60-65 kilometres in an east-west direction, and its width from north to south varies between 40 and 45 kilometres. The lowest part of the basin floor is about 1100 metres above sea level.

The western part of the basin is closed in by the massive and extensive Binboga mountain range which is well over 2500 metres high. The basin is bounded on its southern side by two massive mountains. They are Mt. Berit (3054 m.) and Mt. Nurhak (3090 m.) which are the highest points in the Elbistan region. The mountains to the east and north of the basin are not as high as those to the south and west, but here too, there are peaks rising to as 2000 metres (Fig. 2).

The basin and the surrounding mountains cover almost 3000 sq. kilometres. However, the present research is concerned only with about a quarter of the total area, and is especially concentrated on the southwestern part of the basin, which seemed to be particularly suitable for pedological investigation. The total working area extends between 25 and 30 kilometres in an east-west direction, and its width varies from 15 to 20 kilometres. Thus the total

Plate - 1 Elbistan Town



The rectangle represents the boundary of soil map.

Plate - 2 A panaroma of the western Elbistan basin looking towards the south. The Mt. Berit (3054 m.) at background and in the centre Asaği Kargabükü village.

research area covers about 600 sq. kilometres. Its eastern boundary extends 3 kilometres east of Elbistan Town to include Ketizmen village. The northern boundary is formed by the Soluk hills which are just over 1500 metres high and the study area includes Cicek, Izgin and Burtu villages, but excludes Afsin Town. In the west, the study area includes both Büyük and Kücük Kargabükü villages which are situated near the Göksun River. Finally, the southern boundary extends between Cardak Town and Igde village (Fig. 2).

1.2. Aim of the work:

Knowledge of the basic characteristics of Turkish soils is still lacking for many areas and only a very limited amount of material has been published, mainly concerning the soils of western Turkey. Detailed studies have so far been restricted to a few small areas. Only one nationwide soil survey has appeared in the international bibliography, that of Hargey Oakes (1954), who attempted a general reconnaissance of soils in Turkey. This publication includes a soil map of Turkey on a scale of 1:800,000 which is the only soil map covering the whole country. As has already been indicated that pedology is a relatively new field of study in Turkey and much more detailed research is needed to reveal the characteristics of Turkish soils. Furthermore no detailed research has been attempted on pedogenesis in Turkey.

For these reasons the present author has attempted not only to discuss the detailed characteristics of the soils of the Elbistan basin, but also to investigate pedogenic factors which might have a wider application to other parts of the country. The author selected an area of arid conditions and has attempted to identify the main pedogenic factors operating in that area.

The Elbistan basin is transitional in climate between the Mediterranean and continental regimes. The western part of the basin is influenced by degraded Mediterranean climate characterized by cold moist winter and dry very hot summer and has more rainfall while eastern part of the basin is influenced by the continental climate which is characterized by hot dry summer and very cold winter and precipitation is less than in western part of the basin. As a result, a great variety of different type of soil occur in this area. The Elbistan basin also has a very complicated geological history which gives a wide range of parent materials. Palaeozoic rocks and recent sediments occur in close proximity in the area. There is also number of volcanic activity occured during the geological time, characterized by acid and basic igneous rocks as well as metamorphics in the area. Thus, it has already been mentioned that the area has number of different rock outcrops as well as different age of sediments.

The study has two main aims. The first is to investigate detailed profile morphology and its relationship with the environmental factors. Since Dokuchayev's (1896) first attempt to discuss the formation factors for soil development, pedogenesis has been a major aspect of Pedology.

Much has been revealed in various parts of the world, but in Turkey pedogenic factors have been neglected and attention has been confirmed to soil morphology particularly in relation to land use.

1.3. Lay-out of thesis:

The thesis comprises two parts. Part one outlines briefly the general soil environment of eastern Anatolia and the Elbistan basin, both past and present. This section begins with a discussion of the various elements of the physical environment. The geological structure of the Elbistan basin are discussed in relation to the geology of eastern Turkey. In the case of climate both present and past conditions are discussed and particular attention is paid to climatic change during the Pleistocene which is believed to be have played an important role in pedogenesis in the Elbistan basin. Some detail is also given of glacial and periglacial activity which appeared to be of considerable relevance in the Elbistan basin. The basin is surrounded by high mountains which provided favourable conditions for glacial and periglacial activity, especially during the Pleistocene. Vegetation is also discussed in some detail for eastern Turkey and the basin, a vegetation map of eastern Turkey is also presented.

In part two, an account is given of soil characteristics and an attempt is made of classifying and interpreting the profiles in the light of existing information. Specific problems arising from the analyses of individual profiles are discussed and emphasis is given to pedogenesis which is the major aspect of the present research.

Each soil group was investigated in the field especially its morphological characteristics and representative profiles were subjected to laboratory analyses, for further information. During the sampling particular attention was paid to the following characteristics:

1. Different parent material
2. Different slope and altitude
3. Different crops (especially for cultivated soils)

Physical and chemical characteristics of representative profiles are given in the text accompanied by some figures, diagrams and photos of each individual soil group. All the other results and methods of field and laboratory investigations are presented in the form of appendices.

C H A P T E R   T W O

PREVIOUS WORK

2.1. Previous work on the soils of the Elbistan basin

This chapter describes earlier work on the soils of Turkey and assesses the extent to which these earlier studies have thrown light on the nature of the soils of the Elbistan basin.

In early 1950's, the American soil scientist Harvey Oakes was invited by the Turkish Ministry of Agriculture to prepare a soil map of Turkey and this map, the first of its kind, together with a legnthy commentary, was published in 1954. Oakes' report was based on his personal field work, carried out mainly in the western two-thirds of Turkey west of an approximate line from Antalya north, through Gaziantep, Malatya and Erzincan to Trabzon, which he used as a basis for a nation-wide classification of Turkish soils. Large areas of eastern Turkey were not mapped in the field, the soils of these areas being classified on the basis of large-scale geological and topographic maps. Thus Oakes' work, as he himself admits, was essentially a reconnaissance survey, designed to give a very general classification which would inevitably require considerable modification in the light of any later, more detailed investigations carried out by other workers.

In his report he points out that "It should not be assumed that this first study will supply specific answers to the many questions concerning the use, management or classification of the soils of Turkey. The limited time in which it was made, the almost complete lack of published information on the soils, the difficulty of travel and of close coverage of the country, the lack of help from locally trained personnel and the lack of specialists in other fields of research for consultation and help practically preclude the possibility of precise answers to most of the questions. This study can do little more than furnish preliminary useful information pending more detailed research and indicate where it is most needed and to some extent how it can be obtained."

He describes his methods as follows: "Samples of soils tentatively classed as members of named soil groups were collected from sites that appeared to be representative of the group. These samples, which included all recognizable horizons as well as the parent material, in many instances to a depth of 1.5 to 2 metres, were subsequently examined in the laboratory of the Ministry of Agriculture at Ankara. In most cases two or more samples of each important soil group from widely separated sites were collected. Vegetation, land use, apparent productivity as indicated by crops, topography or slope of land, and other features were observed and recorded in field notes. The description of soil profiles sampled for laboratory study which are given in this report are based directly on the original field notes. The variations or range in characteristics are based on these as well as a large number of additional soil descriptions made during the field work."

A major element in Oakes' work was the relationship between soils and topography, and relief conditions formed a first stage in his classification. The following categories were recognized:

Class A : Mainly level, slope 0-1%

Class B : Gently sloping, 1-3%

Class C : Moderately sloping, 3-8%

Class D : Strongly sloping, 8-15%

Class E : Rough, broken land, 15-40%

Class F : Rough, mountainous land with slopes over 40%

In this report, Oakes explains that relief or slope influences soil formation and indicates differences in soils that are significant to land use and management. Soil slope classes in his work are intended to indicate morphological and genetic differences of soils as well as significant changes relative to the capabilities of soil for use. According to H. Oakes "The native vegetation is as varied as are the relief and climate. As a whole the character of vegetation differs mainly according to moisture conditions which are closely related to relief and depth of soil. Thus it is apparent that a close relationship exists between character and depth of soil, relief, moisture and vegetation. The natural vegetation as a rule is typical of that of the climate in which it is found." He adds that "In summing up the combined effects of the factors in soil formation in Turkey (i.e. parent material, climate, vegetation, relief and time) it will be necessary to take an oversimplified view of the whole. There is a wide variation in the combination of factors within very short distances.

For example, parent materials range from sedimentary rocks such as highly calcareous clays or limestone to igneous rocks such as ryolite and basalt, or to metamorphic rocks such as marble, schist and gneiss within a very small area. There may be no measurable change in climate, yet vegetation and relief may show great differences. This produces different sets of factors which in turn produces soils with different characteristics." As an example he quotes regions of high temperature and rainfall, where conditions are suitable for chemical and biological action, as in the Antalya area, where soils are quite different from those developed on similar parent material in Central Anatolia. He also points out that moisture is the limiting factor in plant growth in much of Turkey. Therefore vegetation does not play an important role either in soil development or in holding a soil in situ. Lack of moisture also reduces the rate of chemical decomposition and inhibits leaching. According to Oakes, under the low rainfall of most of Turkey, both rate of weathering and growth of vegetation are restricted and strongly developed soil profiles with leached surface layers are rare. He also comments that much of the relief of Turkey is unsuitable for rapid soil development in situ owing to erosion and that, geologically speaking, large areas of Turkey are relatively young. Lastly he points out that "however, soil formation is not dependent on one factor alone but on a favourable combination of all the factors working together."

As regards classification of Turkish soils, he comments that "the system of soil classification and nomenclature followed in this study is based on that used in the United States. The system outlined in Soils and Man, 1938 Yearbook of Agriculture, and modified slightly in the Symposium on Soil Classification published in Soil Science, 1949."

In his classification of Turkish soils, Oakes identifies 18 major soil groups as follows:

1. Brown soils
2. Reddish-brown soils
3. Reddish Chestnut soils
4. Reddish Prairie soils
5. Sierozem
6. Chestnut soils
7. Terra Rossa
8. Noncalcic Brown soils
9. Red Podzolic soils
10. Grey-Brown Podzolic soils
11. Brown Forest soils
12. Rendzina
13. Grumusol
14. Solonchak
15. Lithosol
16. Alluvial soils
17. Hydromorphic Alluvial soils
18. Grey - Calcareous Regosols

Each of these is discussed in detail in the text of his report.

In the Elbistan basin, Oakes' map distinguishes the following four soil types:-

5 B Reddish-brown soils, gently sloping, 1-3%

5 C Reddish-brown soils, moderately sloping, 3-8%

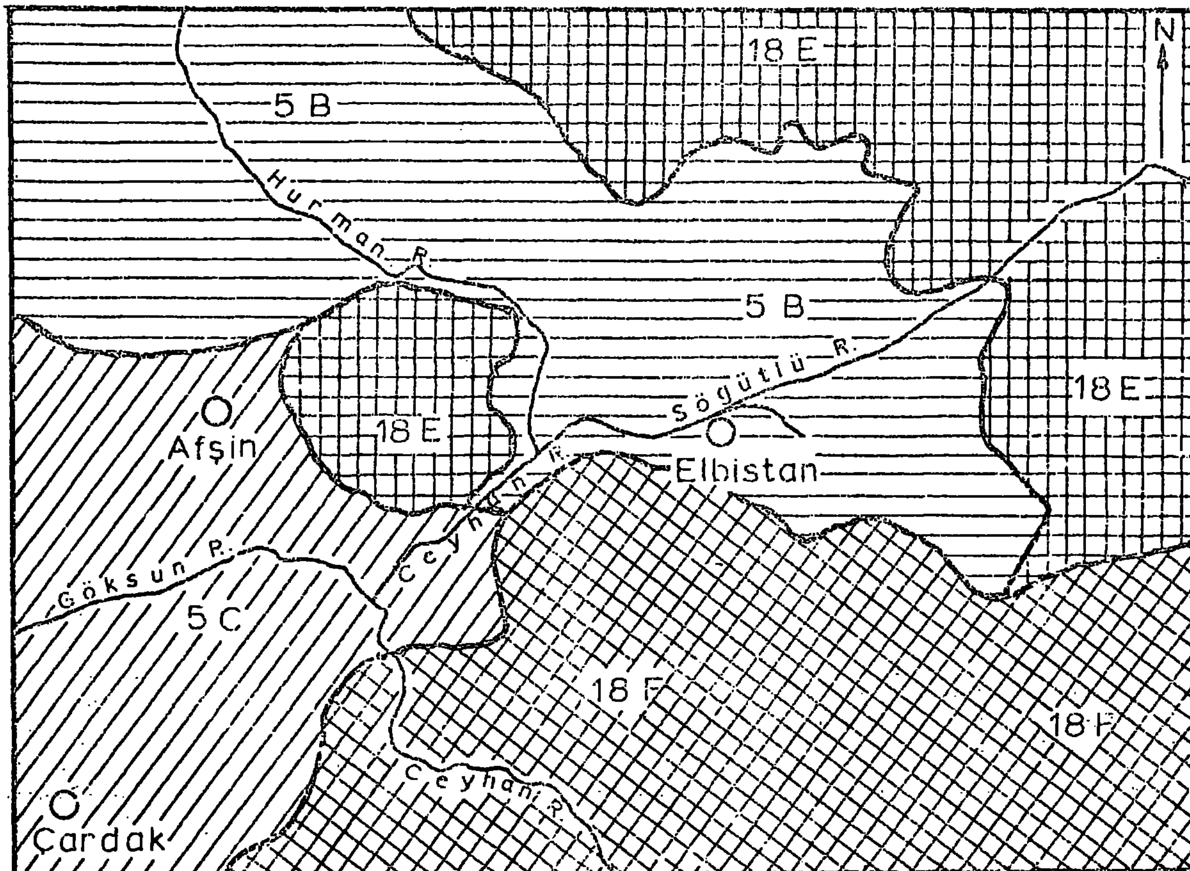
18 E Rough broken land (Brown soil material)

18 F Rough broken land (Over limestone) (Fig 3)

It can be seen that these types are distinguished mainly on the basis of relief and that, according to Oakes, Reddish-brown soils are dominant in the area of the present study. On the soil map, his category 5 B soils cover the area to the north, east and northwest of Elbistan Town and to the south of Afsin Town. However, the present investigation in the same area has shown that, in addition to the Reddish-brown soils, there are also areas of brown soil material derived from alluvium. These occur along river courses in belts varying in width between 100 and 500 metres. Between Afsin and Cardak Town, soils are shown by Oakes as Reddish-brown, moderately sloping. Again not only 5 C type of soils occur in that area but also brownish soils which have been revealed by the present investigation.

2.2. Government Agencies:

Various government agencies have also worked in various parts of the region and have produced a number of reports concerning land capability classification and water utilization in the Elbistan basin. The main aim of these authorities has been to give advice to the farmer on land and water utilization. In 1963, D.S.I. (Devlet Su



SOILS OF THE ELBISTAN BASIN (according to H. OAKES)

5 B Reddish-brown soils, gently sloping 1-3 %

5 C Reddish brown soils moderately sloping 3-8 %

18 E Rough broken land (brown soil material)

18 F Rough broken land (over limestone)

0 km. 20

Fig. 3

Isleri) prepared a report called "Land capability classification of the Elbistan Basin". In that report they identified six different land types in the basin according to their irrigation potential. Of these, four categories are classified as "irrigated land" which means that water is available at any time. The fifth category is "irrigable land" and the sixth is "non-irrigable". This land is worthless and attempts to irrigate would cause problem of erosion or salinity in the areas concerned.

In the basin, D.S.I. dug 1758 pits and collected 5276 soil samples and 56 water samples. All these were taken at points on the floor of the basin. These samples have been analysed in the D.S.I. soil laboratory. In the preparation of their reports D.S.I. used topographic maps at a scale of 1:25,000 and air photos at 1:35,000. The report makes a number of favourable conclusions. Soil erosion is not a serious problem in the area. Soil permeability is very good in most parts of the region and there is no salinity or alkalinity problem in the area. The report is concerned mainly with the structure, texture, water permeability, conductivity and pH of the soils in the area, but contains no general soil classification, though it does suggest that the soils of the basin are for the most part reddish-brown or brown types.

In 1969, D.S.I. published a second report entitled "Water utilization of the Afsin - Elbistan basin". This is very similar to the earlier report, but covers a smaller area in greater detail. The report is concerned particularly with surface and underground water in the area. Water permeability is rapid or very rapid in most places. In some areas the water table is very near the surface and 102.5 ha. of land showed alkalinity problems requiring immediate action.

Both these reports give a clear picture of surface and underground water movement and the suitability of the area's water supplies for irrigation.

Lastly it should be mentioned that the recent discovery of lignite deposits by M.T.A.[1] in the Elbistan basin has given great importance to the area. Nearly four years of geological exploration has shown that the northern part of the Elbistan basin has very rich lignite deposits which are worthy of exploitation. As a result of these investigations, a detailed geological map at a scale of 1:25,000 has been produced and this has proved of great value in the present pedological investigation. In particular it has indicated the nature of the solid geology concealed under the superficial deposits which cover much of the area and thus gives a clear picture of the parent materials from which the soils have been formed. Secondly the hydrogeological investigations carried out by M.T.A. have involved studies of fluvial morphology and underground water movements which have been of considerable help in explaining the action of water in soil formation.

Oakes' soil report together with the soil map is regarded as a preliminary attempt which suggests definitions

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1. M.T.A. Maden Tetkik ve Arama Enstitusu.

and names for rather broad groups of soils. Oakes' work also gives a general idea of the types of soils which occur in the Elbistan basin. Samples from the basin itself were not analysed by Oakes but his text does contain chemical and physical data for representative samples of 5B and 5C soils. These data have been of value for comparison with the profiles collected in the basin during the present investigation.

The reports by the government agencies mentioned above have been concerned only with the soils on the floor of the basin. The main aim of these agencies has been to demonstrate the irrigation potential and the utilization of both land and water in the Elbistan basin. Finally M.T.A. has described the nature of the solid, geology concealed beneath the superficial materials.

The formation of the soils in the basin has not been explained by these earlier investigations and no detailed soil research has hitherto been attempted in the basin. Although the D.S.I. investigations in the area give some details they have not answered many questions on the problems of the area. Thus there is scope for much more detailed work on pedogenesis in the basin and this is a major aspect of the present research.

C H A P T E R T H R E E

PHYSICAL ENVIRONMENT

3.1. GEOLOGY

INTRODUCTION

Two major mountain systems run almost parallel to each other along the northern and southern sides of the Anatolian peninsula. In the north, the Pontic ranges rise steeply from the Black Sea and extend over 1200 km from the Rioni valley, south of the Caucasus, almost to the Bosphorus. Metamorphic and intensely folded Palaeozoic rocks form the basal series of the eastern Pontic block and are overlain by extensive Upper Cretaceous and Eocene volcanic masses and are intruded by mainly acid plutonic rocks. In the south, the Taurus ranges fron the Mediterranean, widening eastwards to give extensive mountain country in eastern Anatolia. Throughout this section limestones and series of basic and ultrabasic igneous rocks are dominant. Between these two mountain zones lies the Anatolian massif where high plateaus are separated by mountain ranges and where there are numerous volcanoes and lava plateaus. Since the two mountain systems converge eastwards, eastern Anatolia is characterised by a dominance of rugged mountainous terrain. However it contains a number of downtrown basins with generally level floors, for example those of Malatya, Elazig and Elbistan.

Geology of the Elbistan Basin:

The stratigraphy of this area can be described under the headings of Metamorphic, Paleozoic, Mesozoic, Tertiary and Quaternary (M.T.A. 1966).

A. - Metamorphic series: This series may be seen exposed in the Nurhak and Binboga mountains. The oldest and most metamorphosed formations in this area are found within the exposures of the old basement in the south. It is difficult to observe the relationship between these rocks and the surrounding formations which have distinct sedimentary characteristics. Basic intrusions occur chiefly in the outcrops of the old basement around the Nurhak, Berit and Binboga mountains. The greater part of them have been serpentinized. (Fig. 4).

B. - Palaeozoic: The outcrops of Palaeozoic age consist of alternating beds of non-fossiliferous clay, shales and blue limestones which occur between metamorphic series and younger formations. There are also fossiliferous formations of Devonian and Permo-carboniferous age. Outcrops of Devonian age are seen immediately west of the Binboga mountains. Permo-carboniferous outcrops appear on the eastern and western section of this area and also in the southeast and southwest areas. The higher parts of the mountain ranges are formed of blanket limestones which display many karstic features. Rocks of Permo-carboniferous age rest variously on the metamorphic basement and on Silurian and Devonian strata and in places are covered by formations of Triassic, Cretaceous or Tertiary age.

GEOLOGICAL MAP OF THE ELBISTAN BASIN

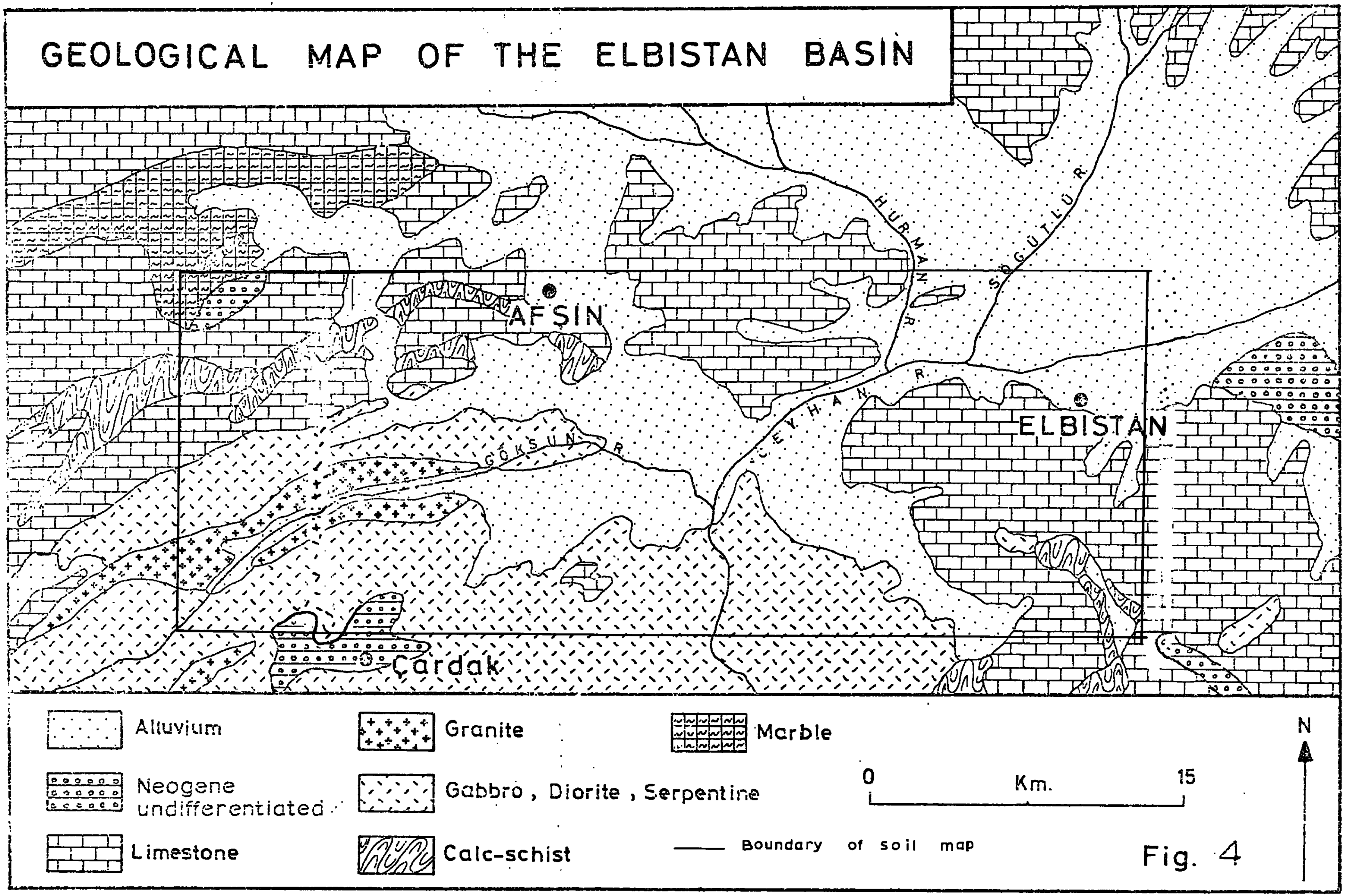


Fig. 4

C. - Mesozoic: Within the Elbistan basin the thinnest outcrops are those of Triassic age and the thickest are the Jurassic and Cretaceous. Volcanic activity increased during the Upper Cretaceous and continued throughout Tertiary times. Rocks of Triassic age do not appear as separate and distinct outcrops. Part of the higher levels of the Permo-carboniferous limestones may be of Triassic age. Triassic series may also be exposed at Agacasar village southeast of Elbistan and have also been found within the limestone resting above the Permo-carboniferous limestones of Ordekli yaylasi east of Dayioluk village which is about 25 km south of Sariz.

Outcrops of Lower Cretaceous are few and generally occur as the upward continuation of strata of Triassic and Jurassic age, all forming a comprehensive series. Upper Cretaceous rocks outcrop on the highest parts of Nurhak and Binboga mountains.

D. - Tertiary: Tertiary rocks are seen in very few areas within the Elbistan basin. Outcrops of rocks described by the geological survey as "Miocene, continental undifferentiated" occur near and to the north of Elbistan Town. This very broad category includes rocks of Lower Eocene and Middle Eocene (Lutetian) age, together with Eocene flysch, gypsiferous Oligocene rocks and Neogene deposits.

E. - Quaternary: Quaternary deposits are generally found on basins and valley bottoms and terraces are especially well developed in the Malatya and Elbistan basins. In the Malatya basin, within the conglomeritic series generally indicated as Pliocene, Plio-Quaternary and Quaternary deposits there are also some lacustrine limestones. In the Elbistan basin on the other hand this conglomeritic series is absent and is replaced by gastrapod-bearing lacustrine limestones. Overlying these limestones and covering extensive areas there is a great amount of mobile material of alluvial type which should also be considered of Quaternary age.

Metamorphism:

Metamorphic rocks indicative of regional as well as contact metamorphism have been distinguished in this area.

A. - Regional metamorphism: The regional metamorphic formations of the Elbistan basin appear chiefly in the Binboga and Nurhak mountains. Calc-schist and chlorire-schists are dominant in the Binboga district. On the other hand, in the Nurhak mountain extensive serpentinization occured in Gabbro basic intrusives as a result of regional metamorphism (M.T.A. 1966).

B. - Contact metamorphism: Contact metamorphism and mineralization have been caused by different agencies at different times. The old basement rocks and Mesozoic strata have been affected by acid intrusions. Mesozoic strata have also been largely affected by ultrabasics, while Tertiary rocks have come chiefly under the influence of basalts and andesites. At the contact zones there is an abundance of hornfels, garnet, epidote and calcite. There are also many serpentine inclusions in granites and dolomitic limestone inclusions in syenite.

Igneous Activity:

The igneous activity seems to have been largely connected

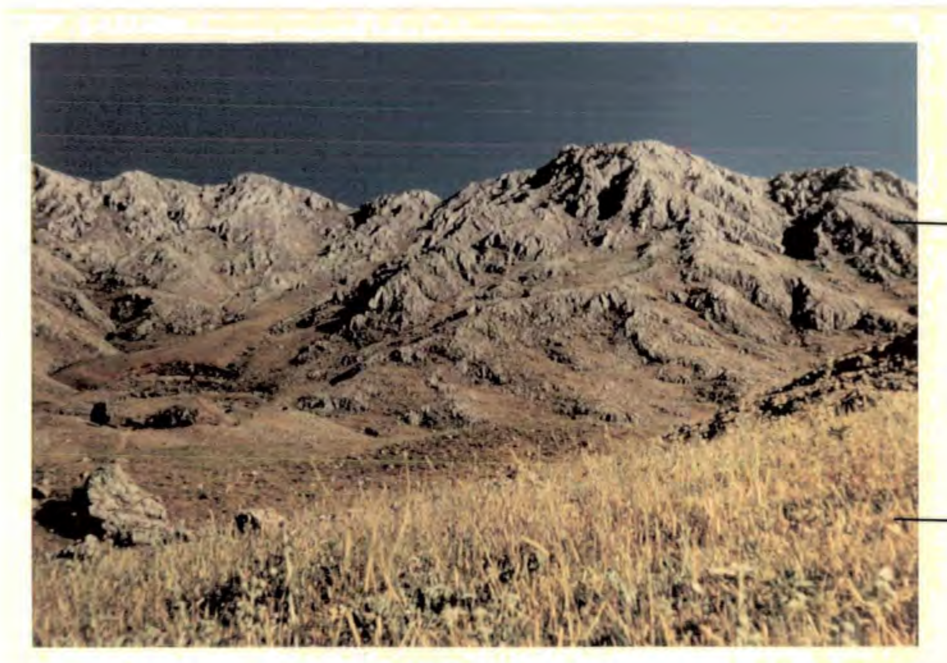


Plate - 3 The eastern Elbistan basin, looking towards south. The picture taken about 5 km west of Elbistan Town.

Plate - 4 A panaroma of western Elbistan basin. The highest point of the area is Tülce tepe (1900 m.). The picture taken towards the south western direction.

with Alpine orogenic movement (KETIN, 1966). There are isolated outcrops of acid and intermediate plutonic rocks of late Eocene and Oligocene age at Kargabuku village in the west and a single small mass in the southwest near Cardak Town. These rocks have been identified as Granite, Granodiorite and Quartz-diorite. Basic igneous rocks cover southern parts of the area. On the upper slopes of Kargabuku valley there are some Gabbro and Diabase identified as Diorite and some iron rich basic intrusives. The Ophiolithic series are serpentinized in places.

3.2. STRUCTURE AND RELIEF

There is little physical unity in eastern Turkey, since the region consists of a series of mountain ranges, extensive and continuous in the north but falling away in the south, first into broken plateau country and finally into undulating plain which continues through north Syria and Iraq. Further disunity arises from the presence of several large basins, along the courses of the major rivers, such as the Aras, Firat (Euphrates) and Dicle (Tigris). The majority of these basins are fault-bounded.

The Elbistan basin lies in the valley of the Ceyhan river and is one of the down thrown basins of eastern Anatolia. Its long axis extends 60-65 km in an east-west direction and its width varies from 40-45 km. The western part of the basin is surrounded by the Binboga mountains which form massive and extensive ranges rising to a height of 2500metres, above sea level, while the southern part of the basin is enclosed by Berit Dag (3014 m) which is composed of Palaeozoic limestones, crystalline schists and basic igneous rocks. At intermediate levels between the basin floor and the steep slopes of Berit Dag there is a pronounced shelf about 6 to 8 kilometres wide developed on Neogene deposits at 1200 to 1300 metres. The mountains on the eastern side of the basin are composed of Permocarboniferous limestones, which have been strongly folded in a northwest - southeast direction. The highest point in these eastern ranges is Sardag, 2300 metres. The massifs of the Binboga, Berit Dag and Sardag surround the basin, forming steep slopes reaching altitudes between 2000 and 3000 metres in the highest parts. (Fig. 5).

Morphologically, the basin floor shows a high degree of uniformity. Apart from the Soluk Hills in the centre of the basin, which probably formed an island in the lake, the land is flat or gently sloping. Slopes become somewhat steeper in a hill-foot zone between the old Lake floor and surrounding mountains; this intermediate zone is most clearly marked on the western and north-eastern sides of the basin (Fig. 6). The lowest parts of the basin floor are about 1100 metres above sea level.

From the uplands around the Elbistan basin many stream channels enter the plain, especially from the mountains in the south-west, north-west and east. Where the streams enter, sediments form well-marked alluvial fans. The type and size of the fans and nature of their soils are directly related to the size, the present and past climates and the geology of the rivers' catchment areas. The river Ceyhan has the largest catchment area of all rivers and its deposits

Plate - 5 The Ceyhan River and its valley. The picture taken near the junction of Goksun and Ceyhan rivers of the southern Elbistan basin. The direction is northeast. In the centre of the picture (background) Mehre village.

in the basin cover the largest area. The drainage pattern appears to be of a dentritic type (Fig. 7).

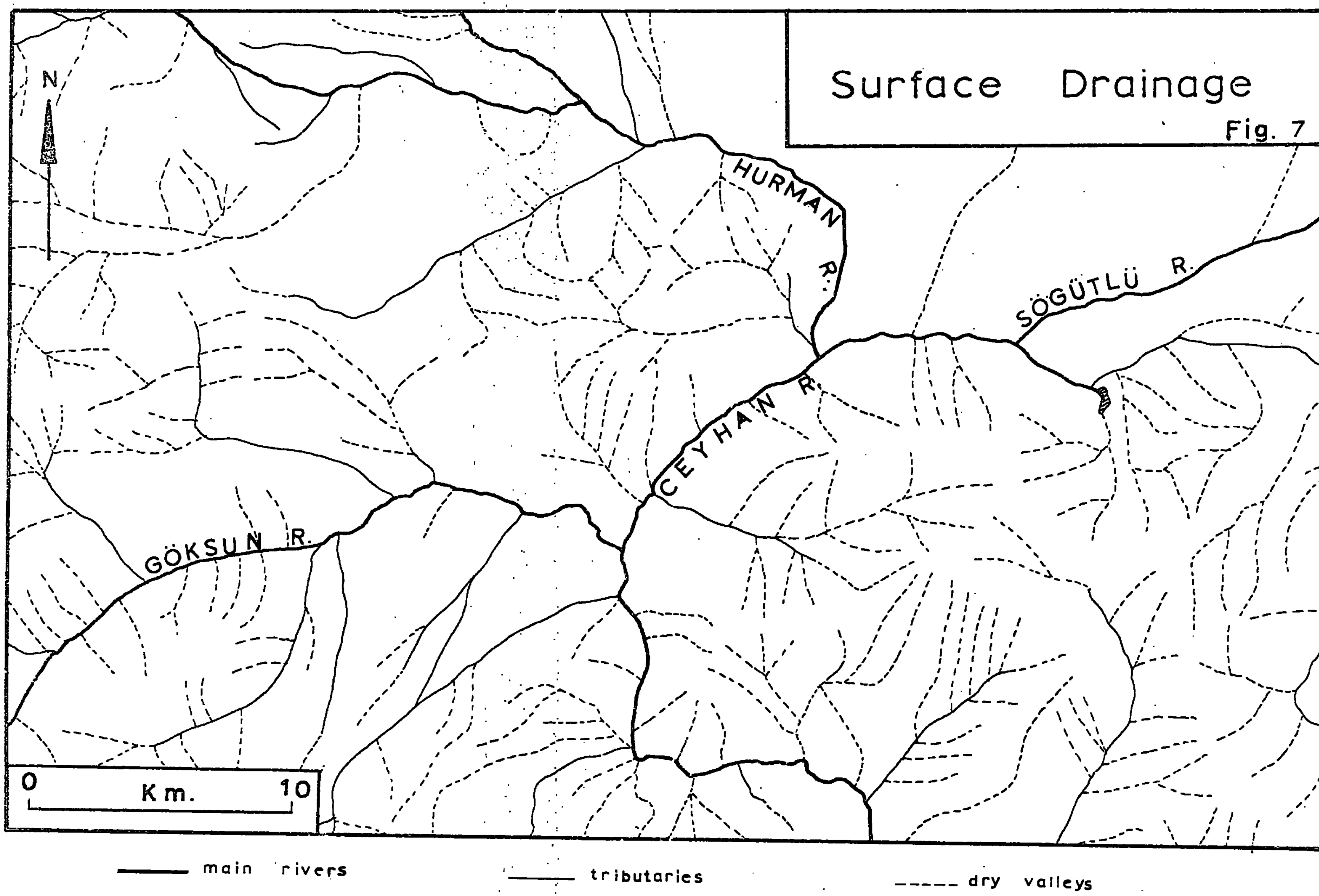
3.3. CLIMATE

Climate of eastern Anatolia:

The climate of eastern Anatolia may be characterised as strong continental. Winters are very long and severely cold and snowy. On the other hand summers, even on the high plateaus, are short but very hot. Therefore the annual temperature range is usually more than 25°C in eastern Anatolia. The temperature range at Kars is 30°C, at Erzurum 28.7°C, at Malatya 28.4°C and at Van 26.3°C. These are the largest temperature ranges recorded anywhere in Turkey.

Air Masses

From late May to late September maritime tropical and maritime polar and also continental polar air masses move across Turkey from the Azores anticyclone and from the Siberian anticyclone in the north and northwest towards the Intertropical convergence to the south and southwest. These air masses are diverted by the Pontic barrier eastwards along the Black Sea coast. In the eastern Black Sea region they are finally forced to surmount the mountain barrier and bring orographic rains. On the other hand continental tropical air is spread over the southern regions of Turkey. At this season Maritime Equatorial air masses are displaced northwards but being far from reaching Turkey do not have any effect on the summer weather type. Thus, the properties of the air masses occupying the area and also the direction of general circulation are not favourable for producing rainfall over central and eastern Anatolia. Indeed, continental tropical air is extremely dry


Surface Drainage
Fig. 7
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tributaries
dry valleys

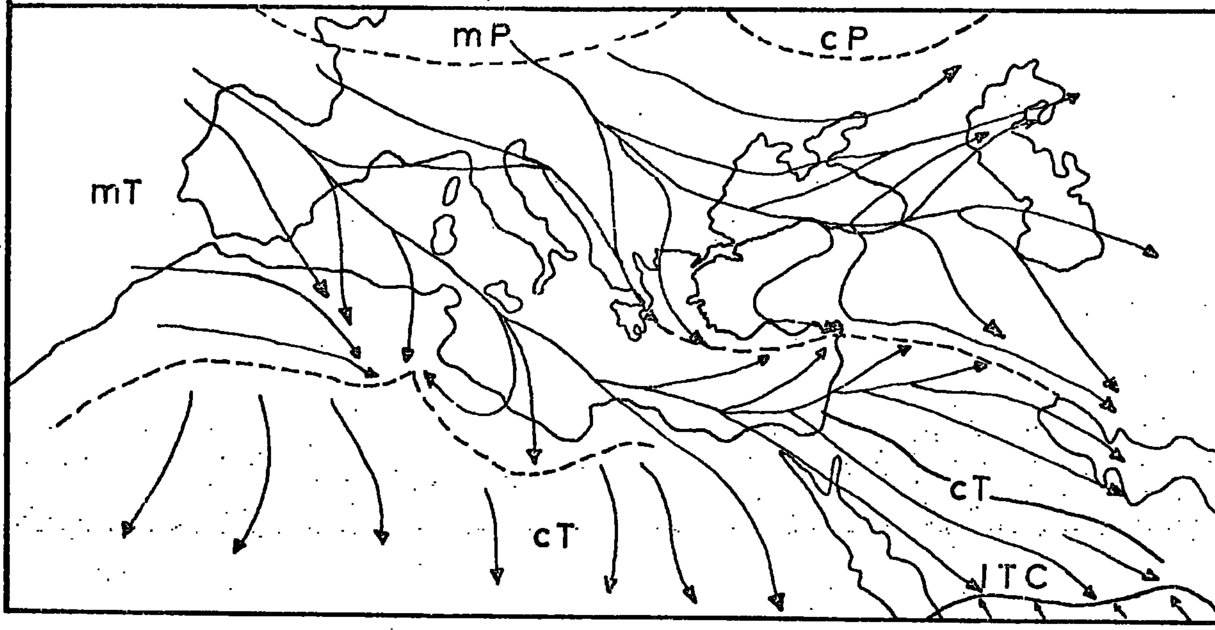
and stable. Maritime tropical air from the Atlantic is also stable. Therefore, the temperature of its surface layers increases gradually as it moves southwards which results in lowering of relative humidity and a rise of condensation level in the same direction.

According to Erinc (1959) the circulation pattern is a consequence of the average pressure distribution which characterises the cold period of the year. The Mediterranean region, including Turkey, becomes a zone of convergence during the cold season. At this season northeastern winds prevail over the northern part of the Mediterranean and southwesterly winds over its southern part. The Mediterranean basin including Turkey is a zone of active frontogenesis in winter.

The most common polar air masses over Anatolia are maritime polar air (mPW), intruding from the northwest, and continental polar (cPK) air from the north and northwest. Erinc (1959) suggest that even arctic air may reach the area, although only very occasionally. The southern part of the country is occupied by mTW and cTW air masses in winter. Erinc (1959) points out that the extensive interior parts of the country, such as eastern and central Anatolia remain longer under cold polar air (cPK). Therefore in the winter three air masses influence the average weather in Turkey. These are cPK from north and northeast, cTW and mTW in the south and west. The cPK air masse very often is the most common over Turkey, therefore the country, especially eastern and central Anatolia, are invaded by cold polar air in winter. (Fig. 8).

Circulation Pattern and Air Masses in July

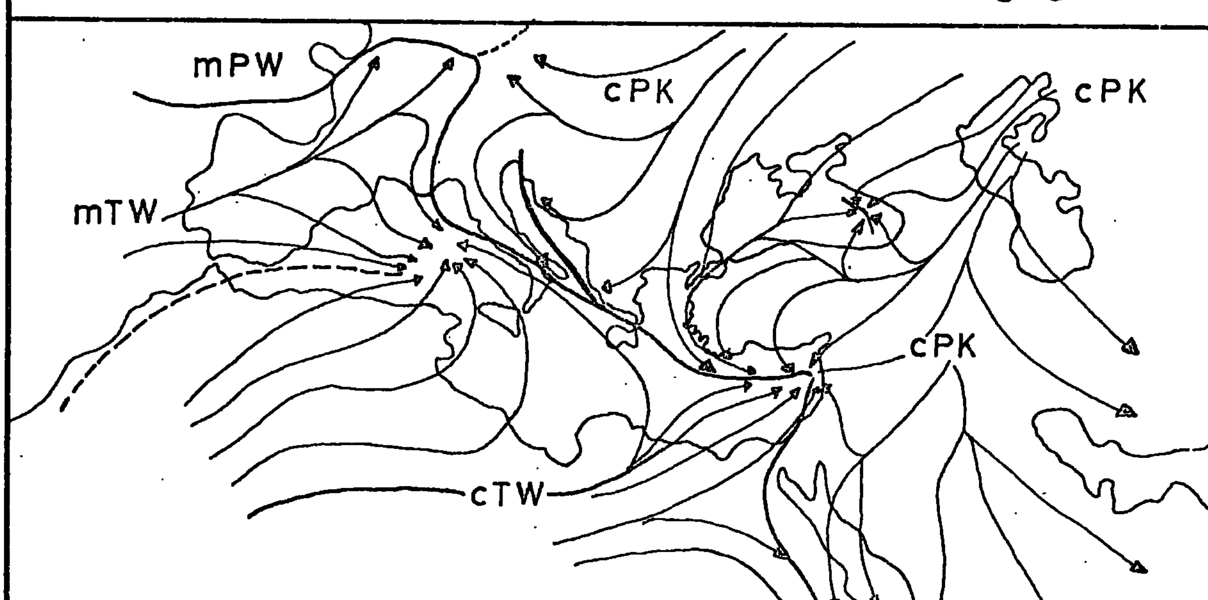
Fig. 8



(from ERINÇ)

Circulation Pattern and Air Masses in January

Fig. 8



(from ERINÇ)

In winter, when the interior plateaus are occupied by polar air coastal lowlands, especially in the south, are often protected by high mountain walls from the cold air invasion and enjoy mild weather. At such times great temperature and precipitation contrasts occur between the interior and the coastal lowlands of northern and southern Anatolia. According to Erinc (1959, p.29) "A comparison between a physical map and a rainfall map or an actual temperature map makes clear that relief plays an important role in causing differences both in the amount of rainfall and the degree of temperature. Therefore, the great amount of precipitation, increased rainfall intensity, higher humidity and cloudiness on the outer slopes of the Black Sea mountains and Taurus ranges, whereas an exaggerated rain shadow effect on the lee of the mountain is caused."

Continentality

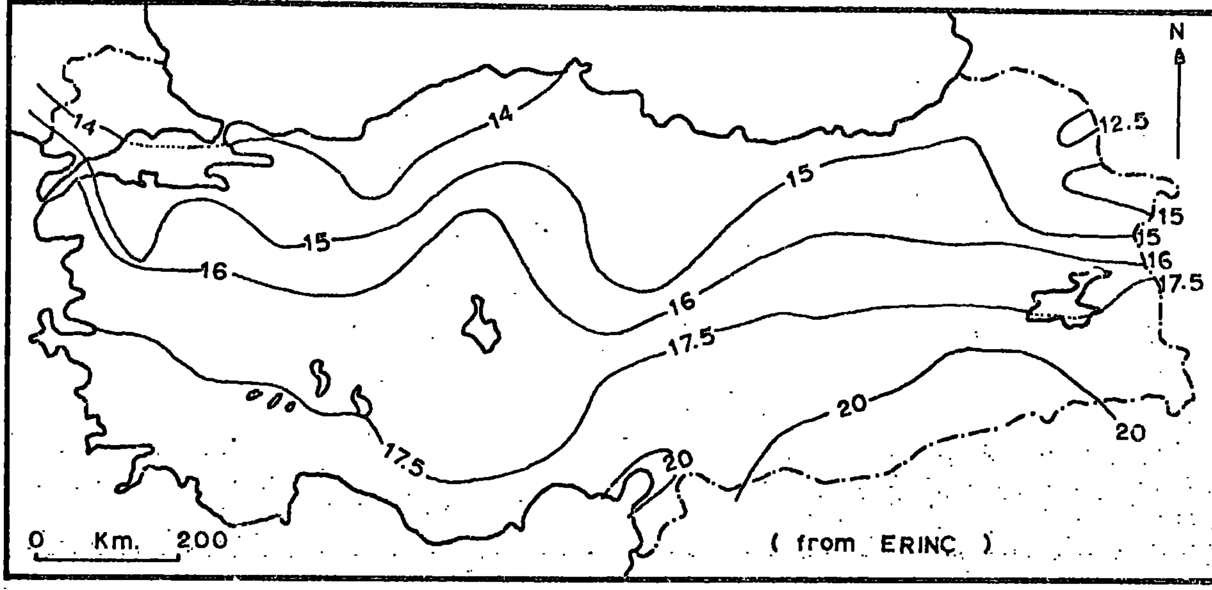
Continentality has already been analysed by Akyol (1951) and Erinc (1952). According to Erinc, Anatolia, broadly connected to Asia, has a massive form and shows therefore a high degree of continentality, although it is surrounded by seas on the north, west and south. The degree of continentality in the interior is over 40 according to Johansson's formula and equals 60 in the northeastern plateaus. Degree of continentality for eastern Anatolia is shown in Fig. 9

Temperature

Distribution of mean annual temperatures reduced to sea level is shown in Fig. 10 It clearly shows that the values of the annual temperature are largely influenced by the degree of continentality and by the land and sea distribution.

Reduced Average Annual Temp. C°

Fig. 10



The Degree of Continentality

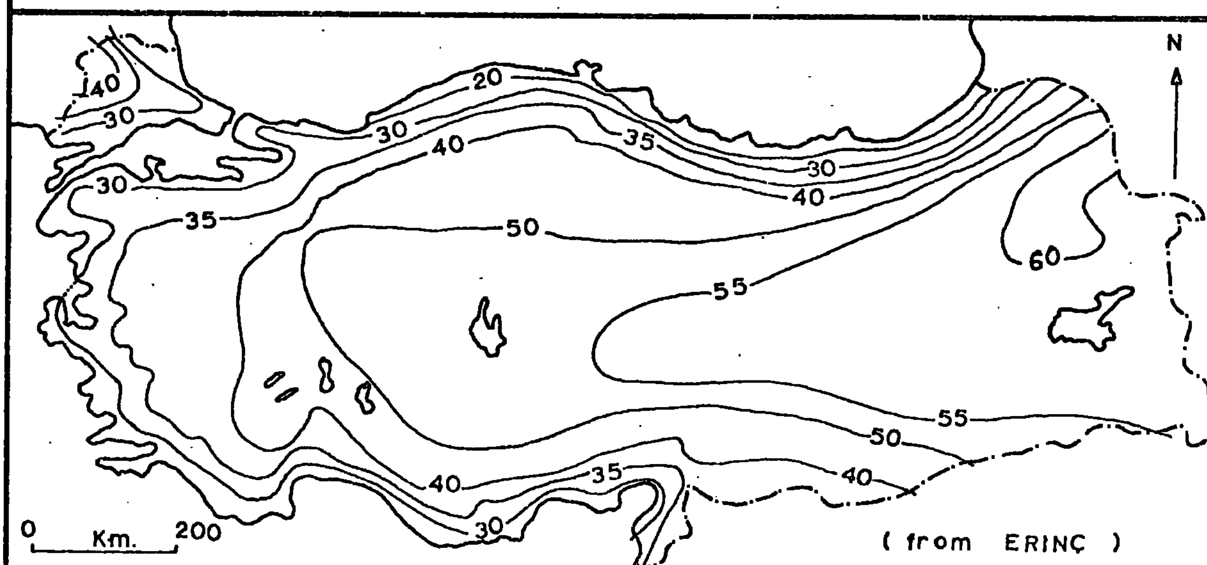


Fig. 9

Thus mean annual temperature decrease from the southeast, where maximum values are observed, towards the northeast and northwest. The distribution of actual annual temperatures however depends on the altitude, according to Kurter (1958). Actual temperatures in the coastal lowland are higher than in interior and eastern Anatolia.

The distribution of mean July temperature in eastern Anatolia reduced to sea level, is shown in Fig 11. The highest sea level means are observed in southeast Anatolia. The actual maximum July temperature recorded in the Malatya basin is 41°C. (1) According to Erinc (1959) an altitude of about 1000 metres of central Anatolia is as warm as the coastal lowland in the north and northwest even some interior depressions of eastern Anatolia, July temperatures are higher than those in the Mediterranean lowland because of the effect of continentality.

Continentality and altitude are again the main factors in the distribution of temperature in January which represents the cold season in general. The main characteristic of winter is the sharp contrast between the coastal lowland showing positive anomalies and the continental interior where the largest negative anomalies occur Fig. 12 Great regional thermal differences are the characteristic feature of winter in Turkey. The January mean in the Malatya basin is -4.3°C.

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(1) There is no observatory in the Elbistan basin recording temperature. Therefore climatological data from the Malatya observatory, which is about 120 km northeast of the Elbistan basin, have been used in this chapter. On the other hand there are three rain gauges recording daily precipitation in the Elbistan basin.

Reduced July Temperatures C°

(from ERINÇ)

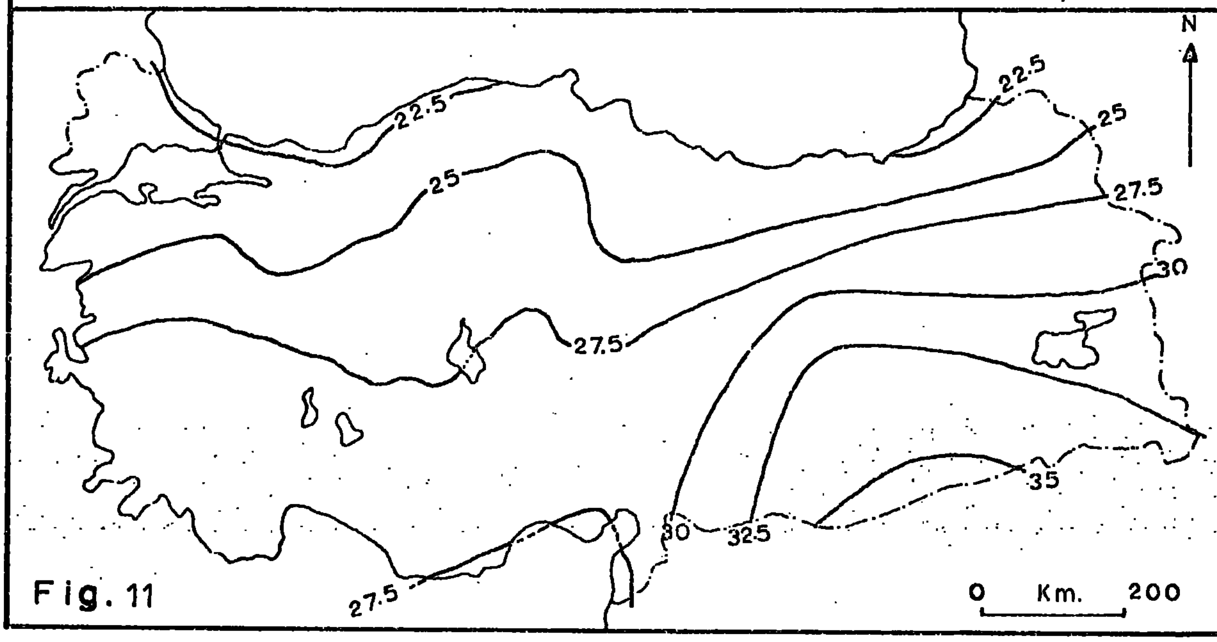

Fig. 11

Reduced January Temperatures C°

(from ERINÇ)

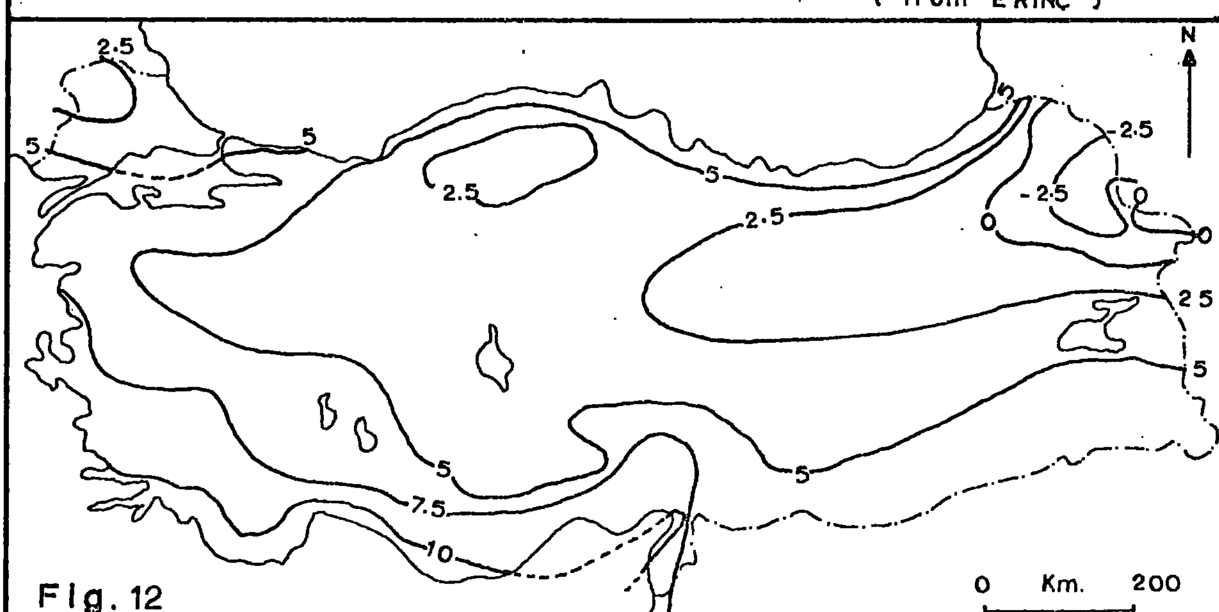

Fig. 12

Seasonal distribution of temperature at Malatya is shown in Fig. 13

Rainfall, Humidity, Evaporation

The seasonal distribution of the annual precipitation has been studied by various geographers including Akyol (1944) and Erinc (1951-1957) Erinc (1957 points out that two different precipitation regimes with one transitional sub-type may be distinguished in eastern Anatolia:

1 - The continental type, which occurs in northern and northeastern part of Turkey.

2 - The Mediterranean type, in southern and southeastern part of Turkey.

3 - The Central Anatolian sub-type, which occurs in the eastern part of Turkey.

The Elbistan basin is under the influence of the Mediterranean type of precipitation regime Fig 14 , As is seen on the figure, rainfall increase from east to west in the basin, and reaches 541 mm at Goksun Town.

Probability of rainfall is of course subject to seasonal changes as a result of different precipitation regimes. It is also varies from year to year. These variations have been analysed by Tumertekin and Conturk (1959) for the whole of Turkey. According to them, the geographical distribution of both the positive and negative departures from the mean number of rainy days show a close resemblance to the average distribution of rainy days. Indeed, the highest number of rainy days expected within a period of 10 years occurs in the northern part of the country. The number of rainy days[1.]

1. According to the definition given by the Turkish Met. Office any day having a precipitation equal to or more than 0.1 mm is regarded as a rainy day.

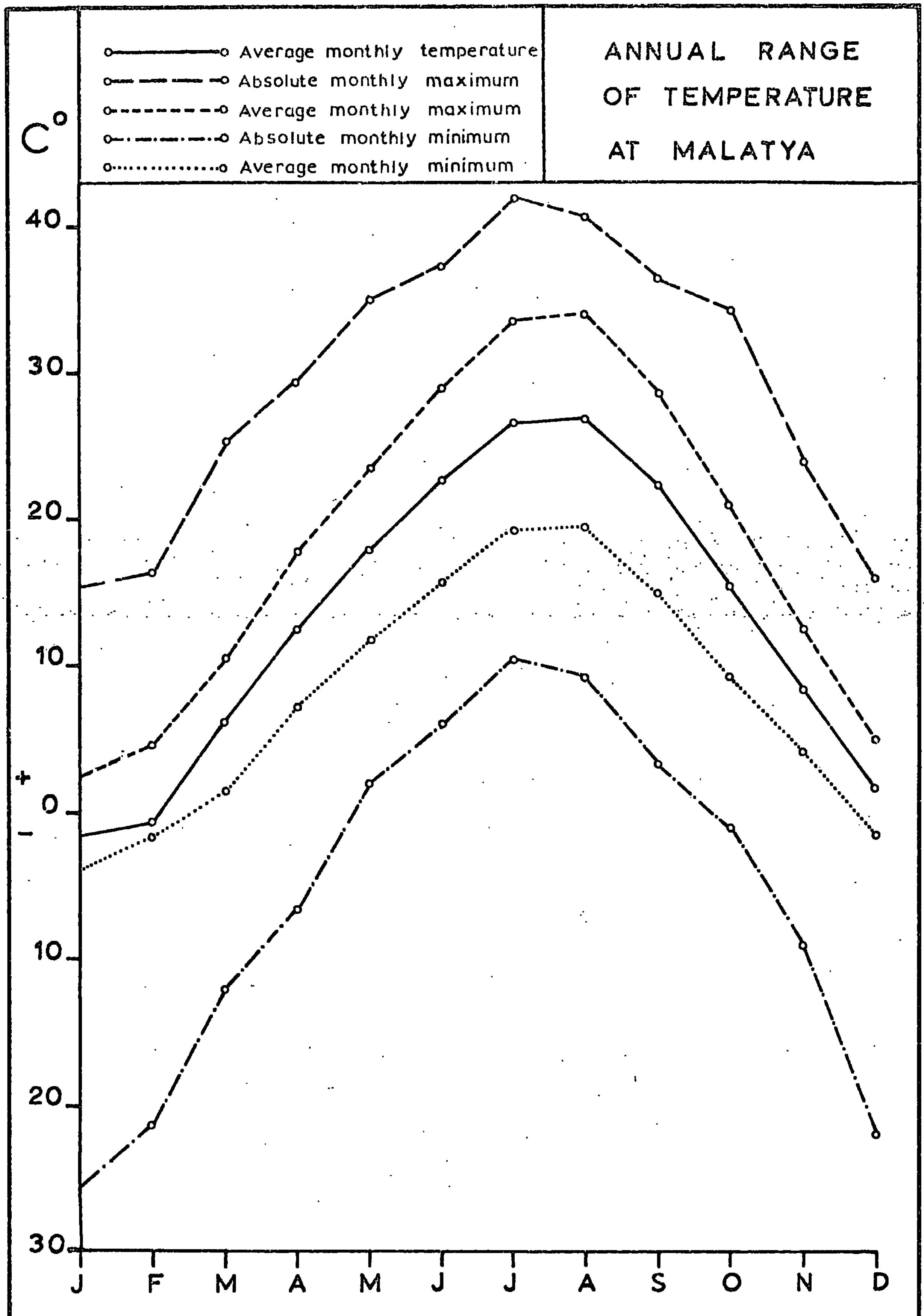
Average monthly temperature
Absolute monthly maximum
Average monthly maximum
Absolute monthly minimum
Average monthly minimum
ANNUAL RANGE OF TEMPERATURE AT MALATYA
C°
40
30
20
10
+
0
-
10
20
30
J F M A M J J A S O N D

Fig. 13

expected within a period of 10 years for Malatya are 81 days.

There is a great difference between marginal areas and eastern and central Anatolia regarding the average number of days with snow cover.[1] The number of days with snow cover is higher than in the Marmara and Black Sea regions (10-20 days). In central Anatolia the ground is covered with snow 20-40 days, on the average. The maximum occurs on the northeast plateaus where the number of days with snow cover exceeds 120. This figure is 34 days in the Malatya basin.

Erinc suggests that, in Turkey, the snow line lies between 3100 and 4200 metres. In eastern and central Anatolia it varies from 3500 m on Mt. Erciyas to 3700 m on Mt. Suphan and to more than 4000 m on Mt. Agri (Mt. Ararat).

Relative humidity is highest in the northern coastal region. Here it varies between 70 and 80 per cent, and decreases southwards where the values in central and eastern Anatolia are 60 and 70 per cent and 50-60 per cent respectively. On the other hand in southeastern Anatolia this value is recorded as 40 to 50 per cent. Seasonal changes of relative humidity in the Malatya basin are from a minimum of 30 per cent in summer to a maximum of 78 per cent in winter.

The average annual evapotranspiration reaches its maximum in the southern part of eastern Anatolia where it is more than 100 cm.

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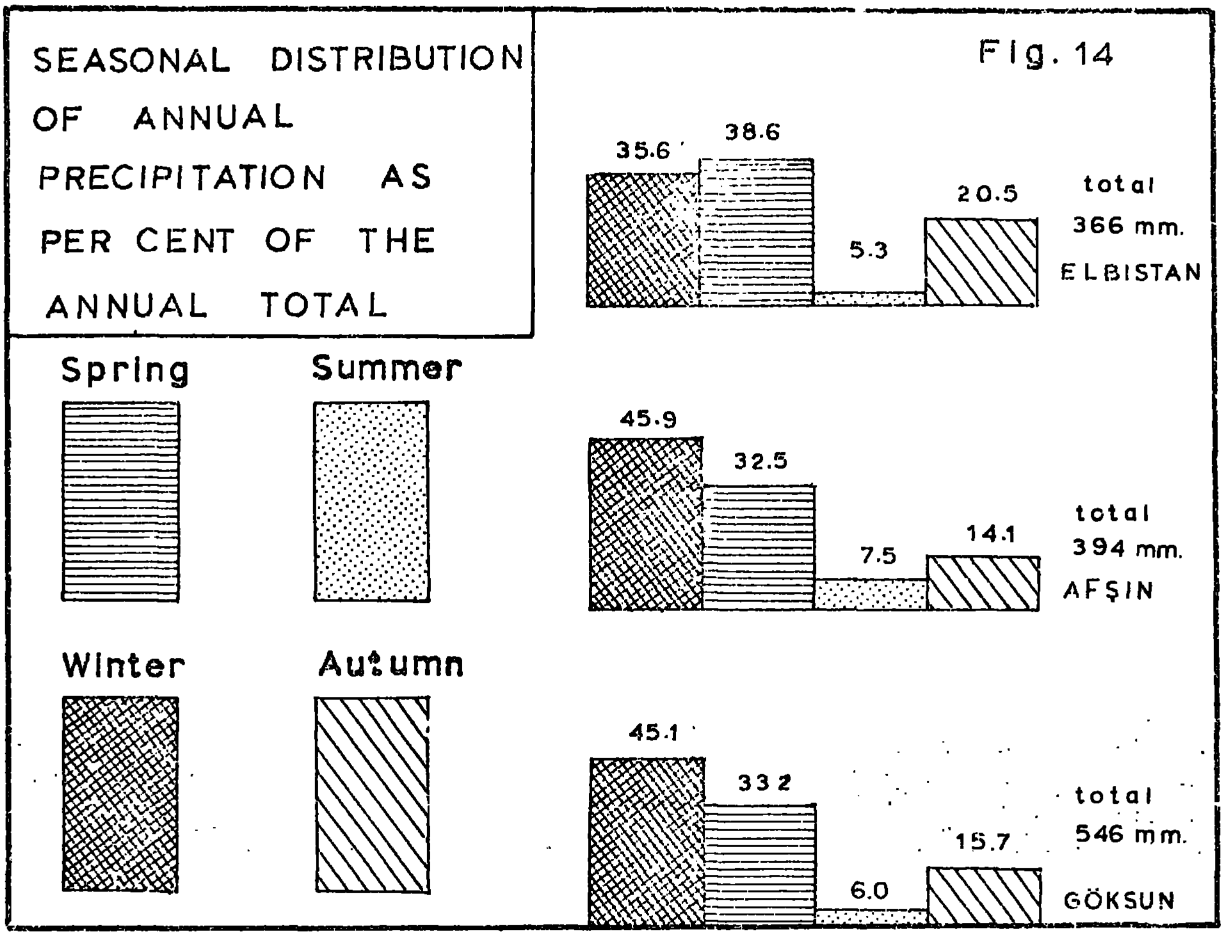
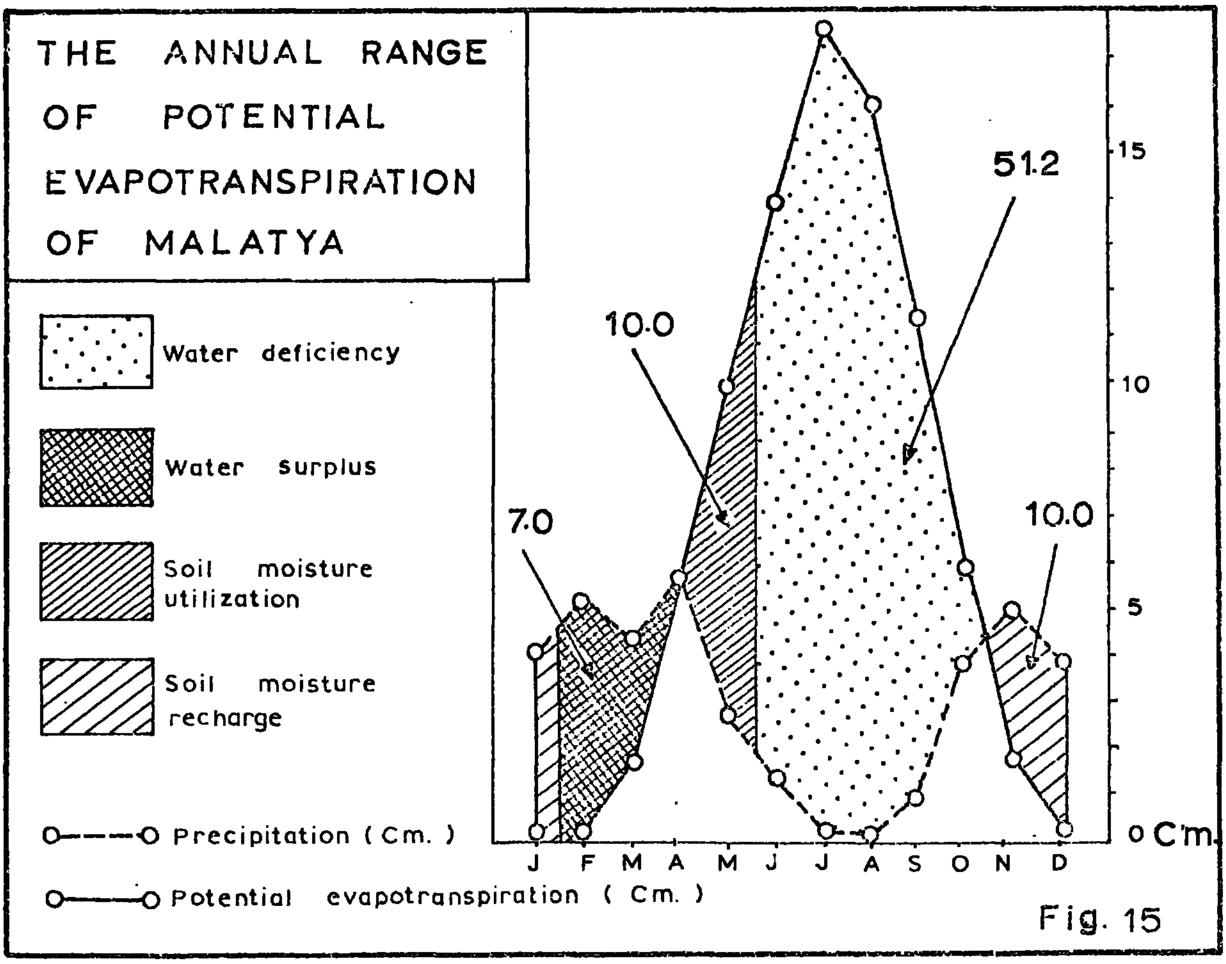
1. According to the Turkish Meteorological Office any day which the ground is covered by snow equal to or exceeding 5 mm thickness during the observation at 7 o'clock is defined as a day with snow cover.





(from Erinc 1957)

In northeastern highland areas it is as low as 45 to 55 cm. The annual range of potential evapotranspiration at Malatya is shown in Fig. 15 This diagram shows that the Malatya basin has a water deficiency between May and October. On the other hand between January and April there is some water surplus. Thus, for almost six months the soils in the basin are dry and deprived of moisture.

Climatic changes since the Pliocene

During the greater part of geological history, world temperatures were higher and more uniform than at present. There were no polar ice caps and the temperature gradient between equator and poles was considerably less than today. The general circulation of the atmosphere was slack with widespread aridity even in higher latitudes during the several geological periods. This then is the normal climate of geological time. Those few Ice Ages which have occured were periods in which polar and continental ice sheets drastically changed the climatological picture but were of comparatively brief duration. The recent Ice Age or Pleistocene period comprised at least five or six glacial periods during a time of not more than a million years.

During the various Pleistocene glaciations, millions of cubic kilometres of ocean water were stored up in the continental ice masses so that world sea level fell more than 100 metres. During the warmer inter-glacial periods, the ice caps of Greenland and Antarctica were reduced to a size smaller than that of today, with corresponding rises of the ocean level to somewhat above the present mean sea level.

Climatic and ecological character of the various climates of the Pleistocene was obviously different in the temperate or cool arid lands on the poleward margins of the trade wind desert belts and the tropical lands on their equatorial margins.

Butzer (1961) suggests that the great Eurasian steppe zone, covering Anatolia, the Iranian interior, the Spanish meseta and the Atlas Ranges of Morocco and Algeria falls within the temperate dry climate today and is usually delimited by the annual isotherm of 18°C or the January isotherm 10°C. The glacial periods of the Pleistocene here were characterized by a cold climate but little or no increase in precipitation. According to Butzer, reduced evaporation associated with lower summer temperatures, which, he suggests fell by 5°C or more, had a positive effect on the hydrological budget, and the levels of lakes and inland seas were considerably higher than today.

In his book, Flint (1957 p.   ) gives some evidence of possible lake level changes in central Anatolia. He suggests that "It seems possible that the two pluvials are correlative respectively with early Würm and Main Würm of the Alpine sequence" and that "the later dry phase occured during the Hypsithermal. In central Turkey several basins without outlet contained more water during pluvial ages than they have now. He suggests that the levels of some oakes in central Anatolia such as Lake Burdur rose to an altitude 95 m above the lake level of 1950, Lake Tuz (Salt Lake) rose about 75 m above its existing level but had no outlet. The Konya basin is now dry but strandlines and lacustrine sediments with fossils demonstrate a former lake. Also Sungur (1967) suggests that the Konya basin had a large lake and more water during the pluvial ages than it has now, and also suggests three possible different lake levels for the Konya basin lake.

Flint also give some evidence of lake level changes for Lake Van. He points out that "Lake Van has abandoned strandlines at 14, 30, and 60 m above its existing surface. Also Lake Iznik has strandlines at 15, 45, and 55 m above its existing (1949) level.

Butzer (1957) suggests that "The existence of period of considerably greater rainfall during the Near Eastern Pleistocene has been known many years. The post glacial period is usually regarded as beginning with the drainage of the Baltic ice-lake about 8000 B.C., while the last Würm pluvial subphase had probably ceased at the end of the last glacial maximum. In fact it looks as if the general characteristic of the late glacial period in the Near East was arid climate with a rainfall considerably less than today, in view of the prevailing temperatures still a little below those of the present."

The result of Butzer's (1957) investigation of the different climatic phases identified for the Near East may be summarized as follows:

Post Pluvial I. (during the eleventh millenium) During this period wind erosion was particularly pronounced. The rainfall of the Near East was somewhat less than that of the present.

Subpluvial I. (during the ninth millenium) a marked but temporary improvement of moisture conditions is evident in the Near East with a mean precipitation a little higher than today. Würm glaciers developed during this time.

Postpluvial II a. (perhaps 8000 - 6500 B.C.) Typical post pluvial conditions. Temperature a little higher than today; on the other hand, rainfall a little less than that at present.

Postpluvial II b. (6500 - 5000 B.C.) Precipitation a little higher than at present with moisture conditions closely resembling those of today.

Subpluvial II. (5000 - 2400 B.C.) A rainfall greater than that present time, despite indications of higher local temperature.

Postpluvial III. (2400 - 850 B.C.) A renewed decrease in precipitation led to a longer period of arid conditions, probably accompanied by greater warmth with an average rainfall below that of the present, interrupted by at least one moister interval (in the twelfth century B.C.).

Postpluvial IV a. (2400 - 850 B.C. - 700 A.D. A short interval of quite moist conditions, the period characterized by a rainfall. In general the winters still appear to have been warmer. A severe drought between perhaps A.D. 590 - 645 can actually be determined, which however only represent a minor climatic fluctuation prior to a change to slightly different conditions of rainfall and temperatures.

Postpluvial IV b (700 A.D.   ) After about A.D. 650 an increasing number of quite cold winters were recorded in the Near East during which Black Sea was apparently frozen over on occasions (in A.D. 673 and 800 - 801 and ice even formed on the Nile in A.D. 829 and 1010 - 11) The rainfall was a little higher on the average but marked by short term fluctuations over a fairly wide range.

As a synthesis of the old world Pleistocene, Butzer (1961) has given as a table which is shown below:

Synthesis of the Old World Pleistocene (from Butzer 1961)

	Northern Europe	Lower latitude arid zone
c. 1 million years Lowest Pleistocene	Several cold phases	For the greater part quite moist
Lower Pleistocene	Gunz glaciation	Fluvial
	Gunz/Mindel interglacial	Interpluvial
Middle Pleistocene	Mindel glaciation	Pluvial
	Mindel/Riss interglacial	Major interpluvial
	Riss glaciation	Pluvial Interpluvial
c. 100,000 years	Riss/Würm interglacial	
Upper Pleistocene	Late interglacial	Pluvial
	Early Main Würm	Pluvial
	Late Würm Glacial	Postpluvial phase I.
c. 10,000 years	Post glacial period	Minor fluctiations

Erinc (1954) has reached the conclusion that there were considerable climatic differences within the Black Sea and the adjacent countries during the Pleistocene. He points out that, within the inner belt[1.] including Romania, Bulgaria, Ukraine, Southern Russia and the Black Sea, glacial period were characterized by more arid conditions, and interglacial period were marked by a more humid and warmer climate than today. Therefore interglacials were periods during which soils were deeply weathered and leached. They also were periods corresponding to the valley fills at least in the lower parts of the rivers because of the higher sea levels.

In an exterior belt, surrounding the inner belt, climatic changes were somewhat different. This belt extended parallel to the inner belt and to the southern limits of continental glaciation and included Greece, Anatolia, the Caucasus and Caspian Sea. Within this area Erinc suggests that glacial periods were moister and interglacial periods were more arid than today.

Secondly he points out that the soil processes (leached soils under warmer climate during the interglacial) and palaeobotanical evidence show a marked change in rainfall and this excludes also any attempt to explain glacial and interglacial climates only by decrease and increase in temperature.

The northern Anatolian mountains (better known as the Pontic Mountains) show traces of glaciation in areas above 2500 metres. These are better studied in the east where small glaciers exists even today (Erinc 1945). The Pleistocene

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1. Erinc uses this term with respect to the southern boundaries of the ice sheet. Thus the "inner belt" is the zone nearest the ice sheet.

glaciation affected the eastern parts of these mountains and was more extensive on the northern side of the main crest. Glaciers also exist in eastern Anatolia at the present time. Louis (1944) hoped to have proved, basing on allegedly older moraines, a repeated glaciation for the Kesis Mountain near Erzincan. The same tentative conclusion was reached for Erciyas Mountain by Erinc (1952). On the other hand, during the Pleistocene some valley glaciers existed on the eastern Anatolian mountains such as Agri (Mt. Ararat), Suphan, Palandoken, Bingol and Munzur.

During the Pleistocene the level of the snowline in Turkey changed and this is shown on Fig 16 . This shows that the minimum height of the snowline in the north, northwest and southwest was about 2200 metres. On the other hand towards the east the height of the snowline gradually increased and reached a maximum of 3200 metres in the extreme east.

Pleistocene Glaciation and Periglacial Activity in Anatolia

Butzer (1958) points out that in eastern Anatolia the Kesis mountain (3537 m) near Erzincan has U shaped glacial valleys and end moraines down to 2250 metres on its southern flank, while on the northern flank what he describes as "piedmont glaciation" extends down to 1750 metres. The würm snowline is estimated at 2700 metres. A stream ravine has exposed an older moraine with solidly cemented, distinctly striated material underlying the younger Würm moraine. He suggests that the Munzur chain was extensively glaciated but the lower elevation of the piedmont prevented any greater extension of the glaciers into lowlands. On the other hand the Erciyas mountain (3916 m), which still harbours a tiny glacier at 3900 metres today, apparently had a Pleistocene snowline of 2900 metres judging by two cirque glacier and moraines. This gives a snowline depression of 700 - 800 metres. On the other hand Birman (1968) found what he describes as "at least 3 perhaps 4 cirques on north and northwest flanks." He also suggests that the oldest possible morainic material is found about 2300 metres above sea level. The youngest moraines of the sequence extend about 1.5 kilometres from the cirque mouth. He suggests that their age may be late Würm or more likely early post-Würm.

According to Blumental (1958) the present glaciers on the summit of Buyuk Agri Dagi (mt. Ararat) are as low as 3900 metres on the north facing slope and 4200 metres on the south. He assumes a Pleistocene snowline of 3000 metres, which would result in an ice cap of 100 km^2. However he finds no clear evidence of moraines other than those which are close to the present glacier tongues. Blumental believes that the Mt. Agri was already higher than 5000 metres in the Pleistocene and explains the absence of moraines by lack of confining ridges to control glaciers, insufficient debris load in the ice to form moraines, and burial by later eruption.

In eastern Anatolia, where Bobek (1940) estimates a contemporary snowline of 3500 metres from persistance of perhaps 20 small glacier up to 2.5 kilometres long, Cilo mountain (4170 m) and Sat mountain (3810 m) were extensively glaciated, one tongue being about 10 kilometres long. Bobek estimates a lowering of the snowline by 700 metres and has interestingly connected glacial outwash terraces in the upper river valleys with these extended glaciers.

The only large glaciers in the central Taurus area were found on the Bulgur mountain (3585 m) and Aladag (3910 m). On the former, moraines were deposited down to 1700 metres, eroding deep U-shaped valleys with large moraines suggesting a Würm snowline about 2600-2700 metres.

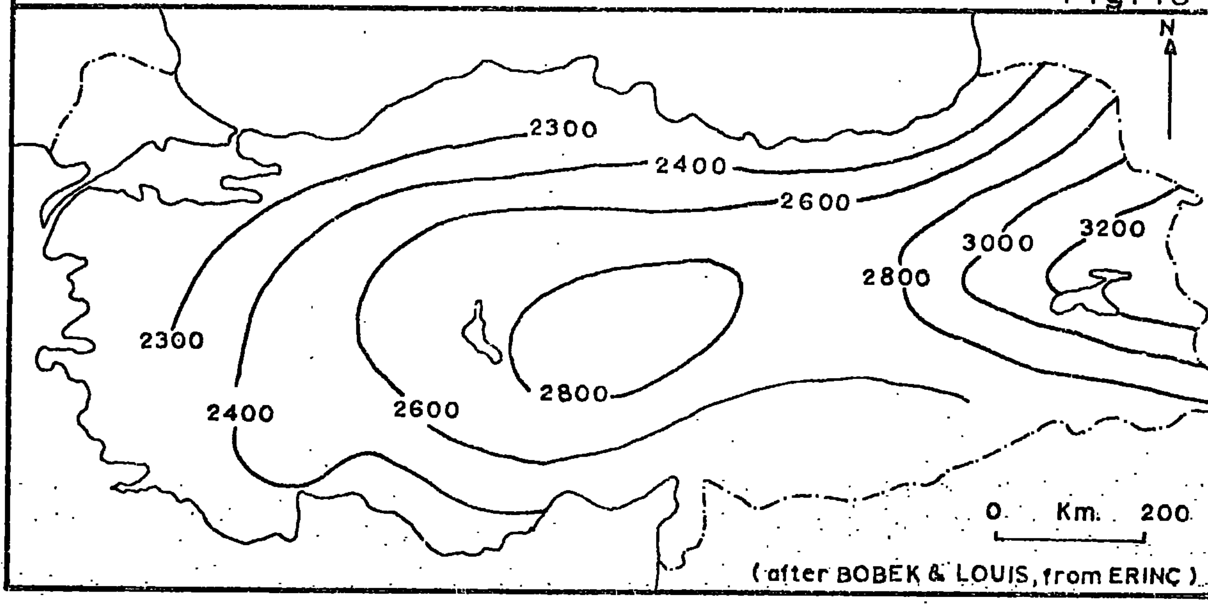
According to Butzer (1958) "the strong mechanical weathering above the lower limit of structure soil provides large quantities of rock detritus and when, during the glacial phases, this boundary was lowered by an amount perhaps corresponding to the snowline depression, vast areas of the eastern Anatolian plateau were able to deliver immense quantities of angular gravels to the strongly overloaded rivers which deposited great terraces of such material." Butzer (1958) found such material in the middle Firat (Euphrates) valley. The present author has found similar deposits in the eastern part of the Elbistan basin and it can be suggested that immense quantities of angular gravels have been deposited at the foot of steep slopes as a result of periglaciation during the Pleistocene. Further research on this aspect is necessary before firm conclusions can be reached concerning the precise origin of these colluvial deposits. However it has already been mentioned by Butzer (1958) that "The morphological activity of present and past periglacial activity cannot be overestimated and this topic well deserves a seperate treatment, although our scanty knowledge of the present occurence of frost pattern soils and cryoturbation (even that of the Pleistocene) make such a treatment appear almost presumptious."

A most important contribution to the study of frost pattern soils and solifluction was made by C. Troll (1944 b., 1947, 1948). The periglacial cycle of denuation according to Troll (1948) occurs not only in areas of permafrost but also in all climatic zones with morphologically active soil frost. Butzer (1958) points out that the alternating freezing and thawing leads to considerable movements within the soil and the gentlest slope suffices to set the water-permeated soil in motion, so directing huge quantities of soil and detritus down hillsides and slopes. When the snow within the higher elevations melts, this material is transported by the overloaded mountain streams leading to aggradation further downstream.

In the Pontic Mountains of northern Anatolia, Butzer (1958) points out that stone polygons and soil stripes occur as low as 2600 m today while in the Central Taurus area they occur even lower. The lower limit of frost pattern soils on the Aladag lies at 2500 metres and he suggests that there are fine examples of stone nets, stone stripes and stone rings especially on the gentler slopes between 3000 - 3200 metres and adds that, although most of these Anatolian forms are of the miniature tropical pattern with a diameter of 15 to 30 cm, the polar types occured too. He suggests that the reason for the occurence of both comes from cold winter temperatures

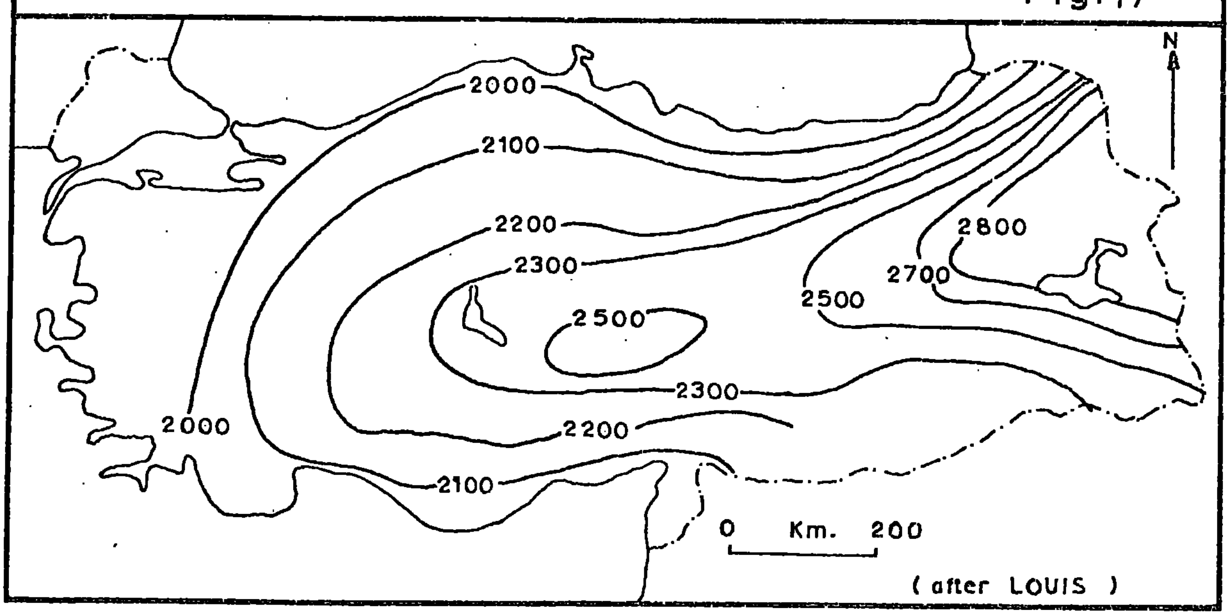
Snowline during the Pleistocene

Fig. 16



Upper limit of Forests

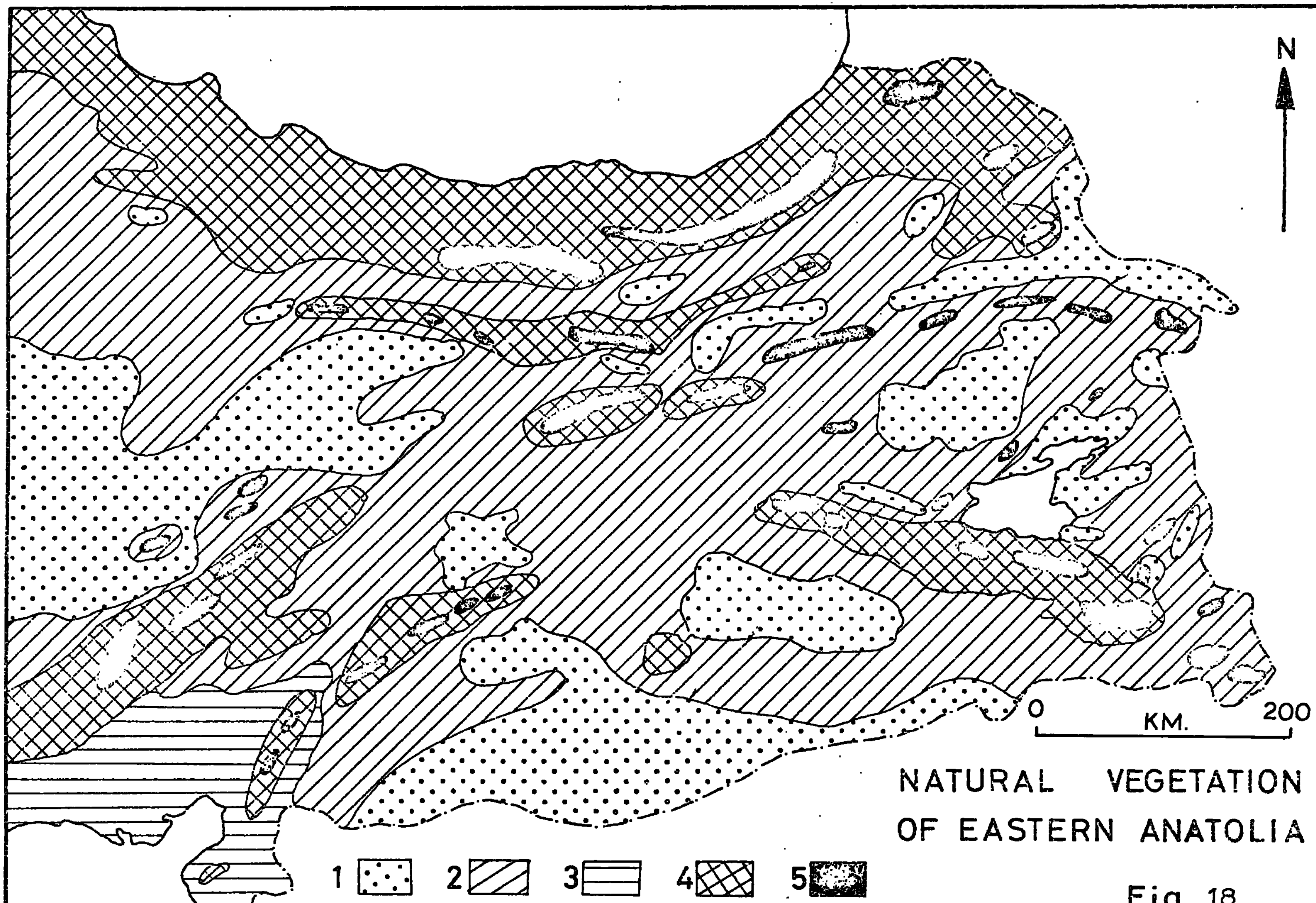
Fig.17



accompanied by a thick snow cover which lasts until June, after which dry summer climate permits strong insolation and nocturnal reradiation leading to strong diurnal variations, with nightly soil frosts. The fossil cryoplanation terrace at about 2000 metres has been determined by Erinc (1955). Further, Pfannenstiel (1956) notes frost pattern soils at and above 2400 metres on Uludag. Bobek (1940) found miniature earth stripes and stone nets at 3500 metres. Bobek (1954) has made a contribution to fossil periglacial form in the Near East. He considers the breccias occuring on the slopes down to 2300 metres, which are at present all being eroded, as cemented remnants of ice-age congeliturbate sheets. The limit of periglacial activity was lowered 700 metres during the Würm glaciation. This agrees with observations of similar fossil slope breccias occuring between 2300 and 1500 metres at the foot of the Aladag also associated with a period of greater periglacial activity, soil and rock creep. (Blumental 1952). On the other hand the present author suggests that the surrounding mountains of the Elbistan basin are well over 2500 metres height. Therefore periglaciation can have occured during the Pleistocene and brought huge quantity of angular gravels to be deposited at the foot of steep slopes.

3.4. NATURAL VEGETATION

It is possible to distinguish four different vegetation groups in eastern Anatolia. These are illustrated by Erinc (1953) according to Louis (1944) and shown on Fig. 18 .



NATURAL VEGETATION
OF EASTERN ANATOLIA

Fig. 18

1 steppe 2 shrubs & bushes 3 maquis & gariques 4 forests 5 Alpine flora

These are:

1. - Natural steppes: these are located in the eastern Anatolian basins with bushes and shrubs.
2. - Main forested area: mainly coniferous and mixed deciduous forests.
3. - Generally shrubs, bushes and grasses: this vegetation is secondary, replacing the original forests which have been destroyed by Man.
4. - Alpine flora: mainly in high mountains at an average height of 2300 to 2800 metres increasing from west to east.

Forests can be distinguished as high as 2800 metres in eastern Anatolia Fig. 17 . There is no other region in Turkey where the forests can grow as high as they grow in eastern Anatolia. Forests are adapted to severe winter cold in eastern Anatolia and comprise very few species. Forests show a number of different characteristics in eastern Anatolia. In the north they are dominated mainly by Pinus sylvestris while in the south they are dominated by oaks (Quercus). Also on high mountains one can find Populus tremula (aspen) and this is the main tree which can survive severe cold.

The most extensive area of alpine flora is found on the eastern Anatolian mountains and is rich in species.

History of the Vegetation

In Anatolia during the Ice Age, glaciation occured only on the high mountains. However Louis (1939) believes that this period was characterized by a much higher rainfall in the mountains but not in the steppes of Central Anatolia. Almost nothing is known about the history of Anatolian flora[1]. The occurence of a cedar forest near Samsun on the Black Sea and forests of Fagus Orientalis in the Taurus and Amanus mountains would seem to indicate a different distribution of vegetation types in prehistoric times. It is however more important to trace changes in vegetation in historical times based on relicts of Juniperus and Quercus found on the mountains of Central Anatolia and on the inside of the mountain rim. The occurence of these relicts indicates former forests. Birand (1958) reaches the conclusion that the forest area has been reduced from 70 to 13 per cent of the total area of the country.

On the other hand some relict species have been determined in the eastern Black Sea region. It is possible that Mediterranean vegetation in the eastern Black Sea area may data from relatively dry period of the Post Glacial or even from the era of forest clearance by Man when a relatively dry climate favoured the invasion of Mediterranean species.

Natural vegetation in the Elbistan basin

The natural vegetation of the Elbistan basin is as varied as are the relief and climate. In general the character of the vegetation differs mainly according to moisture conditions which are closely related to relief and depth of soil. Thus it is apparent that a close relationship exists between character and depth of soil, relief, moisture and vegetation. The natural vegetation as a rule is typical of that of the climate in which it is found. In the southwestern part, in high mountainous areas, the vegetation shows the combined effects of the Mediterranean type of climate. Here the vegetation cover is mainly of shrubs and herbaceous plants. Among those observed are Quercus Ilex as dominant and common. Some steppe grasses are present also in open areas. Further west, at higher elevations, these shrubs give way to coniferous forests, mainly of Pinus sylvestris. In the eastern and middle parts of the basin the vegetation is that typical of semiarid regions. A thin growth of shrubs, mainly Artemisia fragans, with perennial grasses form the main associations. Perennial grasses are mainly Andropogen sp., Agrophyron cristatum, Stipa sp., Dactylis sp., and Festuca ovina. Annual grasses were mainly Horeum sp. Festuca sp., Elymus sp., Avena sp. and Bromus sp.

C H A P T E R   F O U R

SOIL CLASSIFICATION

SOIL CLASSIFICATION

4.1. Introduction

Soil classification was impossible until it was recognised that soils are independent natural bodies having distinct morphologies. The first natural classification was propounded by Dokuchaiev in 1886. In this classification he divided the soils on the basis of their morphology (normal, transitional and abnormal). They were subdivided on the basis of their origin and six classes recognized. Sub-classes were recognized based on the criteria of climate and humus content. In his final classification, put forward in 1900, Dokuchaiev retained the terms normal, transitional and abnormal but dropped classes. Normal soils were subdivided on the basis of seven climatic zones and he introduced the term "soil type". This was the soil characteristic of a particular climatic zone, for instance the chernozem in the steppe zone. Transitional soils included three soil types: carbonate containing soils, dry land moor soils or moor-meadow soils, secondary alkali soils. Abnormal soils, too, included three types, alluvial soils, moor soils and aeolian soils.

Sibirtsev, Dokuchaiev's closest collaborator, followed Dokuchaiev's last grouping closely, but introduced the concept of zonal, intrazonal and azonal soils in place of Dokuchaiev's division of normal, transitional and abnormal. Other Russian soil scientists such as Zakharov, Kossovich and Glinka included the peats in their soil classification.

Russian soil types are defined in part by climate and vegetation and to this extent, the definitions are genetic. But, the definitions also include colour and other morphologic features. In the United States, the first clear recognition of soil as an independent natural body was made by Coffey in 1912. Coffey believed that the criteria of classification should be the properties of the soils themselves and objected to classification based on climate and vegetation. Hilgard had earlier drawn attention to important soil differences associated with climate and vegetation, but had not attempted a classification. Marbut (1913) reflected the opinion of most of his colleagues when he suggested that, in the classification of soils, it was important to recognize the character of the rock from which the soil parent material has been derived. Marbut's system of soil classification was presented first in 1927 and developed more in 1936. Marbut recognized that soils change with time and early stages of development may only have weakly formed horizons. Because characteristics of immature individuals are not considered in the classification of plants and animals, Marbut believed that they should not be considered in the higher categories in soil classification.

Baldwin, Kellog and Thorp evolved a further classification scheme in 1938 which was subsequently modified in 1949. While it was called a classification according to soil characteristics, it was in fact no more so than others, the two highest categories being defined, in part, in genetic terms. The classification contained three levels: order, suborder and great soil group. There were three orders: namely, zonal soils, intrazonal soils and azonal soils. The authors suggested that the zonal soils occured over large areas, or zones limited by geographical characteristics. Thus, the zonal soils included those great groups having well developed soil characteristics reflecting the influence of the active factors of soil genesis, climate and vegetation. It was assumed that these characteristics were best developed on gently undulating uplands, with good drainage, from parent material not of extreme texture or chemical composition that had been in place long enough for the biological forces to have expressed their full influence. According to Baldwin and his co-workers the intrazonal soils have more or less well developed soil characteristics that reflect the dominant influence of some local factor such as relief or parent material over the effect of the climate and vegetation. On the other hand, the azonal soils are without well-developed soil characteristics either because of their youth or because conditions of parent material or relief have prevented the development of definite soil characteristics.

Several major defects have been common to all these early classification schemes. One is the vague definitions of the classes. The great soil groups were defined in the American system in terms of soil properties but the definitions were brief, and various differences of opinion developed on the interpretation of a number of definitions.

Another general defect was that they were based primarily on the genesis or on the properties of virgin soils in the natural landscape. Cultivated soils have either been ignored or classified on the basis of the properties that they are presumed to have had when virgin.

4.2. Modern Classification Systems

The latest United States classification is called "A comprehensive system to soil classification 7th Approximation", which has been developed by United States Department of Agriculture in 1960. Ten orders are recognized in this classification. The orders correspond most closely to Dokuchaiev's soil types though they are by no means identical. The criteria used to distinguish the orders are based on a generalization of the common properties of soils that seemed to differ little in the kinds and relative strengths of processes, resulting in well developed horizons. As an example, Chestnut, Chernozem and Brunizem soils seem very closely related. All have the same general sequence of horizons, grade from one to the other, and are, in fact sometimes difficult to distinguish in the absence of the native vegetation if they have developed on comparable parent materials of comparable age. If one abstracts the properties that are always present, one finds that the character of the surface horizon is the most obvious feature that distinguishes these soils from other soils. It is dark in colour, is thick relative to the solum, and has structure of relatively high base saturation, and a narrow C/N ratio. Preliminary definitions of such a surface horizon were developed and tested by determining which soil series would be grouped by the use of the above criteria.

Each order has been subdivided into sub-orders primarily on the basis of the characteristics which produced classes having the greatest genetic homogeneity. The definitions of several orders group some soils that have similar morphology but little or no genetic relationship. Where such groupings resulted, an effort has been made to select properties which would seperate the soils at the sub-order category. Other orders have included soils with wide ranges of climate. In these orders, an attempt was made to differentiate according to properties that would narrow the climatic range in each sub-order. As an example, the lack of horizons in soils of recent origin on flood plains is due to lack of time for pedogenetic horizons to develop. Yet there are quartz sands on which horizon formation is difficult. Such sands might have been in place for longer than would be required to form horizons in more mixed parent materials, but because horizons are weak, these sands are all grouped in the order of Entisols. Because there were different genetic reasons for the lack of horizons in the order of Entisols, suborders were defined to seperate the sands from materials of mixed lithology. A second example will illustrate the reason for desiring to reduce climatic variations. The definition of Mollisols includes soils which lie near the margin between the steppes and the desert as well as soils in humid climates that are subject to annual leaching: some have developed under forest and others under grass vegetation. Some have a horizon of accumulation of soluble salts, others do not. The soils formed near the margin of the desert and the steppe tend to be thin, and to be saturated with bases. Those formed in the more humid part of the range tend to be thicker and are often acid. Other properties, such as the amount of organic matter, are associated with the climatic variations. Abstraction of the properties that are common to the soils in the drier range of the order and which are lacking in the soils in the more humid areas led to the selection of the nature of the replaceable bases and the percentage of base saturation as criteria which would produce sub-orders having smaller climatic ranges.

Each great group is defined within its respective sub-order, mainly by the presence or absence of diagnostic horizons and the arrangments of these do not vary within a sub-order. Horizons used as criteria include those horizons containing illuvial clay, iron and humus, thick dark coloured surface horizons; pans that interfere with root development, water movement or both; and anthropic horizons that formed under cultivation. Properties that cannot be considered as constituting horizons are used where differences in horizons are not relevant. For example, diagnostic features that have been used in this category are the self mulching properties of some clays, the dark-red and dark-brown colours associated with basic rocks, wide differences in base saturation, the property of irreversible hardening, the tonguing of elluvial horizons into illuvial horizons, and low soil temperatures. From the viewpoint of soil morphology, each great group is to be thought of as uniform with respect to arrangement of diagnostic horizons and features.

If one thinks of a great group as occupying a segment of the spectrum of soil properties, the core and central part of that segment is one sub-group. The fringes where the properties of one great group merge with those of others are areas where the soils intergrade between the great groups. These areas are intergrade sub-groups. The dominant properties of intergrade subgroups are those of the great group to which it belongs. The additional properties of the intergrade sub-group are those of the great group towards which the sub-group intergrade.

The first draft of this classification was published in 1960 and to take account of the comment and criticism supplements were published in 1964 and 1967. The latter includes changes in the definitions of diagnostic horizons as well as new names and additions of various groups and subgroups. For example the order of Mollisols has six sub-orders and 22 great groups in the early draft of the system, but in the 1967 supplement it has seven sub-orders and 32 great groups.

The 7th Approximation has been used in various parts of Turkey. De Meester (1970) and his team from Agricultural

University, Department of Tropical Soil Science the Netherland (Holland) have classified the soils of the Great Konya Basin in central Anatolia according to this classification. De Meester and his co-workers "..... a taxonomic classification of representative profiles of the mapped soils is scientifically desirable, many countries have designed national taxonomic system, as exist in Turkey and the Netherland. But in this soil study, preference is given to the United States Department of Agriculture's new classification system, because of its wide international acceptance. The representative profiles included in the description of mapping units have all been classified according to the 1964 and 1967 supplements, wherever our data were sufficient." Dent (1969) also classified the soils of the Trabzon area according to the 7th Approximation.

In 1965, the Turkish Soil Survey Organization (Toprak-Su) introduced a new national classification system for Turkey at the Third Soil Correlation Seminar for Europe. The system is still in draft form and it is currently being tested in several parts of the country. The names of the soil groups are formed by the symbols of the four distinctive criteria used at this level of generalization, namely: natural vegetation, soil moisture and temperature, soil forming process and soil colour. The names of the soil families are formed by adding to the soil group name the symbols for the criteria used for subdividing the soil families, namely: the nature of the parent material and the kind of soil horizons. The names of soil series are composed of the symbol standing for the land form and soil depth, the texture of the solum, or the type of organic matter for the organic soils the distinctness of the horizons and the colour of the surface horizons. The series name is separated from the family name by a dash. Soil types are differentiated by the texture of the surface mineral horizon and the texture of the sub-horizons or layers in the rooting zones. The type name is formed by adding these texture symbols to the series name. For example; when the vegetation is deciduous forest (D), the soil zone is moist and warm (I), the soil forming process is colloidal accumulation (F) and soil colour is brown (O), the name of soil group is DIFO soil. A DIFO soil formed on non-calcareous alluvial deposits (K) and with a colour horizon (O) belongs to DIFOKO families. A DIFOKO soil located on a footslope and having normal depth (K) with moderately coarse textures solum (E) a distinct horizon boundary (K) and a dark coloured surface soil (O) belongs to DIFOKO - KEKO series. A KEKO soil having a clay loam textured surface and subsurface horizon is the KEKOCI soil type. This classification scheme has not been finally adopted for Turkish soils. Therefore, the Turkish classification system has not been used for the soils of the Elbistan basin. On the other hand in this soil study preference is given to FAO classification system because of its universal legend, and the present author attempted to show the soils of the Elbistan basin according to this system.

In 1968, the FAO/UNESCO introduced a new universal classification system. The scope of this project has been described as "... the correlation of soil units used in various part of the World with the aim of preparing a universal legend. Such an approach ensures geographical validity of the legend on a global basis and permits, therefore, a realistic representation of the distribution of the different world soils. Eventually it will effectively contribute towards the possibility of transfering land use knowledge and experience gained in one particular area to other areas having similar soils and environmental conditions."

The classification report suggests that an attempt has been made to use as many traditional names as possible such as Chernozems, Podzols, Solonchak, Solod, Rendzinas and Regosols. Names like Vertisols, Rankers, Andosols and Ferralsols have been used because in recent years they have become increasingly popular in soil science. Finally the term Gleysols has been taken from the Canadian classification. Such names are meant to sum up in one easily remembered word a set of characteristics which have been found to be representative of a particular soil in extensive parts of the world. A number of names, though firmly established in soils literature, have had considerable confusion in use. These include such names as Podzolized soils, Podzolic soils, Brown Forest soils, Prairie soils, Mediterranean soils, Desert soils or Semi-arid Brown soils and alluvial soils and the classification seeks to remove any ambiguities.

The definitions of the diagnostic horizons used in this classification system have been adopted from the 7th Approximation system of United States Department of Agriculture (1960) and subsequent supplements (1964 and 1967). The melanic, sombric and pallid A horizons have been defined after the mollic, umbric, ochric epepedons, but have been renamed. The concepts of cambic, natric, oxic, spodic, salic and gypsic horizons have been taken over in their original form. However, the terms argillic and calcic have been renamed as argilluvic and calxic respectively.

The name Luvisols has been used in this classification system for soils in which the dominant characteristic is illuvial accumulation of clay and which at least in the lower part of the argilluvic B horizon (see appendix 1) have a base saturation of more than 35 per cent. The term "luvic" has been used to designate soils which have an argilluvic B horizon but in which clay accumulation is not the dominant soil forming process. If the soils show an illuvial clay accumulation resulting in an abrupt textural change between the A or E horizon and the B horizon then the soils are designated Planasols. The term Podzols is considered in this classification for soils which have a B horizon showing illuvial accumulation of iron or organic matter, or both, but lacking clay skins on ped faces or in pores. Certain soils show characteristics both of Luvisols and Podzols. They are characterized by an illuvial accumulation of clay but reflect simultaneously the action of a podzol process by one or more of the following: the formation of a bleached surface horizon, a destruction of the B horizon reflected by tonguing of the E horizon into the B horizon, an accumulation of iron and organic matter in addition to the accumulation of clay. On the basis of the definitions adopted in this classification, these soils have been grouped with the Luvisols, either as Albic Luvisols or as Glossic Luvisols.

The name of Cambisols is proposed to replace the name of Brown Forest soils which has been used to describe a wide variety of different soils. The original concept of the Brown Forest soil was that, it developed in subhumid climates with a "mull" humus layer, a (B) horizon having a stronger colouration and a slightly higher clay content than the C horizon, but showing no clay illuviation, nor having calcium carbonate in the lower part of the solum. This term has also been used to include Acid Brown Forest soils, tropical soils and Podzolized Brown Forest soils.

Mediterranean soils are another group of soils which have created much misunderstanding between soil scientists. When used as a geographical or climatic concept the term "mediterranean" is rather heterogenous since physiography and climatic conditions vary widely in the Mediterranean area itself. Even if the use of the term "Mediterranean were restricted to describe specific climatic conditions characterized by a hot summer and a mild winter, with closely defined conditions of soil moisture and temperature, it could not be used to express a specific concept of soil development. Indeed, it would include a wide variety of disperate soils, including the so-called "Terra Rossa", "Meridionale Braunerde", "Sol Bruns Mediterraneens Lassives", Rendzina, Podzols Vertisols. The term has therefore been abondoned and the different soils which were previously included under this name have based on the existing soil units in accordance with their profile development, e.g. so-called Red-brown Mediterranean soils are named "Chromic Luvisols" if they have argilluvic B horizon (see appendix 1) or "Eutric Cambisols" if they have only a Cambic B horizon (see appendix 1) with high base saturation or "Calcic Cambisols" for those Brown Mediterranean soils which are calcareous throughout or show a strong accumulation of lime at shallow depths.

The term Fluvisols has been proposed to replace the name Alluvial soils. However, as pointed out " ..... in its most restricted sense this name has been applied to soils on recent alluvial deposits enriched at regular intervals by fresh sediments and showing no profile development (not even clearly marked gley phenomena) except for a pallid A horizon (see appendix .1..). It is realized that the term is not completely satisfactory since not only river deposits but also marine lacustrine, deltaic and even colloidal sediments are included."

It has already been pointed out that, the main purpose of the FAO classification is to introduce a universal legend of soils of the world and produce small scale soil map. The FAO classification system has been used for the present investigation because of its universal legend. The 7th

Approximation system was not considered suitable when classifying the soils of the Elbistan basin, because this system needs considerable data to identify the diagnostic horizons. Major difficulties arise when some diagnostic horizons require annual and seasonal soil temperature; in the Elbistan basin, there is no such data available. In recent years usage of the FAO classification system has become more popular in some parts of the world. The author has classified the soils of the Elbistan basin according to this system so as to show their relationship with world soils. Profile morphology or diagnostic horizons of the Elbistan soils have been identified easily in this classification system. Thus it has been decided to use this system as a suitable classification for the soils of the Elbistan basin.

4.3 The Soils of the Elbistan Basin

The soils of the Elbistan basin have been classified according to the FAO classification system. The following six main orders have been distinguished according to their physical and chemical characteristics. Also, representative profiles have been included in the description of profile morphology.

FLUVISOLS: This term has been suggested for soils which have developed on recent alluvial deposits, enriched at regular intervals by fresh sediments and showing no profile development except for a pallid A horizon. The alluvial soils of the Elbistan basin have been identified as "Eutric

Fluvisols". These are the subgroup of Fluvisols having a pallid A horizon with a pH more than 4.2 in part of the upper 50 cm of the soil profile.

REGOSOLS: These soils are formed from unconsolidated materials, excluding recent alluvial deposits. They do not have diagnostic horizons though possibly a pallid A horizon may form. "Eutric Regosols" are the subgroup of the Regosols which have been identified in the Elbistan basin. These soils are derived from various parent material and usually occur on steep slopes. These soils are also eroded soils, because of the steep slopes and weak vegetation cover. They have weakly developed pallid A horizon and a pH more than 4.2 in part of the upper 50 cm.

GLEYSOLS: Calcic Gleysols are the subgroup of the Gleysols which have been identified in the Elbistan basin. The Calcic Gleysols have been developed over limestone; on the other hand pluvic gleysols which is another subgroup of Gleysol which developed calcareous colluvial deposits as a result of poor drainage. The soils possess calxic and gleyic horizons and also a well developed pallid A horizon. They are calcareous throughout the profile.

CASTANOZEMS: These soils are one of the major soils in the basin, and cover large areas. These soils have been derived from basic igneous rocks and limestones in the study area. Two subgroups have been identified in the working area. These are "Haplic Castonozems" and "Calcic Castanozems".

Haplic Castanozems are derived from basic igneous rocks (Gabbro, Serpentine and Diorite). The soils have a melanic

A horizon with a moist chroma of more than 1.5 to a depth of 15 cm or more and show an increase with depth of Na plus K saturation within 125 cm of the surface.

Calcic Castanozems are derived from limestone in the basin. The soils have a melanic A horizon with a moist chroma more than 1.5 or more and also calxic horizon. These soils are calcareous throughout the profile.

<u>CAMBISOLS</u>: This is the second most important soil group occuring in the Elbistan basin. They have developed on Granite, Calc-schist and Limestone parent materials. Two subgroups have been identified in the study area. These are Ochric Cambisols and Calcic Cambisols.

The soils derived from Granite parent material may be classified as Ochric Cambisols. These soils have pallid A horizon and cambic B horizon, having a base saturation of less than 50 per cent in all subhorizons.

The Calcic Cambisols have been developed over limestone and calc-schist metamorphic rock. These soils have a pallid A horizon, free calcium carbonate in the B horizon and a calxic horizon within the top 100 cm. These soils are generally calcareous throughout the profile.

<u>LUVISOLS</u>: Chromic Luvisol soils only occur in very small areas in the Elbistan basin, where crystalline limestone is found. The bright red soils of the area can be classified as Chromic Luvisols in the Elbistan basin. The Chromic Luvisols are the equivalent of Terra Rossa soils which is a characteristic soil of the Mediterranean region. Chromic Luvisols have a pallid A horizon which harden when dry

and a strong brown to red argilluvic B horizon. The major part of this profile has a cation exchange capacity of more than 24 m.e / 100 gram in which the base saturation is 35 percent or more at least in the lower part of the B horizon.

C H A P T E R   F I V E

SOILS OF THE ELBISTAN BASIN

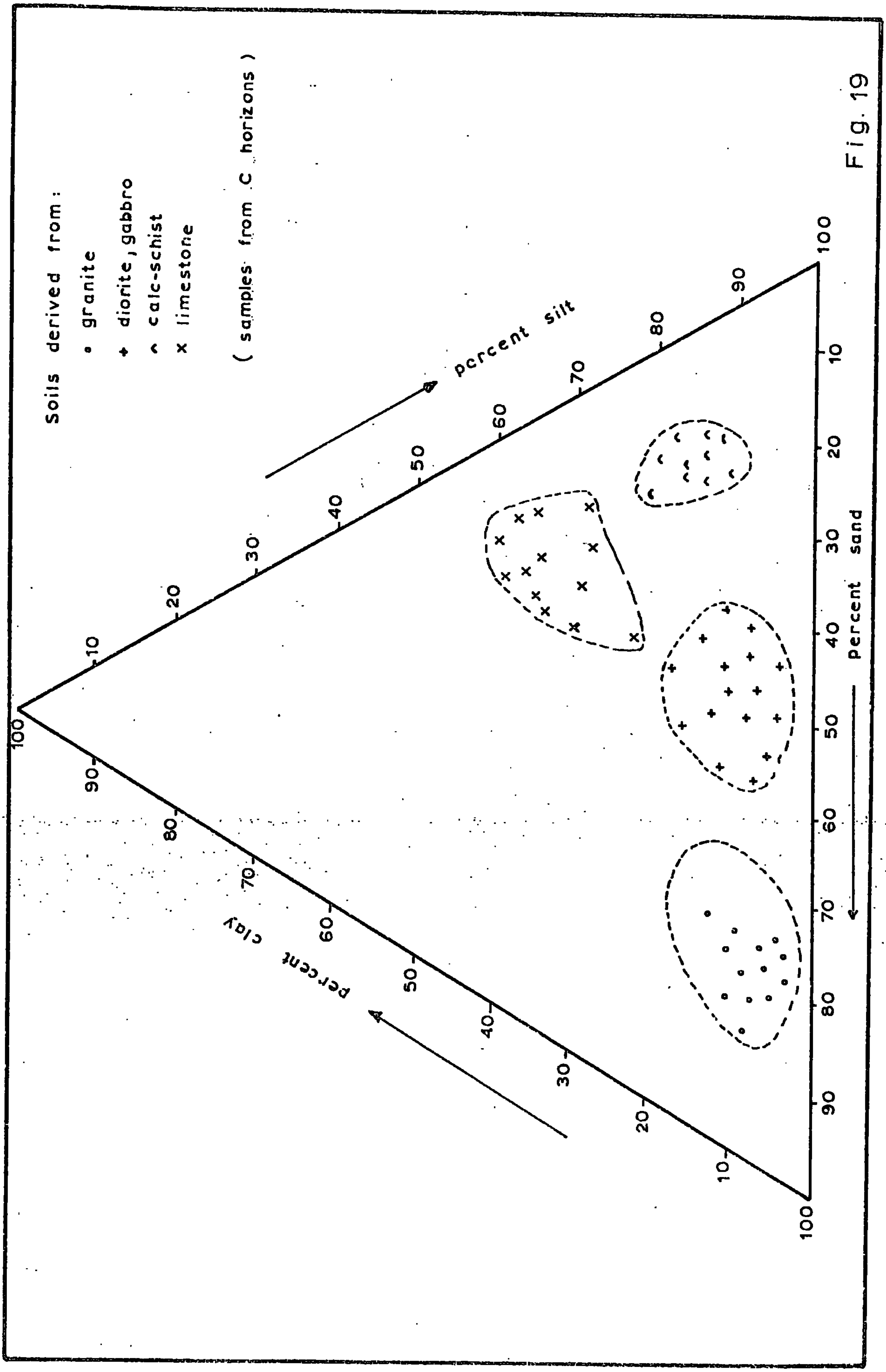
5. SOILS OF THE ELBISTAN BASIN

5.1. GENERAL CHARACTERISTICS

The Elbistan basin lies within the transitional zone between the continental climate characterized by cold winters and hot summers, with a moderate to low rainfall (max 366 mm in the eastern part of the basin) and the mesothermal, semi-arid Mediterranean zone, mainly characterized by cold moist winters and hot dry summers, with a moderate rainfall (max 540 mm in the western part of the basin). The soils in this area are characterized by semi-arid brown to reddish-brown colour, and generally show well developed profiles.

The soils of the Elbistan basin are closely related to the underlying geological strata. For example granite produces light textured soils, mainly characterized by sandy loam and loamy sand textures, which cover the north-western part of the basin. On the other hand in the southern part of the basin, soils derived from basic igneous rocks are medium textured, characterized by loam and silty loam textures. In the eastern and northeastern part of the basin, soils derived from limestone and calcareous parent material are moderately fine-textured soils which are characterized by clay loam and silty clay-loam textures (Fig. 19).

The soils of the Elbistan basin have moderate to weakly developed surface structure usually characterized by granular type. On the other hand, the B horizons show good structure development, usually characterized by medium to coarse angular



Texture of soils derived from various parent materials blocky and medium prismatic structure, due to slow shrinkage during the summer.

The Elbistan soils have developed under steppe vegetation. They have brown to dark brown A horizons that are moderately high in organic carbon (>2%) and contain abundant fibrous roots. However, the organic carbon content decreases rapidly with depth and is less than 0.5% in the subsoil.

The soils of the Elbistan basin show alkaline reaction in general. However, parent material has an important effect in determining local variations in pH. Generally soils derived from igneous rocks show lower pH than soils derived from limestones and other calcareous parent materials. (Fig. 20). All soils of the eastern part of the basin have a high percentage of fine earth carbonates in common. This is mainly caused by the calcareous nature of the parent material, which is derived from the surrounding limestone uplands. Due to the semi-arid climate no part of the soil is entirely decalcified. Secondary carbonate enrichment is common, causing the formation of a calxic horizon at a depth of about 50 cm. (Table 1). The pH and Calcium Carbonate are usually correlated; highest pH value is always represented by highest calcium carbonate content (Fig. 20).

Cation exchange capacity is very closely related with clay content in the soils of the Elbistan basin. Generally, cation exchange capacity increases with depth; the maximum is invariably recorded in the B horizon, which also has the maximum clay content. (Fig 21). Usually, soils derived from granitic parent material show low cation exchange

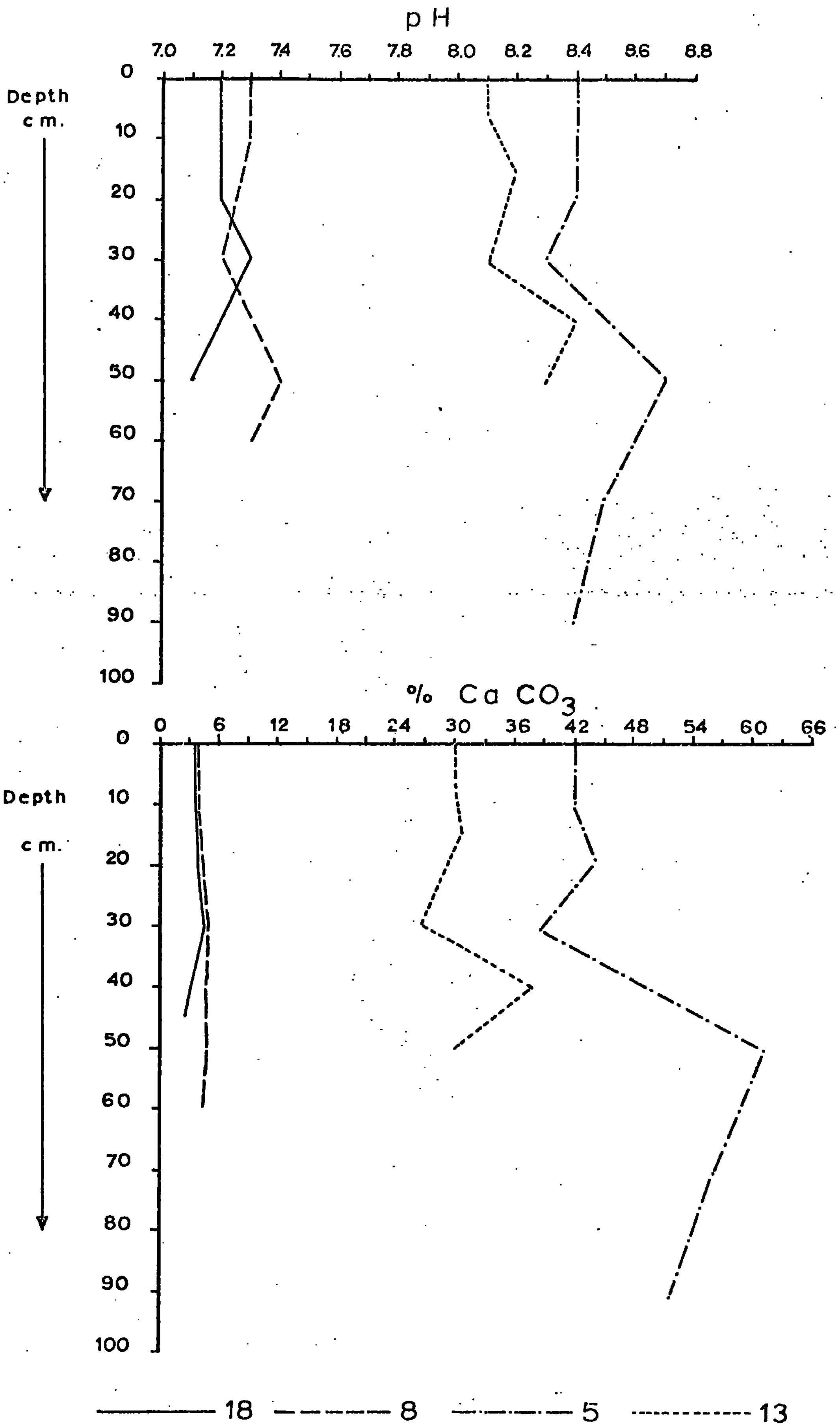


Fig. 20

pH and calcium carbonate content of soils derived from various parent materials: Profile 18: granite; 8: diorite; 5 limestone; 13 calc-schist.

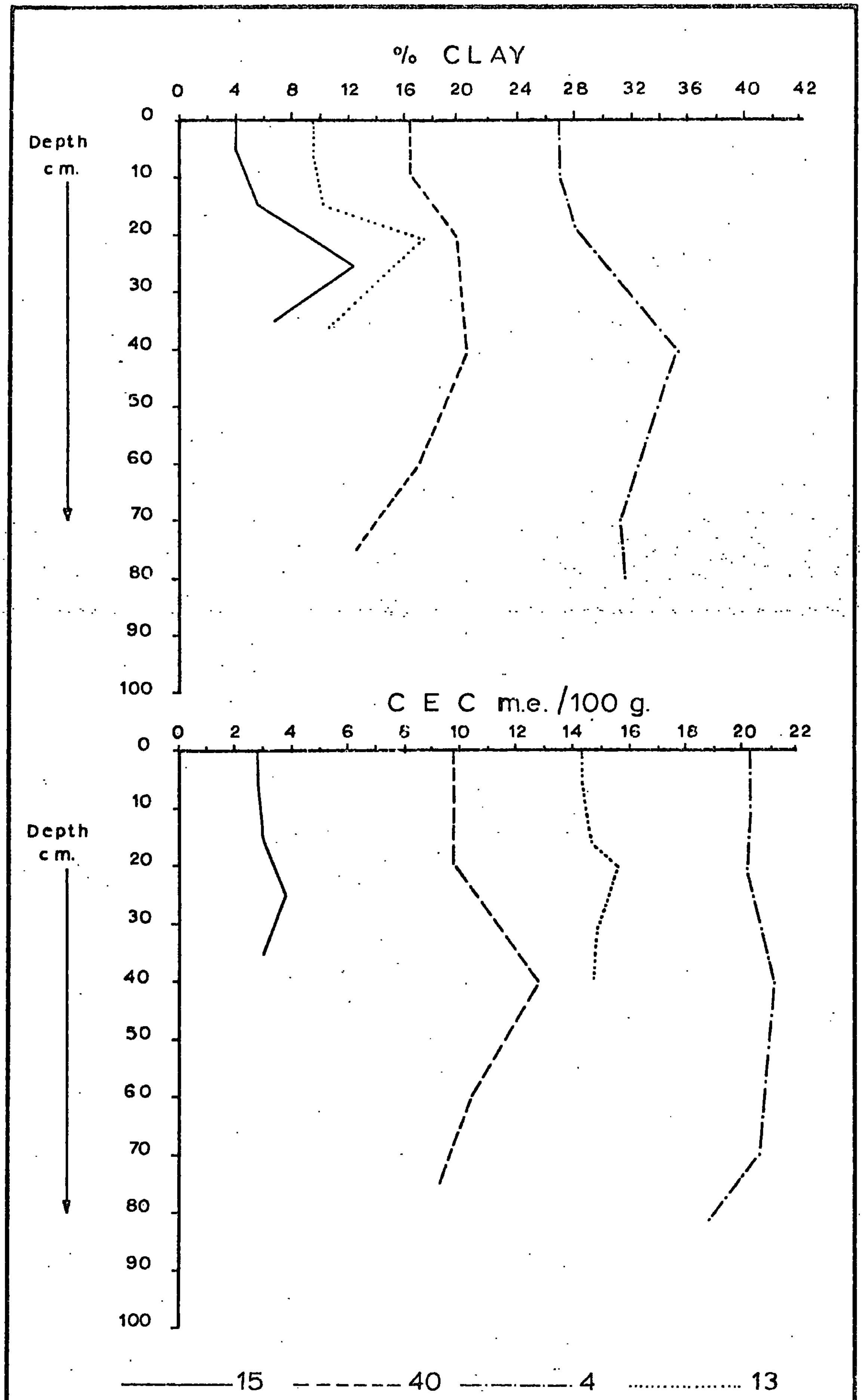


Fig. 21

Clay content and cation exchange capacity of soils derived from various parent materials: Profile 15: granite; 40 diorite; 4 limestone; 13 calc-schist.

TABLE 1

Variation of Calcium Carbonate content of soils derived from various calcareous parent materials.

Profile	Horizon	Depth of sample cm.	Parent material	% $CaCO_3$
	A	5-10		43.1
2	(B)	20-30	Cretaceous	38.5
	B_{ca}	40-50	Limestone	56.5
	B/C	70-80		51.0
13	A	0-10		30.1
	(B)	20-30	Calc-schist	26.5
	B_{ca}	35-40		38.0
	B/C	45-50		30.5
25	A	0-10	Calcareous	40.9
	(B)	30-40	colluvial	36.4
	B_{ca}	60-70	deposits	59.3
	B/C	70-80		52.6

capacity (3-6 m e / 100 g.), because these soils have very low clay content (less than 10 per cent) in their B horizon. On the other hand, soils derived from basic igneous rocks usually have moderate cation exchange capacity (10-15 m. e/100 g) with moderate amount of clay content (15-25 per cent) in their B horizon. The soils derived from Limestone and calcareous parent material have high cation exchange capacities (15 m.e/100 g.) with a high clay content (more than 2.5 per cent)[1.] (Table 2).

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1. However soils derived from calc-schist parent material show high cation exchange capacity but low clay content, because these soils have very high silt content in their texture (more than 70 per cent) which permits high cation exchange capacity.

TABLE 2

Relationship between total cation exchange capacity and the texture of soils derived from various parent materials

Profile	Horizon	Depth of samples cm.	Parent material	% sand	% silt	% clay	Total CEC m.e/100g.
	A	0-5		74.7	21.3	4.0	2.85
	(B)	10-15	Granite	70.4	22.8	6.8	2.98
15	(B)/C	20-25		65.6	22.3	12.1	3.74
	C	30-35		75.7	16.5	7.8	3.05
	A	0-10		20.9	52.6	27.5	20.12
	(B)	20-30	Paleozoic	14.8	49.5	35.6	21.13
4	B	50-60	Limestone	14.9	53.3	31.7	20.53
	B/C	70-80		14.3	53.8	31.8	19.02
	A	0-5		16.6	75.0	9.4	14.12
	(B)	10-15	Calc-schist	16.0	73.8	10.2	14.53
23	B_{ca}	15-20		14.8	67.4	17.7	15.63
	B/C	30-35		16.7	72.4	10.9	14.93
	A	0-10		39.4	44.2	16.4	9.84
	B	30-40	Diorite	33.2	43.5	21.3	12.76
40	B/C	50-60		41.4	41.0	17.6	10.35
	C	65-75		46.9	40.8	12.3	9.08

The soils of the Elbistan basin have been classified according to the FAO classification system. (See Chapter 4). The distribution of the soils of the Elbistan basin are shown Table 3 and Fig 22 .

TABLE 3

Distribution of Soils in the Elbistan basin

Order	Suborder	area sq. km.	% area sampled
FLUVISOLS	Eutric Fluvisols	120	20
REGOSOLS	Eutric Regosols	30	5
GLEYSOLS	Fluvic Gleysols	24	4
	Calcic Gleysols	6	1
CASTANOZEMS	Haplic Castanozems	210	35
	Calcic Castanozems	60	10
CAMBISOLS	Ochric Cambisols	60	10
	Calcic Cambisols	60	10
LUVISOLS	Chromic Luvisols	30	5

5.2. EUTRIC FLUVISOLS

INTRODUCTION:

On the floor of the basin the soils developed on coluvial and alluvial deposits have been classified as Eutric Fluvisols. They are the most productive soils in the basin and occupy about 20 per cent of the total working area. The parent material of these soils has been transported relatively short distances (about 3-4 km) from the surrounding mountains, by streams of varying size. The alluvial and coluvial deposits including diorite, serpentine, gabbro and limestone. Ten profile pits were examined in the field and three characteristic profiles were sampled for chemical and physical analyses in order to establish the character of soils in more detail.

The Eutric Fluvisols usually occur on gentle slopes, varying between 0^{o} and 4^{o} at elevations between 1100 and 1150 metres. They are recent deposits, and soil forming processes have not been active long enough or with sufficient intensity to develop any horizon apart from the pallid A horizon.

MORPHOLOGY: Profile 26 represents a typical Eutric Fluvisol under thick short grasses. It is located near the river bank of the River Ceyhan. This is an imperfectly drained soil, being located about 20 metres above the present flood

PROFILE 39

Plate - 6 The Eutric Fluvisol profiles.

PROFILE 26

levels of the River Ceyhan. The profile characteristics of Profile 26 include brown to dark brown to yellowish brown B/C and C. horizons. It shows little evidence of horizon development except that there is some calcium carbonate accumulation between 50 and 60 cm. The morphological characteristics of Eutric Fluvisol are illustrated by Profile 26 (p 78).

The pallid A horizon is a characteristic of all Eutric Fluvisol profiles but variations in the organic matter content and depth of this horizon do occur. The organic matter content of the pallid A horizon varies from a minimum of 2.59 per cent in Profile 39 to a maximum of 6.03 per cent in Profile 38. Field investigation showed that the depth of the pallid A horizon also reaches a maximum value of 26 cm in Profile 38. (Table 4).

TABLE 4

Variations in organic matter content and the thickness of pallid A horizon in the Eutric Fluvisol profiles

Profile	Land-use	% Organic Matter	Thickness of Pallid A horizon cm.
26	Thick short grasses	5.34	19
38	Thick short grasses	6.03	26
39	Recently ploughed field sparse vegetation mainly short grasses.	2.59	11

PROFILE 26

Location 3.5 km west of Elbistan Town

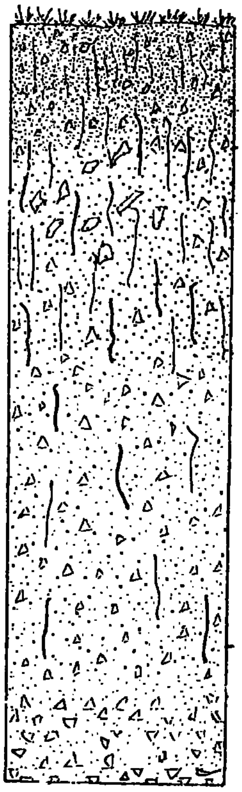
Elevation 1150 m.

Slope 2^{o}

Parent material Calcareous alluvial deposits

Land use Thick short grasses (grazing land)

Profile Description



A 0-19 cm 10 YR 5/3 (Brown); silty clay loam; slightly moist and friable; abundant fibrous roots; well developed granular structure; many small limestone fragments (up to 2 cm diameter); wavy boundary.

(B)/C 19-61cm 10 YR 5/4 (yellowish brown); silty clay loam; slightly moist and friable; weak angular blocky structure; frequent dead fibrous roots; many angular limestone fragments (up to 5cm diameter); occasional small lime accumulations (3-5 mm diameter); wavy boundary.

C 61 + cm 10 YR 5/4 (yellowish brown); clay loam; massive structureless; moist and friable; occasional dead fibrous roots; many small limestone fragments (up to 3 cm diameter); no clear horizon boundary.

PROFILE 26

Analytical Data

Depth CM.	Mechanical Analysis % Coarse SAND	Medium SAND	Fine SAND	SILT	CLAY	pH	% $CaCO_3$	% L.O.I	% Fe_2O_3 $\times 10^{-1}$
0-10	11.0	5.1	8.0	51.8	24.1	8.0	30.4	-	3.3
10-15	12.5	5.4	6.2	52.7	23.2	8.1	31.2	-	3.8
20-30	8.1	4.5	6.6	54.5	26.4	8.1	31.3	-	4.1
30-40	6.2	4.4	4.8	57.9	27.7	8.3	32.7	-	4.4
40-50	6.4	2.7	4.6	59.1	28.2	8.3	38.4	-	5.0
50-60	6.1	2.5	4.4	58.8	28.2	8.2	36.9	-	5.1
60-70	6.5	4.5	5.3	57.3	26.4	8.2	36.5	-	4.9
70-75	5.4	3.2	4.4	58.9	28.1	8.1	35.3	-	4.3

Depth CM.	Cation Exchange Capacity m.e./100 g. Na	K	Mg	Ca	Total	% C	% N	C/N	P_2O_5 m.e./100 g.
0-10	1.60	0.55	0.75	13.06	15.96	3.1	0.10	31.0	-
10-15	1.72	0.64	0.88	12.40	15.64	2.9	0.06	48.3	-
20-30	1.94	0.61	0.94	12.22	15.71	2.1	0.04	52.5	-
30-40	1.91	0.84	0.72	14.66	18.13	1.3	0.02	65.0	-
40-50	1.28	0.72	0.69	13.79	16.48	1.1	0.02	55.0	-
50-60	1.60	0.66	0.76	13.92	16.94	0.6	0.01	60.0	-
60-70	1.30	0.54	0.78	14.35	16.97	0.2	0.01	-	-
70-75	1.97	0.77	0.78	13.59	17.11	0.1	0.01	-	-

Table 4 indicates that the density of vegetation plays an important role in determining the organic matter content and the thickness of the pallid A horizon in the Eutric Fluvisols of the Elbistan basin.

TABLE 5

Mechanical analysis of Eutric Fluvisol profiles

Profile	Parent material	Horizon	Depth of samples (cm)	% Sand C.S.	% Sand M.S.	% Sand F.S.	% SILT	% CLAY
	calcareous	A	0-10	11.0	5.1	8.0	51.8	24.1
26	alluvial	B/C	20-30	8.1	4.5	6.6	54.5	26.4
	deposits		40-50	6.4	2.7	4.6	59.1	28.2
		C	60-70	6.5	4.5	5.3	57.3	26.3
	non-calcareous	A	0-10	14.3	10.5	28.6	36.7	9.9
38	alluvial	B/C	20-30	12.5	7.9	29.5	39.4	10.7
	deposits		40-50	6.2	5.2	33.2	43.5	11.9
		C	60-70	8.4	6.9	34.2	41.5	9.0
	calcareous	A	0-10	11.3	8.2	10.4	49.5	20.6
39	colluvial	B/C	20-30	7.1	5.9	5.1	53.4	28.5
	deposits		30-40	3.4	3.2	3.0	54.2	33.6
		C	50-60	5.6	4.8	4.7	54.5	30.4

PHYSICAL AND CHEMICAL CHARACTERISTICS

The Eutric Fluvisols have been derived from calcareous parent material, usually characterized by high silt and clay contents. On the other hand soils from non-calcareous alluvial deposits tend to be coarser, with the fine sand being the dominant particle size. Typical variations of these characteristics are shown in table 5 . Table 5 illustrates that in all Eutric Fluvisol profiles silt and clay content increase with depth and that the maximum is always recorded in the B/C horizon. Typical variations of clay content are shown in Fig 23 for all Eutric Fluvisol profiles.

The Eutric Fluvisols usually have a weak to moderately well developed granular structure in the surface horizon varying according to organic matter content. But in the sub-surface horizons the structure varies between moderately developed, angular, blocky and weak medium, prismatic structure according to clay content. For example, the structure is weakly developed usually characterized by weak medium angular blocky in B/C and C horizons of Profile 38 because it has low clay content. On the other hand the structure is well developed characterized by coarse angular blocky and medium prismatic in the same horizons of Profile 39 and Profile 26. Because they have more clay content. (Table 5).

The Eutric Fluvisols generally have an alkaline reaction. However, parent material has an important effect in the local variation in pH. The profiles that have developed over calcareous alluvial and colluvial deposits show higher pH values than the profiles which have developed over non-calcareous alluvial deposits. (Table 6). Table 6 suggests that the highest pH values usually occur in the B/C horizons of Eutric Fluvisols. The variation of calcium carbonate content seems to be related very closely with pH values, as shown on Table 6 and Fig 24 . The maximum calcium carbonate value recorded is 48.5 per cent in the B/C horizon of Profile 39 whilst the highest pH value 8.5 was also recorded in the same sample. This relationship

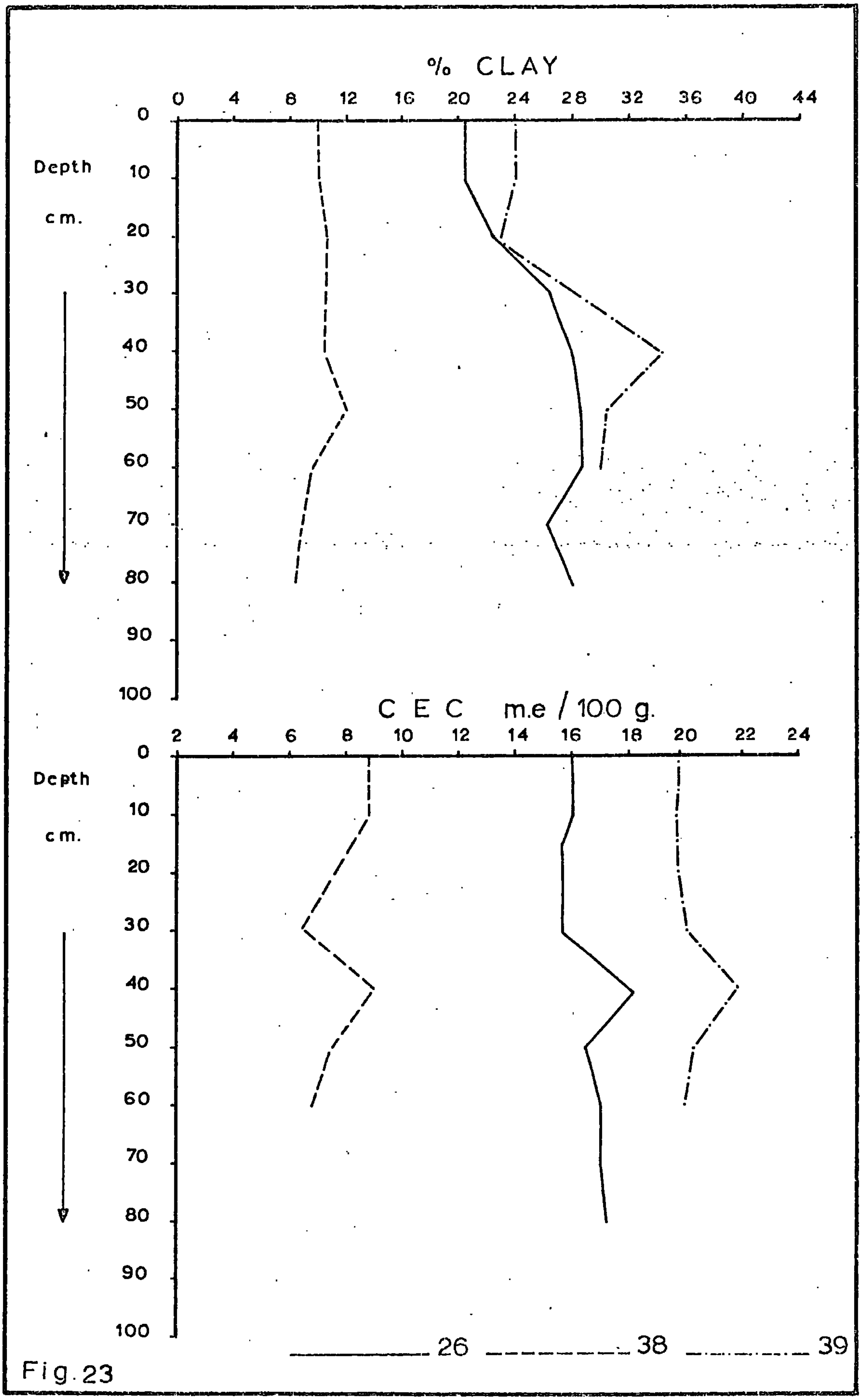


Fig. 23

Clay content and cation exchange capacity of Eutric Fluvisol soils

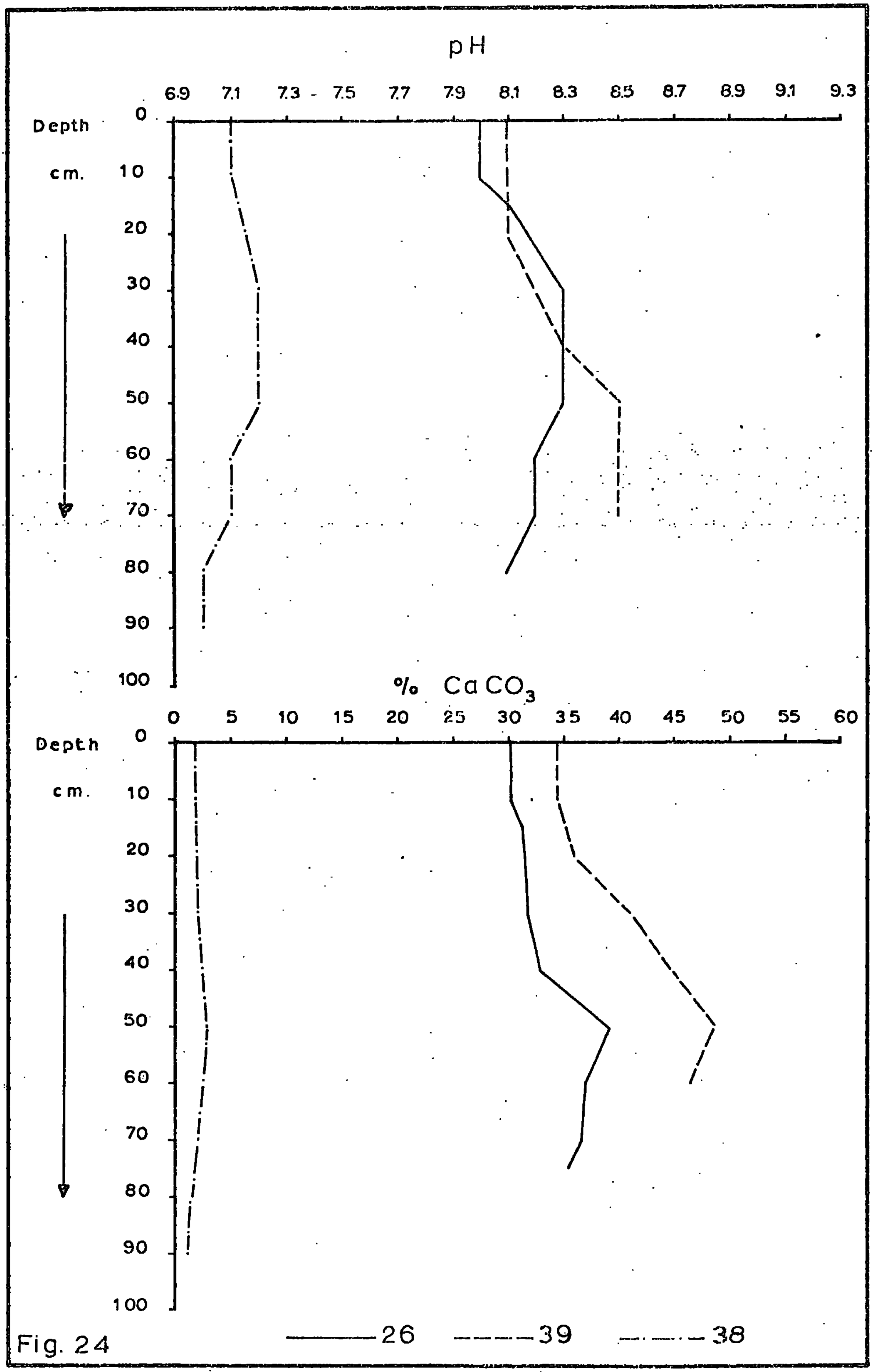


Fig. 24

pH and calcium carbonate content of Eutric Fluvisol soils seems to be present in all Eutric Fluvisol profiles.

TABLE 6

Variation of calcium carbonate content and the pH of soils derived from calcareous and non-calcareous parent materials

Profile	Parent material	Horizon	Depth cm	pH	% $CaCO_3$
26	calcareous alluvial deposits	A	0-10	8.0	30.4
		B/C	20-30	8.1	31.3
			40-50	8.3	38.4
		C	60-70	8.2	36.5
38	non-calcareous alluvial deposits	A	0-10	7.1	1.8
		B/C	20-30	7.2	2.0
			40-50	7.2	2.7
		C	60-70	7.1	2.0
39	calcareous colluvial deposits	A	0-10	8.1	34.5
		B/C	20-30	8.3	41.9
			40-50	8.5	48.5
		C	60-70	8.4	46.2

The cation exchange capacity tends to be higher in soils developed on calcareous parent material than in the soils developed on non-calcareous material. Furthermore, there is a close correlation between cation exchange capacity and the clay content. For example the highest cation exchange capacity 21.82 m.e/100 g. is found in the B/C horizon of Profile 39 on calcareous material whilst the highest clay contnent of 33.6 per cent also recorded in the same horizon. There is a wide range in cation exchange capacity of Eutric Fluvisols. This range reflects the nature of the soil parent materials. Soils derived from calcareous alluvial deposits are usually of finer texture and therefore higher cation exchange capacity than the soils derived from non-calcareous alluvial deposits which are usually coarse textured soils, which are also characterized by lowest cation exchange capacity.

5.3. EUTRIC REGOSOLS

INTRODUCTION:

In the western Elbistan basin, soils derived from soft, highly weathered Gabbro parent material have been identified as Eutric Regosols. These are the soils which usually occur on steep slopes and at elevations ranging between 1300 m and 1400 m. They are infertile and have no diagnostic horizons apart from the pallid A horizon. They cover almost 5 per cent of the thesis area. The western Elbistan basin has a higher rainfall than the eastern part, ranging between 400 mm and 600 mm and increasing with altitude. Precipitation always occurs as heavy showers within a short period of time. The natural vegetation is dominated by Quercus ilex and there is also some steppe vegetation comprising Festuca ovina, stipa sp., Avena sp. All the soil profiles are excessively drained and eroded. Five different sites have been examined in detail in the field and samples taken from three of these in order to determine the physical and chemical characteristics of the Eutric Regosols.

MORPHOLOGY:

The profile characteristics of Eutric Regosols include a thin surface horizon, often stripped off by excessive run off, and grey brown to yellowish brown B and C horizons. The

PROFILE 11

Plate - 7 Eutric Regosol

Eutric Regosols have developed on fairly steep slopes and usually possess a thin pallid A horizon less than 10 cm in thickness with a low organic matter content (less than 1%). Profile 11 represents a typical Eutric Regosol under scattered Suercus ilex vegetation. It shows little evidence of profile development. The morphological characteristics of Eutric Regosols are illustrated by Profile 11 (p. 87).

In the Eutric Regosol profiles the following morphological characteristics have been recorded in the field. Firstly, the profiles have thin surface horizons; this is due to the effect of steep slopes and sparse vegetation. Secondly the horizon boundaries are irregular and not very clear. Slope is an important agent in effecting the boundaries of horizons. Thirdly, there are clear erosion levels which have been investigated in the area. During the rainy season rainfall occurs as heavy showers over a short period of time and surface run off is rapid, causing erosion especially of the top soil; for instance Profile 7 was sampled on one of the steepest slopes in the area and has only 3 cm of weakly-developed surface horizon.

PHYSICAL AND CHEMICAL CHARACTERISTICS

The only diagnostic horizon present in the Eutric Regosols is the pallid A horizon. This horizon is variable especially with respect to organic matter content and thickness. Table 7 shows that the slope plays an important role in the development in the Eutric Regosol profiles.

The Eutric Regosols have weakly developed surface structure

PROFILE 11

Location Tülce tepe, south face

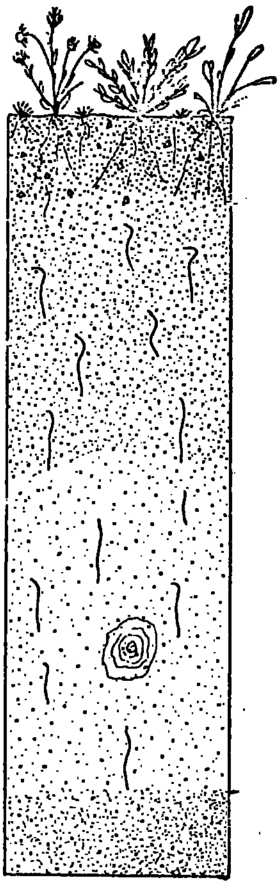
Elevation 1300 m

Slope 14°

Parent material highly weathered Gabbro

Land use <u>Quercus</u> <u>ilex</u>, <u>Festucu</u> <u>ovine</u>, <u>Stipa</u> sp;

Profile Description



A	0-10 cm	10YR 5/4 (yellowish brown); sandy loam; weak granular structure; dry soft; abundant fibrous roots; high faunal activity; few small bedrock fragments; wavy boundary.
(B)	10-32 cm	10YR 6/2 (Light brownish grey); silty loam; weak small subangular blocky structure; dry loose; occasional fibrous roots; no bedrock fragments; irregular boundary.
B/C	32-46 cm	10YR 7/2 (Light grey); silty loam; massive and structureless; dry and loose; one dead tree roots (about 3 cm diameter); high faunal activity; no bedrock fragments; irregular boundary.
C	46 + cm	10YR 8/3 (very pale brown); highly weathered Gabbro; massive.

PROFILE 11

Analytical Data

Depth CM.	Mechanical Analysis % Coarse SAND	Medium SAND	Fine SAND	SILT	CLAY	pH	% $CaCO_3$	% L.O.I	% Fe_2O_3 (x 10^{-1})
0-10	28.7	9.3	9.2	46.3	6.5	7.2	4.1	-	11.7
15-20	29.4	10.6	10.1	42.4	7.5	7.3	4.4	-	12.3
35-40	31.5	10.4	10.2	36.5	11.4	7.4	7.7	-	11.1
40-45	33.6	12.5	10.6	34.3	8.3	7.3	5.9	-	10.9

Depth CM.	Cation Exchange Capacity m.e./100 g. Na	K	Mg	Ca	Total	% C	% N	C/N	P_2O_5 m.e./100g.
0-10	1.35	0.37	0.27	1.92	3.91	0.5	0.02	25.0	-
15-20	1.10	0.35	0.28	2.32	4.05	0.2	0.01	20.0	-
35-40	1.45	0.69	0.51	2.32	4.97	0.08	-	-	-
40-45	1.28	0.19	0.33	2.25	3.05	0.02	-	-	-

TABLE 7

Variation in organic matter content and the thickness of pallid A horizon related to the different slopes

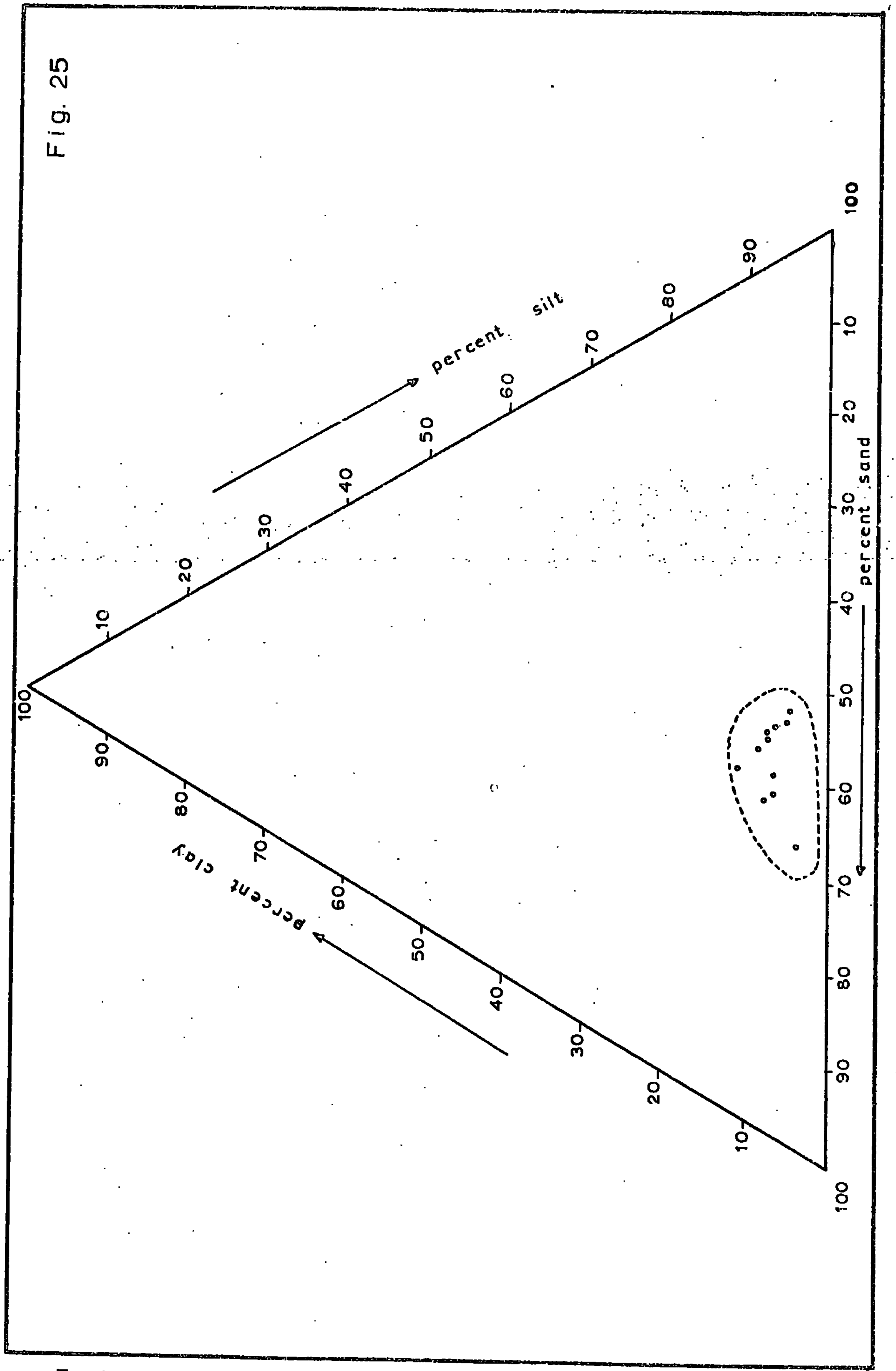
Profile	Slope°	% Organic Matter	Thickness of the Pallid A horizon (cm.)
7	29	0.34	33
11	14	0.86	10
20	22	0.52	6

varying between moderately developed granular and weakly developed angular blocky structure, because of the lack of organic matter content in the A horizon. On the other hand B horizons of all Eutric Regosol profiles also show weak structure development as a result of low clay content.

The Eutric Regosols are usually moderately coarse-textured and medium-textured soils varying between sandy loam, loam and silty loam textures. Generally the surface horizons are loamy texture, and becomes silty loam texture in all B horizons. On the other hand C horizons are always sandy laom texture in all Eutric Regosol profiles. (Fig. 25). Clay content generally increases with depth and reaches a maximum in the B horizon. Coarse sand is the dominant sand in all Eutric Regosol profiles and increases with depth. (Table 8).

Eutric Regosols show a lack of organic matter content in their pallid A horizon as indicated previously. Topography cause of this low organic matter content. During the heavy showers, run-off water causes sheet erosion in the area and

Fig. 25



Texture of Eutric Regosol soils

TABLE 8

Mechanical analysis of Eutric Regosol

Profiles	Depth of samples cm.	% SAND C.S.	M.S.	F.S.	% SILT	% CLAY
	0-3	31.3	10.1	7.9	45.6	5.1
7	10-15	36.1	10.1	7.1	44.3	6.4
	20-25	37.2	7.2	7.1	37.8	7.7
	25-30	38.8	12.4	12.7	31.9	4.2
11	0-10	28.7	9.3	9.2	46.3	6.5
	15-20	29.4	10.6	10.1	42.4	7.5
	35-40	31.5	10.4	10.2	36.5	11.4
	40-45	33.6	12.5	10.6	34.3	8.3
20	0-5	31.4	10.2	8.3	44.9	5.2
	10-20	33.5	8.2	7.9	43.6	6.8
	25-30	35.8	7.4	7.6	40.1	9.1
	30-35	37.1	8.6	6.4	35.7	7.2

strips off the top soil. Also, the steep slopes permit rapid run off and moisture has a limited influence on chemical and biological reactions. Vegetation is rather sparse in this area and some of the steppe vegetation - usually characterized by short grasses - is totally destroyed by rapid run off. (Fig.26)

The Eutric Regosols are slightly alkaline. Typical pH variation is shown in Fig. 27. . The figure illustrates that the pH gradually increases with depth and reaches a maximum of 7.4 at 20-30 cm in all profiles. On the other hand analytical results indicate that there is a slight Calcium carbonate accumulation (about 10 per cent) in the same depth of all profiles. (Fig. 27). Generally high calcium carbonate values are reflected in higher pH values.

Total cation exchange capacity is very low in the Eutric

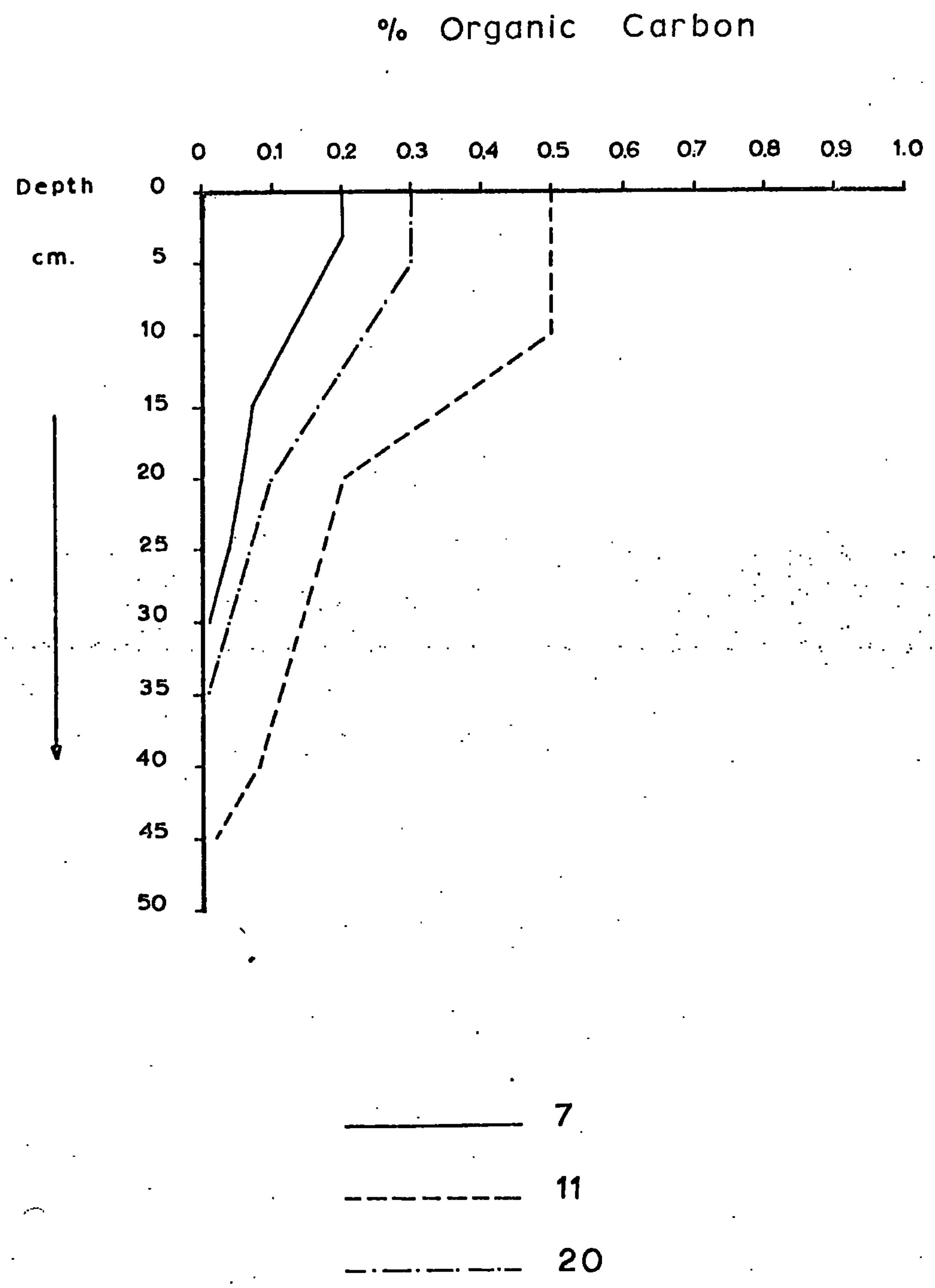
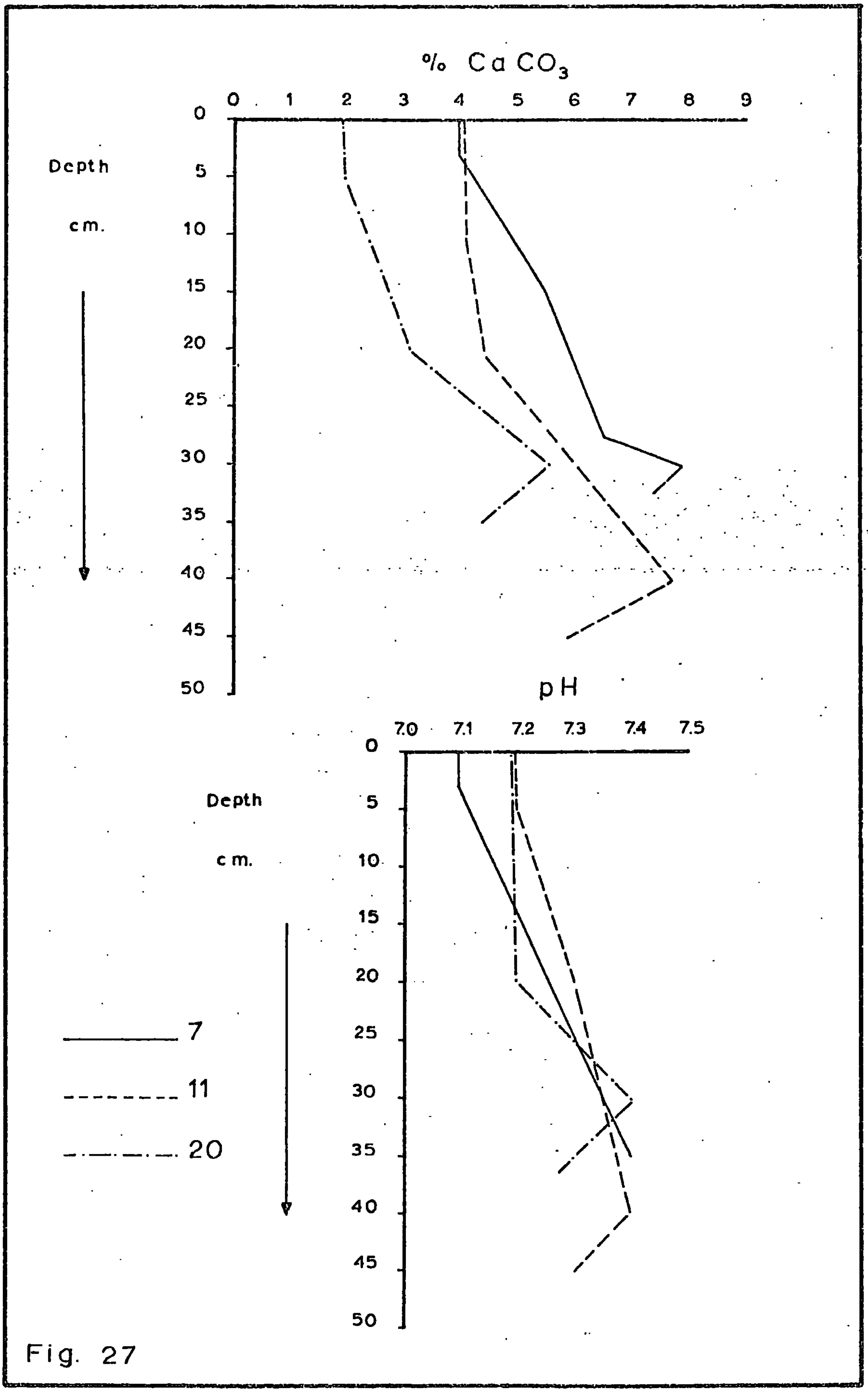


Fig. 26

Organic carbon content of Eutric Regosol soils



Calcium carbonate content and pH of Eutric Regosol soils

Regosol profiles, because they are coarse textured soils. The cation exchange capacity does not exceed 5.0 m.e/100g. Generally calcium cations dominate the exchange capacity in all profiles of Eutric Regosols.

5.4. GLEYSOLS

INTRODUCTION

Seasonal variations in the level of the water table often cause poor drainage conditions and lack of aeration in the soil profiles, thus accelerating the gleization process and producing Gleysols in the Elbistan basin. This process is dominant in the profiles which have developed from calcareous alluvial deposits on the floor of the basin and the resultant soils have been identified as Fluvic Gleysols. On the other hand the process of calcification is dominant with the process of gleization in the profiles developed from Cretaceous limestone on slopes and the resultant soils in this case have been identified as Calcic Gleysols. Gleysols cover about 5 per cent of the basin at heights between 1100 and 1300 metres. Five different sites have been examined in the field and two of the characteristic profiles have been sampled for laboratory analysis. One is Profile 24 which represents Fluvic Gleysols, near Mehre village; the other is Profile 3 which represents Calcic Gleysols and was sampled about 5 km west of Elbistan Town.

MORPHOLOGY:

The groundwater occuring at a shallow depth (often within 0.6 metres) ensures that gleization is the dominant process.

PROFILE 3

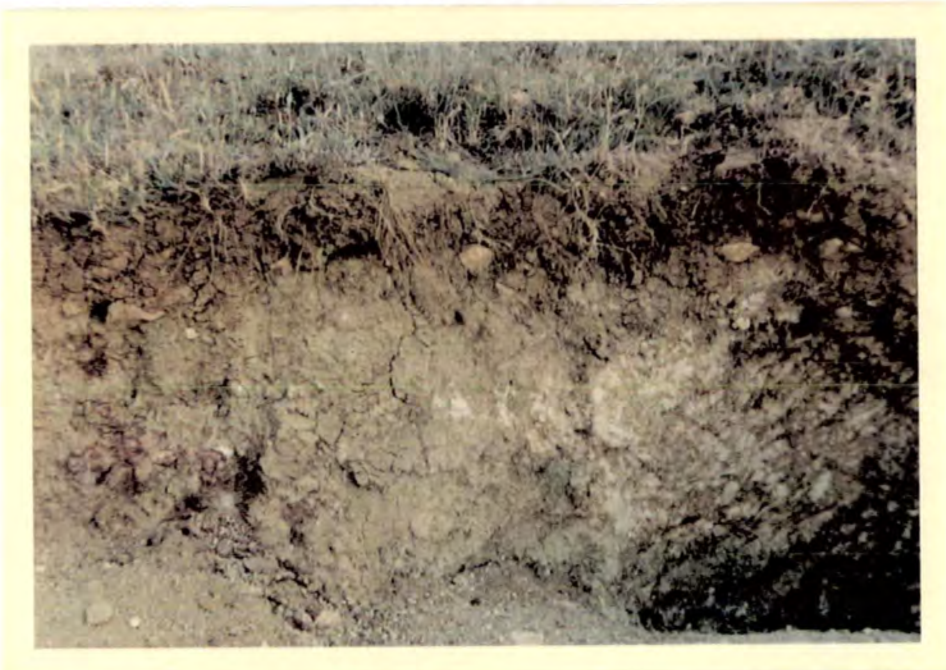


Plate - 8 Calcic Gleysol

The soils generally only have a well-developed pallid A horizon in addition to the gley horizon. The morphological characteristics of Fluvic Gleysol are illustrated by Profile 24 (p 96)

The morphological characteristics of a Calcic Gleysol include a pallid A horizon overlying a weakly developed (B) horizon. Some clay accumulated is apparent in this latter horizon probably the result of slight leaching during the wet season (October to March). A strongly developed calxic horizon is often present and this probably reflects the long dry season when evaporation is intense. Below the Calxic horizon, the gley horizon is present. The morphological characteristics of Calcic Gleysols are illustrated by Profile 3 (p 100).

PHYSICAL AND CHEMICAL CHARACTERISTICS OF GLEYSOLS:

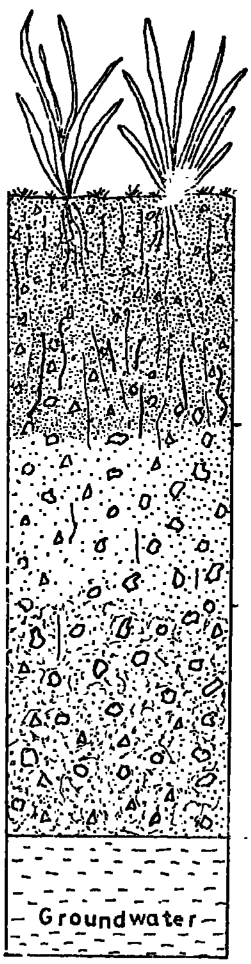
The pallid A horizon varies somewhat in colour, organic matter content and thickness. Colour varies from brown to dark brown; darker colours (10YR 3/3) are usually found in profiles of Fluvic Gleysols while lighter colours (10YR 5/3) occur in Calcic Gleysol profiles.

The depth of the pallid A horizon would appear to depend on the slope, the character of the natural vegetation and the moisture content. The deeper pallid A horizons occur in Fluvic Gleysol profiles. Because the water table is near the surface, the profiles are moist throughout much of the year and thick short grasses are green for longer periods. On the other hand Calcic Gleysols, developed under sparse short

PROFILE 24

Location	Mehre village
Elevation	1100 m.
Slope	0^{o}
Parent material	Calcareous alluvial deposits
Land use	Thick short grasses

Profile Description



A 0-28 cm	10YR 3/3 (Dark brown); clay loam; medium granular structure; moist very friable; abundant fibrous roots; occasional small angular limestone fragments (less than 2 cm diameter); wavy boundary.
B/C 28-41 cm	10YR 5/3 (Brown); silty clay; weak medium angular blocky structure; moist and firm occasional fibrous roots; no fragments; wavy boundary.
Cg 41 + cm	10YR 6/3 (Pale brown); clay massive and structureless; occasional reddish brown (5YR 5/4) mottles; no roots; no fragments; wet and sticky; irregular boundary.

PROFILE 24

Analytical Data

$\times 10^{-1}$

Depth CM.	Mechanical Analysis %					pH	% $CaCO_3$	% L.O.I	% Fe_2O_3
	Coarse SAND	Medium SAND	Fine SAND	SILT	CLAY				
0-10	12.3	10.2	6.5	40.5	30.5	7.9	18.1	-	6.5
10-20	11.6	8.2	5.4	42.1	32.6	7.8	16.9	-	6.2
30-35	6.1	5.1	5.7	47.5	35.6	8.0	21.1	-	4.9
35-40	5.1	3.6	3.7	49.4	38.2	8.0	22.4	-	7.5
40-45	6.5	4.5	4.2	44.8	40.0	8.2	27.6	-	11.7
45-50	5.1	5.0	4.0	42.1	43.8	8.1	24.3	-	16.2

Depth CM.	Cation Exchange Capacity m.e./100 g.					% C	% N	C/N	P_2O_5 m.e./100g.
	Na	K	Mg	Ca	Total				
0-10	3.25	0.97	0.80	13.94	18.96	4.0	0.12	33.3	-
10-20	3.28	0.85	0.75	16.53	21.41	3.1	0.10	31.0	-
30-35	3.31	0.49	0.78	18.54	23.12	1.4	0.04	35.0	-
35-40	3.20	0.98	0.86	18.08	23.48	0.8	0.02	40.0	-
40-45	3.41	0.79	0.84	19.15	24.19	0.3	0.01	30.0	-
45-50	3.46	0.92	0.88	19.59	24.85	-	-	-	-

grasses, have less organic matter content, because the steppe vegetation which covers the Calcic Gleysol area dies off very quickly in the dry season (between April and September) because of the lack of moisture in the profile. Table 9 shows the variation of organic matter content depth and colour in the pallid A horizon of Gleysols.

TABLE 9

Variation in colour, organic matter content and thickness of pallid A horizon in Gleysols on different slopes

Profile	Slope	Colour	% O.M.	Thickness of Pallid A horizon cm.
3	4^o	10YR 5/3	2.59	12
26	Flat(0^o)	10YR 3/3	6.90	28

Gleying is the dominant process in both Calcic and Fluvic Gleysols. The gley horizon is well developed in the Fluvic Gleysol profiles on the floor of the basin because the groundwater is very near the surface. Also these profiles, developed in flat areas, possess the physical situation suitable for the development of gley horizons in these profiles. The gley horizon is weakly developed in the Calcic Gleysol profiles which have developed on slopes, because the groundwater table is about 2 metres below the surface and thus it does not have the same effect on the development of the gley horizon. However, field and Laboratory analyses indicate that there is a moderately well developed gley horizon in Profile 3 which represents Calcic Gleysol in the basin.

The surface structure of the Gleysol profiles varies according to the moisture content and organic matter in the profile. The Fluvic Gleysol profiles are fairly moist and rich in organic matter and have well developed structure in their morphology. Structure becomes more massive with depth due to the increased percentage of clay content and excessive moisture. On the other hand the Calcic Gleysol profiles have medium to weakly developed small angular blocky structure in the surface horizon, the structure becomes well developed coarse angular blocky structure in the B horizon due to slow shrinkage during the summer. The structure becomes more massive with depth below 50 cm as a result of increased percentage of silt content and moisture in the profile morphology.

The gleysols are usually fine textured soils. They are derived from different parent materials. The Fluvic Gleysols on the floor of the basin are derived from clay rich calcareous alluvial deposits and contain more than 30 per cent clay throughout the profile. On the other hand Calcic Gleysols derived from Cretaceous Limestone on the slopes are dominated by particles of silt size; 60-70 per cent throughout the profile is common. The variation of particle sizes in the Gleysol profiles is shown in Table 10 ; it indicates that clay increased with depth and reaches a maximum in Gley horizons in Fluvic Gleysols. On the other hand Calcic Gleysols indicates some clay accumulation in the B horizon.

The Gleysols generally have an alkaline reaction. However the degree of alkalinity is mainly dependent on Calcium carbonate content in the profile. (Table 11) Table 11 suggests that the highest pH values usually occur

PROFILE 3

Location 3.5 km west of Elbistan Town

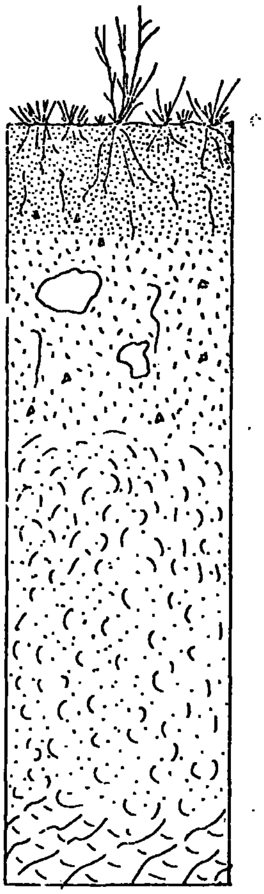
Elevation 1200 m.

Slope 4°

Parent material Cretaceous Limestone

Land use Sparse short grasses and some <u>stipa</u> sp.

Profile Description



A 0–12 cm

10YR 5/3 (Brown); silt loam; medium angular blocky structure; abundant fibrous roots; dry, soft; occasional small angular limestone fragments (less than 2 cm diameter); high faunal activity; wavy boundary.

B 12–33 cm

10YR 5/8 (Yellowish brown); silty clay; coarse angular blocky structure; slightly moist and friable; occasional white (2.5 Y 5/8) calcium carbonate Accumulations (about 2–3 mm diameter); occasional dead fibrous roots; few small angular limestone fragments (2–3 cm diameter); wavy boundary.

B_{ca} 33–76 cm

10YR 5/6 (Yellowish brown); silt; coarse to medium angular blocky structure; many medium to coarse distinct white (2.5Y 8/2) soft lime pockets and nodules; slightly moist; occasional small limestone fragments (less than 3 cm diameter); diffuse boundary.

C_g 76 + cm

56 Y 5/1 (Greenish grey); silty clay; weak prismatic and medium angular blocky structure; moist and firm; no bedrock fragments; smooth boundary.

PROFILE 3

Analytical Data

Depth CM.	Mechanical Analysis %					pH	% $CaCO_3$	% L.O.I	% Fe_2O_3 (x 10^{-1})
	Coarse SAND	Medium SAND	Fine SAND	SILT	CLAY				
0-10	5.3	4.4	6.6	67.4	16.2	8.2	30.2	-	6.2
20-30	4.4	3.0	5.4	61.9	25.3	8.3	33.5	-	5.7
40-50	2.1	2.6	5.7	71.6	17.9	8.3	34.2	-	6.4
50-60	2.7	2.6	5.8	70.2	18.6	8.5	42.4	-	8.8
60-70	2.3	2.6	6.5	67.9	20.6	8.4	38.4	-	8.2
70-80	2.0	4.9	5.7	66.8	20.5	8.3	36.8	-	14.4

Depth CM.	Cation Exchange Capacity m.e./100 g.					% C	% N	C/N	P_2O_5 m.e./100g.
	Na	K	Mg	Ca	Total				
0-10	1.26	1.73	0.32	8.12	11.43	1.5	0.09	16.7	-
20-30	2.41	1.75	0.73	11.82	16.71	0.9	0.03	30.0	-
40-50	1.82	1.12	0.44	12.87	16.25	0.7	0.01	70.0	-
50-60	1.63	0.38	0.35	12.45	14.81	0.4	-	-	-
60-70	1.65	0.39	0.38	12.87	15.29	0.1	-	-	-
70-80	1.34	0.97	0.36	12.70	15.37	-	-	-	-

TABLE 10

Mechanical analysis of Gleysols

Profile	Parent material	Horizon	Depth of samples cm.	% SAND	% SILT	% CLAY
		A	0-10	16.3	67.4	16.2
	Cretaceous	B	20-30	12.8	61.9	25.3
3	Limestone	Bca	50-60	11.1	70.2	18.6
		Cg	70-80	12.6	66.8	20.5
	Clay rich	A	0-10	19.0	40.5	30.5
24	calcareous	B/C	30-35	16.9	47.5	35.6
	Alluvial deposits	Cg	45-50	14.1	42.1	43.8

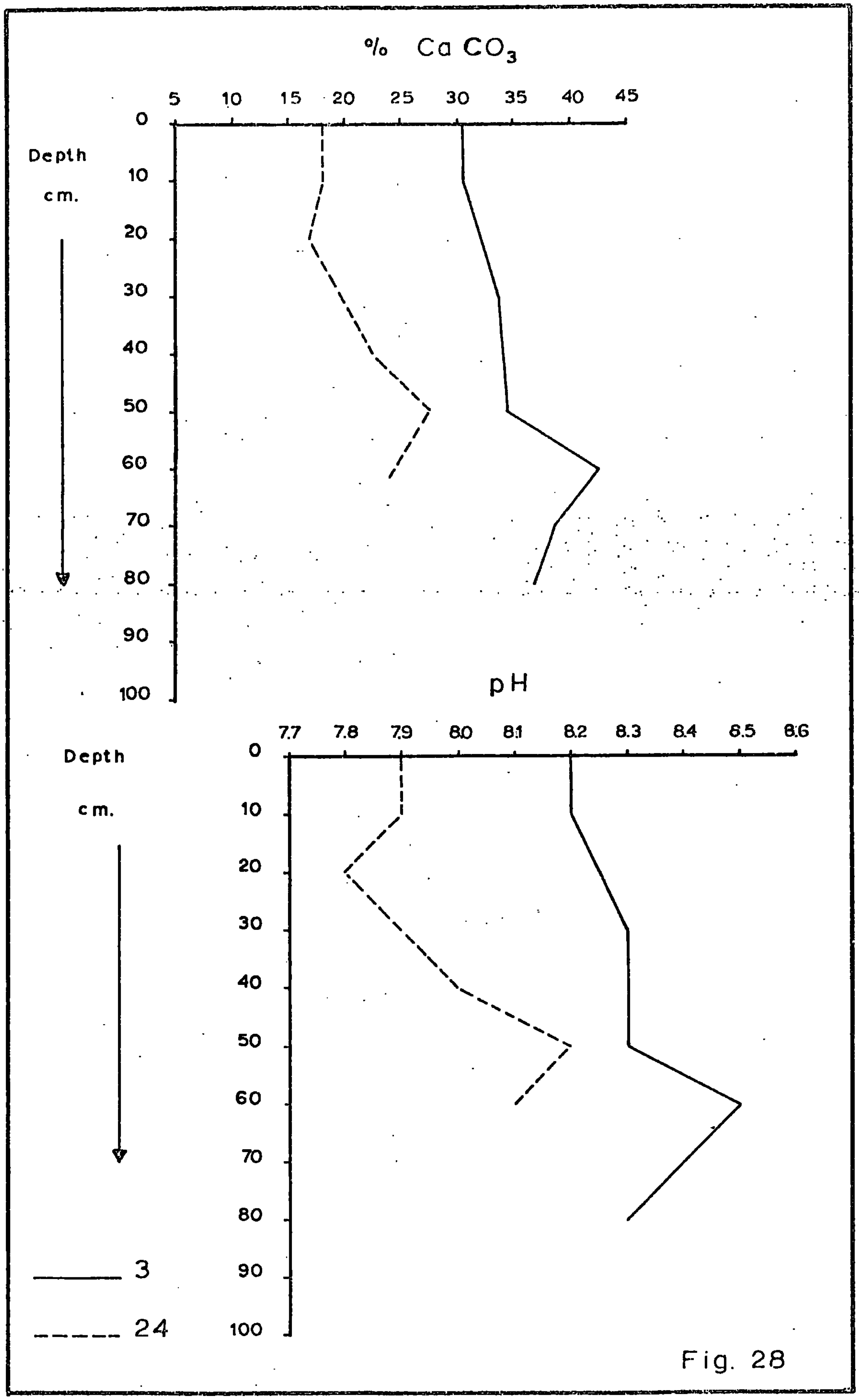
at depths between 40 and 60 cm in all profiles of Gleysols. The percentage of calcium carbonate content increases with depth and reaches its maximum in the same depths.

TABLE 11

Relationship between calcium carbonate content and pH in Gleysol profiles

Profile	Horizon	Depth cm	pH	% $CaCO_3$
	A	0-10	8.2	30.2
	B	20-30	8.3	33.5
3	Bca	50-60	8.5	42.4
	Cg	70-80	8.3	36.8
	A	0-10	7.9	18.1
	B	30-35	8.0	21.1
24		40-45	8.2	27.6
	Cg	45-50	8.1	24.3

Fig. 28 shows the typical relationship between pH and calcium carbonate content in the Gleysols of the Elbistan basin. For instance maximum calcium carbonate value is 42.4



Calcium carbonate content and pH of Gleysols per cent in the calxic horizon of Profile 3 which represents Calcic Gleysols in the basin while the highest pH value 8.5 was also recorded in the same sample.

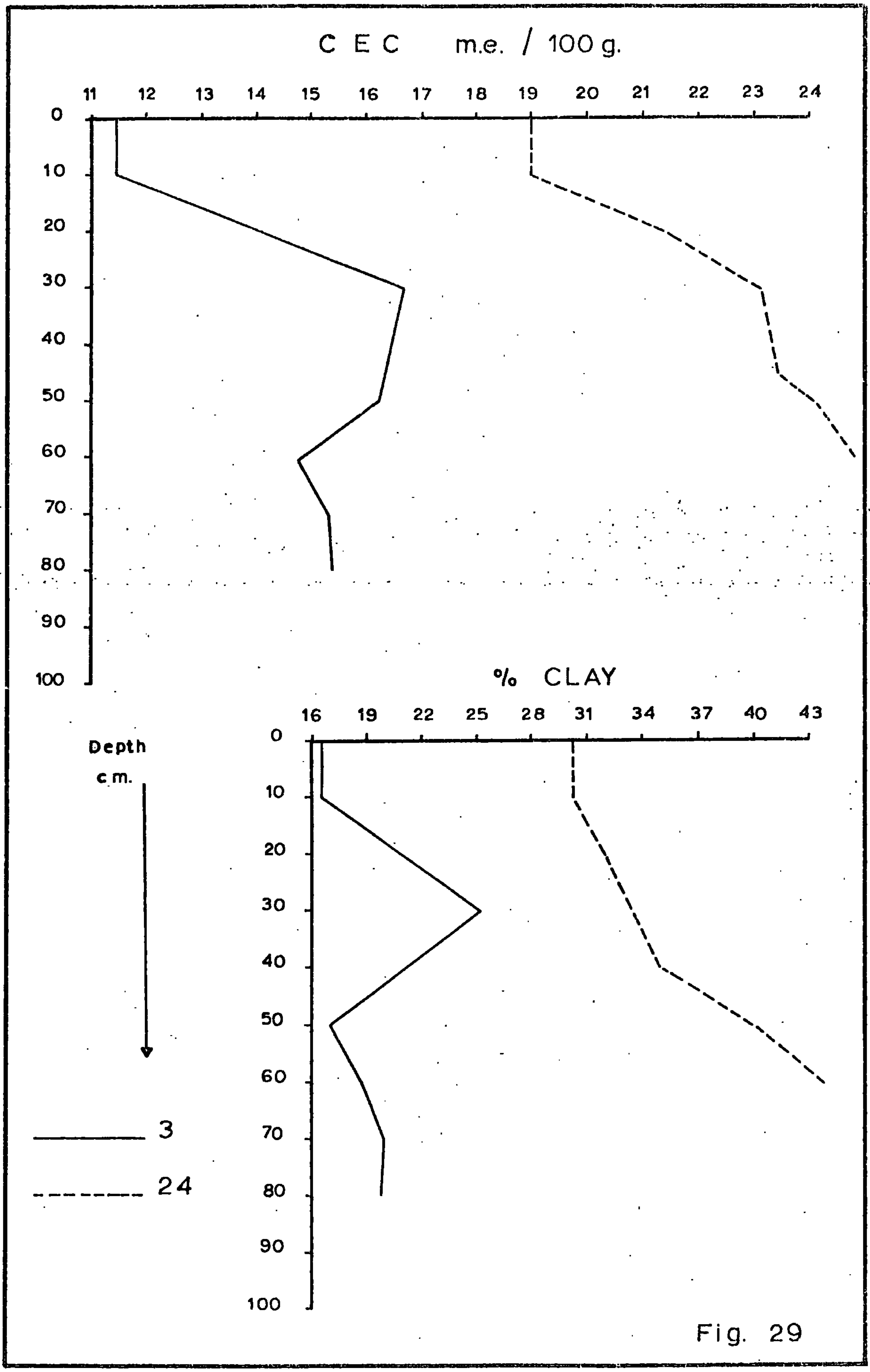
The cation exchange capacity tends to be higher in the Fluvic Gleysols which are derived from clay rich calcareous alluvial deposits than the Calcic Gleysols which are developed on Cretaceous Limestone. Furthermore, there is a close correlation between total cation exchange capacity and the percentage of clay content in Gleysol profiles (Fig 29). For example the highest cation exchange capacity, 24.85 m.e/ 100g., is found in the gley horizon of Fluvic Gleysols (Profile 24) while the highest clay content, 43.8 per cent, was also recorded in the same sample. Thus, high clay content is always reflected in high cation exchange capacity. Calcium is the dominant exchangeable cation in the Gleysol profiles.

In general the Gleysols show an accumulation of iron oxides (Fe_2O_3) in their gley horizon (Fig 30). Table 12 illustrates that the percentage of iron oxide varies between 3 and 6 per cent in the A and B horizons and then increases dramatically to more than 10 per cent in the gley horizon.

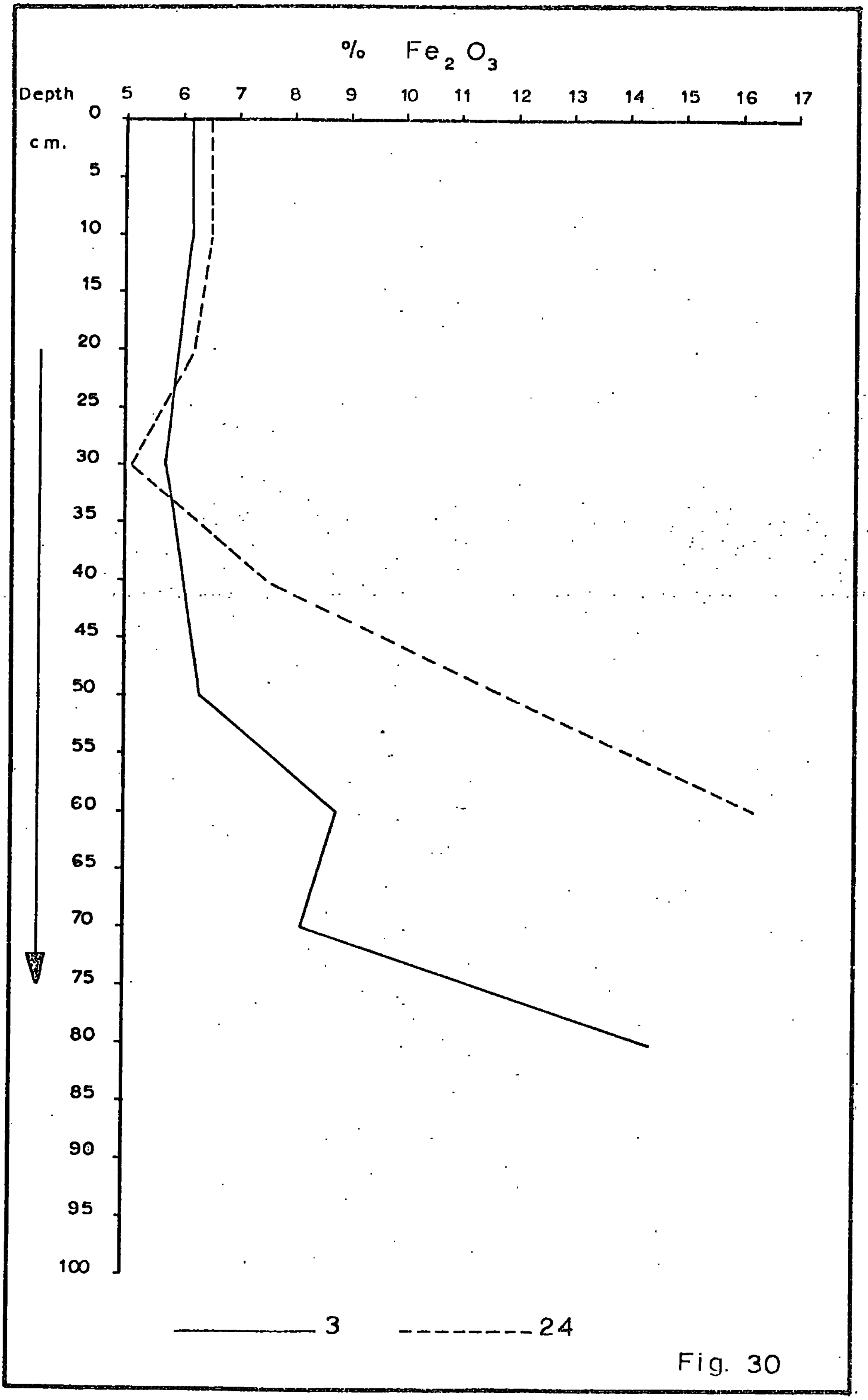
TABLE 12

Variation of Fe_2O_3 content in Gleysols

Profile	Horizon	Depth (cm)	% Fe_2O_3 x 10^{-1}
	A	0-10	6.2
	B	20-30	5.7
3	Bca	50-60	8.8
	Cg	70-80	14.4
	A	0-10	6.5
24	B	30-35	4.9
		35-40	7.5
	Cg	45-50	16.2



Cation exchange capacity and clay content of Gleysols



Iron oxide content of Gleysols

5.5. HAPLIC CASTANOZEMS

INTRODUCTION:

Haplic Castanozems occur extensively in the south and southwestern part of the basin. They occupy almost 200 sq km of the total area. Haplic Castanozems are derived from basic igneous rocks, mainly diorite, gabbro and serpentine (M.T.A. 1966). The Haplic Castanozem soils usually occur on gentle and moderate slopes ranging between 2° and 10° and at elevations of between 1150 metres and 1450 metres. The Haplic Castanozem soils are characterized by a moderate to well developed melanic A horizon and by a cambic B horizon which usually occurs about 30 cm below the soil surface. These soils are medium textured and usually have a well developed surface structure.

MORPHOLOGY:

Profile 40 represents a typical Haplic Castanozem which has developed on dioritic parent material under thick short grasses and scattered small trees. It is located about 3 km south of Poskoflu village on gullied land near the junction of the River Göksun. Profile 40 includes a moderately deep dark greyish brown melanic A horizon overlying a brown Cambic B horizon with a little clay accumulation in the same horizon. (Table 14) Morphological characteristics of Haplic Castanozem soils are illustrated by Profile 40 (p108).

PHYSICAL AND CHEMICAL CHARACTERISTICS

The melanic A horizon is a characteristic surface horizon of all Haplic Castanozem soils. It is characterized by dark

Plate - 9

Profile 19

haplik castanozems

Plate - 10

Profile 8

haplik castanozems

Plate - 11

Profile 42

aplik castanozems

PROFILE 40

Location near Paskoflu village

Elevation 1170

Slope 5^{o}

Parent material Diorite

Land use _Festuca Sulcata_, _Artemisia Incana_, _Artemisia terrae albae_.

Profile Description

A	0-21 cm	10YR 3/2 (very dark greyish brown); loam; small medium weak angular blocky and well developed granular structure; slightly moist and very friable; abundant fibrous roots; occasional small to medium angular diorite fragments (up to 3 cm diameter); wavy boundary.
B	21-43 cm	7.5YR 5/4 (Brown); sandy clay loam; medium angular blocky structure; frequent fibrous roots; occasional medium and small angular diorite fragments (up to 5 cm diameter); slightly moist and very friable; wavy boundary.
B/C	43-66 cm	10YR 5/4 (Yellowish brown); sandy loam; weak angular blocky structure; occasional large roots; few very small angular diorite fragments (up to 2 cm diameter); slightly moist and still very friable; wavy boundary.
C	66 + cm	10YR 6/4 (light yellowish brown); sandy loam; massive and structureless; no roots; occasional very small angular diorite fragments (not more than 2 cm diameter) and very few soft lime concretions about 2-4 mm diameter; irregular boundary.

PROFILE 40

Analytical Data

Depth CM.	Mechanical Analysis %					pH	% $CaCO_3$	% L.O.I	% Fe_2O_3 ($\times 10^{-1}$)
	Coarse SAND	Medium SAND	Fine SAND	SILT	CLAY				
0-10	9.1	3.9	26.4	44.2	16.4	7.2	2.7	-	13.4
10-20	8.6	2.8	26.5	42.8	19.3	7.2	2.8	-	16.8
30-40	6.4	2.1	26.7	43.5	21.3	7.3	3.0	-	19.7
50-60	8.1	5.2	28.1	41.0	17.6	7.4	3.9	-	20.4
65-75	9.4	9.0	28.5	40.8	12.3	7.3	3.1	-	18.8

Depth CM.	Cation Exchange Capacity m.e./100 g.					% C	% N	C/N	P_2O_5 m.e./100 g.
	Na	K	Mg	Ca	Total				
0-10	1.86	1.66	0.32	6.00	9.84	3.4	0.12	28.3	-
10-20	1.95	1.55	0.40	5.87	9.77	2.7	0.08	33.7	-
30-40	1.60	1.64	0.65	8.87	12.76	1.8	0.04	45.0	-
50-60	1.76	1.73	0.49	6.37	10.35	0.6	0.01	60.0	-
65-75	1.61	1.77	0.39	5.31	9.08	0.2	-	-	-

colour and relatively high humus content varying between 2.06 and 7.24 per cent organic matter content. The variation in the organic matter content of the melanic A horizon is very closely related with slope. The slope also effects the thickness of the melanic A horizon in the Haplic Castanozem soils of the Elbistan basin. Generally gentle slopes have more organic matter content and thicker melanic A horizon than the steeper slopes (Table 13) Jenny (1941) describes the relationship between slope and the structure of the surface horizon in the following terms "the work of Norton and Smith on the forested loessal soils of Illinois made a great number of measurements of slopes and correlated data with the depth of the A horizon. The average trend of the relationship indicates that on flat areas, the thickness of the surface soil is 24 in., on steep slopes it is only 9 in." Table 13 illustrates this relationship in the Elbistan basin comparing the results with those given by Norton and Smith.

TABLE 13

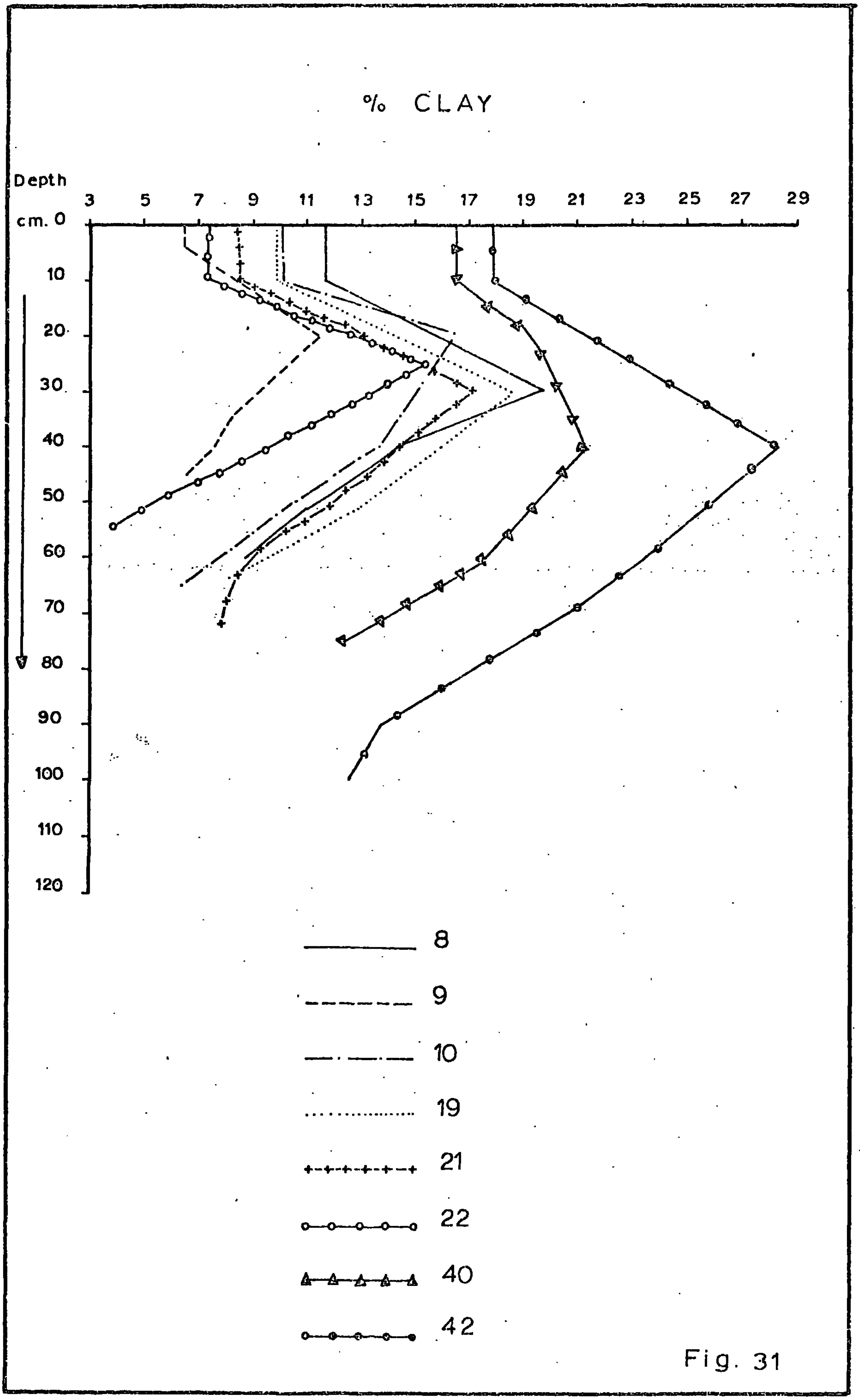
Relationship between organic matter content and the thickness of melanic A horizon in Haplic Castanozem on different slopes

Profile	Slope	% Organic Matter	Thickness of melanic A horizon cm.
8	4^o	4.82	18
9	10^o	2.06	8
10	7^o	2.58	12
19	5^o	3.36	16
21	6^o	2.93	14
22	8^o	2.41	10
40	3^o	6.03	21
42	2^o	7.24	25

The Haplic Castanozem soils also have a cambic B horizon with slight clay accumulation (Table 14) in the same horizon. The texture of the cambic B horizon is usually heavier than that of the melanic A horizon. The cambic B horizon also contains some weatherable minerals such as biotite, some pyroxines and amphiboles. The minerals however have not been completely destroyed in the Cambic B horizon. The cambic B horizon normally has the brown, reddish brown and yellowish brown colour of all Haplic Castanozem profiles.

The Haplic Castanozem soils usually have a moderate to well developed granular surface structure varying according to organic matter content. The structure becomes moderate to good angular blocky to a weak prismatic structure in the B horizon varying according to clay content and shows sometimes massive or weak angular blocky structure in the C horizon because of the low clay content.

The Haplic Castanozem soils are medium and moderately coarse textured soils, varying between loam, sandy loam, silty loam and very fine sandy loam (Table 14). Usually slope plays an important role in the variation of clay content in the Haplic Castanozem profiles. Generally clay increases with depth and reaches a maximum in the B horizon and decreases gradually in the C horizon (Fig. 31) Table 14 indicates variations of slope and clay contant in the Haplic Castanozem profiles. For example gentle slopes show higher clay content than steeper slopes. Accumulation of clay content in the B horizon also occurs due to clay movement during the wet season. (October to April). The Haplic Castanozem soils also have a high proportion of fine-sand particles in the texture as a



Clay content of Haplic Castanozem soils

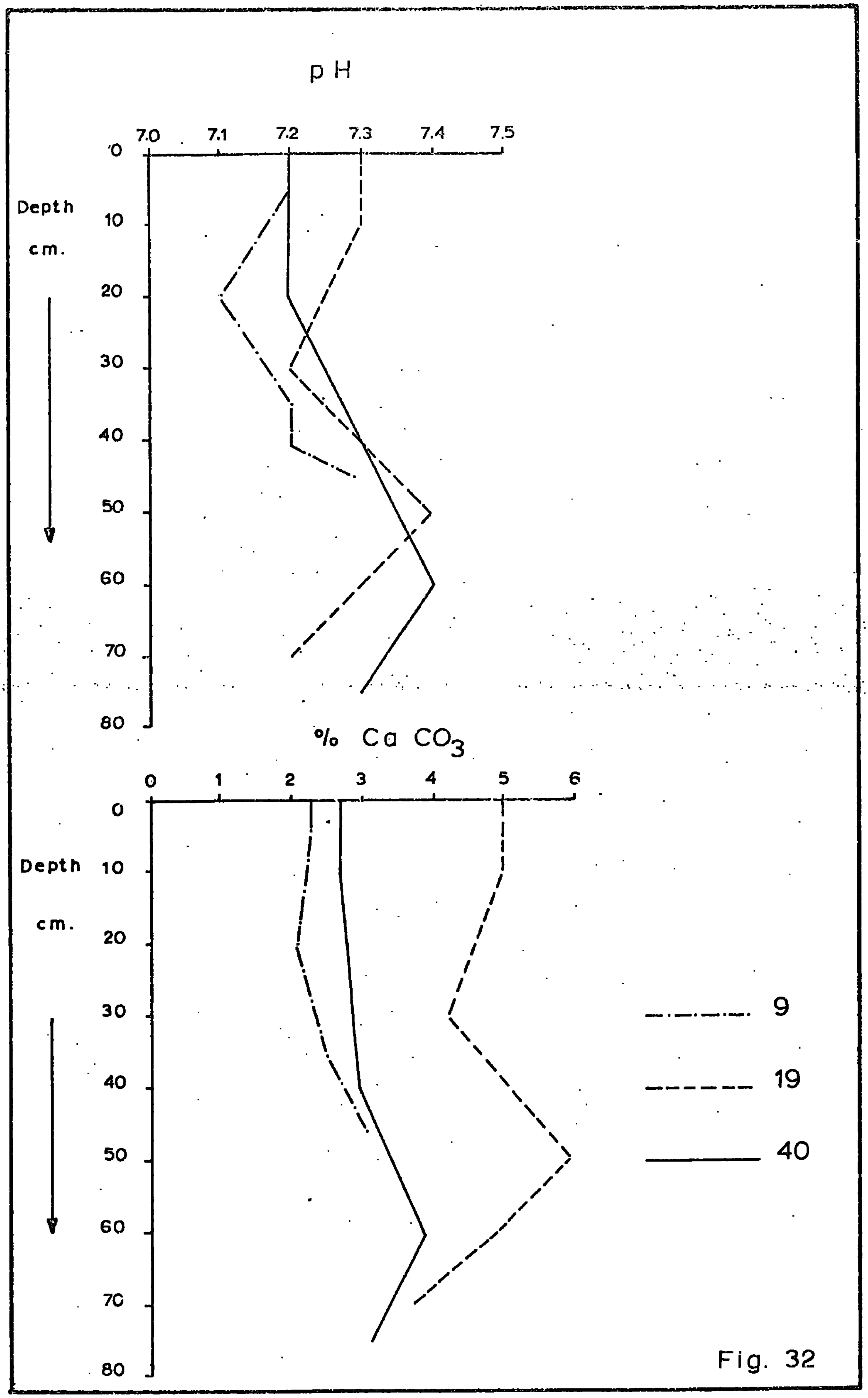
result of the degree of chemical and mechanical weathering (Table 14).

TABLE 14

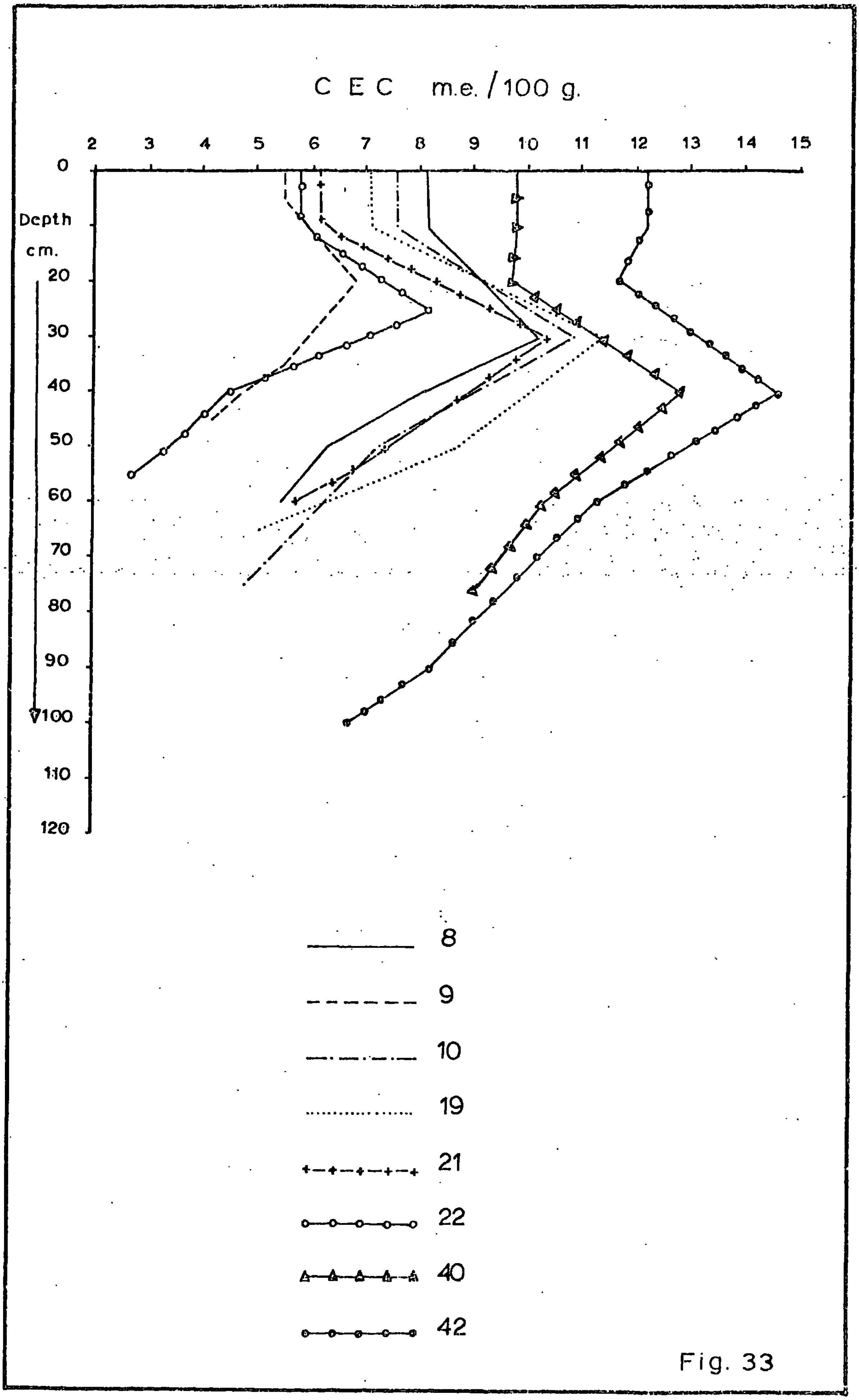
Mechanical Analysis of Haplilc Castanozem

Profile	Horizon	Depth of samples cm.	Slope	% SAND C.S.	M.S.	F.S.	% SILT	% CLAY
8	A	0-10	4°	10.4	7.4	28.1	42.4	11.7
	B	20-30		6.1	4.3	26.4	43.4	19.8
	B/C	30-40		5.3	3.6	39.7	46.1	14.3
	C	50-60		10.1	5.1	31.5	41.8	11.5
9	A	0-5	10°	13.0	9.9	29.1	42.5	5.5
	B	10-20		12.6	7.4	28.5	40.0	11.5
	B/C	25-30		14.1	5.9	30.3	41.4	8.3
	C	35-45		14.6	5.9	35.2	39.7	4.6
10	A	0-10	7°	14.3	8.5	26.4	42.7	8.1
	B	20-30		10.4	6.7	23.5	44.9	14.5
	B/C	45-50		10.9	6.0	28.7	43.8	10.6
	C	60-65		12.5	8.2	30.4	42.5	6.4
19	A	0-10	5°	13.4	7.2	22.8	46.7	9.9
	B	20-30		7.5	6.2	24.6	43.1	18.6
	B/C	40-50		7.4	5.3	29.5	44.4	13.4
	C	55-60		8.4	4.1	31.7	46.1	9.7
21	A	0-10	6°	12.4	7.1	19.9	42.1	8.5
	B	20-30		9.1	5.1	24.1	44.6	17.1
	B/C	40-50		8.2	7.1	28.2	43.4	12.1
	C	60-70		11.6	5.5	24.3	40.7	7.9
22	A	0-10	8°	12.5	9.4	29.4	41.3	7.4
	B	20-25		7.2	4.1	29.8	43.6	15.3
	B/C	30-40		10.1	6.4	31.6	42.2	9.7
	C	45-50		10.4	5.2	34.3	44.7	5.4
40	A	0-10	3°	9.1	3.9	26.4	44.2	16.4
	B	30-40		6.4	2.1	26.7	43.5	21.3
	B/C	50-60		8.1	5.2	28.1	41.0	17.6
	C	65-75		9.4	9.0	28.5	40.8	12.3
42	A	0-10	2°	7.4	4.5	26.7	43.5	17.9
	B	30-40		3.4	2.1	27.4	38.7	28.4
	B/C	60-70		6.4	3.5	29.5	39.9	20.7
	C	80-90		6.8	4.1	30.6	44.7	13.8

The Haplic Castanozem soils are slightly alkaline. Typical pH values range from 7.2 to 7.4. The variation of pH



pH and calcium carbonate content of Haplic Castanozem soils



Cation exchange capacity in Haplic Castanozem soils within profiles is shown in Fig. 32 . It increases with depth and reaches a maximum at a depth of between 40 and 50 cm and decreases slowly below that depth. The Haplic Castanozem soils have low calcium carbonate contents, generally less than 6 per cent. This low figure is the effect of parent material, derived from potassium and iron rich basaltic lavas which contain only limited amounts of calcite intrusions. pH and calcium carbonate are closely related, high pH values correlating with the highest calcium carbonate content.

The cation exchange capacity tends to be higher in the cambic B horizon which the highest clay content is also recorded in the same profile. However the melanic A horizon of Haplic Castanozems also shows high cation exchange capacity, especially the first 10 cm of the surface horizon, which is rich in organic colloids (Fig 33). Figure 33 illustrates that cation exchange capacity reaches a maximum of 14.63 m e/100g in the B horizon of Profile 42, whilst the highest clay content (28.4 per cent) is also recorded in the same horizon. This relationship seems to be present in all Haplic Castanozem profiles. Calcium again is the dominant exchangeable cation in all profiles. However sodium and potassium cations increase slightly with depth below 50 cm in all Haplic Castanozem profiles.

5.6. CALCIC CASTANOZEMS

INTRODUCTION

In the Elbistan basin reddish chestnut coloured soils derived from Paleozoic Limestone (M.T.A. 1966) parent material

Plate - 12

Profile 25

calcic castanozems

Plate - 13

Profile4

calcic castanozems

Plate - 14

Profile 32

calcic castanozems

have been identified as Calcic Castanozem soils. The Calcic Castanozem soils cover about 10 per cent of the total area of the basin. They are characterized by a moderate to well developed melanic A horizon and by a Cambic B horizon usually 20-30 cm below the soil surface. The Calcic Castanozems also have a well developed calxic horizon approximately 50 cm below the soil surface. This horizon has a Calcium Carbonate accumulation up to 60 per cent.

Calcic Castanozems usually occur on gentle slopes ranging between 0^{o} and 6^{o} and at an elevation varying between 1150 metres and 1350 metres. Five different profiles have been examined in the field and three profiles have been sampled for physical and chemical analyses in the laboratory. Calcic Castanozems are uncultivated soils and generally use as grazing land in the Elbistan basin.

MORPHOLOGY

The typical Calcic Castanozem is represented by Profile 25 which is located near Kücukkabaagac village about 15 kilometres northwest of Elbistan Town

Profile 25 includes a dark reddish brown melanic A horizon overlying a bright reddish brown (B) horizon overlying a bright reddish brown (B) horizon and a pinkish white B_{ca} horizon which contains a high percentage of Calcium Carbonate (59.3 per cent). The morphological characteristics of Calcic Castanozem soils are illustrated by Profile 25 (p 118).

PHYSICAL AND CHEMICAL CHARACTERISTICS:

The melanic A horizon is a characteristic of all Calcic Castanozem profiles, but variations of organic matter content

PROFILE 25

Location	Küçükkaıbaağaç village
Elevation	1200 m
Slope	2^{o}
Parent material	Paleozoic Limestone
Land use	<u>Artemisia terrae albae</u>, <u>Artiplex cana</u>

Profile Description

A	0-18 cm.	5YR 3/3 (Dark reddish brown); Loam; medium granular structure; abundant fibrous roots; many limestone fragments (up to 5 cm diameter); dry and slightly hard; wavy boundary.
B	18-42 cm.	5YR 5/4 (Reddish brown); silty clay loam; medium angular blocky and weak prismatic structure frequent fibrous roots; many limestone fragments (up to 10 cm diameter); dry and slightly hard; wavy boundary.
B_{ca}	42-71 cm.	7.5YR 7/6 (Pink); silty loam; coarse angular blocky structure; dry and slightly hard; medium distinct powdery lime pockets and lime concretions; no roots; many small limestone fragments (up to 2 cm diameter); wavy boundary.
B/C	71+cm.	5YR 5/3 (Reddish brown) silty loam, weak angular blocky structure; dry and slightly hard; no roots; many medium to coarse limestone fragments (up to 10 cm diameter); smooth boundary.

PROFILE 25

Analytical Data

Depth CM.	Mechanical Analysis % Coarse SAND	Medium SAND	Fine SAND	SILT	CLAY	pH	% $CaCO_3$	% L.O.I	% Fe_2O_3 $\times 10^{-1}$
0-10	6.5	6.8	10.8	47.2	26.7	8.0	40.9	-	7.4
20-30	5.3	8.1	10.2	50.1	26.3	8.1	44.4	-	7.6
30-40	5.8	3.1	8.6	51.5	31.0	8.3	~~41.4~~ 36.4	-	8.1
60-70	5.2	4.8	8.8	52.9	28.3	8.5	59.3	-	7.9
70-80	6.2	4.4	8.2	53.1	28.1	8.4	52.6	-	8.6

Depth CM.	Cation Exchange Capacity m.e./100 g. Na	K	Mg	Ca	Total	% C	% N	C/N	P_2O_5 m.e./100g.
0-10	1.30	0.96	0.90	14.62	17.78	2.5	0.10	25.0	-
20-30	1.19	0.63	0.65	14.50	16.97	1.2	0.04	30.0	-
30-40	1.41	0.70	0.92	15.30	18.43	0.7	0.02	35.0	-
60-70	1.26	0.47	0.80	15.20	17.63	0.4	0.01	40.0	-
70-80	1.28	0.45	0.70	14.61	17.04	0.1	-	-	-

and thickness of this horizon do occur. The organic matter content of the Melanic A horizon varies from a minimum of 2.59 per cent in Profile 32 to a maximum of 6.03 per cent in Profile 4. The variation in organic matter content closely related with slope. Generally, gentle slopes show higher organic matter content and thicker surface horizons than the steeper slopes (Table 15)

TABLE 15

Relationship between organic matter content and the thickness of melanic A horizon in Calcic Castanozems on different slopes

Profile	Slope	% O.M.	Thickness of Melanic A horizon cm.
4	0°	6.03	25
25	2°	4.31	18
32	6°	2.58	9

Calcic Castanozems also have a Cambic B horizon. This horizon is usually characterized by stronger chroma and redder hues than the underlying horizon. It shows well developed structure characterized by medium angular to moderately well developed prismatic structure. The Cambic B horizon also indicates some clay accumulation (Table 17) and evidence of the removal of calcium carbonate (Table 16). Calcic Castanozems also have a well developed calxic horizon. In all three profiles a calxic horizon occurs at about 50 cm; it represents secondary lime accumulation, as normal soils of semi-arid regions. (Table 16) For all soils the calcium carbonate equivalent ranges from 30 to 60 per cent in Calcic

Castanozems. The surface soil is often less calcareous than the subsoil, presumably because of leaching during the wet season which occurs from March to October. (Table 16).

TABLE 16

Variation of Calcium Carbonate content in Calcic Castanozem soils

Profile	Horizon	Depth of samples cm.	% $CaCO_3$
	A	0-10	38.2
4	(B)	30-40	39.5
	Bca	60-70	55.5
	B/C	70-80	48.6
	A	0-10	40.9
	(B)	20-30	36.4
25	Bca	60-70	59.3
	B/C	70-80	52.6
	A	0-5	36.6
	(B)	20-30	37.4
32	Bca	50-60	55.1
	B/C	60-65 ~~65-75~~	51.3

The Calcic Castanozem soils are usually moderately-fine-textured soils. But there are variations in texture. For example clay usually increases with depth and reaches a maximum in the cambic B horizon. Which indicates slight clay accumulation in this horizon (Table 17). Generally slope effects the variation of silt and clay content in all the Calcic Castanozem profiles. For instance flat areas have more clay and silt content than steeper slopes. This is presumably because of down-wash movements. (Table 17). Table 17 indicates that Profile 4 has higher silt and clay content than the other two profiles. This is because it has developed on flat areas.

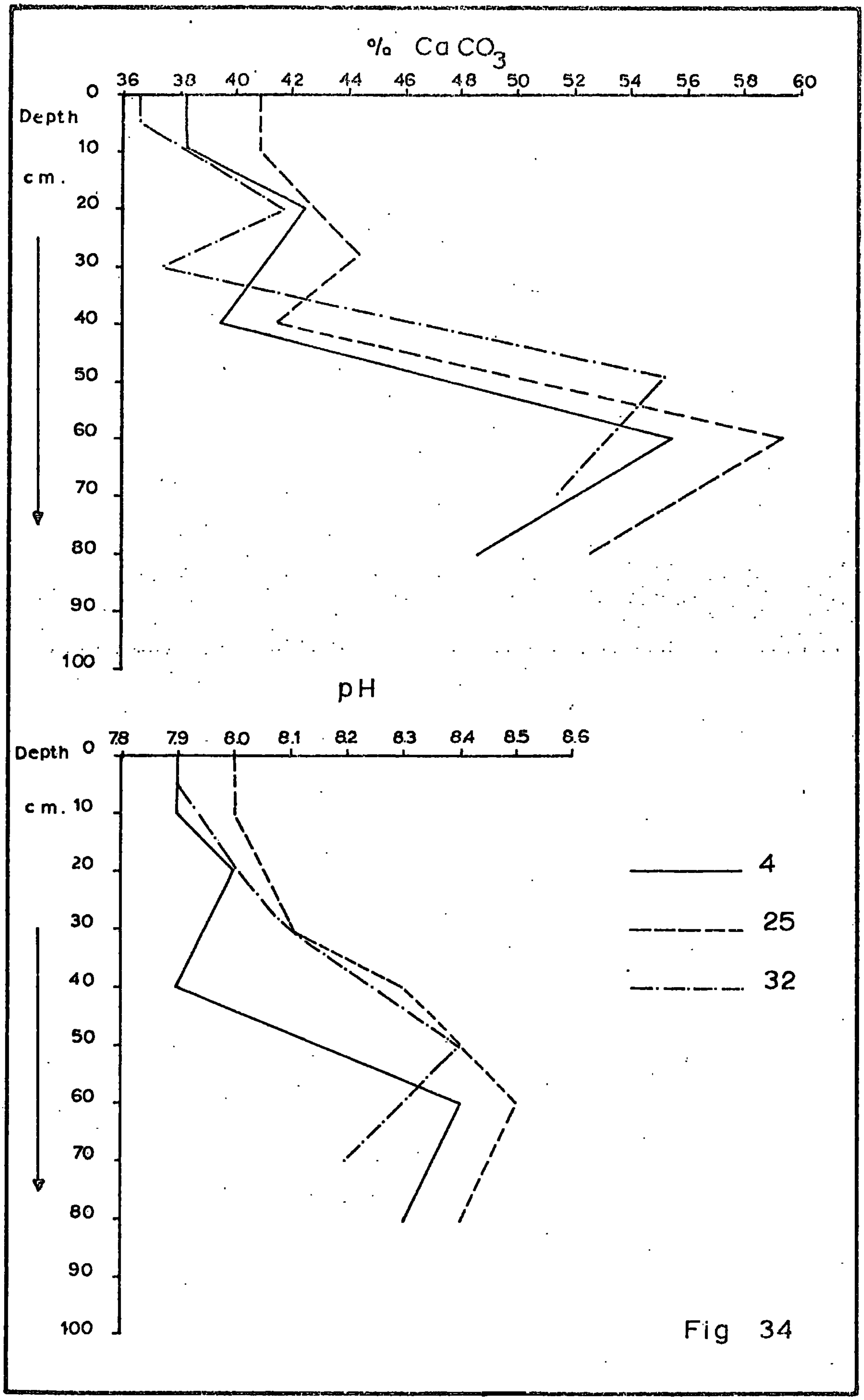
TABLE 17

Mechanical analysis of Calcic Castanozem Soils

Profile	Horizon	Depth of samples cm.	Slope	% SAND C.S.	M.S.	F.S.	% SILT	% CLAY
	A	0-10		5.3	6.8	8.8	52.6	27.5
	(B)	30-40	0°	3.4	3.6	7.8	49.5	35.6
4	Bca	60-70		4.3	3.8	6.8	53.3	31.7
	B/C	70-80		2.3	5.1	6.9	53.8	31.8
	A	0-10		6.5	6.8	10.8	47.2	26.7
	(B)	30-40	2°	5.8	3.1	8.6	51.5	31.0
25	Bca	50-70		5.2	4.8	8.8	52.9	28.3
	B/C	70-80		6.2	4.4	8.2	53.1	28.1
	A	0-5		14.0	16.6	15.3	42.2	14.9
	(B)	20-30		11.5	10.0	14.8	43.6	20.1
32	Bca	50-60	6°	13.4	11.2	12.7	46.3	16.4
	B/C	60-65		13.5	10.1	12.8	46.1	17.5

Calcic Castanozems usually have a moderate to well developed surface structure characterized by a moderate to well developed granular structure varying according to the organic matter content. The calcic castanozem soils also have moderate to well developed angular blocky and small to medium prismatic structure in the (B) horizon due to the swelling and shrinkage of the clay during wetting and drying. The structure is again well developed in Profile 4 which developed on the flat area, characterized by well developed granular surface structure and medium prismatic structure in the B horizon. This profile also has the highest organic matter content (Table 16).

Calcic Castanozem is an alkaline soil with pH ranging from 7.9 to 8.5. Fig. 34 indicates that pH generally increases with depth and reaches a maximum in the calxic horizon below which it decreases slowly with depth. pH and calcium carbonate



Calcium carbonate content and pH of Calcic Castanozem soils

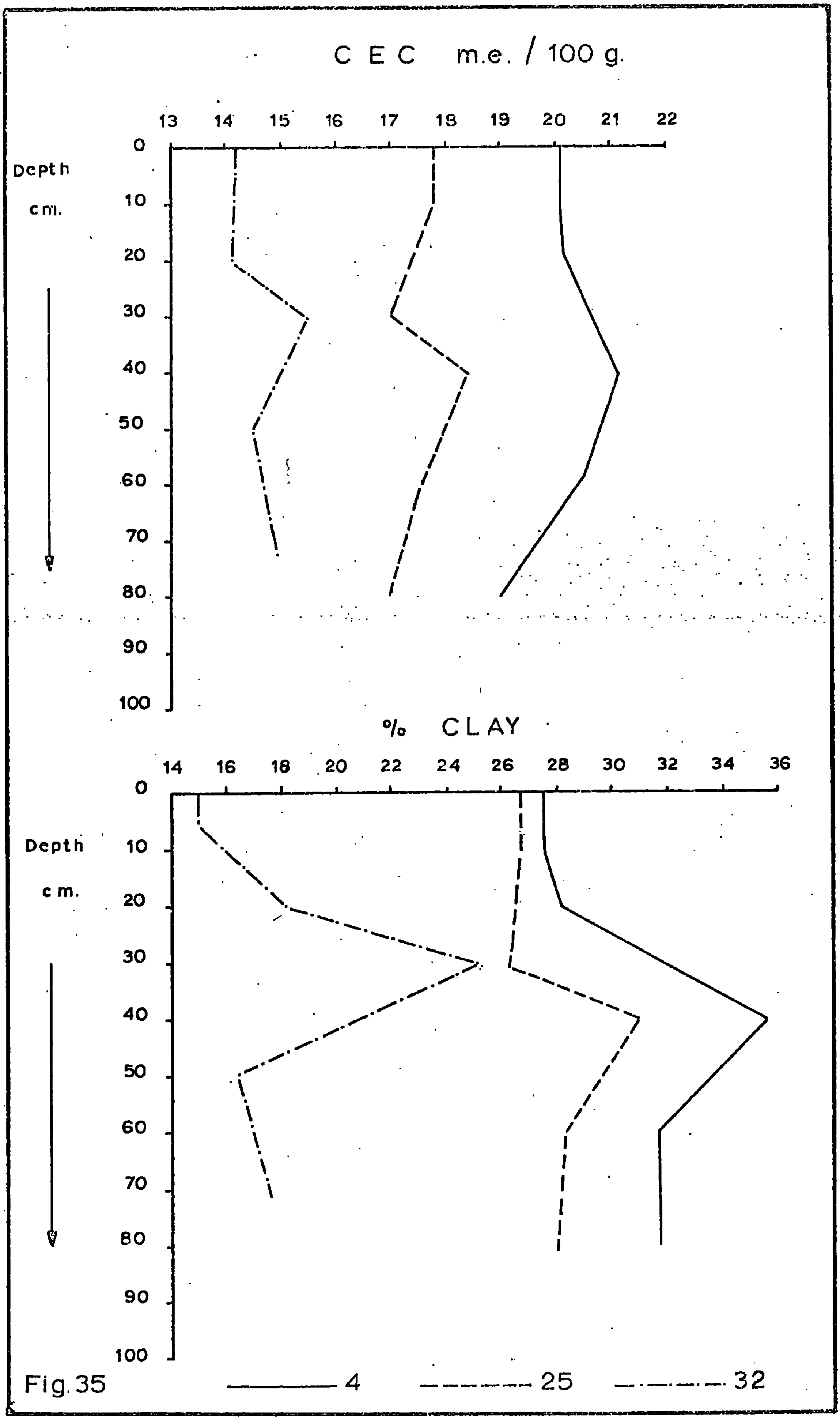


Fig. 35

Cation exchange capacity and clay content of Calcic Castanozem soils are very closely related in the profiles of Calcic Castanozems. For instance, the highest pH value of 8.5 has been recorded in the Calxic horizon of Profile 25 which also has the highest calcium carbonate value of 59.3 per cent.

The cation exchange capacity is very closely related with the clay content in the Calcic Castanozem soils. Generally cation exchange capacity increase with depth and reaches a maximum in the (B) horizon, whilst clay content also recorded its maximum percentage in the same horizon (Fig. 35). For example maximum cation exchange capacity has been recorded at 21.13 m.e/100 g. in the (B) horizon of Profile 4, whilst maximum clay content of 35.6 per cent also recorded in the same horizon. This relationship generally occurs in all profiles of the Calcic Castanozem group of soils. Finally, calcium is always the exchangeable cation in all profiles.

5.7. OCHRIC CAMBISOLS

INTRODUCTION

Soils that have developed in situ front Granite, have been identified as Ochric Cambisols. They occur along the north-western fringe of the Elbistan basin. They usually occur on gentle slopes varying between 2^{o} and 8^{o} at elevations ranging between 1150 metres and 1250 metres.

These are the soils that have a light coloured, humus deficient "pallid A" horizon, overlying a light brownish and reddish brown (B) and C horizon. The profiles usually have a thin surface horizon rarely exceeding 10 cm thickness and a shallow (B) horizon less than 15 cm thickness. Between these and the C horizon, is usually a well developed (B)/c horizon

PROFILE 15

Plate - 15 The Ochric Cambisol Profiles.

PROFILE 16

of the same colour as the (B) horizon (Kubiena 1953). Ochric Cambisols cover about 10 per cent of the total area. The amount of ferric iron oxide plays an important role in determining the colour of the profiles.

The Ochric Cambisols are usually coarse textured soils varying between sandy loam, sand and loamy sand. Structure is generally massive, or weakly developed. Surface horizons usually have a non-porous weakly developed granular structure; in the B horizon the structure varies from weak to moderate medium angular blocky structure.

Ten different sites have been examined in the field and four profiles have been sampled for further physical and chemical analyses in the laboratory.

MORPHOLOGY:

The typical Ochric Cambisol is represented by Profile 15 which has developed from Granite. It is located near the river bank of the River Göksun about 50 metres above the present flood levels. Profile 15 is freely drained and uncultivated soil. The morphological characteristics of Profile 15 include a thin, humus-deficient, pallid A horizon overlying reddish brown to brown and yellowish brown (B), (B)/C and C horizons. It shows good horizon development. However, it is a rather shallow soil with the total thickness of solum being just over 35 cm. The morphological characteristics of Ochric Cambisols are illustrated by Profile 15 (p. 127).

PHYSICAL AND CHEMICAL CHARACTERISTICS:

The pallid A horizon is very shallow in the profiles of Ochric Cambisols. However, variations in the thickness of the pallid A horizon do occur from one profile to another. The

PROFILE 15

Location 1 kilometre north of Kargabükü village

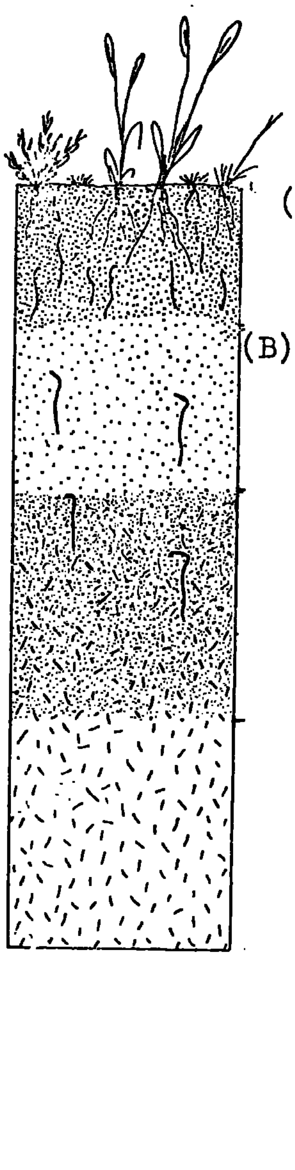
Elevation 1181 m.

Slope 4°

Parent material granite

Land use *Thymus vulgaris*, *Stipa juncea* *Quercus ilex*

Profile Description



A 0-8 cm. 7.5YR 5/4 (Brown); sandy loam; non-porous weak granular structure; abundant fibrous roots; occasional small granite fragments; dry and friable; wavy boundary.

(B) 8-17 cm. 5YR 5/4 (Reddish brown); sandy loam; medium angular blocky structure; frequent fibrous roots; occasional granite fragments; dry and friable; wavy boundary.

(B)/C 17-32 cm. 5YR 5/4 (Reddish brown); loam; medium angular blocky structure; occasional fibrous roots; few bedrock fragments; dry and friable; wavy boundary.

C 32+cm. 5YR 6/4 (Light reddish brown); loamy sand; massive structureless; no roots; no bedrock fragments; dry friable smooth boundary.

PROFILE 15

Analytical Data

Depth CM.	Mechanical Analysis % Coarse SAND	Medium SAND	Fine SAND	SILT	CLAY	pH	% $CaCO_3$	% L.O.I	% Fe_2O_3 x 10^{-1}
0-5	27.7	23.7	23.2	21.3	4.0	7.2	2.5	-	6.5
10-15	27.0	21.9	21.4	22.8	6.8	7.3	4.2	-	8.4
20-25	26.4	20.4	18.8	22.3	12.1	7.2	3.5	-	8.7
30-35	32.7	24.4	18.5	16.5	7.8	7.1	2.0	-	7.3

Depth CM.	Cation Exchange Capacity m.e./100 g. Na	K	Mg	Ca	Total	% C	% N	C/N	P_2O_5 m.e./100g.
0-5	0.32	0.32	0.41	1.80	2.85	0.6	0.07	30.0	-
10-15	0.63	0.45	0.70	2.12	2.98	0.4	0.01	40.0	-
20-25	0.62	0.39	0.84	1.89	3.74	0.1	-	-	-
30-35	0.50	0.45	0.67	1.73	3.05	0.1	-	-	-

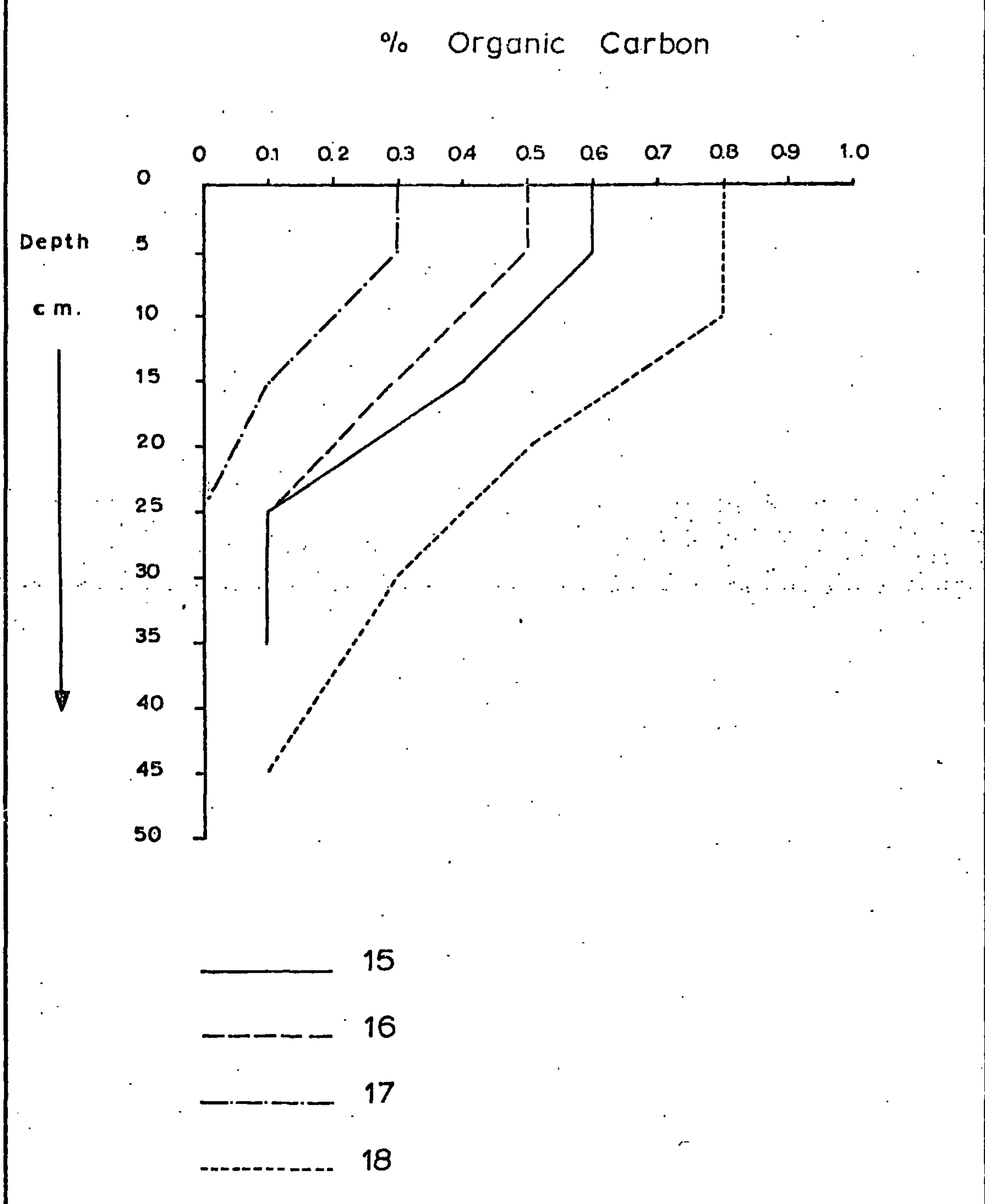


Fig. 37

Organic carbon content of Ochric Cambisol soils

Organic matter content shows very little variation in the profiles of Ochric Cambisols ranging between 0.4 and 0.8 per cent organic carbon. However, field investigation revealed that the thickness of the pallid A horizon is closely related with slopes. The trend of this relationship is shown in Table 18 .

TABLE 18

Relationship between organic earbon content and the thickness of pallid A horizon in Ochric Cambisols on different slopes.

Profile	% Organic C	Slope	Thickness of Pallid A horizon cm.
15	0.6	4°	8
16	0.5	6°	5
17	0.4	8°	3
18	0.8	0°	11

The Ochric Cambisol Soils also have a cambic B horizon. A cambic B horizon is an altered horizon reaching about 20-30 cm below soil surface in all profiles of Ochric Cambisols. It is usually of sandy loam or loam texture and has a weak medium to coarse angular blocky structure. It also contains easily weatherable minerals such as biotite, some pyroxenes and some amphiboles. Evidence of alteration is reflected by stronger chromas redder hues than the underlying horizon.[1.] The cambic B horizon also show some clay accumulation (Table 19).

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1. See profile description and appendix .

TABLE 19

Mechanical analysis of Ochric Cambisol soils

Profile	Depth of samples (cm)	% Coarse sand	% Medium sand	% Fine sand	% Silt	% Clay
	0-5	27.7	23.7	23.2	21.3	4.0
	10-15	27.0	21.9	21.4	22.8	6.8
15	20-25	26.4	20.4	18.8	22.3	12.1
	30-35	32.7	24.4	18.5	16.5	7.8
	0-5	37.6	22.6	15.8	20.9	3.1
16	10-15	31.5	22.2	16.1	25.1	5.0
	20-25	25.7	20.1	17.7	23.4	13.0
	30-35	37.1	29.1	13.2	11.9	8.7
	0-3	35.4	24.6	16.3	20.5	3.1
17	5-10	30.9	20.7	19.0	24.9	3.3
	20-25	30.3	26.3	12.6	23.2	8.5
	30-35	37.5	23.2	13.9	17.6	6.8
	0-10	35.3	18.1	13.9	26.7	5.9
18	15-20	21.2	21.2	16.5	29.5	11.5
	25-30	19.1	22.8	16.3	25.7	16.1
	35-45	25.0	21.9	20.9	22.6	9.5

The Ochric Cambisol soils usually have weak to moderate surface structure, aggregation being characterized by poorly formed indistinct peds, that are barely observable in the profiles. However the structure is better developed in Profile 18 because it has higher organic carbon and clay content than other Ochric Cambisol profiles. In the B horizon of all Ochric Cambisol profiles, the grade of structure is characterized by well-formed distinct peds varying from medium to coarse angular blocky structure; presumably due to the slight increase of silt-plus-clay content in this horizon varying between 30 and 40 per cent. But in the C horizon of all Ochric Cambisol profiles, the structure becomes very massive.

The Ochric Cambisol soils are coarse and moderately coarse-textured soils throughout the profile varying from loamy sands to sandy loam (Fig. 36), with a high percentage of coarse sand (Table 19). Generally Y_2 silt-plus-clay content increases with depth and the maximum always is recorded in the (B)/C horizon (Table 19). The parent material is a primary influence on the texture of the Ochric Cambisol profiles, being derived from coarse textured Granite parent material which is easily weatherable.

The variation of organic carbon is shown in Fig.37 that, only top 15 cm of profile has higher organic carbon content. It drops down dramatically in the subsoil. This is probably due to the sparse vegetation cover in the area. The main species are Thymus vulgaris, Stipa juncea and some scattered Quercus Ilex. They have a shallow rooting system and consequently only influences the surface horizon of the profile.

The Ochric Cambisol soil is usually neutral to weakly alkaline in reaction with pH's ranging between 7.0 and 7.3. Fig.38 shows typical pH variation of Ochric Cambisol soils. The soil has a neutral reaction of the surface and pH increases with depth to reach a maximum in the B horizon in which there is also a higher calcium carbonate content. The Ochric Cambisol soils show very little calcium carbonate content in the profiles, rarely exceeding 5.0 per cent. Maximum calcium carbonate content is also recorded in the B horizon coincidental with the highest pH's (Fig. 38).

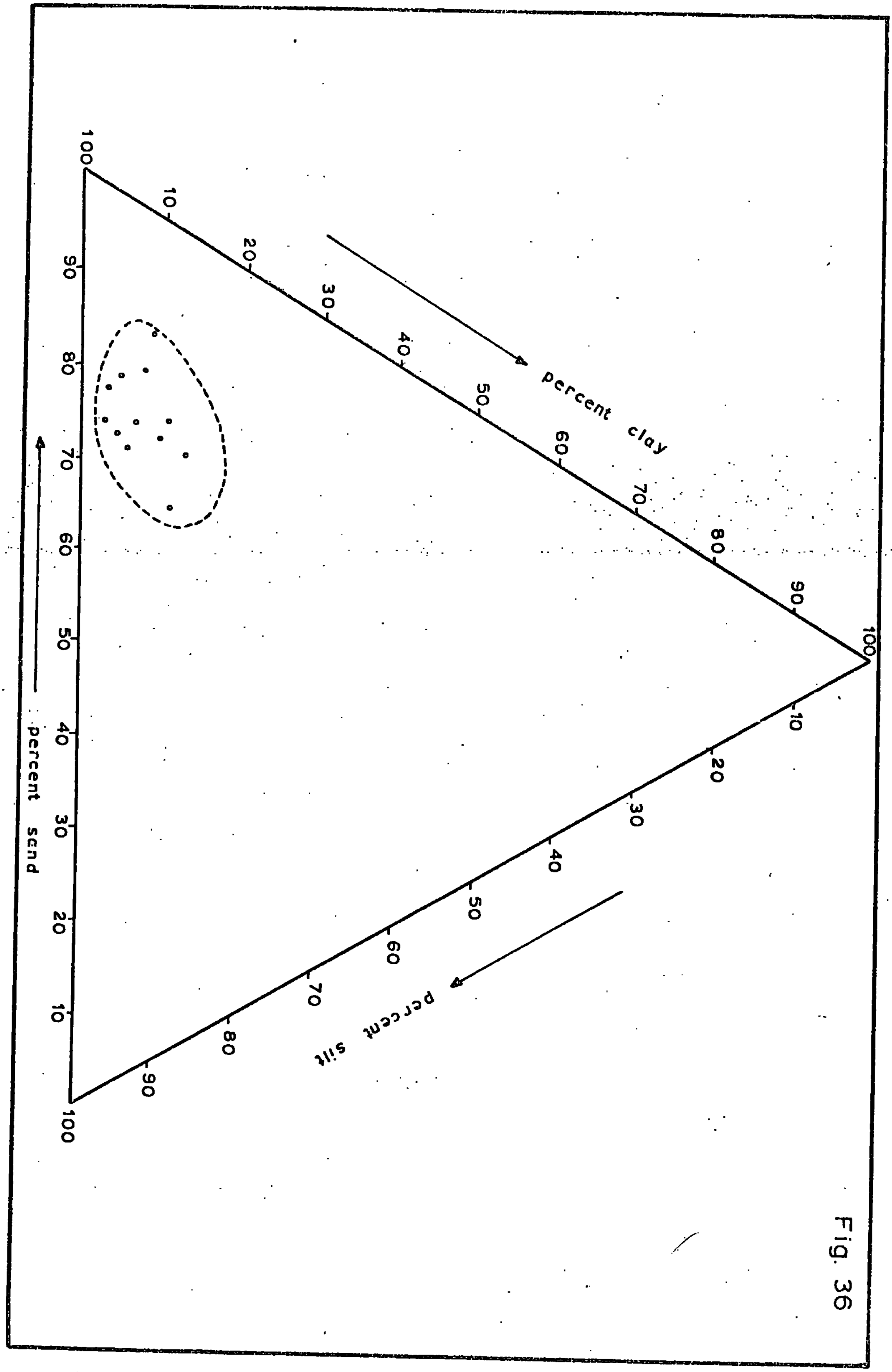


Fig. 36

Texture of Ochric Cambisol soils

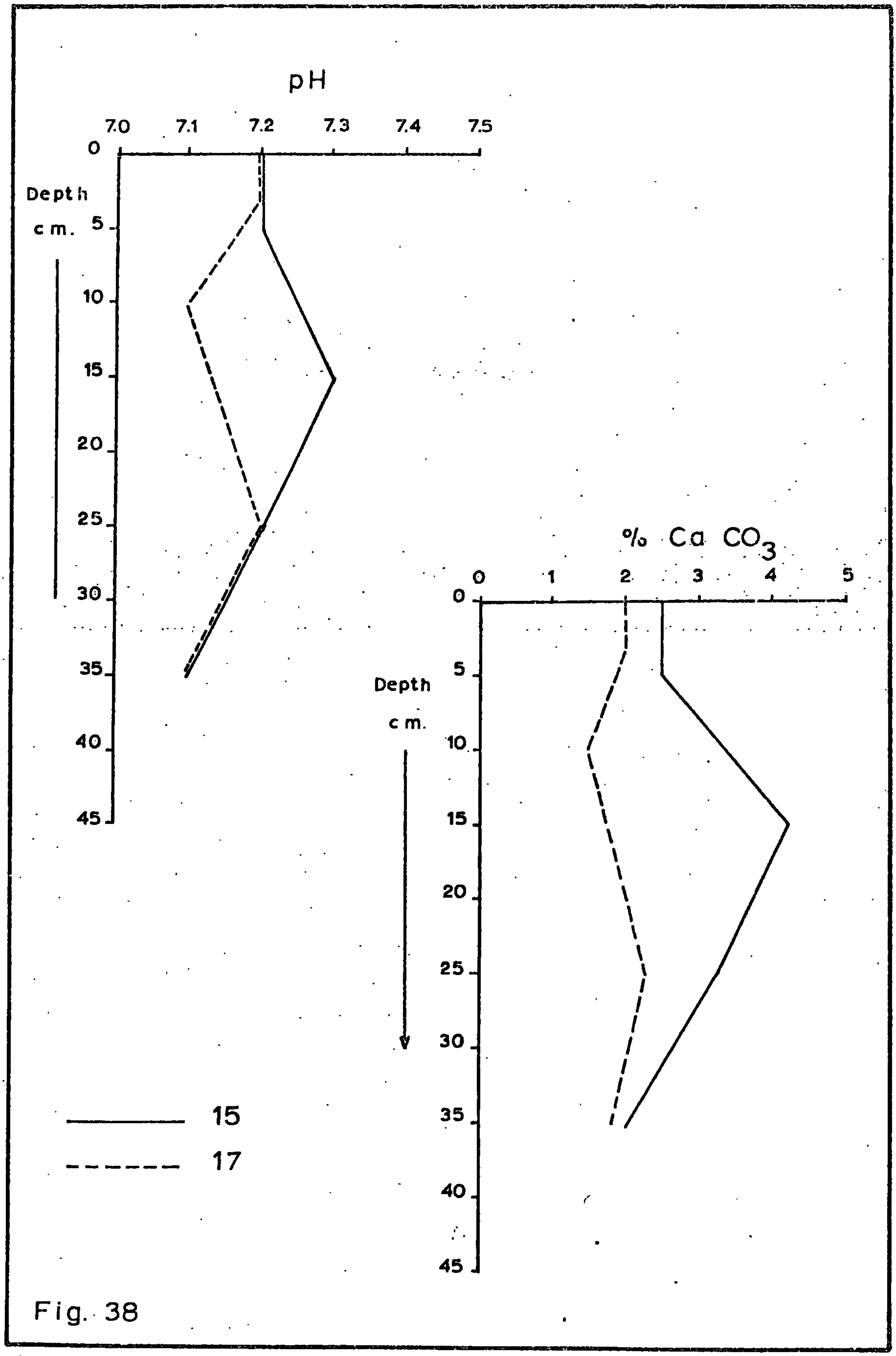


Fig. 38

pH and calcium carbonate content of Ochric Cambisol soils

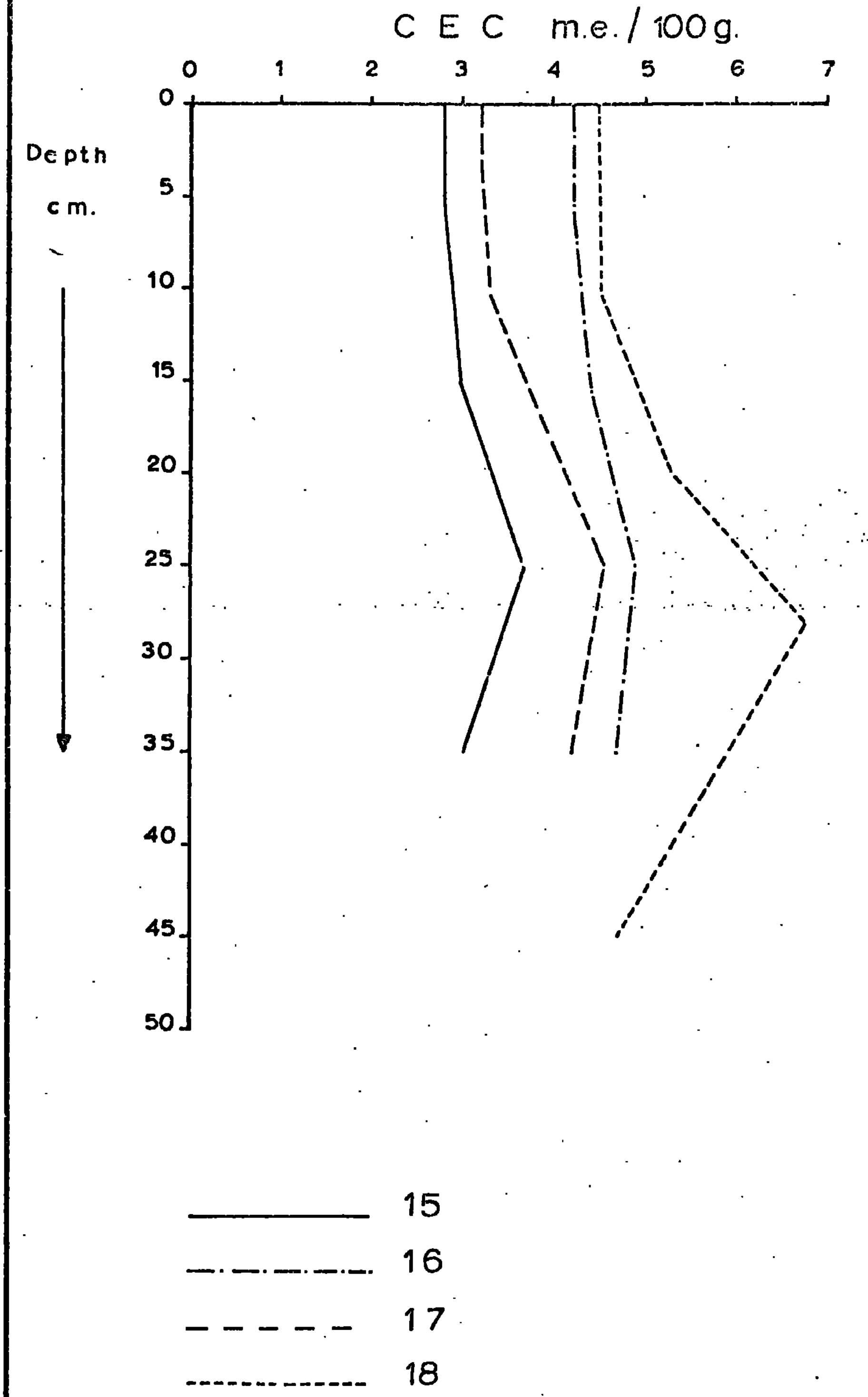


Fig. 39

Cation exchange capacity in Ochric Cambisol soils

The Ochric Cambisol soils usually have a low cation exchange capacity because of their coarse texture. Typical variation of cation exchange capacity is shown in Fig. 39 The maximum cation exchange capacity is always recorded in the (B)/C horizon, being related to the highest clay contents. For example maximum cation exchange capacity of 6.54 m.e/100g. occurs in the (B)/C horizon of Profile 18 which is highest clay content of 16.1 per cent also recorded in the same profile.

Ferric iron oxide content is a reflection of soil colour in all Ochric Cambisol profiles. The redder profiles are usually characterized by high Ferric Iron Oxide content. On the other hand dull light brownish colour profiles usually have a low iron oxide content. The typical variation of Ferric iron oxides with relation to soil colour is shown in table 20 Table indicates that profiles 15 and 18 have redder colour and therefore higher iron oxides content than two other profiles.

TABLE 20

Relationship between soil colour and total iron oxides in Ochric Cambisol soils

Profile	Horizon	Depth of samples cm.	Munsall Colour (moist)	% Fe_2O_3 $\times 10^{-1}$
15	A	0-5	7.5YR 5/4	6.5
	(B)	10-15	5 YR 5/4	8.4
	(B)/C	20-25	5 YR 5/4	8.7
	C	30-35	7.5YR 6/4	7.3
16	A	0-5	10 YR 5/4	3.8
	(B)	10-15	10 YR 5/6	4.5
	(B)/C	20-25	7.5YR 5/6	5.9
	C	30-35	7.5YR 5/4	6.1
17	A	0-3	10 YR 5/4	3.9
	(B)	5-10	10 YR 5/4	4.2
	(B)/C	20-25	7.5YR 5/4	5.1
	C	30-35	10 YR 6/4	3.8
18	A	0-5	7.5YR 5/4	6.0
	(B)	15-20	5 YR 5/4	8.7
	(B)/C	25-30	5 YR 5/4	9.0
	C	35-45	7.5YR 6/4	8.5

5.8. CALCIC CAMBISOLS

INTRODUCTION:

A small area of the eastern and northeastern parts of the Elbistan basin is covered by light brown to yellowish brown soils, which are derived from Calc-schist and Cretaceous Limestone parent material. These soils have been identified as Calcic Cambisols. Calcic Cambisols cover about 10 per cent of the total area of the basin. They are characterized by a weak to moderately developed pallid A horizon which rarely exceeds 20 cm in thickness, and by a cambic B horizon usually 20-30 cm below the soil surface, characterized by stronger chroma and redder hues than the underlying horizons. Calcic Cambisols also have well developed calxic horizons usually 40 to 50 cm below the surface (Kubiena, 1953). This horizon has a calcium carbonate accumulation up to 61.0 per cent.

Calcic Cambisols usually occur on gentle slopes ranging between 3^{o} and 8^{o} and at an elevation varying between 1150 metres and 1350 metres. Ten different sites have been examined in the field and four profiles have been sampled for physical and chemical analyses in the laboratory. Two of the profiles have been taken from calc-schist parent material the other two have been sampled from Cretaceous Limestone area.

MORPHOLOGY:

The typical Calcic Cambisol is represented by Profile 2 which has developed on Cretaceous Limestone. It is located about 3 km west of Elbistan Town. The morphological characteristics of Profile 2 include a well developed Pallid A horizon which has moderate humus content. The reddish

Plate - 16

Profile 2

calcic cambisols

Plate - 17

Profile 5

calcic cambisols

Plate - 18

Profile 13

calcic cambisols

PROFILE 2

Location 8 km west of Elbistan town

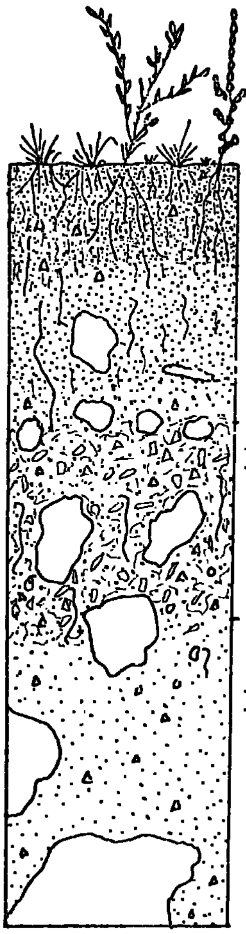
Elevation 1200 m.

Slope 3°

Parent material Cretaceous Limestone

Land use _Festuca Sulcata_, _Artemisia incana_, _Poa bulbosa vivipara_, _Ranunculus severtzovi_.

Profile Description



A	0-16 cm.	10YR 5/3 (Brown); loam; weak medium granular structure; abundant fibrous roots; dry and slightly hard; high faunal activity; many small to medium limestone fragments (up to 5 cm diameter); wavy boundary.
(B)	16-38 cm	7.5YR 5/6 (Strong brown); clay loam; medium angular blocky to weak fine prismatic structure; frequent fibrous roots; still some signs of faunal activity; many different sizes of limestone fragments (up to 10 cm diameter); wavy boundary.
Bca	38-55 cm	10YR 7/4 (very pale brown); silty loam; medium angular blocky structure; occasional fibrous roots; many white (2.5Y 8/2) calcium carbonate accumulation; many different sizes of limestone fragments (up to 10 cm diameter); dry slightly hard; wavy boundary.
B/C	55 + cm	10YR 6/4 (light yellowish brown); silty loam; massive structureless; no roots; occasional very large limestone fragments (up to 20 cm diameter); slightly moist very friable; irregular boundary.

PROFILE 2

Analytical Data

Depth CM.	Mechanical Analysis % Coarse SAND	Medium SAND	Fine SAND	SILT	CLAY	pH	% $CaCO_3$	% L.O.I	% Fe_2O_3 $\times 10^{-1}$
0-10	13.2	6.4	9.1	50.6	20.7	8.3	43.1	-	3.1
20-30	10.2	5.9	6.6	48.7	28.6	8.2	38.5	-	5.6
40-50	11.0	5.1	8.1	50.3	25.4	8.5	56.5	-	5.3
50-60	10.8	6.2	7.8	51.4	23.8	8.4	53.4	-	3.6
70-80	11.3	6.4	8.8	44.8	24.6	8.4	51.0	-	4.0

Depth CM.	Cation Exchange Capacity m.e./100 g. Na	K	Mg	Ca	Total	% C	% N	C/N	P_2O_5 m.e./100g.
0-10	2.63	0.67	0.28	12.25	15.83	1.7	0.08	21.2	-
20-30	2.19	0.96	0.35	14.30	17.78	1.1	0.04	27.5	-
40-50	2.26	0.89	0.29	14.00	17.44	0.8	0.02	40.0	-
50-60	2.68	0.87	0.35	12.65	16.55	0.3	0.01	30.0	-
70-80	2.65	0.24	0.29	13.65	16.83	0.1	-	-	-

yellow (B) horizon shows some clay accumulation (Table 23). The profile also contains a well developed Calxic horizon at a depth of 50-60 cm (Table 22).

PHYSICAL AND CHEMICAL CHARACTERISTICS

The pallid A horizon is well developed in the profiles of Calcic Cambisols which have been derived from Cretaceous Limestone. This is due to the fairly thick vegetation that occurs on these rocks. On the other hand the pallid A horizon is weakly developed in the profiles which have developed on Calc-schist parent material. The Calc-schist area is covered by very sparse short grasses which having a shallow rooting system.

The organic matter content in the pallid A horizon varies from a minimum of 1.03 per cent in Profile 23 which has developed on Calc-schist parent material to a maximum of 4.65 per cent in Profile 5 developed on Cretaceous Limestone. The slope effects the variation of organic matter content and the thickness of the pallid A horizon in the profiles. For example gentle slopes show higher organic matter content and thicker surface horizon than the steeper slopes (Table 21). The type of rock also effects the variation of organic matter content. For instance the limestone area are covered by thicker vegetation. It gives more organic matter content to the profiles developed on this rock than calc-schist parent material, on which vegetation is very sparse. (Table 21).

The Cambic B horizon is usually well developed as in Profile 5. It forms about 20-30 cm below the surface. The characteristics of a cambic B horizon have already been described in the previous section (see Ochric Cambisols). Furthermore

TABLE 21

Relationship between organic matter content and the thickness of pallid A horizon of soils developed on different slopes from various parent materials.

Profile	Parent material	Land use	Slope	% O. M.	Thickness of Pallid A horizon cm.
2	Cretaceous Limestone	Thick grasses	3^{o}	3.03	16
5	Cretaceous Limestone	Thick grasses	2^{o}	3.62	22
13	Calc-schist	Short sparse grass	6^{o}	1.20	8
23	Calc-schist	Short sparse grass	8^{o}	1.03	6

cambic B horizons have a clay accumulation in the depths between 20 and 30 cm which varies from one profile to another (Table 23).

The third diagnostic horizon is the calxic horizon. Again this is usually well developed. Variation in calxic horizons do occur from one profile to another. The calxic horizon usually occurs about 30 to 50 cm below the surface. The calxic horizon is thicker and well developed in the profiles which have developed from Cretaceous Limestone. These profiles also show a higher calcium carbonate content than the profiles developed from Calc-schist parent material. Table 22 shows the variation of calcium carbonate content and the thickness of Calxic horizon in the Calcic Cambisols.

The Calcic Cambisols usually have weak to medium granular structure in the surface horizon varying according to the organic matter content. They are uncultivated soils and do not have well developed distinct surface structure. Because the relatively sparse vegetation cover does hot provide sufficient protection. Also, the top soil is always disturbed

TABLE 22

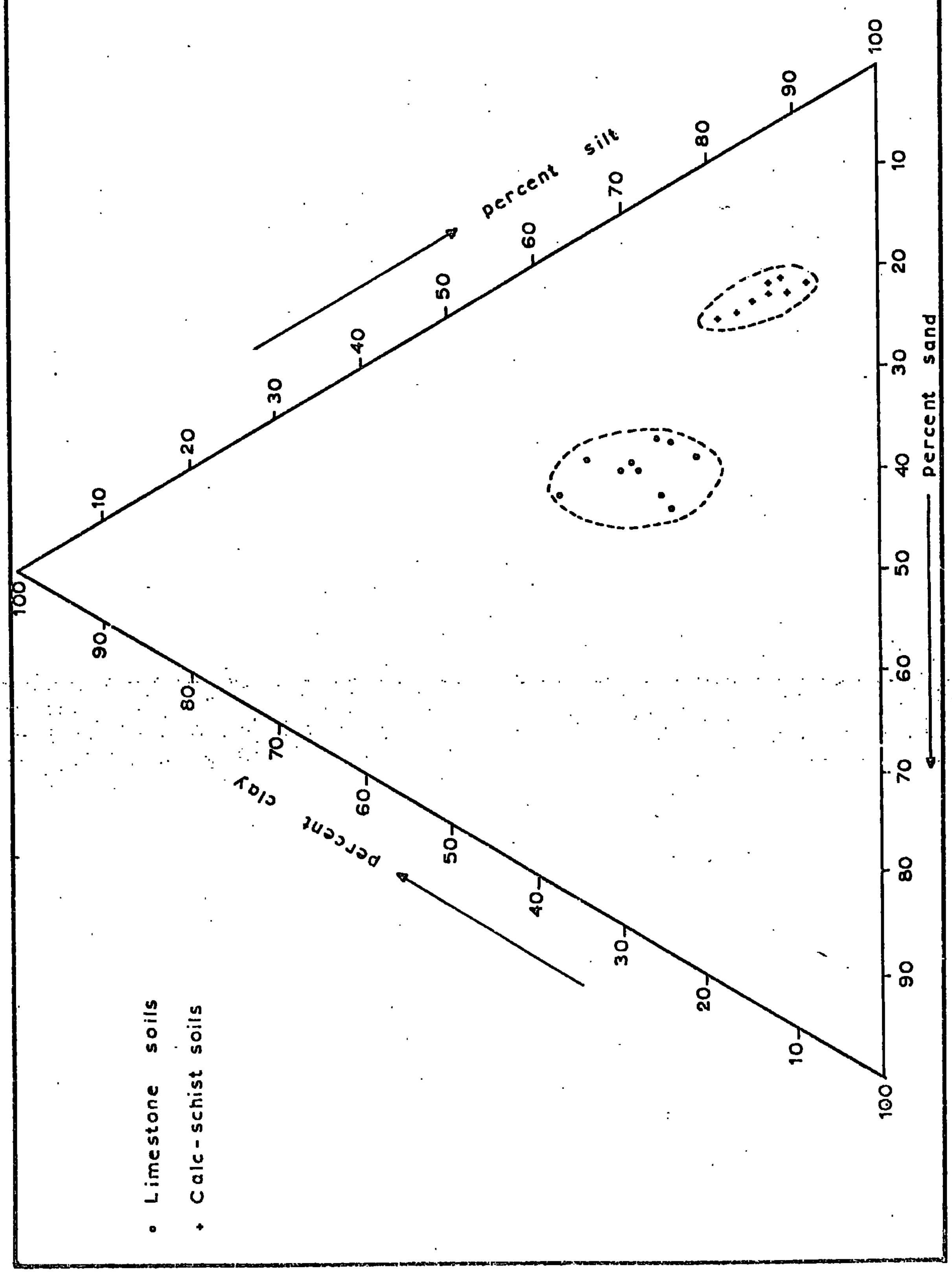
Relationship between calcium carbonate content and the thickness of calxic horizon.

Profile	Parent material	Depth of samples cm.	% $CaCO_3$	Thickness of calxic horizon cm.
		0-10	43.1	
2	Cretaceous	20-30	38.5	
	Limestone	40-50	56.5	17
		70-80	51.2	
		0-10	42.0	
5	Cretaceous	30-40	39.1	
	Limestone	40-50	61.3	19
		80-90	52.7	
		0-5	30.1	
13	Calc-schist	20-30	26.5	
		35-40	38.0	11
		45-50	30.5	
		0-5	29.0	
23	Calc-schist	15-20	25.0	
		20-25	35.0	6
		25-30	29.4	

by animals. However, in the B horizon, structure is well developed and ranges from coarse angular blocky to medium prismatic structure due to the swelling and shrinkage of the clay during wetting and drying. The structure is well observed in Profile 5 which contains a higher clay content in its B horizon (36.6 per cent). As clay content decreases with depth the structure becomes more massive especially in the Calc-schist profiles due to the high amount of silt content (more than 70 per cent).

The textures of the Calcic cambisols are usually loam, silty loam and clay loam (Fig 40). The calcic cambisol profiles contain high amounts of silt and clay particles,

Fig. 40

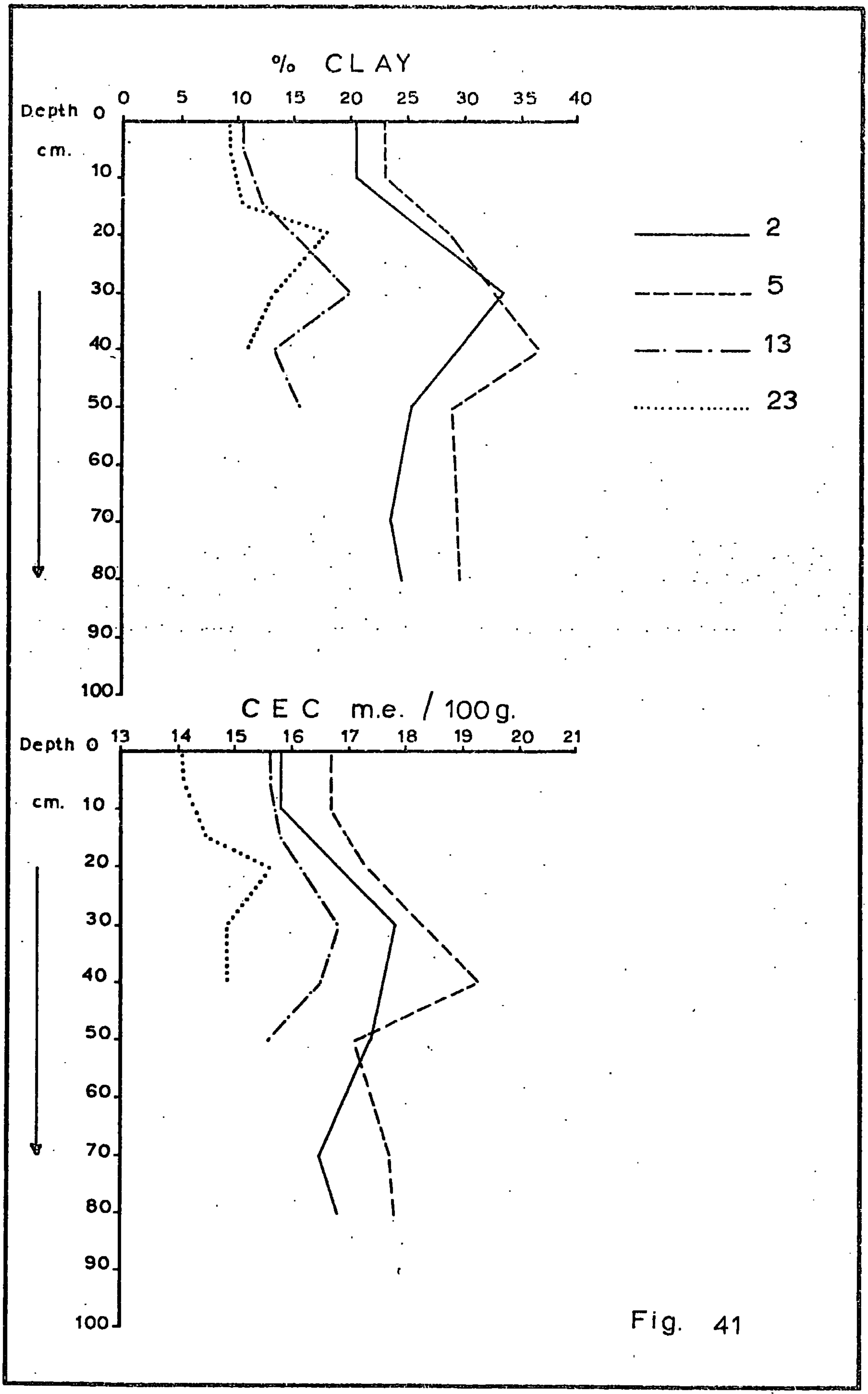


Texture of Calcic Cambisol soils

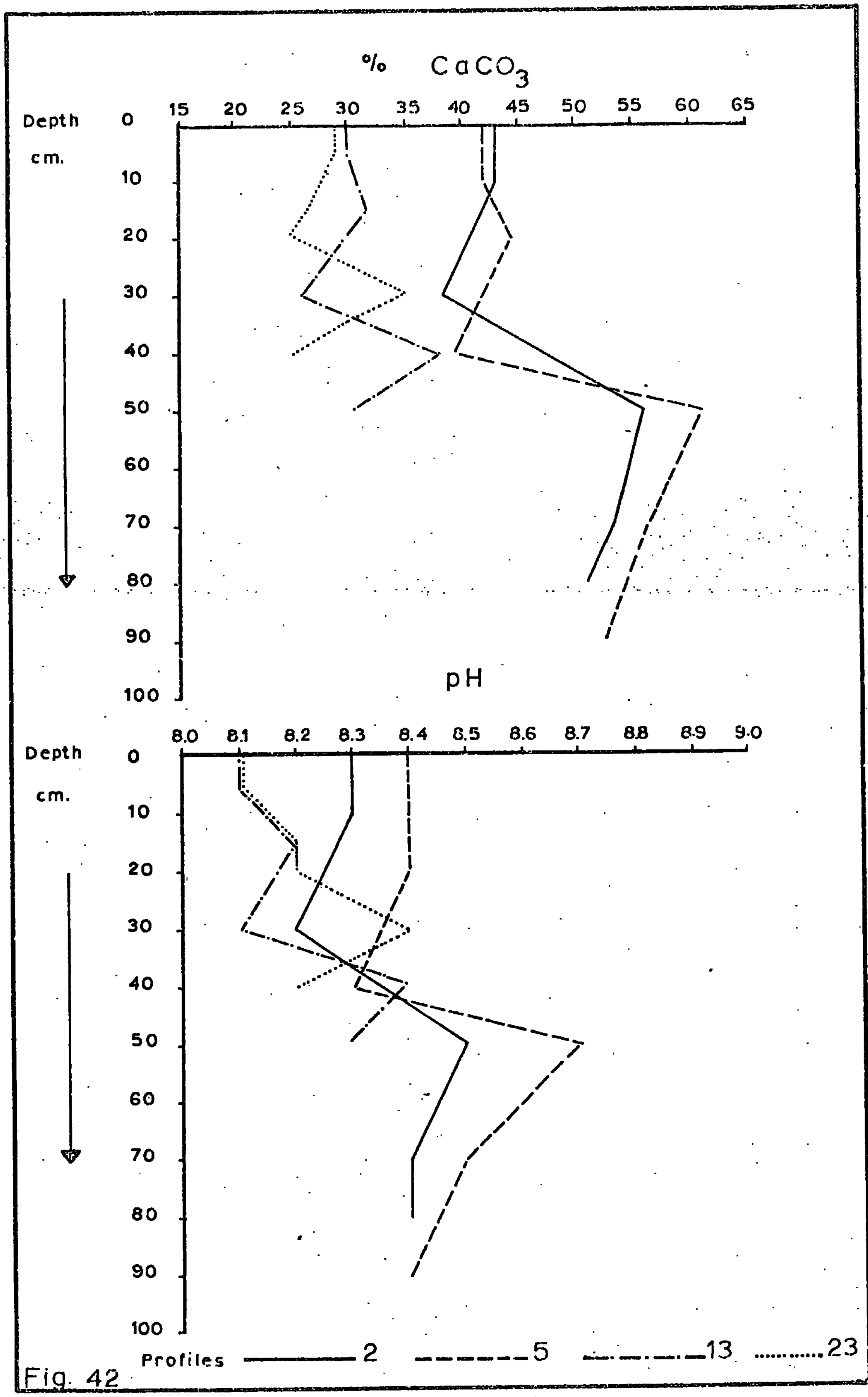
especially in the (B) and B/C horizons. Variations in particle sizes do occur from one profile to another. For instance profiles which have developed from Calc-schist parent material show higher silt content and lower clay content than the profiles which have developed from Cretaceous Limestone parent material (Table 23). Generally clay content increases with depth to a maximum figure recorded in the (B) horizon (Table 23). The percentage of sand particles is lower in soils derived from calc-schist than Limestone profiles. Generally coarse sand is the dominant particles in all Calcic Cambisol profiles (Table 23).

The Calcic Cambisol is an alkaline soil with pH ranging 8.2 to 8.7 Fig. 41 indicates that the pH generally decreases with depth and reaches a minimum in the (B) horizon and increases abruptly in the calxic horizon. Maximum pH always occurs in the calxic horizon of the profiles. Generally pH and calcium carbonate content are very closely related. For example, maximum calcium carbonate content of 61.3 per cent has been recorded in the calxic horizon of Profile 5 which also has the highest pH value of 8.7.

The cation exchange capacity is very closely related with the clay content in the Calcic Cambisol profiles. Generally cation exchange capacity increases with depth and reaches a maximum in the 20 to 40 cm, whilst clay content also records its maximum percentage in the same depth (Fig. 42). For example maximum cation exchange capacity 19.34 m.e/100g. has been recorded in the (B) horizon of Profile 5 whilst maximum clay content of 30.6 per cent was also recorded in the same horizon. This relationship generally occurs in all profiles of the Calcic Cambisol group of soils. Calcium is



Clay content and cation exchange capacity of Calcic Cambisol soils



Calcium carbonate content and pH of Calcic Cambisol soils

TABLE 23

Mechanical analysis of Calcic Cambisol soils

Profile	Horizon	Depth of samples cm.	Parent material	% c. sand	% m. sand	% f. sand	% SILT	% CLAY
	A	0-10	Cretaceous	13.2	6.4	9.1	50.6	20.7
2	(B)	20-30	Limestone	10.2	5.9	6.6	48.7	28.6
	Bca	40-50		11.0	5.1	8.1	50.3	25.4
	B/C	70-80		11.3	6.4	8.8	44.8	24.6
	A	0-10	Cretaceous	13.4	8.9	10.5	44.3	22.8
5	(B)	30-40	Limestone	10.0	6.9	7.4	45.1	30.6
	Bca	40-50		10.3	6.8	8.0	45.9	29.0
	B/C	80-90		11.6	5.9	7.4	45.4	29.6
	A	0-5		9.6	2.5	5.9	71.6	10.4
13	(B)	20-30	Calc-schist	7.5	2.2	5.3	65.1	19.9
	Bca	35-40		8.1	3.6	3.7	71.3	13.3
	B/C	45-50		9.1	2.7	3.9	68.9	15.4
	A	0-5		8.4	2.8	5.4	75.0	9.4
23	(B)	15-20	Calc-schist	8.3	2.1	4.4	67.4	17.7
	Bca	25-30		6.1	3.2	4.7	71.6	13.3
	B/C	30-35		9.5	2.1	5.1	72.4	10.9

always the dominant exchangeable cation in all profiles.

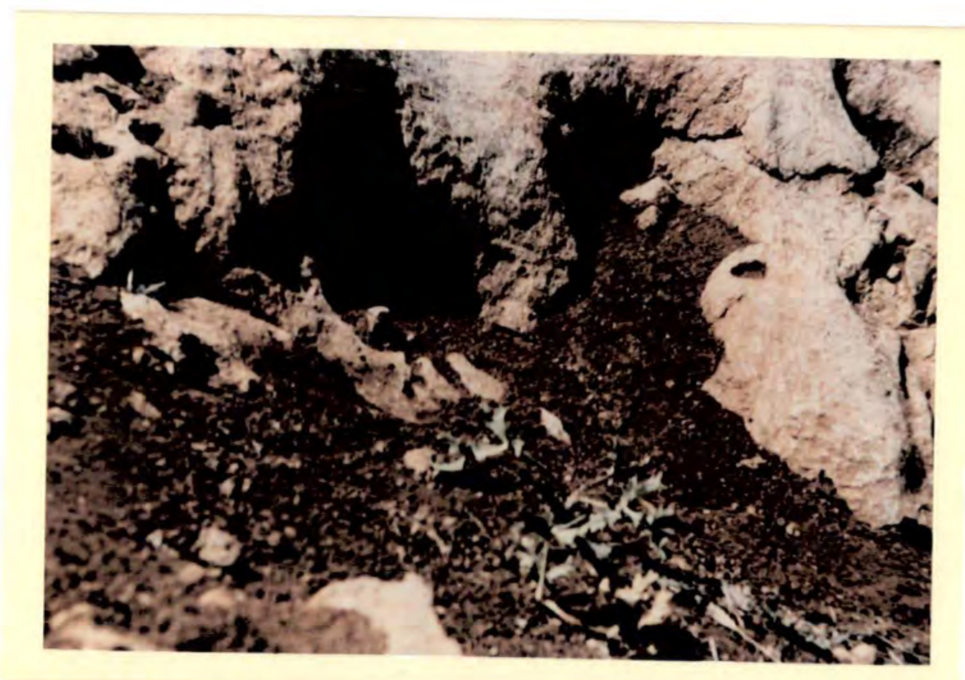
5.9. CHROMIC LUVISOLS

INTRODUCTION

A very small area of the eastern part of the Elbistan basin is covered by bright red and reddish brown soils which are derived from hard crystalline limestone. These soils have been identified as Chromic Luvisols.

Chromic Luvisols cover about 5 per cent of the total working area of the basin. They are characterized by moderately developed pallid A horizons which rarely exceed 10 cm in thickness and by an Argilluvic B horizon, Characterized by

Plate - 19   Chromic Luvisol



bright red colour with clay skins and lie sharply on hard crystalline limestone.

Chromic Luvisols usually occur on slopes ranging between 2° and 5°, at an elevation varying between 1200 metres and 1250 metres. Ten different sites have been examined in the field and 3 characteristic profiles have been sampled for physical and chemical analyses in the Laboratory.

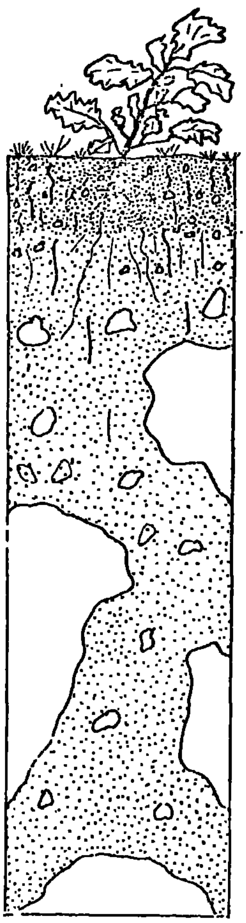
MORPHOLOGY

The typical Chromic Luvisol is represented by Profile 31 which has developed on greyish blue hard crystalline limestone. It is located about 3 km east of Elbistan Town. The morphological characteristics of Profile 31 includes a moderately developed pallid A horizon which has moderate humus content. (1.5% organic carbon) The bright red colour of Argilluvic B horizon shows some clay coating which is typical features of the argilluvic horizon, the whole profile resting sharply on crystalline limestone. Structure is generally massive throughout, shows some weak granular and angular blocky peds in the surface horizon and some prismatic units in the B horizon. The morphological characteristics of typical Chromic Luvisol are illustrated by Profile 31 (p. 149).

The pallid A horizon is moderately developed in the Chromic Luvisol profiles. Maximum thickness of pallid A horizon varies between 5 and 10 cm and organic carbon content ranges between 1.0 and 1.5 per cent. The percentage of organic carbon content and the thickness of pallid A horizon shows very little variation as indicated above. The

PROFILE 31

Location	4 km east of Elbistan Town
Elevation	1200 m.
Slope	2^{o}
Parent material	Greyish blue crystalline limestone
Land use	Some short grasses and scattered oak trees.



Profile Description

0-9 cm	5YR 3/4 (Dark reddish brown); silty clay; medium granular structure; dry slightly hard; abundant fibrous roots; many small limestone fragments (up to 2 cm diameter); many signs of faunal activity; wavy boundary.
9-42 cm	2.5YR 5/6 (Red); Clay; weak small to medium blocky structure; occasional fibrous roots; clay skins; occasional bedrock fragments; still some signs of faunal activity; slightly moist and very friable; rests sharply on crystalline limestone.
42 + cm	Hard, greyish blue crystalline limestone.

PROFILE 31

Analytical Data

$\times 10^{-1}$

Depth CM.	Mechanical Analysis % Coarse SAND	Medium SAND	Fine SAND	SILT	CLAY	pH	% $CaCO_3$	% L.O.I	% Fe_2O_3
0.5	5.4	4.0	3.9	46.6	40.1	7.7	3.8	-	5.1
10-20	2.2	3.2	3.5	38.5	52.6	7.6	3.5	-	8.1
20-30	2.1	2.1	2.6	36.9	56.3	7.6	3.6	-	9.6
30-40	2.1	2.0	2.9	~~35.1~~ 36.7	56.9	7.6	3.4	-	11.4

Depth CM.	Cation Exchange Capacity m.e./100 g. Na	K	Mg	Ca	Total	% C	% N	C/N	P_2O_5 m.e./100g.
0-5	1.52	1.92	0.39	22.37	26.70	1.0	0.04	25.0	-
10-20	1.41	0.74	0.44	28.37	30.96	0.4	0.02	20.0	-
20-30	1.40	0.75	0.26	29.20	31.61	0.1	-	-	-
30-40	1.42	0.76	0.22	31.41	33.81	0.1	-	-	-

organic carbon content drops dramatically in the B horizon of all chromic luvisol profiles (Fig. 43). This is probably due to sparse vegetation which covers on this area, having a shallow rooting system. Chromic Luvisols also have argilluvic B horizon of their profile morphology. Detail characteristics of argilluvic B horizon are given in Appendix 1 . The presense of a clay coating in the B horizon is a typical feature of argilluvic horizon. The argilluvic B horizon is an illuvial horizon in which shows a clay accumulation. Table 24

TABLE 24

Mechanical analysis of Chromic Luvisol Soils

Profile	Horizon	Depth of samples	% Sand	% Silt	% Clay
1	A	0-5	14.0	37.4	48.6
	(B)	30-40	8.0	34.0	58.0
		40-50	5.9	35.4	58.7
31	A	0-5	13.3	46.6	40.1
	(B)	20-30	6.8	36.9	56.3
		30-40	6.4	36.7	56.9
36	A	0-5	12.2	37.6	50.2
	(B)	30-40	10.9	29.3	59.8
		40-50	10.6	29.4	59.9

The Chrmoic Luvisols are fine-textured soils varying between silty clay and clay (Fig. 44). Usually the B horizon is finer texture than the A horizon. Generally surface horizons have more sand content.

The Chromic Luvisols usually have a well developed granular structure in the surface horizon. Generally the B horizon of all chromic luvisol profiles have medium prismatic

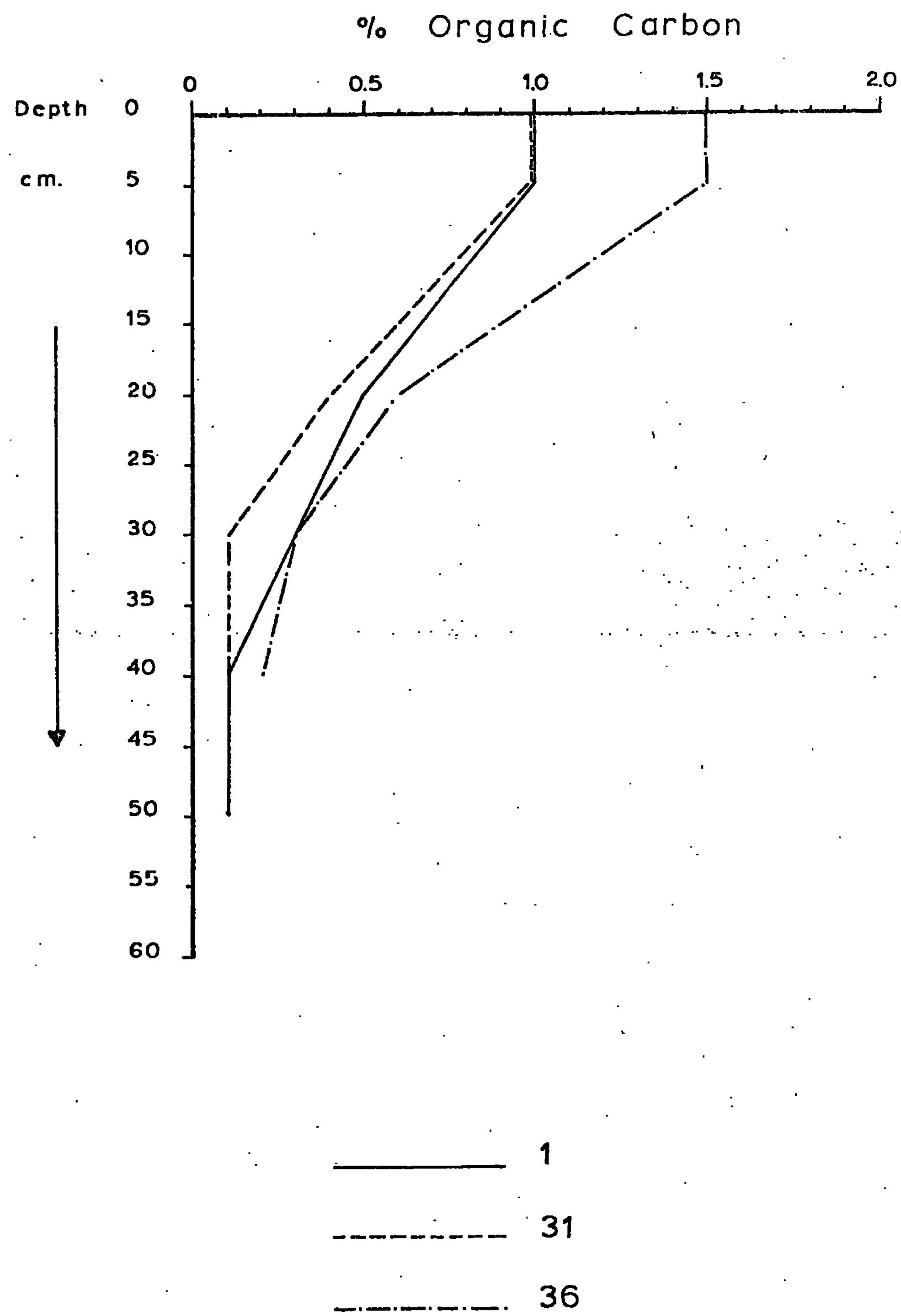
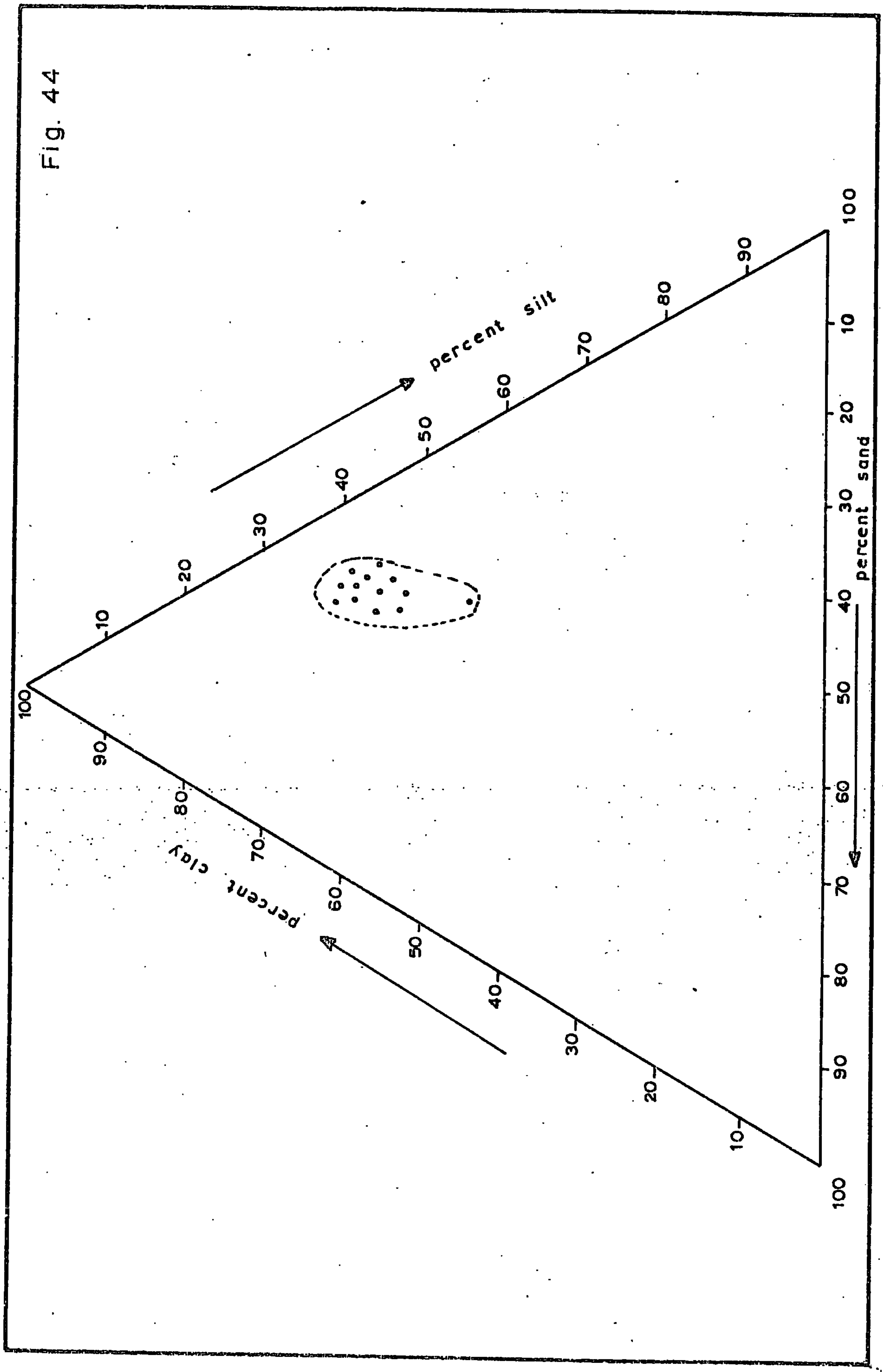


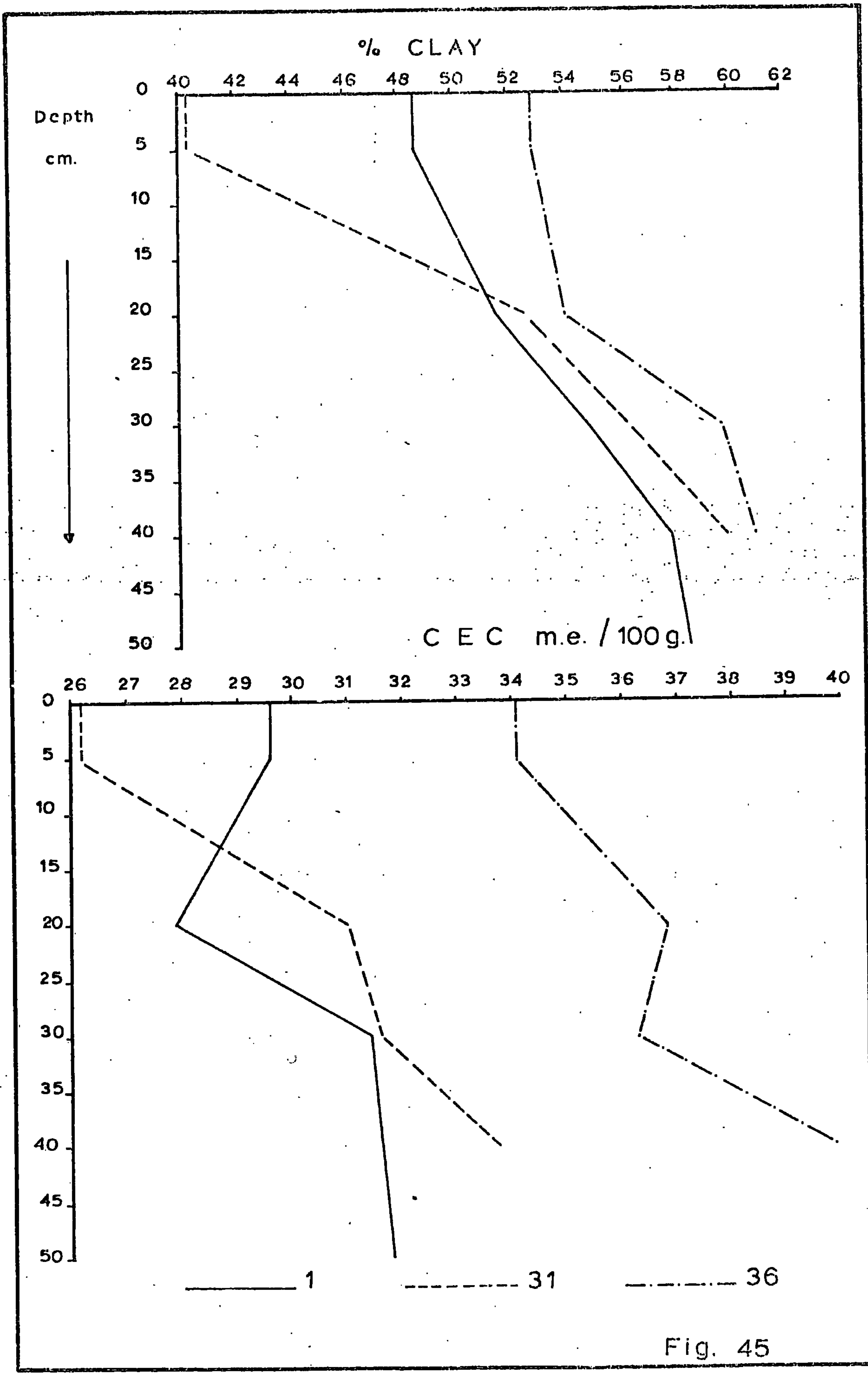
Fig. 43

Organic carbon content of Chromic Luvisol soils

Fig. 44



Texture of Chromic Luvisol soils



Clay content and cation exchange capacity of Chromic Luvisol soils structure due to swelling and shrinkage during wetting and drying.

The Chromic Luvisol are slightly alkaline soils varying between 7.4 and 7.6. Generally all Chromic Luvisol soils show higher pH content in the surface horizon probably as a result of high faunal activity in these soils. Soil animals bring lime fragments into the upper part of the soil profile and in this way effect the pedogenic process of leaching and lime removal (Atkinson 1969). The calcium carbonate content is low in these soils ranging between 2 to 5 per cent and usually corresponds with pHs. Highest pH value always correlates with highest calcium carbonate.

Cation exchange capacity tends to be very high in the Chromic Luvisol varying between 30 to 40 m.e/100 g. Generally cation exchange capacity is very closely related with clay content in all profiles (Fig. 45). For example the highest cation exchange capacity of 39.9 m. e/100 g is measured in the B horizon of Profile 36 which has highest clay content (57.0 per cent) in the same horizon. Calcium cations are dominant in all profiles ranging between 25 to 35 m.e/100 g. The calcium cations is closely related with calcium carbonate content in the Chromic Luvisol profiles of Elbistan basin. Generally highest calcium carbonate content reflects higher calcium cations.

C H A P T E R   S I X

PEDOGENESIS

6.1. INTRODUCTION

The principle that soil is the end result of the interaction of various identifiable pedogenic factors was first enunciated by the Russian soil scientist Dokuchayev. It is now known that much earlier writers, for example Lomonosov, recognised the importance of external and internal agents in soil formation but Dokuchayev (1896) was the first to state the factors involved. Crocker (1952) quotes Dokuchayev as saying the following about soils, they are "always the result of the mutual action of the following agents: living and dead organisms (plants and animals), maternal rock formations, climate and the relief of the location." These, then, were the soil forming factors as seen by Dokuchayev. Hilgard, a contemporary of Dokuchayev's working in the United States of America, came to similar conclusions to those of Dokuchayev but he considered climate to be of overriding importance; this was also true of many of Dokuchayev collaborators and successors in Russia.

The publication of Jenny's book "Factors of soil formation" in 1941 caused renewed interest in the factoral approach to pedogenesis. In his book Jenny shows the soil forming factors as parent material (p), climate (cl) topography (r), organisms (o) and time (t), and the relationship between these factors was expressed as

$s = f\ (cl,\ o,\ r,\ p,\ t\quad)$ in which (f) stands for "function of" or "dependent on". Organisms included vegetation and man. It was in this same book that Jenny began the "factoral approach" to soil science. In this approach he attempted to represent the soil forming factors as variables in an equation which defined the soil. Jenny added a number of dots after his soil forming factors in case "additional soil formers have to be included". The functional aspect of Jenny's work has been criticsed by Gerasimov (1947) but the book was important as it reviewed the factoral approach.

Rode (1947) added to the soil forming factors of Jenny, and in the conclusion at the end of his book he states that three more factors have to be added namely, gravity, water (surface, soil and ground) and the economic activity of man. Sub-surface water is still considered as a separate factor by German workers e.g. Mückenhausen (1962) but most other workers consider it as a function of topography. Mückenhausen (ibid) also divides the "organism" of Jenny (1941) into vegetation, animals and man, thus giving eight factors in all. Most other writers e.g. Duchaufour (1960) use vegetation and man as separate factors but not animals. Duchaufour has six soil forming factors and also introduces a subdivision of the factors into "facteurs passifs" i.e. parent material and "facteurs actifs" i.e. climate, vegetation topography and man. Mückenhausen states the same thing in a slightly different way when he says that climate, vegetation, water, relief, animals and man act upon parent material through time.

6.2. CLIMATE

INTRODUCTION

The one factor in soil formation which has received far more attention than, any other is the climatic factor. This great emphasis on climate probably dates from the period when the zonal distribution of soils was first recognised by Dokuchayev (1896) and led to the series of soil classifications based on climate. Crocker (1952) states that the zonal concept dates from Sibirtsev (1895).

Temperature is significant as it controls the rate of the chemical reactions which take place in the soil and which are effective in the breakdown of parent material and the formation of authigenic clay minerals. The reactions concerned proceed much more rapidly with higher temperatures. Rainfall determines, to some extent, the amount of leaching which a soil undergoes so that excessive leaching will only be found in wet climates. Soil texture and site topography become very important in wet conditions as a heavy soil or a badly drained site will lead to gleying. Temperature and rainfall must be considered together, as a low temperature will increase the effectiveness of a given amount of rainfall, because it will reduce evapotranspiration.

The regional climate can be taken as a background when considering soil evolution in a particular area, but the micro-climate of a particular site must also be considered. For example, the variation in climate on the two sides of a conical mountain can give completely different soil types.

CLIMATE AS A SOIL FORMING FACTOR IN THE ELBISTAN BASIN

Detailed climatologic variations in the Elbistan basin and eastern Anatolia have already been discussed (see Chapter 3 p. 24). It reveals that in the Elbistan basin the climate is transitional between Mediterranean and continental types and is characterized by cold moist winters and hot dry summers with an increase in average precipitation from east to west.

Local climatic variations within the basin appear to play an important role in pedogenesis, and in this section each of the climatic elements will be discussed in term.

PRECIPITATION: The Elbistan basin may seem a small area within which to discuss variations in precipitation. However, within an east-west distance of 60 km, annual amounts vary from 350 to 550 mm. This is sufficient variation to have a considerable effect on the natural vegetation, which in turn affects the organic matter content of the soils. The natural vegetation is in fact much more luxuriant in the western part of the basin than in the east. While annual precipitation values provide a means for rapid characterization of the main moisture features of a region, seasonal variations must also be taken into account. The Elbistan basin is characterized by a high spring precipitation, usually 40-45 per cent of total rainfall, which occurs as heavy rain and causes runoff. These relatively heavy rains are responsible for more than half of the soil erosion which occurs in the basin. These heavy rains during the spring cause rapid runoff and soil erosion which produces Eutric Regosols on very steep slopes. One is the best examples of this type of soil is Profile 7. It has very shallow profile morphology (just over 30 cm thickness) and very weakly developed A horizon (about 3 cm) and the site has a sparse vegetation cover, mostly characterized by short grasses.

One of the most important factors in the Elbistan basin is aspect, which affects soil development in a variety of ways. Almost all Russian research workers in Asia have noted the enormous influence of aspect on the differentiation of mountain landscape. Gerasimov and Glazovskaya (1960) point out that, in many southern mountain countries, the slopes of varying exposure differ very greatly in their water and heat regimes, while the soils developed on them belong to different groups. Also Stephanov (1967) indicating the nature of soil development on north and south-facing slopes respectively in the Western Tien Shan mountains.

The influence of aspect on soil formation has been discussed in this section for its importance as a pedogenic factor.

Unfortunately there is no precise data on the amount of precipitation on either side of the basin. However, the character of the influence of precipitation on soil formation on the slopes of north and south facing slopes differ. The results however, can be seen in the fact that on south facing slopes the accumulation of Calcium Carbonate occur much nearer the surface whereas on north facing slopes it takes place at a greater depth (Fig 46). Differences in evaporation rates are obviously important. South facing slopes have more sunshine and lower rainfall so that evaporation rates are higher so that calcium carbonate accumulates nearer the surface. Similar conclusion has been drawn by Bridges (1961) who worked around the industrial town of Corby. He suggests that because of the aspect, the dales and north facing slopes are not warmed by sun for much of the year. There is therefore much less evaporation, resulting in almost continual dampness developing poorly drained gley soils.

<u>TEMPERATURE</u>: The temperature variations in the Elbistan basin are quite small (ranging between 25°C $\pm$ 2°C in July and

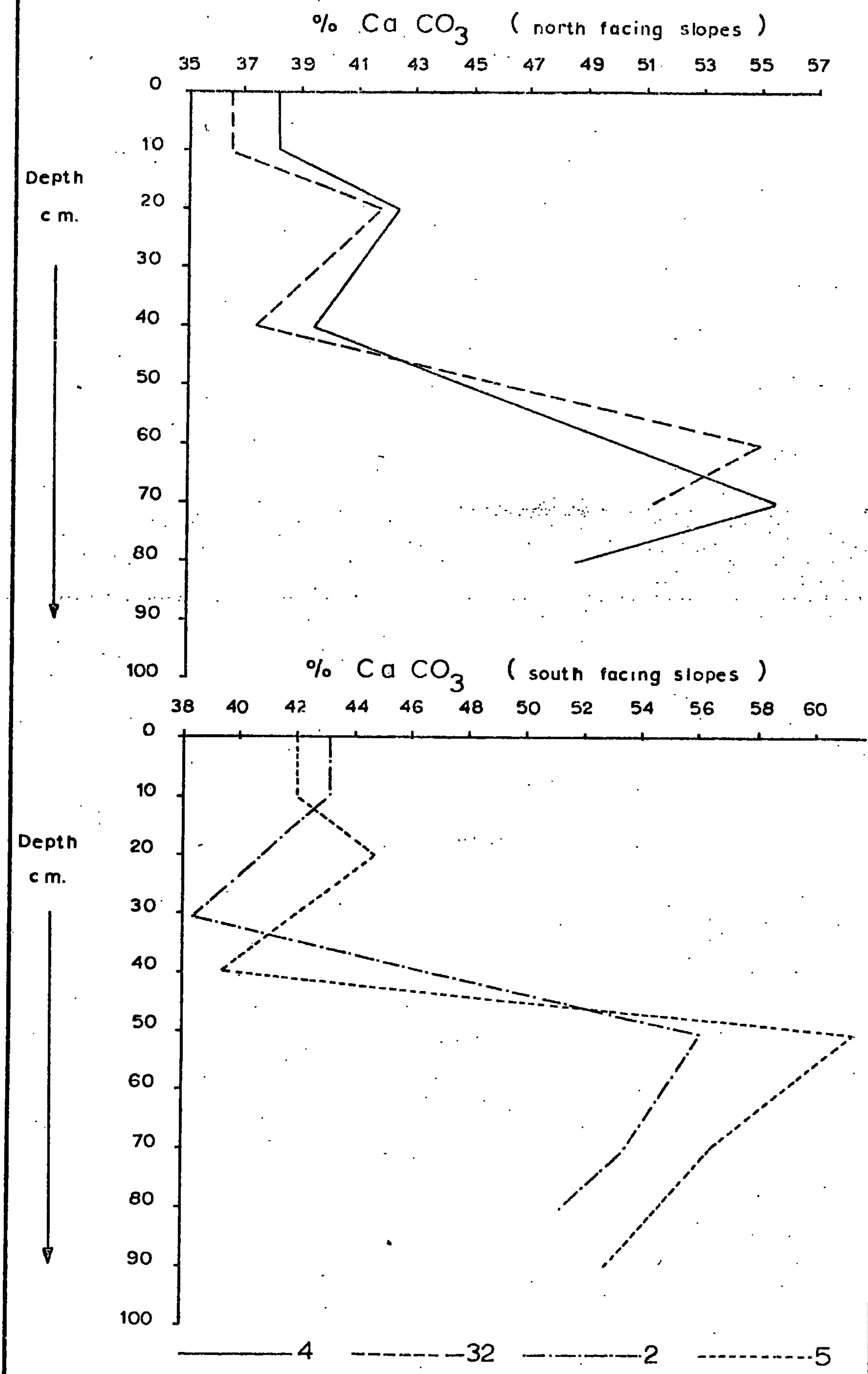


Fig. 46

Calcium carbonate content of soils on north and south-facing slopes Profile 4 and 32 = Calcic Castanozem; 2 and 5 Calcic Cambisol soils

-4°C ± 2°C in January), and increases from east to west. Therefore western Elbistan basin is slightly warmer than eastern Elbistan basin. However there are also temperature differences between north facing and south facing slopes. Unfortunately there is no data available for soil temperature in the Elbistan basin, but it may be assumed that the rate of biological activity is higher on south facing slopes. For example the warm soils of south facing slopes are favourable for the activity of insects, which penetrate to greater depth and impart to the soil specific morphological properties for example high porosity. Also the rate of biological activity influences the organic matter content of soils developed on south facing slopes (Table 25). Indeed table illustrates that south facing slopes have lower organic matter content than northern slope soils. Because the rate of biological activity has been accelerated by temperature and more organic matter content destroyed by microfaunal activity on the south facing slope soils. Thus high biological activity is responsible for low organic matter content in the south facing slope soils.

TABLE 25

Variations of organic matter content in the soils derived from the same parent material on south and north facing slopes in the Elbistan basin

Profile	Depth	Parent material	Aspect	Slope	% O.M.
25	0-10	Limestone	N	2°	4.31
5	0-10	Limestone	S	2°	3.62
26	0-10	Limestone colluvial Dep	N	2°	5.34
39	0-10	Limestone colluvial Dep	S	2°	2.59

6.3. TOPOGRAPHY

INTRODUCTION

Topography can affect soil formation in several ways. It can cause variations in micro-climate which will be reflected in soil developments. Thus precipitation increases with altitude and temperature decreases. In deeply dissected areas aspect can become very important in soil formation. On south facing slopes soils receive more solar radiation than north facing slopes. But on the other hand the north facing slopes receive more precipitation than south facing slopes. These micro-climatic variations resulting from aspect have a major effect on the rate at which the various pedogenic process operate. Stephanov's (1967) work in the Western Tien Shan mountains provides one of the best examples of these effects.

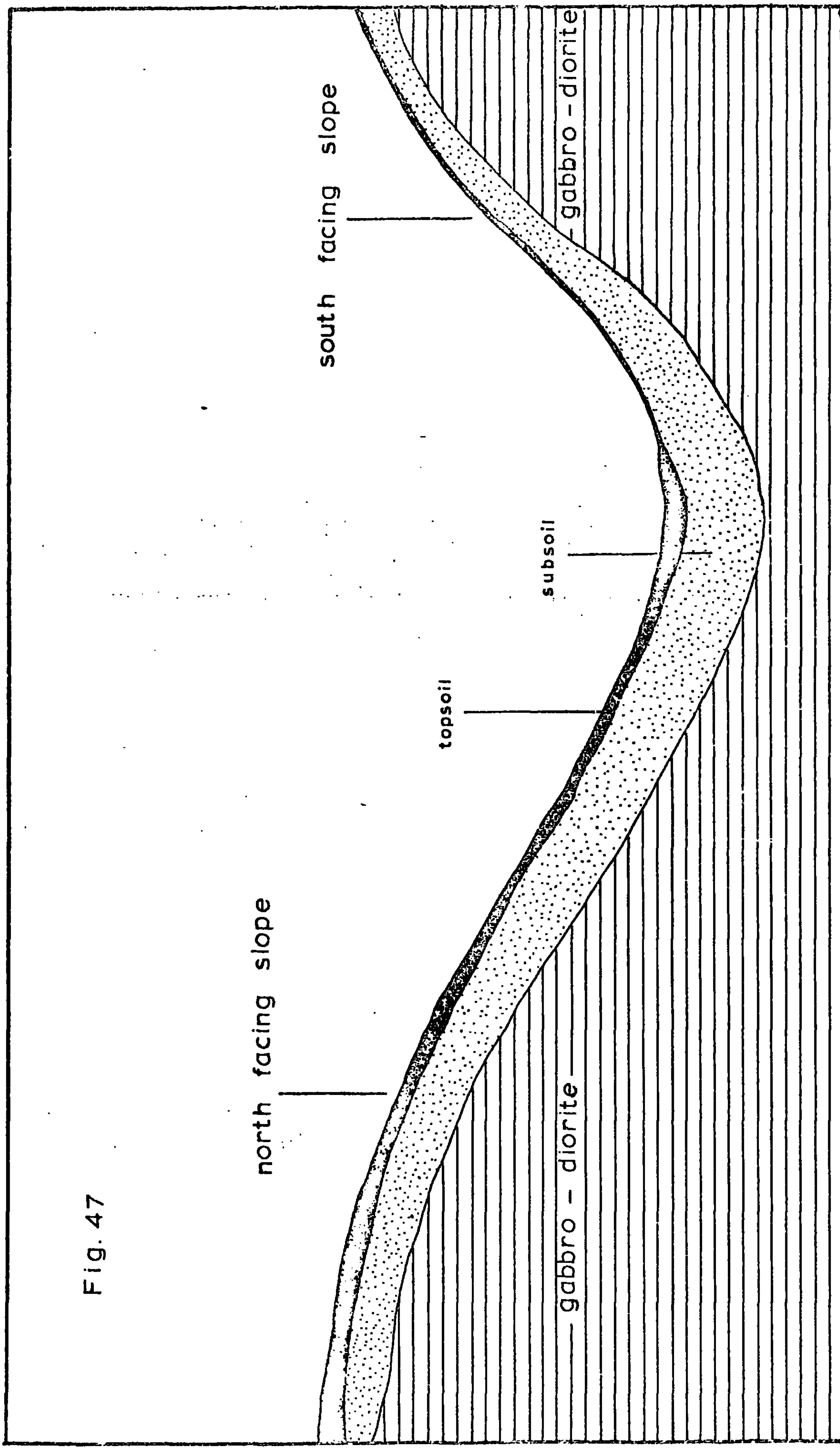
Soil drainage is also greatly affected by variations in topography and this is refered to by Duchaufour (1965) as "the action indirecte". This effect is very important in the Elbistan basin where, on the steeper slopes, soil drainage will be better than on level and very gently sloping sites. One of the best examples of this variation occurs in limestone soils. Freely drained profiles produce Calcic Castanozem soils, while on the other hand, when slopes become more gentle or flat they produce gley soils on the basin floor.

The direct action of topography on soil development is found on very steep slopes where soils fail to reach maturity because of the instability due to soil creep which leads to a thinning of the soils at the top of the slopes and accumulation and thickening at the base of slopes. Duchaufour (1960) describes a soil catena in limestone terrain controlled by this kind of downslope movement in which brown calcareous soils are found on the plateaus, a skeletal rendzina on the very steep slopes, a true rendzina near the base of the slope and brown soils in the depressions. This kind of relationship has been observed in the western part of the Elbistan basin, where the Haplic Castanozem soils occur on more gentle slopes and produce deep profile development, while the Eutric Regosol profiles developed on steep slopes fail to reach maturity and produce very shallow soils, both having developed from the same parent material.

EFFECT OF TOPOGRAPHY ON SOIL DEVELOPMENT IN THE ELBISTAN BASIN:

ASPECT The profile morphology shows some differences between the soils which have developed on either side of the slopes in the Elbistan basin. Thus aspect again becomes a very important factor.

The effect of aspect is particularly important for the development of soils in the western Elbistan basin where the relief is somewhat rugged. There is a series of asymmetrical valleys in this area. One of the interesting asymmetrical valleys was investigated near Kamiscik village (Fig. 47). It has a short steep slope on the south facing side and a longer more gentle one on the north facing side where deep developed soil profiles are predominant. The asymmetry of this valley has developed as a result of the difference in the rate and the character of weathering soil formation and denudation on these slopes. These processes take place in different ways on either side although the rock composition is



A sketch diagram of asymmetrical valley near Kamiscik Village.

the same (basic igneous).

The south facing slope soils are directly affected by denudational processes. Both surface water and sometimes winds act upon the soils upper horizons which are destroyed, eroded and deflated. It is possible that the thin surface horizon of Ochric Cambisol soils on granitic parent material which are also developed on south facing slopes can be explained as a result of denudational processes. The intensity of soil denudation depends on many factors and may therefore vary considerably. In addition to climatic conditions (prolonged dry summer) and the properties of soil themselves (coarse textured soils) a very important factor is topography. The strongest soil erosion is always connected with a very dissected relief, because the amount of runoff and the velocity of surface water increase with steepness of slopes. Thus the formation of Eutric Regosol may be explained by the intensity of the denudational processes on steeper slopes. The natural condition of north facing slopes is more humid and therefore suitable for thick vegetation cover. The natural vegetation is thick and rich on north facing slopes. The natural vegetation influences parent material by giving some humid acid which penetrates into the parent material and accelerates the rate of chemical and physical weathering. Haplic Castanozem soils on basic igneous rocks, which are characterized by moderate to high organic matter content (75 per cent) and deep profile development (more than one metre). On the other hand warmer and less humid south facing slopes have sparse vegetation and low organic matter content (less than 1 per cent) and Eutric Regosols have been derived from the same parent material

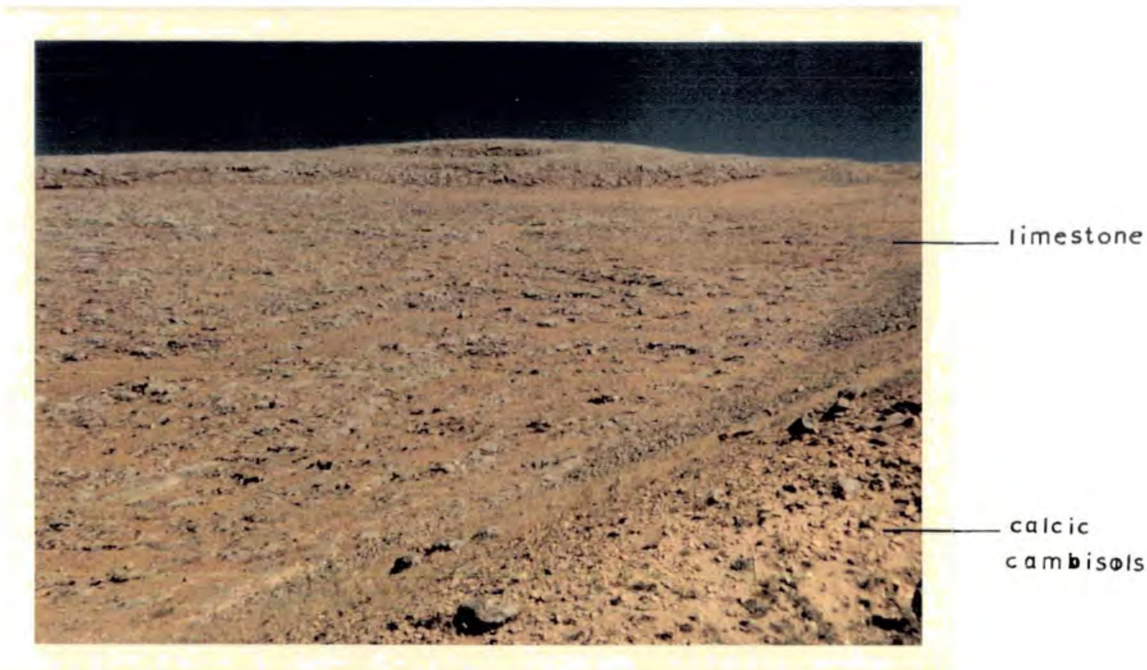


Plate - 20 The south facing slopes; picture taken about 12 km west of Elbistan Town at an altitute about 1250 m.

Plate - 21 The north facing slopes, the picture taken toward southwest direction, the highest point in the area is Tülce Tepe (1900 m) The left centre of the picture is Yukari Kargabükü village dark green area in the centre of the picture is Goksun valley valley and Goksun River.

(basic igneous rocks). These show immature and shallow profile development (less than 50 cm).

SLOPE AND DRAINAGE

Slope and drainage were early recognized as factors affecting soil depth and soil profile by Glinka (1927) and from first principles one may argue that soils are deeper towards the lower end of a slope, for here eroded material and moisture accumulate. More recent reports state that soil profiles in the better drained positions had the same horizon sequence but sola become thinner towards the base of a slope (Wicklund and Whiteside 1959) while Norton and Smith (1930) proved a decrease in the depth of A horizons of Podzols as slope angles increase. Lag (1951) in Norway showed that the depth of the A_2 horizons increases towards depressions and decreases near slight elevations.

Slope / soil relationships have been investigated in various parts of the basin when the parent material is the same. The investigation revealed that the variation of organic matter content and the thickness of pallid A horizons of all soils of the Elbistan basin are closely related with the degree of slope. The steeper slopes are characterized by low organic matter content and thinner surface horizon, whereas the more gentle shallow slopes show high organic matter content and thicker surface horizons (Norton and Smith 1930) Fig. The effect of water penetration is responsible for this variation in the basin.

According to Ellis (1938) well drained upland soils on level topography give rise to soil moisture conditions which are normal for the region. On the other hand local variation in topographical position such as knolls, slopes and depressions will show differences from the normal conditions (Fig. 48) Here for instance, Ellis's figures give a clearer idea of the likely variation in moisture content in the Elbistan basin. He suggests that, if for example the precipitation on a given section of land is 400 mm annually the soils on the knolls will have a locally arid climate in comparison with the soils on level topography such soils may be designated as being "locally arid associates" according to Ellis. The extent of this local aridity will be determined by the amount of water penetrating into the soil and the amount of runoff. The soils of the depressions in the examples given will receive 400 mm of precipitation annually plus the amount of water that runs off from the adjacent higher lands. Therefore more water will penetrate the soils in the depressed areas such soils may be termed "locally humid associates" according to Ellis, because they have a more humid soil climate than the soils on knolls. Therefore the variation of organic matter content on different slopes both on knolls and in the depressions can be explained by the micro-topographical sequences in the Elbistan basin, particularly the degree of slopes which plays an important role.

The slope also affects the variation in the total thickness of the solum (Bunting 1961, 1964) in the area. For instance, along a variable slope there would be encountred an entire sequence of soil types each having slightly different profile features (Parsons and Balster 1966). For example soils which occur on abrupt slopes are shallow and the thickness of the solum increases as slopes become less steep (Table 26)

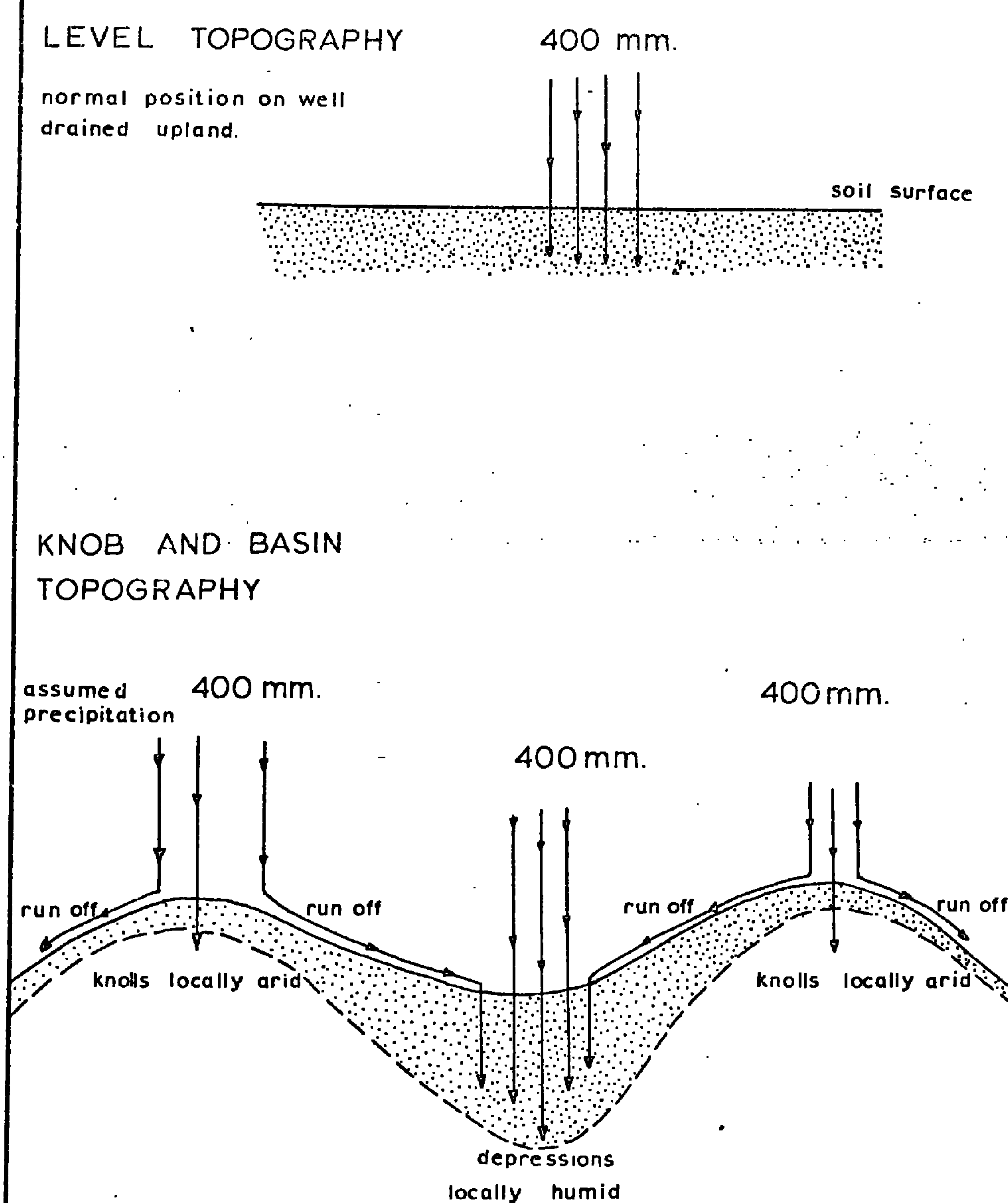


Fig. 48

Relationship between topography and soil moisture conditions (after Ellis 1938)

TABLE 26

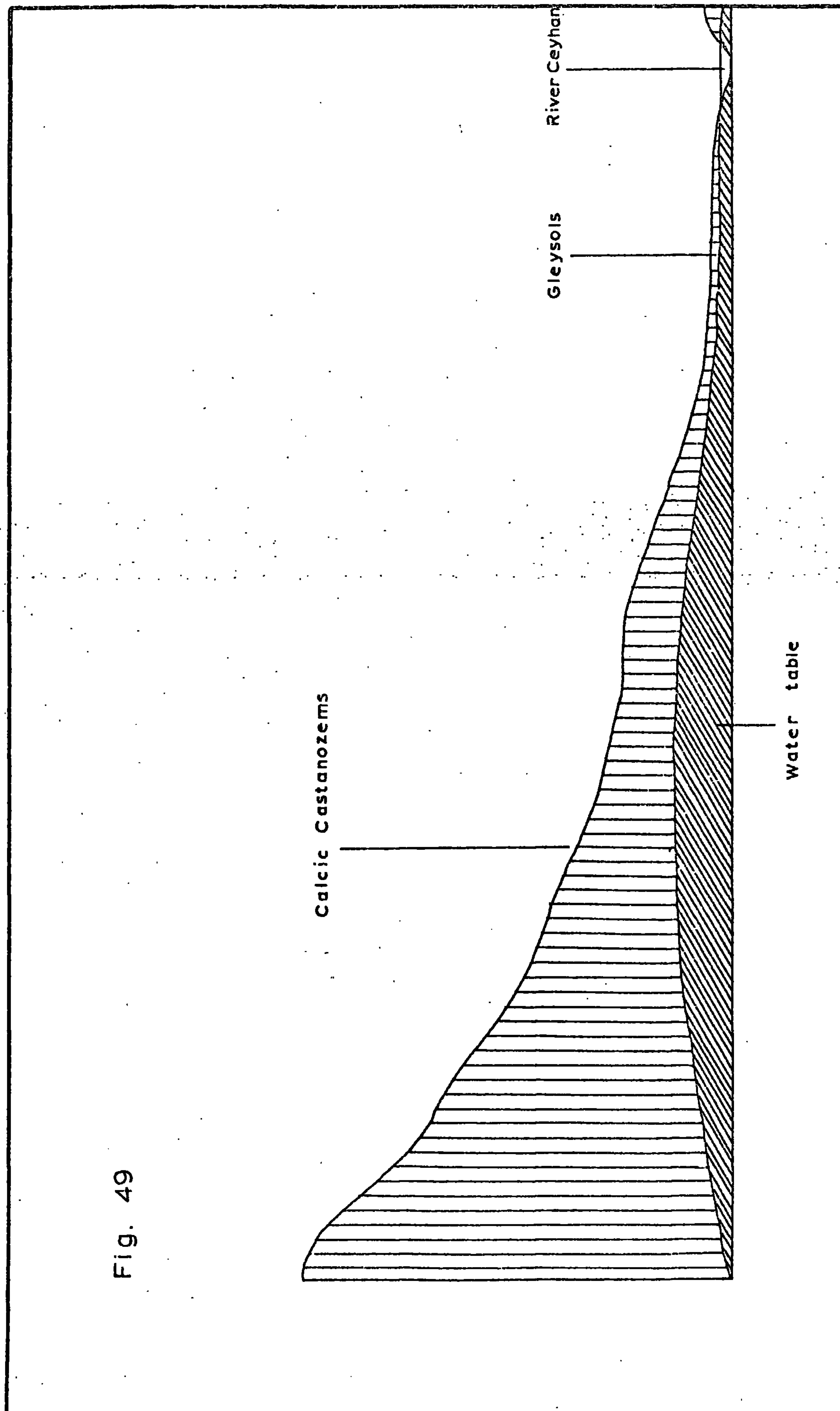
Relationship between degree of slopes and the thickness of solum of soils derived from various parent materials.

Profile	Parent Material	Degree of Slope	Thickness of solum (approx) cm.
4	Limestone	0	113
25	"	2	88
16	Granite	6	38
18	"	0	57
23	Calc-schist	8	33
13	"	6	42
2	Limestone	3	81
5	"	2	98
8	Basic igneous	4	62
9	rocks	10	48
19	(Diorite, Gabbro,	5	59
40	Serpentine)	3	86
7	Gabbro	29	26
11	"	14	46

The variation in the position of the ground-water table also has an influence on soil development and produces gley horizons at various depths. The process of gleization is the result of both the topographical differences and the depth of ground-water (Glenthworth and Dion 1949), Crompton (1952) Bloomfield (1951). According to Clarke (1957) apart from the parent material and the degree of wetness, topography also play an important role for the process of gleization. Indeed the gentle topography and the depth of groundwater table affect primarily the process of gleization in the basin. Fig. 49 indicates the topographical sequence and the seasonal variation in the level of the groundwater table in the basin. The normal sequence of soils on gently undulating topography with slopes about 4-6 degrees average shows Calcic Castanozem soils on the higher ground. On the other hand the intensity of gleization is greatest at lower elevations when slopes are gentle (less than 4^{o}) and thus the soil drainage becomes poor. Therefore the process of gleization occurs in limestone and calcareous alluvial soils in the Elbistan basin.

Two representative profiles have been sampled from the Gleysol area. Field investigation revealed that the morphological development of both profiles is controlled by two properties. One is the degree of slope which affects both surface and soil drainage. The second property is the depth of the groundwater table which is responsible for the gleying process in the profile morphology.

The variation of slope also affects clay movement and clay accumulation in the soils of the Elbistan basin. Generally there is an increased clay content in the profiles related to the degree of slope. This variation has been shown in table 27 Table 27 illustrates that the accumulation of clay in the soil profiles is closely related to slope in the Elbistan basin. There is no evidence of vertical movement of clays in the soil profiles, because there are no clay skins present in profile morphology. However, mechanical analysis indicates that there is a clay accumulation between 20 and 40 cm below the surface



Effect of water table on gleysol formation in almost all soil profiles in the Elbistan basin. Therefore the accumulation of clays at these depths can only be explained as a result of the deposition of downwashed materials carried by runoff water during the wet season. Indeed, during the prolonged dry season the soils of the basin have several sizes of cracks in the profile morphology. When the wet season begins, the precipitation usually occurs as heavy showers as indicated previously (see Chapters 3 and 5) and run off is very rapid on slopes. Therefore the process which may be termed "clay accumulation in cracks" occur very rapidly. Thus the amount of clay material deposited is greatest on gentle slopes and least on steep slopes. (Table 27).

TABLE 27

Variations between the depth of cracks and the amount of clay content related to the degree of slopes

Profile	Horizon	Depth cm.	Parent material	Slope	Depth of Cracks cm. (approx)	% Clay
	A	0-10				20.7
2	(B)	20-30	Limestone	3°	>30	28.6
	Bca	50-60				25.4
	B/C	70-80				24.6
	A	0-5				14.9
32	(B)	20-30	Limestone	6°	>30	20.1
	Bca	50-60				16.4
	B/C	60-65				17.5
	A	0-5				4.0
15	(B)	10-15	Granite	4°	>20	6.8
	(B)/C	20-25				12.1
	C	30-35				7.8
	A	0-3				3.1
17	(B)	5-10	Granite	8°	>20	3.3
	(B)/C	20-25				8.5
	C	30-35				6.8

Profile	Horizon	Depth cm.	Parent Material	Slope	Depth of Cracks cm. (approx).	% Clay
	A	0-10				8.1
	B	(20-30)	Gabbro	7°	>30	14.5
10	B/C	45-50				10.6
	C	60-65				6.4
	A	0-10				11.7
	B	(20-30)	Diorite	4°	>30	19.8
8	B/C	40-50				14.3
	C	50-60				11.1
	A	0-5				10.4
13	(B)	(15-20)	Calc-schist	6°	>20	19.3
	Bca	25-30				13.3
	B/C	30-35				15.4

(1) See Appendix

On the other hand vertical clay movement occurs in Chromic Luvisol profiles in which clays are leached from topsoil to subsoil. In these soils one can define an Argilluvic horizon (for definition see Appendix I). The genesis of Chromic Luvisol will be discussed separately from that of other Elbistan soils. Because, the author believes that the formation of chromic Luvisol occured under different environmental factors and can be referred to as a relict soil.

6.4. PARENT MATERIAL

INTRODUCTION

In the majority of soils the influence of the parent material is most important during the early stages of evolution. This was established by the well known writing of the earlier Russian soil scientists, and it has been the subject of later research by Polynov (1930), Jenny (1941), Stobbe (1952) and others. Parent material usually influences the soil developed on it two ways; through its physical properties and through its chemical properties (Robinson 1949).

The physical properties help to determine the texture of the soil so that limestone and clay-rich calcareous alluvial deposits usually result in heavy soils, whereas granite will give rise to light sandy soils. The permeability of the parent material will also influence soil development as it will help to determine the drainage conditions in the soils.

The chemical properties of the parent material influence the base status of the soil which subsequently forms. Acid igneous rocks tend to give rise to soils with low base status and clay-rich sedimentary rocks will tend to produce soils with a high base status. High base status in a soil encourages biological activity which in turn greatly influences soil development in that it will cause rapid assimilation of humus into the mineral soil and the formation of good structure. The most significant cations seem to be calcium as rocks with a reasonable content of calcium are fairly common, and in limestones it forms a major part of the rock. The character of the parent material also influences soil reaction in the

Elbistan basin. Whereas granitic parent material gives neutral or slightly alkaline soils, the basic igneous tend to produce moderately alkaline soils and limestone and calcareous alluvial deposits always produce alkaline soils.

The parent materials of the soils of the area can be divided into two major groups:

1. Those derived from bedrock in situ
2. Those derived from transported material (Hornung 1968).

The second group includes alluvial and colluvial deposits. The soils formed from transported materials cover relatively small parts of places in the research area. These materials seem to have been derived from within the area and moved very short distances so that they reflect the local solid geology.

The solid geology can be divided into two parts.

1. Palaeozoic and Cretaceous limestones which are dominant in the eastern Elbistan basin.
2. Acid and basic igneous rocks which are dominant in the western Elbistan basin (See Chapter 3 Fig 4 p. 19).

The composition of parent material influences the texture of the soils which have developed from underlying geological strata. It has been pointed out previously that light textured sandy loam and loamy sand soils have been developed from acid igneous rocks. Similar characteristics of light sandy loam soils have been described by Irmak, Gülcur and Mitchell (1967) and Irmak, Gulcur (1964) in the northwestern part of Turkey. On the other hand limestone has weathered more rapidly and produced heavy textured soils characterized by silty clay and clay soils in the basin, whilst the basic igneous rocks produce moderate textured soils characterized by silty loam and loam. Thus, the composition of soil parent material has played an important role in determining or modifying certain types of soil profiles which developed in the Elbistan basin (Table 28). Ehrlich, Rice and Ellis (1955) discuss the importance of the composition of parent material in determining the certain types of soil profiles developed in Manitoba.

TABLE 28

Mechanical analysis of some soils derived from different parent materials in the Elbistan basin

Profile	Horizon	Depth (cm)	Parent material	% SAND	% SILT	% CLAY
26	A	0-10		24.1	51.8	24.1
	B/C	20-30	Calcareous	19.1	54.5	26.4
		40-50	alluvial	12.7	59.1	28.2
	C	60-70	deposits	16.4	57.3	26.3
	A	0-10	non-calcareous	53.4	36.7	9.9
38	B/C	20-30	alluvial	49.9	39.4	10.7
		40-50	deposits	45.6	43.5	11.9
	C	60-70		49.5	41.5	9.0
	A	0-10		49.4	42.1	8.5
21	B	20-30	Diorite	38.3	44.6	17.1
	B/C	40-50		44.5	43.4	12.1
	C	60-70		51.4	40.7	7.9
	A	0-10		49.2	42.7	8.1
10	(B)	20-30	Gabbro	40.6	44.9	14.5
	B/C	45-50		45.6	43.8	10.6
	C	60-65		51.1	42.5	6.4
	A	0-10		19.9	52.6	27.5
4	(B)	30-40	Limestone	14.9	49.5	35.6
	Bca	60-70		15.0	53.3	31.7
	B/C	70-80		14.4	53.8	31.8
	A	0-3		76.4	20.5	3.1
17	(B)	5-10	Granite	71.8	24.9	3.3
	(B)/C	20-25		69.3	23.2	8.5
	C	30-35		75.6	17.6	6.8
	A	0-5		15.6	75.0	9.4
23	(B)	15-20	Calc-schist	14.9	67.4	17.7
	Bca	25-30		15.1	71.6	13.3
	B/C	30-35		16.7	72.4	10.9

The character of the parent material also influences the pH reaction of soils in the basin. A similar conclusion has been drawn by Reifenberg (1947) in the case of the soils of Palestine. Even in the practically semi-humid western part of the Elbistan basin the pH is generally above 7.0. The variation of pH in the Elbistan soils is closely related to the nature of parent material. For instance soils developed on granitic parent material show the lowest pH values.

The low pH of granitic soils is usually considered to be a reflection of the degree of base saturation of the soil absorption complex (Ehrlich, Rice, Ellis 1955). It has already been described (see Chapter 5) that exchangeable cations are closely related to clay content in the soils of the Elbistan basin. Therefore it may be presumed that the reaction of low pH of granitic soils is also affected by low clay content. (Table 29). On the other hand the relationship between parent material and the pH of the soils is visible in all parent materials occurancy in the basin. For example soils derived from basic Igneous rocks such as gabbro and diorite are moderately alkaline (between 7.3 and 7.6) in reaction while their exchangeable cations and clay content is slightly higher than granitic soils (Table 29). Moreover, the soils which have been derived from limestone and calcareous alluvial deposits show high alkaline reaction with a pH typically above 8.0. Therefore the soils which are derived from calcareous parent material show a high clay content and high cation exchange capacity compared with the soils which have developed from igneous rocks (Table 29).

TABLE 29

Relationship between pH, cation exchange capacity and clay content of soils derived from various parent materials

Profile	Horizon	Depth cm.	Parent material	pH	CEC m.e/100g	% CLAY
	A	0-10		8.3	15.83	20.7
2	(B)	20-30	Limestone	8.2	17.78	28.6
	Bca	50-60		8.5	17.44	23.8
	B/C	70-80		8.4	16.55	24.6
	A	0-10		7.9	20.12	27½5
4	(B)	30-40	Limestone	8.0	21.13	35.6
	Bca	60-70		8.4	20.53	31.7
	B/C	70-80		8.3	19.02	31.8
	A	0-10		7.2	9.84	16.4
40	B	30-40	Diorite	7.3	12.76	21.3
	B/C	60-70		7.4	10.35	17.6
	C	80-90		7.3	9.08	12.3
	A	0-10		7.3	7.56	8.1
10	B	20-30	Gabbro	7.2	10.94	16.5
	B/C	45-50		7.4	7.31	10.6
	C	60-65		7.3	4.79	6.4
	A	0-5		7.2	2.85	4.0
15	(B)	10-15	Granite	7.3	2.98	6.8
	(B)/C	20-25		7.2	3.74	12.1
	C	30-35		7.1	3.05	7.8

The calcareous soils of the Elbistan basin usually reflect the character of the parent material from which they have been derived. Jenny (1941) suggests that the red colour of limestone soil may depend upon the quality of parent material. Hard and relatively pure limestone rocks frequently produce red soils, whereas the softer and impure varieties yield dark-grey and brownish weathering products. Indeed, the reddish brown colour of Calcic Castanozem soils has been derived from hard and relatively pure bluish-grey Palaeozoic limestone, whilst the brown and yellowish brown colour of Calcic Cambisol soils have been derived from impure highly weathered whitish-pink Cretaceous limestone.

The relatively high content of total iron oxides (Fe_2O_3) reflects the nature of parent material in the Haplic Castanozem soils. These soils are derived from two different basic igneous rocks, and are similar in all their physical and chemical properties. But total iron oxide content differs markedly between soils derived from the two different parent materials. For instance profiles developed from diorite parent material show a higher iron oxide content than soils derived from gabbro parent material. (Table 30). Table 30 indicates that the amount of iron oxide content is relatively higher in the parent material than in the sola. Thus iron oxide content reflects the differences of chemical composition of both parent materials. (Carson-Künze 1967).

TABLE 30

Variation of total iron oxides (Fe_2O_3) in two different basic igneous rocks

Profile	Horizon	Depth	Parent Material	% Fe_2O_3 $\times 10^{-1}$
	A	0-10		6.6
10	B	20-30	Gabbro	9.1
	B/C	45-50		14.6
	C	60-65		16.8
	A	0-10		12.4
40 B	B	30-40	Diorite	21.8
	B/C	60-70		28.3
	C	80-90		33.1

<u>Process of calcification</u>: The type of parent rock and relatively arid climate produce calxic horizons at various depths in calcareous soils. The main reason for this process is the high evaporation in the area which produces upwards calcium carbonate movement by capillary water and accumulations at various depths. The depth of the calxic horizon and its formation have already been discussed in some detail (See Ch. 5). Calxic horizon depends primarily on the texture of lithology, the age of the soil and the geomorphic history of the soil according to Gile, Peterson and Grossman (1966). Indeed, calcium carbonate content is slightly higher in Calcic Cambisol profiles, because they are derived from Cretaceous limestone which is easily weatherable in the basin, and thus they produce higher calcium carbonate (Sweeting 1964).

The number of limestone fragments in the calcareous and non-calcareous alluvial deposits are responsible for the calcium carbonate content. These fragments may be expressed as a percentage of all fragments in the deposits (Fig. 50). The parallelism of the two curves is striking and there is little doubt that the calcium carbonate content of the fine earth is directly related to the petrographic make-up of the parent material.

6.5. <u>VEGETATION</u>

<u>INTRODUCTION</u>

Crocker (1952) is of the opinion that vegetation is one of the most important soil forming factors and gives a very complete review of the influences which vegetation has on

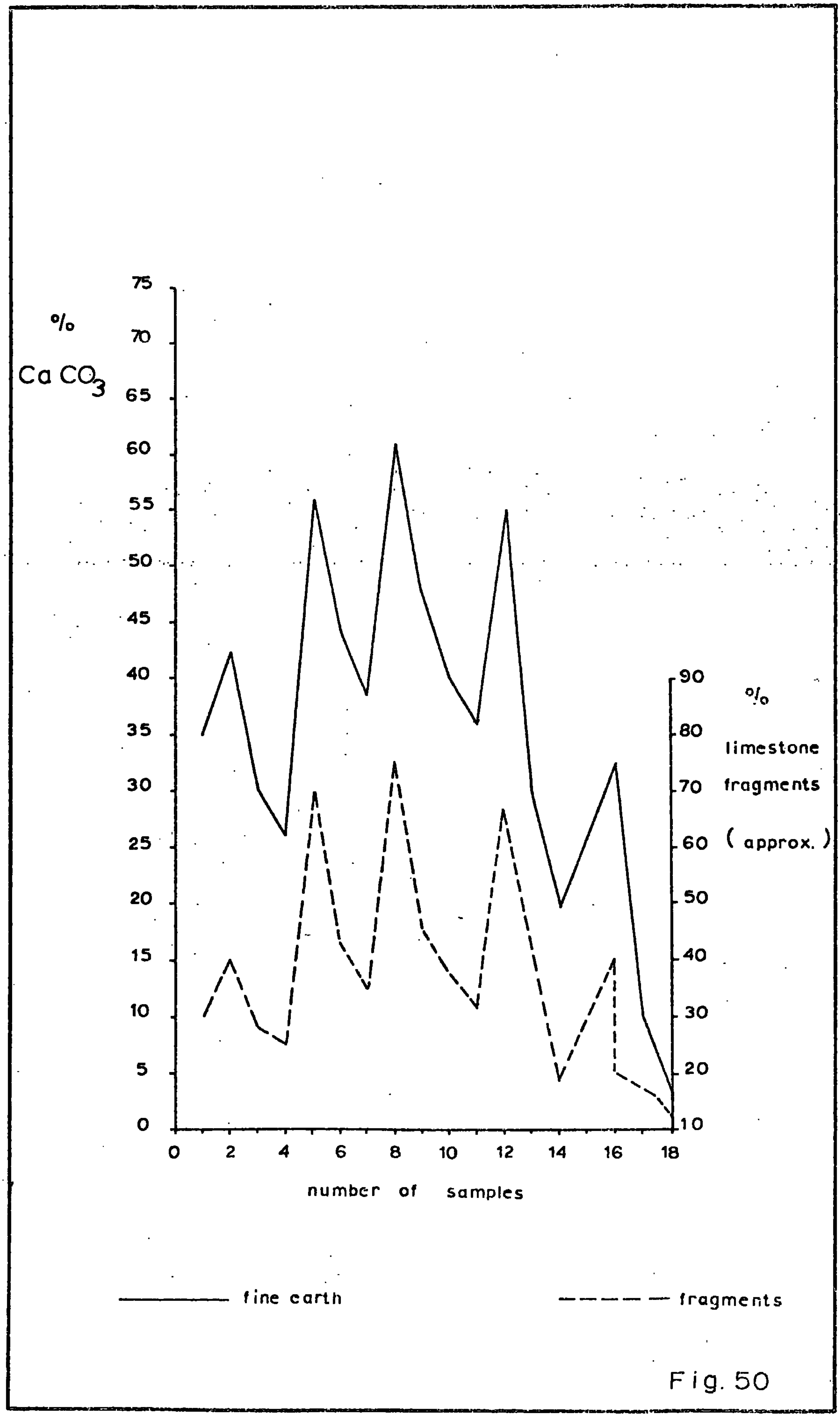


Fig. 50

Calcium carbonate content and percentage of limestone fragments in limestone soils (after Jenny 1941) soil formation and evolution. Mückenhausen (1962) suggests that soil formation would be impossible without the macro and micro flora as they are the source of the organic matter which is an essential constituent of soil. The ways in which vegetation is effective as a soil forming factor are listed by Duchaufour (1960) as follows:

1. By the microclimate which it favours
2. By the depth of rooting
3. By the type of humus it produces
4. By its protection more or less effective against soil erosion (quoted from Hornung 1968)

The microclimate is affected because plant cover reduces the amount of solar radiation reaching the soil, but it also reduces heat loss due to radiation. Plant roots have several kinds of effect upon the soil. Roots from large plants especially trees, will help to break down the parent material. The roots nearer the surface will also break up the soil and are extremely important in the creation of structural units in the upper soil. The dense root cover under some grassland is one factor in the formation of a good crumb structure. The channels through the soil which are created by roots are available for movement of air and water through the soil and this water carries with it clay material in suspension and various elements in solution.

VEGETATION AS A SOIL FORMING FACTOR IN THE ELBISTAN BASIN.

The natural vegetation of the Elbistan basin reflects the present climate. In general, the natural vegetation is of a Mediterranean type in the western part of the basin.

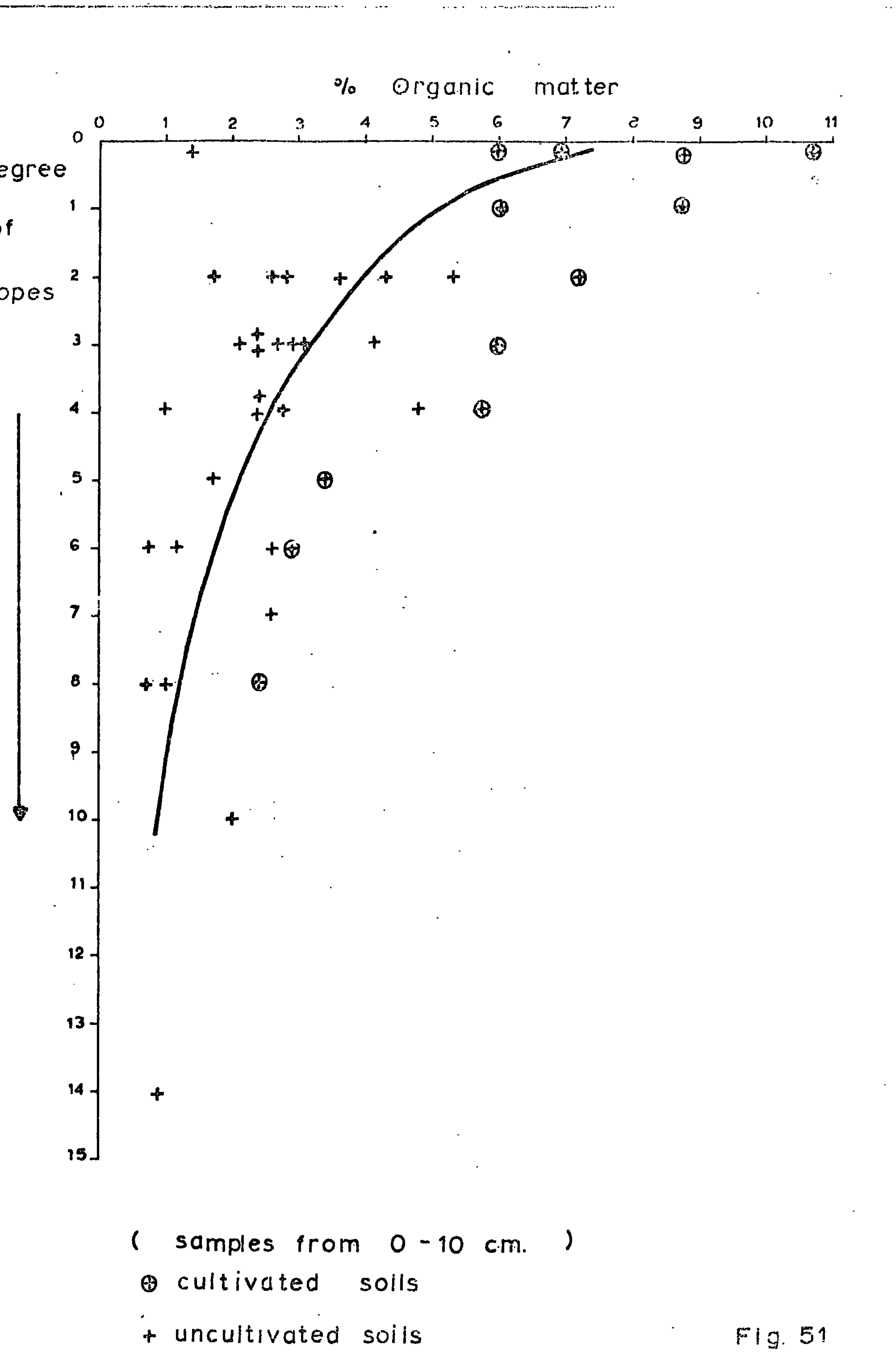
Plate - 22 A panaroma of eastern Elbistan basin. The picture taken towards the north west direction. Ketizmen village is the nearest to the picture.

Plate -(22A) A panaroma of eastern Elbistan basin. The picture taken towards the northwards at an elevation about 1500 m.

Plate - 23
The view of the central Elbistan basin.

On the other hand the eastern part of the basin is influenced by a continental type of climate which gives rise to steppe vegetation mostly short and long grasses. But the distribution of natural vegetation is affected by various factors in the basin and this affects the organic matter content in the soil profiles. According to field investigation in the research area the main factors in the distribution of the natural vegetation are aspect and slope. Therefore the level of organic matter content in the soil profiles is influenced by topography in the basin. The slopes with a southern exposure from low hill to higher mountain are covered by sparse dry steppe vegetation; only some alluvial soils have a more dense grass cover because of the effect of the groundwater table which in places is as little as 60 cm below the surface. On north facing slopes, except in severely eroded sections, the grass stand is dense and tall meadow-like steppe. The grasses of the north facing slope protect the soil from intense heating and physical evaporation and protect it from sheet erosion. When the grasses die they provide a high amount of organic matter content. In the upper soil horizons the root content is 2-3 times higher than in soils of south facing slopes (Table 31) According to Stephanov (1967) the vegetation of south facing slopes poorly protects the soil surface from erosion and yields a small amount of organic matter content.

However the organic matter content of the soils of the Elbistan basin is not influenced solely by aspect. Slope also plays an important role in the variation of organic matter content of the Elbistan soils. Fig 51 . Fig. 51 and Table 31 illustrate the variation of organic matter content



Relationship between organic matter content and degree of slope in south facing and north facing slopes. This figure reveals that aspects affects organic matter content if the slope is not too steep. Therefore the effect of slope is of considerable importance in the variation of organic matter content in the basin.

TABLE 31

Variation of organic matter content of soils derived from the same parent material on north and south facing sides and their relationship to the degree of slope

Profile	Depth	Aspect	Slope	% Organic matter
5	0-10	S	2^{o}	3.62
	10-20			2.76
	0-10	N	2^{o}	4.31
4	10-20			3.82
	0-5	S	6^{o}	1.20
13	10-15			0.55
	0-5	N	6^{o}	2.58
32	10-20			1.90

6.6. TIME AS A FACTOR IN SOIL FORMATION

The estimation of the relative degree of maturity of soil is largely based on horizon differentiation. Jenny (1941) explains this in the following terms. "... in practice, it is generally maintained that the larger the number of horizons and the greater their thickness and intensity the more mature is the soil. However it should be kept in mind that no one has ever witnessed the formation of mature soil. In other words, our ideas about soil genesis as revealed by profile criteria are inferences. They are theories, not facts."

Plate - 24 A panaroma of western Elbistan basin. The picture taken towards northwest direction. In the centre of the picture is Goksun valley. On the north facing slopes vineyard cultivation is dominant.

In recent years pollen analyses and C_{14} data have become available and as a result the pedologist can now estimate the definite age of soils. Unfortunately there is no available data about the age of soils in the Elbistan basin. However, buried Terra Rossa soils beneath the colluvial deposits, believed to be the oldest soils in the basin, are assumed to have developed somewhere between late Tertiary and early Quaternary (p 44).

The process of colluvial deposition occurs widely in the basin but it is difficult to determine the precise age of the various colluvial deposits. Butler (1959) has shown that the sequence of buried soil layers in the landscape of southeast Australia and represents periods of soil development beneath a succession of surfaces or subsurfaces. Butler's theory is that a succession of buried soils indicates a recurrent cycle of stable and unstable phases of landscape evolution which he calls the K cycle. Each cycle starts with an ustable phase (K_u) of erosion and deposition and ends by a stable phase (K_s) in which soil formation is started on newly exposed erosion pavements and adjacent fresh deposits. Butler's cycle theory has been used by Walker (1962a, 1962b) on the south coast of New South Wales. He suggests three possible K cycles called K_1, K_2, K_3 and he indicates recent alluvial deposits as K_0.

For present research purposes it may be assumed that the Terra Rossa soils of the eastern Elbistan basin are the oldest soils in the basin and represent the K_3 cycle Walker (ibid). The formation of these soils was followed by colluvial activity which buried the terra rossas and initiated the K_2 cycle.

Lastly the occurence of alluvial deposits indicate the recent layer called K_1. Therefore it might be suggested that the soils derived from colluvial deposits are younger than terra rossa soils but older than alluvial soils.

However, the process of colluvial activity occurs very rapidly when the slope is steep. Therefore it may be possible that more than one cycle occured after the terra rossa formation. More evidence is required in order to differentiate between the soils derived from successive cycles. Unfortunately no evidence is available as to the number of phases of colluvial activity which occured after the formation of the terra rossas. For this one needs more buried profiles to indicate the actual process which occured from time to time when the deposits lost their stability on steep slopes and were washed down.

Another possible method of determining the relative ages of soils in the basin is that based on the degree of weathering of different parent materials. Hilger (1897) exposed uniform rock particles of from 10 - 20 mm diameter to atmospheric influence for a period of 17 years. After a certain period Hilger assumed that limestone was the most and sandstone the least resistant material. In the Elbistan basin, soils derived from igneous rocks show mature profile development, but according to Hilger's experiment the rate of weathering is probably greater in igneous rocks than in limestone. Thus it may be assumed that, because of the rate of weathering under similar environmental condition, soils derived from igneous rocks develop rapidly and reach maturity earlier than limestone soils. On the other hand this relationship may be modified by the effect of slope. Soils developed on the steeper slopes may never reach maturity even though the related soils derived from same parent material may be relatively mature. The classic example is that of Haplic Castanozems and Eutric Regosols. The former are mature soils while the latter, occurring on the steeper slopes fail to reach maturity.

The youngest soils in the area are probably the alluvial soils, since the deposition of alluvium may be as recent as the last flood. The presence of terraces, however, indicates that there have been several phases of alluvial deposition and thus alluvial soils vary considerably in age, and may in some cases have been buried by later colluvial deposits.

A summary of the relative ages of the soils of the Elbistan basin is as follows.

1. Terra Rossa is the oldest soil in the basin.

2. The occurence of colluvial deposits and soils derived from them indicate that these soils are probably younger than Terra Rossa.

3. Because of the weathering rate, the soils derived from igneous rocks are probably younger than limestone soils if both soils show mature profile development.

4. Slope can affect primarily the maturity of soil development if the soils are derived from same parent material.

5. Alluvial soils are probably the youngest soils in the basin, because the process of alluvial filling can occur very recently even as recent as last flooding.

Plate - 25 Colluvial deposits in the , eastern Elbistan basin.

6.7. GENESIS OF CHROMIC LUVISOL[1].

INTRODUCTION

Reifenberg (1947) was the first to emphasise the importance of the Mediterranean climatic regime as the factor which accounts for the distribution of Chromic Luvisol. Since then many climatic statistics have become available from other parts of the world in which Chromic Luvisol soils occur, and all underline the marked climatic regime of a temperate moist winter alternating with a hot dry summer. According to Atkinson (1969) this seasonal alternation in weather conditions is an important influence on the nature of the soil climate, which affects the process of weathering and pedogenesis in the soil profile. Atkinson also suggests that the sharp distinction between moist and dry pedogenic processesss is very important to understanding the formation of these soils. Reifenberg (1947) emphasised the restriction of Chromic Luvisol to hard crystalline limestone strata. He notes that soft porous limestone give rise to rendzinas and highly calcareous marls occur on friable marly limestones. The correlation between limestone lithology and soil type in the Mediterranean climatic regimes has recently been emphasised by Atkinson and Beaumont (1967) in the northern highlands of Jordan. Here detailed soil mapping on a large scale revealed that the lithology of the underlying limestone strata was the most

1. Terra Rossa soils in the Elbistan basin may be classified as Chromic Luvisol according to the FAO classification.

important factor affecting the formation of chromic Luvisol in the area.

Analyses of the insoluble residue content of greyish-blue crystalline limestones beneath Chromic Luvisols have been made by the author from samples collected in the eastern Elbistan basin. The acid-insoluable non-carbonate residue left after dissolving limestone samples in dilute acids in the laboratory provides a means of assessing the soil material which will accumulate when the limestone is chemically weathered. Generally the crystalline limestones from which Chromic Luvisols form have a low (3%) content of insoluble residues. The hard greyish-blue crystalline limestone is therefore very pure, a feature which reflects the intensity and the time of weathering required to produce deep sola.

The soil forming processes which give Chromic Luvisol soils are now more fully understood than at the time of Reifenberg's (1947) classic analysis. The basic process which produces Chromic Luvisol is of course the chemical weathering and dissolution of the crystalline limestone to produce insoluable residue from parent rock.

The pedogenic process which occurs simultaneously with rock weathering is the process of decalcification or removal of calcium carbonate from the soil. According to Atkinson (1969) the relative slowness of the dissolution process and the very sharp weathering front between unweathered and weathered material indicate that free carbonates are readily leached away. He points out that, on soft and porous limestones, weathering usually occurs very quickly so as to leave fragments and powders of limestone throughout the sola, and produce rendzina and marl soils. Chromic Luvisol on the other hand is typically decalcified and completely leached of free carbonates. The processes of weathering and decalcification take place during the wet season. A further process which is the result of downward soil moisture movement is the process of argillation which results in the formation of the argilluvic B horizon. The presence of an argilluvic B horizon is one of the main diagnostic morphological features of Chromic Luvisol soils used in the classifactory system of FAO (1968). Argillation is the process of leaching of clays from the A horizon into the B. It results in the formation of a textural B horizon characterized by clay skins on soil textural units giving typically blocky or prismatic structure.

The process of rubefaction is the most important process giving Chromic Luvisol soils their characteristic colour and composition.

The physical and chemical features of Chromic Luvisol indicate that the processes described above have combined to produce the profiles. But the evidence that these processes have occured gives very little indication of the actual time when the processes began.

The experiment which has been described above is based on Atkinson's analysis and quoted from his work (Atkinson 1969 p.25). He suggests that "..... the in situ formation of 50 cm of Chromic Luvisol Material from limestone with only a 2 per cent insoluble residue requires the dissolution of no less than 2450 cm of limestone to produce the required residue. The weathering of such great thickness of limestone could obviously not be accomplished during the recent time of Holocene period, particularly as limestone dissolution is known to proceed at a relatively slow rate. Thus Chromic Luvisol soils are often described as the formation of Pleistocene Interglacial periods or even of the Pliocene or late Tertiary period". Atkinson (1970) has studied several sites particularly in northern Turkey and found direct evidence that the Chromic Luvisol is a palaeosol. Kubiena (1963) also suggests that the Chromic Luvisol soils are the indicator of climatic variations during the Pleistocene and late Tertiary, and he has come to the conclusion that Chromic Luvisol is a palaeosol.

Discussion:

The fossil Chromic Luvisol soil in the eastern Elbistan basin on hard crystalline limestone has been buried and preserved beneath the reddish brown colluvial deposits, and characteristic Chromic Luvisol profiles have been exposed in places along the side of the slope at altitudes between 1150 metres and 1200 metres. Three characteristic profiles have been collected for physical and chemical analyses in the laboratory. The characteristics of these profiles have already been described in Chapter 5.

The buried and exposed profiles have all the characteristics of a Chromic Luvisol soil which was produced by pedogenesis acting on hard crystalline limestone during a past climatic variation which occured in the late Tertiary and Quaternary. The occurance of exposed and buried Chromic Luvisol profiles has been shown in (Fig. 52) Fig. 52 also indicates the sampling sites of the profiles. The present soil which

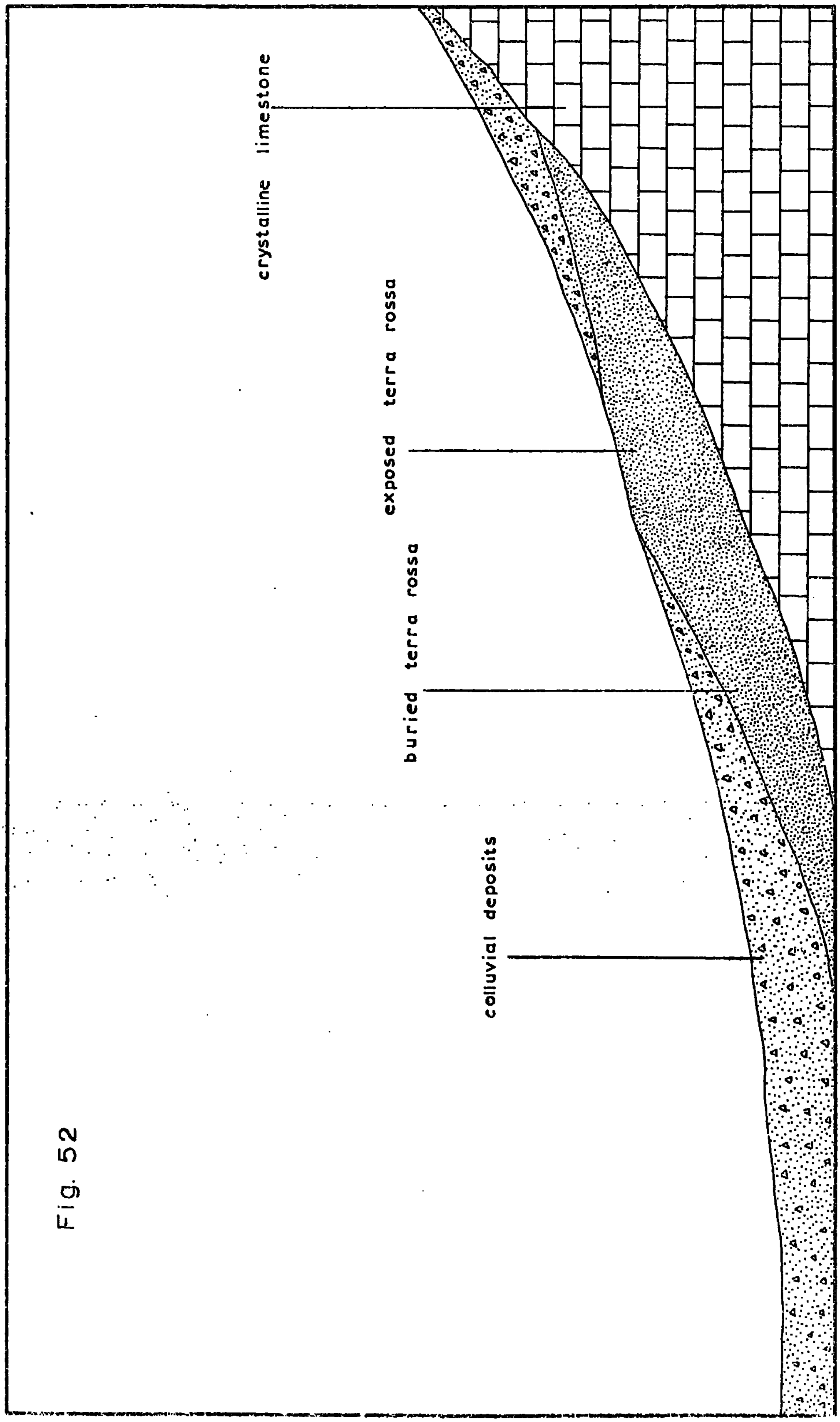


Fig. 52

Buried and exposed terra rossa soils

has developed from the colluvial deposits is entirley different from the buried soils. Apart from the difference in colour the present soil has a lower clay (less than 30 per cent) and higher silt content (more than 40 per cent). The present soil also show high calcium carbonate content (more than 25 per cent). Analytical characteristics of buried and exposed Chromic Luvisols and their relationship with present soil profiles are shown in table 32.

TABLE 32.

Physical and Chemical relationship between buried and exposed Chromic Luvisol in the eastern Elbistan basin

Profile	Depth	pH	$CaCO_3$	Sand	Silt	Clay
	0-10	8.2	26.2	23.8	41.4	34.8
Buried	40-50	8.4	31.5	18.4	43.8	37.8
soil	90-100	7.5	3.4	6.3	36.9	56.8
P43	110-120	7.6	3.6	5.8	36.7	57.5
Exposed	0-5	7.7	3.8	13.3	46.6	40.1
soil	10-20	7.6	3.5	8.9	38.5	52.6
P31	20-30	7.6	3.6	7.6	36.1	56.3
	50-60	7.6	3.5	7.0	35.1	56.9
Exposed	0-5	7.6	4.0	12.5	35.6	52.9
soil	10-20	7.5	3.2	12.6	33.3	54.1
P36	30-40	7.5	3.6	10.9	32.3	56.8
	50-60	7.4	3.6	10.8	32.2	57.0

Table 32 reveals that there is a close relationship between exposed and buried Chromic Luvisol. On the other hand profile sequence and analytical data reveal that buried Chromic Luvisol soil and present coluvial soil show remarkable dissimilarity which can only be explained in terms of parent material and environmental differences between them. Alhtough very little work has been done on Quaternary climatic variations in the southeastern Taurus mountains which surround the Elbistan basin, the scattered evidence available suggests that a main Würm snowline at 2500-2600 metres with local periglaciation and movement of material downslope is likely. The idea that buried soils are the result of periglacial process has already been discussed (see Chapter 3). Thus the present author is of the opinion that Chromic Luvisol soils in this region are palaeosol.

Further research is necessary to establish differences between present calcareous soils and buried and exposed Chromic Luvisol profiles. Thus the study of micromorphology, clay and iron oxide mineralogy would give a better idea of the occurrence of buried and exposed Chromic Luvisols in the basin.

6.8. MAN AND ANIMALS

INTRODUCTION

The role of man as a factor in soil formation and evolution was given little attention in early pedogenic work as described previously (see Chapter 4). Today the influence of man's various activities is fully realised. Mückenhausen (1962) points out that man is the most intensive soil forming factor in central Europa today and also suggests that the major difference between man and other soil forming factors is the speed with which man can affect the soil. Kowalinski (1966) suggests that "…. there are no virgin soils in central and western Europe. All the land there is cultivated to a lesser or greater degree." He proposes a new classification of the soils of Europe which "….. will reflect not only natural factors but also soil changes accompanying the modification of natural environment by Man."

The most dramatic effects of human action on the soil are those resulting from ploughing fertilization and drainage. Ploughing destroys all horizon differentiation within the plough depth and can cause hardpan formation. Deep ploughing increases the depth of shallow soils, increases their porosity and helps the free movement of water. Perhaps most dramatic effect man has had is on the areas of marginal rainfall where large scale erosion has been caused by intensive ploughing. Artificial drainage can also greatly modify the soil, for instance by converting poorly drained gley soils to freely drained types. Fertilizers can provide the necessary nutrients which are required by the crops.

The effects of animals can also be important. In the Mediterranean region of southern and central Anatolia and parts of eastern Anatolia grazing by flocks of goats has completely stripped quite large areas of vegetation and exposed them to erosion.

<u>Man's activities in the Elbistan basin</u>:

There is no published anthropological or archaeological evidence of pre-historic human occupation of the Elbistan basin, though coins and pottery found in the west of the basin near Afsin indicate settlement during the Roman period. There is however, ample evidence of neolithic settlement in many other parts of the Anatolian interior (Cohen 1970). Todd (1968) describes a small pre-historic settlement near Pinarbasi, about 80 kilometres west of Göksun town, and suggests that the community established here was dependent on hunting as well as agriculture. The site bears evidence of occupation in the Neolithic, Chalcolithic and Early Bronze ages as well as in later periods. It may be assumed that settlement in the Elbistan basin dates back at least to the Bronze Age and possibly earlier.

Man's influence on the soils of the Elbistan basin

The present day influence of human action on the soils of the Elbistan basin is very great. About 80 per cent of the basin floor soils (which constitute some 20 per cent of the total study area) are under cultivation and about 30 per cent of the arable land is irrigated. The main crop is wheat with smaller areas devoted to beans, sugar-beet, rice, vegetable and vines.

The characteristics of the various alluvial soils of the basin floor reflect the nature of the uncultivated slope soils from which they are derived. The effects of cultivation are greatest in the top 50-60 cm. Of the basin floor soils, this being the greatest depth to which ploughing is effective. In these soils, A and B horizons lose their original character and become Ap and (B) horizons related to slope soils. The C horizons however, retain their original character melated to slope soils. The major differences between virgin slope soils and cultivated soils are those of pH, calcium carbonate, organic matter content and texture (Table 33).

Table 33 : Physical and chemical characteristics of uncultivated and cultivated soils derived from some parent material.

Profile	Horizon	Depth	Parent Material	Cultivation	pH	% $CaCO_3$	% O.M.	SAND	SILT	CLAY
	A	0-10			7.2	3.4	1.38	67.4	26.7	5.9
18	(B)	15-20	Granite	uncultivated	7.2	3.6	0.86	59.0	29.5	11.5
	(B)/C	25.30			7.3	4.8	0.52	58.2	25.7	16.1
	C	35-45			7.1	3.0	0.17	67.9	22.6	9.5
	A	0-10			7.1	2.4	2.07	53.2	28.4	18.4
		20-30		vineyard	7.1	2.6	1.38	54.8	26.7	18.5
34	(B)	40-50	Granite	cultivation	7.2	2.9	0.51	60.9	26.5	12.6
	(B)/C	60-70			7.2	3.8	0.17	67.6	20.9	11.5
	A	0-10			7.3	3.7	4.83	45.9	42.4	11.7
	B	20-30	Diorite	uncultivated	7.2	4.0	2.41	36.8	43.4	19.8
8	B/C	40-50			7.4	5.3	1.03	46.7	41.8	11.5
	C	50-60			7.3	4.4	0.52	48.9	42.4	8.7
	A	0-10			7.5	7.9	5.86	46.0	31.4	22.6
		20-30	Diorite	wheat	7.4	8.1	3.62	41.1	34.1	24.8
6	B	30-40			7.5	8.8	3.10	40.5	32.0	27.5
		40-50			7.6	7.4	1.90	42.5	34.1	23.4
		60-70			7.5	6.2	1.03	38.6	36.8	24.6
	B/C	80-90			7.5	6.5	0.69	35.8	38.4	25.8
	C	90-100			7.5	6.6	0.52	36.3	38.8	24.9
	A	0-10	calcareous	uncultivated	8.0	30.4	5.34	24.1	51.8	24.1
		20-30	alluvial		8.1	31.3	3.62	19.1	54.5	26.4
26	B/C	40-50	deposits		8.3	38.4	1.90	12.7	59.1	28.2
	C	60-70			8.2	36.5	0.34	16.3	57.3	26.4
	A	0-10	calcareous	sugar-beet	7.7	24.5	8.79	24.1	41.6	34.3
		20-30	alluvial	cultivation	7.7	25.6	8.10	24.1	42.7	33.2
28		40-50	deposits		7.8	27.9	5.86	19.1	44.1	36.8
	B/C	60-70			7.9	28.8	3.27	14.4	45.9	39.7
		80-90			8.1	33.7	1.90	13.0	46.3	40.7
	C	90-100			8.2	36.8	1.21	16.3	47.1	36.6
		100-110			8.1	35.2	0.86	13.0	45.3	41.7

Discussion

Cultivation has been particularly effective in changing the character of high alkalinity and calcium carbonate content in calcareous soils. Irrigation generally affects the pH of calcareous soils which are characterized by a lower pH than related slope soils. It also lowers the calxic horizon to greater depths. Indeed the depth of the calcium carbonate horizon in the uncultivated soils ranges between 30 and 60 cm, whilst in the cultivated soils the calxic horizon occurs below 100 cm as a result of irrigation (Table 33).

The type of crop cultivated also affects the organic matter content and the thickness of surface horizon as a result of the different rooting systems associated with the different crops. Some types of cultivation increase the nitrogen content in the soils. This is considerably higher in soils carrying sugar beet which may have a nitrogen content as high as 0.3%. This is probably due to the fertilizer applied to this crop from time to time by the farmers.

The effect of cultivation is also very important in causing textural differences between uncultivated slope soils and cultivated basin floor soils. The extent of these differences again depends on the type of crop cultivated and the amount of irrigation water applied. For instance fields which are periodically flooded for rice cultivation show two horizons a deep Ap horizon and a Cg horizon Irrigation also causes tremdnous textural differences between cultivated and uncultivated calcareous soils. Irrigated

Plate 26   Rice cultivation.

Plate - 27   Suger - beet cultivation.

calcareous soils show a high clay content, while uncultivated calcareous soils have a high silt content. Thus cultivated soils usually have a clay loam texture while virgin, uncultivated soils have a more silty character.

A different situation occurs in the case of soils derived from granitic parent materials. These retain their sandy texture and low pH so that cultivated and uncultivated granitic soils differ little from each other except that the cultivated soils have a rather higher organic matter content. Such soils are particularly suitable for viticulture because of their texture which gives them special aeration capabilities.

The effects of man's activities on the basin floor soils can thus be summarized as follows:

1. Profile development in the basin floor soils is controlled by cultivation. The true A horizon completely loses its original character and becomes an Ap horizon. The actual thickness of the Ap horizon depends on the type of crop which is cultivated on a particular

2. Irrigation affects the soil reaction and lime content in the basin. The calxic horizon occurs at greater depths in the calcareous soils.

3. The type of cultivation causes textural variations between virgin uncultivated and cultivated soils in the basin.

4. Cultivation has a very great effect on organic matter content in the basin floor soils. The organic matter

Plate - 28 Erosion.

content is controlled by the type of crops.

5. Fields carrying sugar beet show high nitrogene content due to effect of inorganic fertilizer.

C H A P T E R S E V E N

CONCLUSION

7. CONCLUSION

The chief aims of the present research have been to investigate the detailed profile morphology and to discuss the pedogenic factors at work in the Elbistan basin. Field and laboratory analyses have been used in this work to reveal the specific characteristics of the soils of the Elbistan basin.

Perhaps the most important conclusion which derives from the present research concerns the variety of soil profiles which have developed in the basin and their distribution is shown in Fig. 22 (see in pocket). This pedological variety is of course dependent on variations in the factors of soil formation from place to place.

The precipitation regime is very important for soil development in the Elbistan basin. The basin is characterised by heavy spring showers which are responsible for soil erosion. These relatively heavy spring showers cause rapid run-off and produce Regosols on the steep slopes. In addition to the rainfall regime, temperature variations are also very important.

These climatic variations are most marked as between north and south facing slopes respectively and this aspect is a major factor in variations in soil characteristics within the basin. Temperature and rainfall differences between north and south facing slopes produce quite different types of soil from the same parent material (chapter 5) The rate of biological activity is higher on the warmer and drier south-facing slopes and this is responsible for the low organic matter content of soils developed on these slopes.

It would appear that topography is one of the most important pedogenic factors operating in the Elbistan basin and topography influences soil formation in the following ways:

1. Topography affects the variation of organic matter content and the thickness of surface horizon.

2. Physical and chemical characteristics of soils developed on the north and south facing slopes differ considerably Therefore, aspect is one of the most important topographical effects for soil development in the Elbistan basin. Soils developed on slopes with different aspects but with the same degree of steepness also show considerable variation in their physical and chemical characteristics.

3. The thickness of total profile development is controlled by the topography. Slope especially plays a very important role in profile development. Steep slopes produce thin profile development, on the other hand as slopes become more gentle they produce deeper profiles even when both soils are derived from the same parent material and under similar environmental conditions.

4. The position of the groundwater table has an influence on soil development. The process of gleization is the result of both the topographical differences and the depth of groundwater. The seasonal variation in the level of the groundwater table particularly affects the process of gleization in the basin.

5. The variation of slope affects clay movement and clay accumulation in the soils of the Elbistan basin. The

accumulation of clay content at various levels in the soil profiles is a result of slope differences and the size of cracks which occur during the dry season.

The physical and chemical characteristics of soils in the Elbistan basin also reflect the underlying geological strata. The texture of rock composition affects the texture of soil composition. Granite produces coarse textured soils, gabbro and diorite produce medium textured soils and limestone and calcareous alluvial deposits produce fine textured soils in the Elbistan basin. The character of different limestone parent material affects the soil colour in the basin. Pure crystalline limestones produce reddish soils; on the other hand impure highly weathered Cretaceous limestone produces brownish and yellowish soils in the Elbistan basin.

The density of the vegetation cover is of major importance in affecting the organic matter content of the soils. Aspect is important in this respect as well. On north-facing slopes, except where these are severely eroded, the vegetation is relatively dense, while on south-facing slopes vegetation is rather sparse and produces a low organic matter content. At the same time variations in organic matter content are also affected by the steepness of the slopes.

The relative ages of the Elbistan basin soils have still not been revealed precisely and more research is needed on this topic. However, the terra rossas which occur in the basin may be assumed to be palaeosols developed during the Tertiary and Quaternary. These soils presumably reflect past environmental conditions as indicated by Kubiena (1963).

Experiments based on rates of weathering of different parent materials provide some conclusions about the relative ages of soils in the basin, and these may be summarized as follows:

1. Terra rossa is the oldest soil in the basin.

2. Colluvial deposits occur in the basin and the soils derived from these deposits are assumed to be younger than the terra rossa soils since the latter have been buried by these deposits.

3. Because the rate of weathering is higher in igneous rocks than in limestone, mature soils derived from igneous rocks are younger than mature limestone soils.

4. Alluvial soils are probably the youngest soils in the basin, since alluvial filling is a recent and continuing process.

The effects of man's activities on the basin floor soils is very great and the following conclusions may be drawn.

1. Cultivation has most effect on profile development in the basin floor. The character of surface soil (between 0-60 cm) has been completely changed by ploughing and Ap horizons occur at varying depth. In places, the A and B horizons have been mixed as a result of ploughing. The type of crop grown also affects the thickness of the Ap horizon.

2. Irrigation affects the soil reaction, lime content and the texture of cultivated soils. But sometimes excessive water which has been used carelessly by the farmers produces erosion and salinity in the basin.

The present research has revealed some characteristics of the development of soils under continental and Mediterranean climatic zones as has already been explained (see Chapter 5). The Elbistan basin is in a zone which is transitional between the Mediterranean and the continental climatic zones and thus gives rise to a great variety of soil profiles, several of which are difficult to classify according to existing international classification systems.

The present research shows how the various pedogenic factors operate under present environmental conditions and indicates that even seasonal variation of rainfall, temperature and evaporation can affect the profile development, especially clay movement, during the wet season.

Finally more detailed research is necessary to investigate the age of soils occuring in the basin, an aspect which is believed to be of major importance in the development of soil profiles in the Elbistan basin.

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A P P E N D I X I

DIAGNOSTIC HORIZONS

DEFINITIONS OF DIAGNOSTIC HORIZONS (1)

Melanic A horizon

The melanic A horizon is a surface layer which after the surface 18 cm are mixed, as by plowing, has the following properties :-

1. Soil structure is sufficiently strong that the horizon is not both massive and hard or very hard when dry.
2. Both broken and rubbed soils have colours with a chroma of less than 3.5 when moist, a value darker than 3.5 when moist, and 5.5 when dry; and at least one unit darker than the C (both moist and dry). If only hard rock is present, comparison should be made with the next underlying horizon.
3. The base saturation is more than 50 percent (by the NH_4OAc method).
4. The organic matter content is at least 1 percent (0.58 percent organic carbon) throughout. If the dark surface horizon is less than 18 cm thick in a virgin soil with a solum of less than 45 cm, the organic matter content must be sufficient to give an average of 1 percent to a plow-layer that is 18 cm thick. The upper limit of organic carbon content of the melanic A horizon is the lower limit of the peaty A horizon.
5. The thickness is more than 10 cm if resting directly on hard rock. If the soil contains an argilluvic, natric, spodic or cambic B horizon or a fragipan or duripan, the thickness of the A must be more than one-third of the thickness of the solum where the solum is less than 75 cm thick, and must be more than 25 cm where the solum is more than 75 cm thick.
6. The melanic A horizon has less than 250 parts per million of P_2O_5 soluble in citric acid, or has increasing amounts of P_2O_5 soluble in citric acid below the A horizon. This restriction is used to eliminate a number of plow layers of very old arable soils that have acquired, under cultivation, the properties of the melanic A horizon. (An A horizon meeting the requirements 1 to 5 but having a higher content of P_2O_5 soluble in citric acid than specified here is called an "anthropic A horizon". However, this designation has not been used in the present definitions of soil units as it is felt that such a subdivision could not adequately be shown on a small scale map).

(1) Quoted from FAO Publication Report No. 33 1968.

Pallid A horizon

The pallid A horizon is the one which is too light in colour, too low in organic carbon, or too thin to be melanic, sombric or histic.

In order to separate Ermosols from Zerosols a distinction is made between a weakly and a well developed pallid A horizon :

- A weakly developed pallid A horizon is very low in organic matter.

  The criteria used for organic matter are : a weighted average organic matter content in the surface 40 cm of less than 1 percent (0.58 percent organic carbon) if the weighted average sand/clay ratio for this depth is 1 or less; or 0.28 percent organic matter (0.16 percent organic carbon) if the ratio is 13 or more; for intermediate. Or if the upper 18 cm are mixed colour values are more than 4 when moist and more than 6 when dry or the chroma (moist or dry) is more than 4.

- A well developed pallid A horizon is moderately low in organic matter.

  The content of organic matter and the colours of the horizon are intermediate between the limits set above for the weakly developed pallid A horizon and those defined for the sombric or melanic A horizons.

Argilluvic B horizon

An argilluvic B horizon is one that contains illuvial layer-lattice clays. This horizon forms below an eluvial horizon, but it may be at the surface if the soil has been partially truncated. It has the following properties that may be used for identification in the field :

1. If an E horizon remains, the argilluvic B horizon contains more total and more fine clay than the eluvial horizon, exclusive of differences which may result from a lithological discontinuity, in accordance with the following specifications :
    a. If any part of the E horizon has less than 15 percent total clay in the fine earth (less than 2 mm) fraction, the B horizon must contain at least 3 percent more clay (13 percent versus 10 percent for example).
    b. If the E horizon has more than 15 percent and less than 40 percent total clay in the fine earth fraction, the ratio of the clay in the B horizon to that in the E horizon must be 1.2 or more.
    c. If the E horizon has more than 40 percent total clay in the fine earth fraction, the B horizon must contain at least 8 percent more clay (50 percent versus 42 percent, for example).
2. An argilluvic B horizon should be at least one-tenth the thickness of the sum of all overlying horizons, or more than 15 cm thick if the E and B horizons are thicker than 150 cm. The clay increases required under item 1 must be reached within a vertical distance of 30 cm or less.
3. In soils with massive or single grained structure the argilluvic B horizon should have oriented clays bridging the sand grains and in some pores.
4. If peds are present, an argilluvic B horizon either (a) shows clay skins on some of the vertical and horizontal ped surfaces and in the fine pores, or shows oriented clays in 1 percent or more of the cross section; (b) if the B horizon is clayey with kaolinitic clay and the surface horizon has more than 40 percent clay, there are some clay skins on peds and in pores in the lower part of that horizon having blocky or prismatic structure; or (c) if the B horizon is clayey with 2 to 1 lattice clays, clay skins may be lacking, provided there are evidences

of pressure caused by swelling; the evidences of pressure may be occasional slicken-sides or wavy horizon boundaries in the illuvial horizon, accompanied by uncoated sand or silt grains in the overlying horizon.

5. If a soil shows a lithologic discontinuity between the E horizon and the argilluvic B horizon, or if only a plow layer overlies the argilluvic B horizon, the horizon need show only clay skins in some part, either in some fine pores, or if peds exist, on some vertical and horizontal ped surfaces. Thin sections should show that some part of the horizon has about 1 percent or more of oriented clay bodies.

6. The argilluvic B horizon lacks the set of characteristics which are diagnostic for the natric B horizon.

Cambic B horizon

A cambic B horizon is an altered horizon reaching to at least 25 cm below the soil surface that lacks the dark colours and organic matter that are characteristic of melanic, sombric or histic A horizons, and it has :

1. Textures of loamy very fine sand or finer in the fine earth (less than 2 mm) fraction.

2. Soil structure rather than rock structure.

3. Some weatherable minerals.

4. Evidence of alteration reflected by stronger chromas or redder hues than the underlying horizons (1) and/or evidences of removal of carbonates.

5. Too few evidences of illuviation to meet the requirements of an argilluvic or a spodic B horizon.

6. No cementation or induration and lacks a brittle consistence when moist.

Calxic horizon

The calxic horizon includes horizons of secondary carbonate enrichment that are more than 15 cm thick, have a calcium carbonate equivalent content of more than 15 percent, and have at least 5 percent more calcium carbonate equivalent than the C. If no C is present, and a calxic horizon is not indurated, it is more than 6 inches thick, has a calcium carbonate equivalent content of more than 15 percent, and contains more than 5 percent, by volume, of identifiable secondary carbonates in concretions or soft powdery forms. If a calxic horizon is indurated and rests on hard rock the calxic horizon may be as thin as 3 cm, provided that the product of the thickness in cm multiplied by the percentage of calcium carbonate equivalent is 200 or more.

Gleyic horizon

The gleyic horizon is indicative of pronounced wetness occurring within 50 cm of the surface and is reflected by bluish colours (bluer than 10 Y) that change on exposure to the air, and/or by prominent mottling and dominant moist colours of low chroma in the soil matrix. The colour requirements vary with texture and with the thickness and kind of the A horizon; specific indications to be added to the definitions of the various Gleysols are under study.

A P P E N D I X   II

ANALYTICAL METHODS

Analytical Methods

Mechanical analysis: The analysis was carried out using ~~a modification~~ of the pipette method (Piper 1950) (see p. 222 A)

Organic Carbon: Organic carbon was determined by the wet oxidation method of Walkley and Black (1934). (recovery factor of 77 % for Carbon.)

Nitrogen: Total nitrogen was determined by Kjeldahl digestion with copper sulphate and selenium as catalysts, followed by distillation in the Markham micro-kjeldahl apparatus into boric acid (Markham 1962).

Total Fe_2O_3: Total ferric iron was determined by a rapid method outlined in Cornwall (1958) using thioglycollic acid.

Calcium Carbonate: The calcium carbonate in the smaller than 2mm fraction of the soil was determined by the rapid method outlined by Piper (1950). The calcium carbonate is removed by addition of a known quantity of HCl and the acid then neutralised by addition of NaOH from a burette.

pH: 10 g. of the 2mm fraction soil were mixed in 25 ml of distilled water. The resultant suspension was stood for 30 minutes and stirred periodically during this time. After this time the pH was measured using a pH meter.

Exchangeable cations: Exchangeable cations of Na and K: the samples were extracted with $BaCl_2$ - triethanolamine of pH 8.1 (Jackson 1958). Sodium and Potassium were determined on the flame photometer using propone gas, and calcium and magnesium on the Atomic Absorbtion Spectrometer using an acetylene - air mixture.

PARTICLE SIZE LIMITS FOR MECHANICAL ANALYSIS:

British Standard method has been used for limits of particle sizes.

Coarse sand	(2.0 - 0.6 mm)
Medium sand	(0.6 - 0.2 mm)
Fine sand	(0.2 - 0.06 mm)
Coarse silt	(0.06 - 0.02 mm)
Medium silt	(0.02 - 0.006 mm)
Fine silt	(0.006 - 0.002 mm)
Clay	(less than 0.002 mm)

APPENDIX III

PROFILE DESCRIPTIONS AND ANALYTICAL DATA

PROFILE 1

Location 5.5 km. of east Elbistan town.

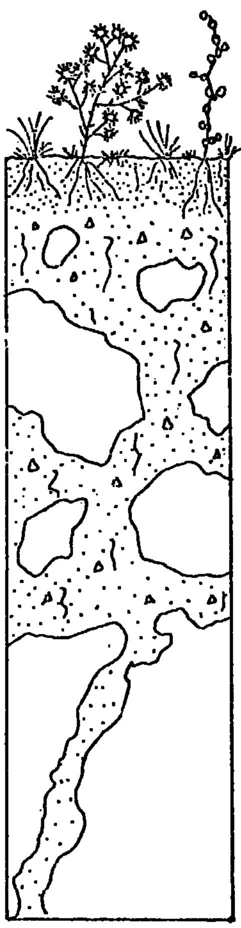
Elevation 1200 m.

Slope 5^0

Parent material grayish - blue crystalline limestone

Land use sparse vegetation grazing land.

Profile Description



0-8 cm 2.5 YR 3/4 (Dark reddish brown); silty loam; crumb structure; large limestone fragments; many small limestone fragments abundant fibreous roots; dry and friable; high faunal activity; wavy boundary.

8-56 cm 2.5 YR 4/6 (Red); silty clay; fine angular blocky structure; moist; large bedrock fragments; no roots; rests sharply on crystalline limestone.

56 + cm Hard crystalline limestone.

PROFILE 1

Analytical Data

$\times 10^{-1}$

Depth CM.	Mechanical Analysis % Coarse SAND	Medium SAND	Fine SAND	SILT	CLAY	pH	% $CaCO_3$	% L.O.I	% Fe_2O_3
0-5	7.6	3.6	2.8	37.4	48.6	7.6	4.0	-	5.7
10-20	4.6	3.0	2.7	38.0	51.6	7.5	3.5	-	5.9
20-30	4.4	2.6	2.8	35.2	54.9	7.5	3.2	-	6.1
30-40	2.7	2.6	2.7	34.0	58.0	7.5	3.5	-	7.7
40-50	2.0	1.5	2.4	35.4	58.7	7.5	3.5	-	9.4

Depth CM.	Cation Exchange Capacity m.e./100 g. Na	K	Mg	Ca	Total	% C	% N	C/N	P_2O_5 m.e./100g.
0-5	1.13	2.56	0.24	25.70	29.63	1.0	0.04	25.0	-
10-20	0.97	1.69	0.21	25.05	27.92	0.5	0.02	25.0	-
20-30	0.97	1.53	0.22	28.70	31.42	0.3	0.01	30.0	-
30-40	1.26	1.47	0.21	28.12	31.66	0.1	-	-	-
40-50	1.26	1.30	0.20	29.12	31.88	0.1	-	-	-

PROFILE 4

Location 4.5km west of Elbistan town

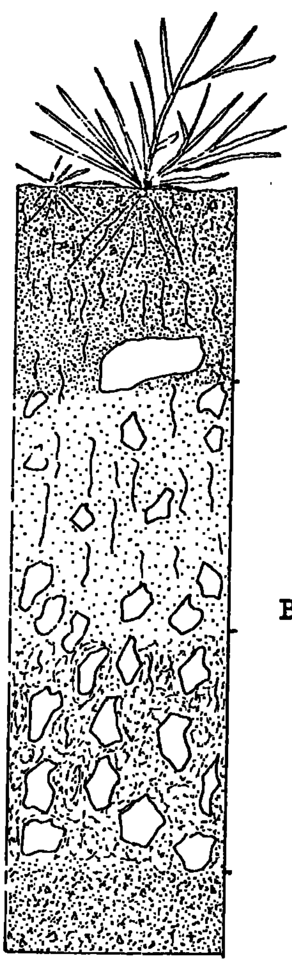
Elevation 1150 m.

Slope 0 °

Parent material Palaeozoic limestone

Land use <u>Artemisia</u> sp., <u>Artiplex cana</u>.

Profile Description



A 0-25 cm 5 YR 3/3 (Dark reddish brown); silty loam; crumb structure; Many small limestone fragments; abundant fibrous roots; high faunal activity; dry and slightly hard; wavy boundary.

B 25-52 cm 5YR 4/4 (Reddish brown); silty clay; small angular blocky structure; abundant fibrous roots; many large limestone fragments; high faunal activity; wavy boundary.

B_{Ca} 52-79 cm 5 YR 4/6 (Yellowish red); silty loam; fine angular blocky structure; many limestone fragments abundant fibrous roots; medium limes pockets and lime concretions; wavy boundary.

B/C 79 + cm 5 YR 5/4 (Reddish brown); silty loam; no roots; no bedrock fragments; high faunal activity; wavy boundary.

PROFILE 4

Analytical Data

Depth CM.	Mechanical Analysis % Coarse SAND	Medium SAND	Fine SAND	SILT	CLAY	pH	% $CaCO_3$	% L.O.I	% Fe_2O_3 ($\times 10^{-1}$)
0-10	~~7.3~~ 5.3	~~7.8~~ 6.8	8.8	~~49.6~~ 52.6	27.5	7.9	38.2	-	7.4
10-20	0.1	7.1	8.3	49.2	28.2	8.0	42.5	-	7.6
30-40	3.4	3.6	7.8	49.5	35.6	7.9	39.5	-	8.8
60-70	4.3	3.8	~~9.8~~ 6.8	~~50.3~~ 53.3	31.7	8.4	55.5	-	6.8
70-80	2.3	5.1	6.9	53.8	31.8	8.3	48.6	-	6.4

Depth CM.	Cation Exchange Capacity m.e./100 g. Na	K	Mg	Ca	Total	% C	% N	C/N	P_2O_5 m.e./100g.
0-10	0.96	2.56	0.98	16.62	20.12	3.5	0.11	31.8	-
~~10-20~~ 20-30	0.86	1.80	0.36	17.05	20.07	2.8	0.08	35.0	-
30-40	0.43	1.92	0.66	18.12	21.13	1.4	0.04	35.0	-
60-70	1.13	1.92	0.38	17.10	20.53	0.8	0.02	40.0	-
70-80	1.63	0.78	0.49	16.12	19.02	0.4	0.01	40.0	-

PROFILE 5

Analytical Data

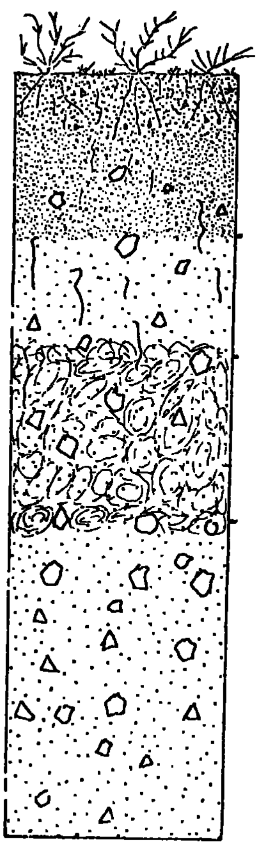
Depth CM.	Mechanical Analysis %					pH	% $CaCO_3$	% L.O.I	% Fe_2O_3 $\times 10^{-1}$
	Coarse SAND	Medium SAND	Fine SAND	SILT	CLAY				
0-10	13.4	8.9	10.5	44.3	22.8	8.4	42.0	-	2.8
10-20	12.5	7.8	7.6	43.6	28.5	8.4	44.7	-	3.4
30-40	10.0	6.9	7.4	45.1	30.6	8.3	39.1	-	3.9
40-50	10.3	6.8	8.0	45.9	29.0	8.7	61.3	-	4.7
60-70	11.3	6.5	6.6	46.4	29.2	8.5	56.4	-	5.6
80-90	11.6	5.9	7.4	45.4	29.6	8.4	52.7	-	4.4

Depth CM.	Cation Exchange Capacity m.e./100 g.					% C	% N	C/N	P_2O_5 m.e./100g.
	Na	K	Mg	Ca	Total				
0-10	2.26	1.94	0.87	11.70	16.77	2.1	0.11	24.5	-
10-20	2.54	1.92	0.85	12.00	17.31	1.6	0.06	26.6	-
30-40	2.94	1.95	0.83	13.62	19.34	1.3	0.04	32.5	-
40-50	1.34	1.21	0.72	13.92	17.19	0.8	0.02	40.0	-
60-70	2.35	1.95	0.81	12.63	17.74	0.2	-	-	-
80-90	2.97	2.05	0.97	11.95	17.94	0.1	-	-	-

PROFILE 5

Location	near Burtu village.
Elevation	1200 m.
Slope	2^{o}
Parent material	Cretaceous limestone
Land use	<u>Festuca Sulcata</u>, <u>Poa bulbosa vivipara</u>.

Profile Description



A 0-22 cm — 10 YR 4/4 (Dark yellowish brown); silty loam; weak medium granular structure; frequent fibrous roots; dry and slightly hard; high faunal activity; few small limestone fragments; wavy boundary.

(B) 22-40 cm — 7.5 YR 5/4 (Brown); sily clay loam; medium angular blocky structure; few small limestone fragments; dry and loose; high faunal activity wavy boundary.

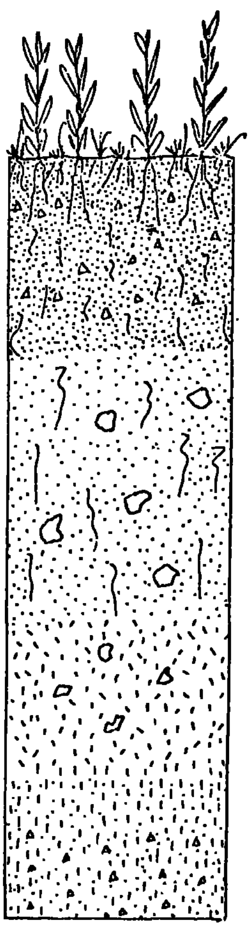
Bca 40-59 cm — lo YR 6/2 (Light brownish gray);silty loam; medium angular blocky structure; occasional fibrous roots; many white (2.5 YR 8/2) calcium carbonate accumulation; few limestone fragments; dry and friable; wavy boundary.

B/C 59 + cm — 10 YR 6/2 (Light brownish gray); silty loam; massive; no roots; occasional limestone fragments; dry and loose; wavy boundary.

PROFILE 6

Location	near Kemal village
Elevation	1150 m.
Slope	4°
Parent material	Diorite
Land use	Wheat cultivation

Profile Description



Ap	0-38 cm	5YR 3/3 (Dark reddish brown); loam; medium granular structure; sligtly moist; many fibrous roots; many small angular diorite fragments; smooth boundary.
B	38-72 cm	5YR 4/4 (reddish brown); silty loam; coarse angular blocky structure; frequent fibreous roots; many small diorite fragments; dry and friable; wavy boundary.
B/C	72-91 cm	5YR 4/6 (yellowish red); silty loam; coarse angular blocky structure; no roots; few bedrock fragments; wavy boundary.
C	91+ cm	5YR 5/6 (yellowish red);silty loam; massive and structureless; no roots; no bedrock fragments; wavy boundary.

PROFILE 6

Analytical Data

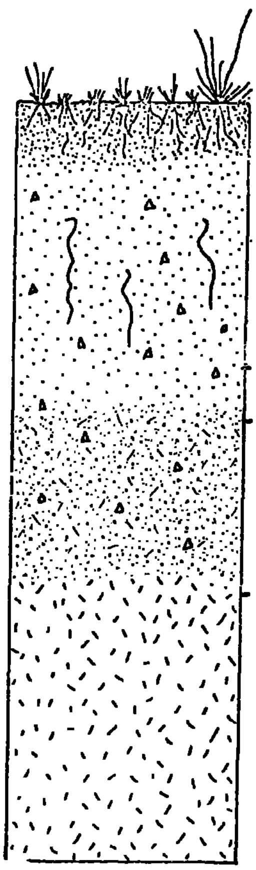
Depth CM.	Mechanical Analysis % Coarse SAND	Medium SAND	Fine SAND	SILT	CLAY	pH	% $CaCO_3$	% L.O.I	% Fe_2O_3 ($\times 10^{-1}$)
0-10	15.9	13.3	16.7	31.4	22.6	7.5	7.9	-	8.4
20-30	16.0	9.4	15.7	34.1	24.8	7.4	8.1	-	8.6
40-50	10.8	13.2	16.5	32.0	27.5	7.5	8.8	-	9.9
60-70	13.0	13.4	16.1	34.1	23.4	7.6	7.4	-	11.5
80-90	15.1	10.9	12.6	36.8	24.6	7.5	6.2	-	14.6
90-100	12.2	10.2	13.4	38.4	25.8	7.5	6.5	-	14.9
100-110	11.7	10.3	14.3	38.8	24.9	7.5	6.6	-	15.2

Depth CM.	Cation Exchange Capacity m.e./100 g. Na	K	Mg	Ca	Total	% C	% N	C/N	P_2O_5 m.e./100g.
0-10	2.84	2.16	0.96	7.45	13.41	3.4	0.11	30.9	-
20-30	2.38	2.18	0.94	9.86	15.36	2.1	0.08	26.25	-
40-50	2.24	2.11	0.98	10.91	16.24	1.8	0.05	36.0	-
60-70	2.41	1.96	0.88	9.11	14.36	1.1	0.02	55.0	-
80-90	2.83	1.94	0.66	9.45	14.88	0.06	0.01	60.0	-
90-100	2.88	1.91	0.69	9.68	15.16	0.04	-	-	-
100-110	2.86	1.82	0.74	9.51	14.93	0.03	-	-	-

PROFILE 7

Location	4 km west ofKamiscik village
Elevation	1350 m
Slope	29°
Parent material	Gabbro
Land use	<u>Quercus</u> <u>ilex</u>, <u>Stipa</u> sp.

Profile Description



A	0-3 cm	10 YR 4/4 (dark yellowish brown);sandy loam; weak granular structure; frequent fi fibrous roots; high faunal activity; few small bedrock fragments; wavy boundary.
(B)	3-18 cm	10 YR 5/4 (yellowish brown); sandy loam; weak small angular blocky structure; occasional fibrous roots; few small bedrock fragments; dry and slightly hard; wavy boundary.
B/C	18-26 cm	10YR 5/4 (yellowish brown);sandy loam; massive and structureless; no roots; few small bedrock fragments; wavy boundary.
C	26+ cm	10 YR 6/4 (light yellowish brown); highly weathered gabbro; massive.

PROFILE 7

Analytical Data

Depth CM.	Mechanical Analysis %					pH	% $CaCO_3$	% L.O.I	% Fe_2O_3 ($\times 10^{-1}$)
	Coarse SAND	Medium SAND	Fine SAND	SILT	CLAY				
0-3	31.3	10.1	7.9	45.6	5.1	7.1	4.0	-	10.6
10-15	36.1	10.1	7.1	44.3	6.4	7.2	5.5	-	10.8
20-25	37.2	7.2	7.1	37.8	7.7	7.3	6.5	-	15.1
25-30	38.8	12.4	12.7	31.9	4.2	7.4	7.9	-	14.3

Depth CM.	Cation Exchange Capacity m.e./100 g.					% C	% N	C/N	P_2O_5 m.e./100g.
	Na	K	Mg	Ca	Total				
0-3	0.65	0.26	0.45	1.57	2.93	0.2	0.01	20.0	-
10-15	0.65	0.14	0.98	1.62	3.39	0.07	-	-	-
20-25	0.60	0.14	0.69	1.00	2.43	0.04	-	-	-
25-30	0.55	0.14	0.92	1.50	3.11	0.01	-	-	-

PROFILE 8

Location near Kamisoik village

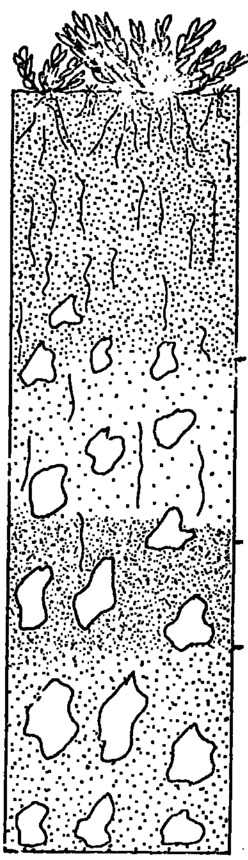
Elevation 12oom

Slope 4°

Parent material Diorite

Land use grazing land.

Profile Description



A 0–18 cm — 10YR 3/3 (dark brown); silty loam; medium granular structure; abundant fibreous roots; few very small bedrock fragments; slightly moist and very friable; high faunal activity; wavy boundary.

B 18–30 cm — 10YR 4/4 (dark yellowish brown); silty loam; medium angular blocky structure; few bedrock fragments; frequent fibreous roots; slightly moist and friable; wavy boundary.

B/C 30–41 cm — 10 YR 4/4 (dark yellowish brown); silty loam; fine angular blocky structure; occasional fibrous roots; many large bedrock fragments; moist and friable; wavy boundary.

C 41+ cm — 10 YR 5/3 (brown); silty loam; massive and structureless; no roots; many bedrock fragments; moist and friable; wavy boundary.

PROFILE 8

Analytical Data

$\times 10^{-1}$

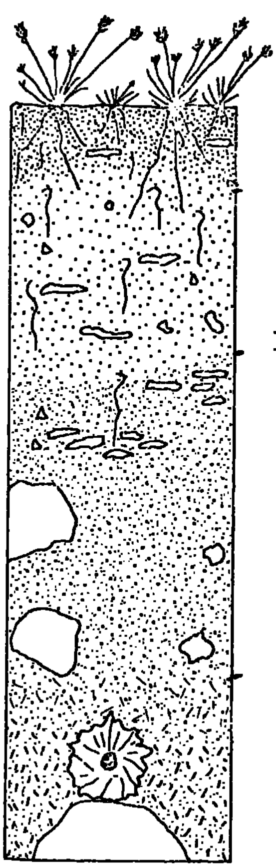
Depth CM.	Mechanical Analysis % Coarse SAND	Medium SAND	Fine SAND	SILT	CLAY	pH	% $CaCO_3$	% L.O.I	% Fe_2O_3
0-10	10.4	7.4	28.1	42.4	11.7	7.3	3.7	-	7.7
20-30	6.1	4.3	26.4	43.4	19.8	7.2	4.0	-	10.8
30-40	5.3	3.6	39.7	46.1	14.3	7.3	4.2	-	11.1
40-50	10.1	5.1	31.5	41.8	11.5	7.4	5.3	-	10.0
50-60	11.2	5.9	31.8	42.4	8.7	7.3	4.4	-	13.1

Depth CM.	Cation Exchange Capacity m.e./100 g. Na	K	Mg	Ca	Total	% C	% N	C/N	P_2O_5 m.e./100 g.
0-10	1.63	0.56	0.45	5.50	8.14	2.8	0.10	28.0	-
20-30	2.35	0.82	0.90	7.12	10.19	1.4	0.07	20.0	-
30-40	1.65	0.32	0.84	5.25	8.06	1.1	0.04	27.5	-
40-50	1.65	0.32	0.90	3.47	6.34	0.6	0.02	30.0	-
50-60	1.73	0.26	0.29	3.21	5.49	0.3	0.01	30.0	-

PROFILE 9

Location	near Cardak town
Elevation	1400 m
Slope	10°
Parent material	Gabbro
Land use	grazing land

Profile Description



A	0–8 cm	10 YR 4/2 (dark grayish brown); loam; crumb structure; frequent fibrous roots; few small bedrock fragments; dry and friable; wavy boundary.
B	8–20 cm	10 YR 4/3 (brown); silty loam; weak angular blocky structure; dry and hard; occasional fibrous roots; few small bedrock fragments; wavy boundary.
B/C	20–34 cm	10 YR 5/3 (brown); sandy loam; fine angular blocky structure; no roots; occasional bedrock fragments; wavy boundary.
C	34+ cm	10 YR 6/2 (light brownish gray); sandy loam; massive structureless; dry;one large wooden root; no bedrock fragments; irregular boundary.

PROFILE 9

Analytical Data

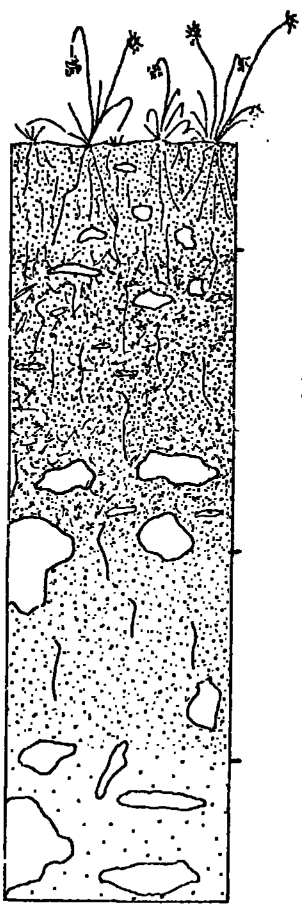
Depth CM.	Mechanical Analysis % Coarse SAND	Medium SAND	Fine SAND	SILT	CLAY	pH	% $CaCO_3$	% L.O.I	% Fe_2O_3 $\times 10^{-1}$
0-5	13.0	9.9	29.1	42.5	5.5	7.2	2.5	-	4.4
10-20	12.6	7.4	28.5	40.0	11.5	7.1	2.1	-	7.3
30-35	14.1	5.9	30.3	41.4	8.3	7.2	2.3	-	8.3
35-40	13.8	6.2	31.2	41.2	7.6	7.2	2.4	-	7.9
40-45	14.6	5.9	33.2	39.7	6.6	7.3	3.0	-	8.1

Depth CM.	Cation Exchange Capacity m.e./100 g. Na	K	Mg	Ca	Total	% C	% N	C/N	P_2O_5 m.e./100g.
0-5	1.47	0.87	0.77	2.35	5.46	1.2	0.05	24.0	-
10-20	1.57	0.81	0.76	3.51	6.85	0.5	0.02	25.0	-
30-35	1.56	0.75	0.71	2.48	5.50	0.2	-	-	-
35-40	1.73	0.68	0.64	1.75	4.80	0.1	-	-	-
40-45	1.51	0.52	0.45	1.71	4.19	-	-	-	-

PROFILE 10

Location	Tülce tepe north face
Elevation	1450m
Slope	7°
Parent material	Gabbro
Land use	<u>Quercus</u> <u>ilex</u>.

Profile Description



A	0-12 cm	7.5YR 3/2 (dark brown); silty loam; medium weak granular structure; abundant fibrous roots; few bedrock fragments; slightly moist and friable; wavy boundary.
B	12-38 cm	5YR 4/3 (reddish brown); silty loam; weak angular blocky structure; frequent fibrous roots; many bedrock fragments; slightly moist and friable; wavy boundary.
B/C	38-49 cm	5YR 4/4 (reddish brown);silty loam; medium angular blocky structure; occasional fibrous roots; few bedrock fragments; slightly moist and friable; irregular boundary.
C	49+ cm	5YR 4/6 (yellowish red); silty loam; massive and structureless; few bedrock fragments; no roots; slightly moist and friable; irregular boundary.

PROFILE 10

Analytical Data

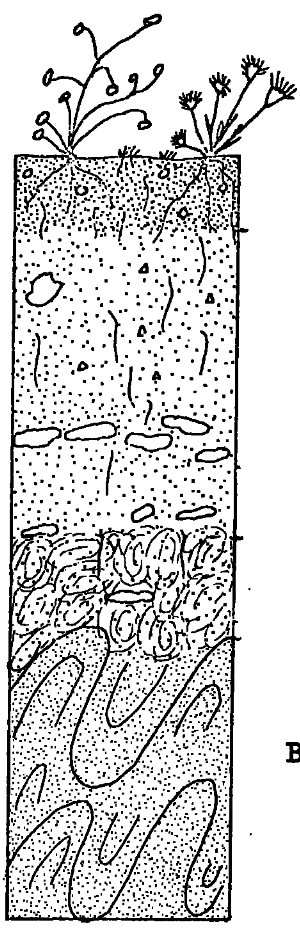
Depth CM.	Mechanical Analysis % Coarse SAND	Medium SAND	Fine SAND	SILT	CLAY	pH	% $CaCO_3$	% L.O.I	% Fe_2O_3 ($\times 10^{-1}$)
0-10	14.3	8.5	26.4	~~42.5~~ 42.7	8.1	7.3	4.0	-	6.6
20-30	10.4	6.7	~~21.5~~ 23.5	40.0	~~16.5~~ 14.5	7.2	3.5	-	9.1
30-40	10.6	7.4	27.4	~~40.9~~ 44.9	13.7	7.3	4.2	-	10.0
45-50	10.9	6.0	28.7	~~41.4~~ 43.8	10.6	7.4	5.1	-	14.6
60-65	12.5	8.2	30.4	~~39.7~~ 42.5	6.4	7.3	4.6	-	16.6

Depth CM.	Cation Exchange Capacity m.e./100 g. Na	K	Mg	Ca	Total	% C	% N	C/N	P_2O_5 m.e./100g.
0-10	1.66	0.54	0.52	4.84	7.56	1.5	0.08	18.7	-
20-30	1.76	0.84	0.62	7.72	10.94	1.1	0.03	36.6	-
30-40	1.54	0.72	0.66	6.14	9.06	0.7	0.01	70.0	-
45-50	1.48	0.68	0.54	4.61	7.31	0.4	-	-	-
60-65	0.86	0.36	0.41	3.16	4.79	0.2	-	-	-

PROFILE 13

Location	near Çiğilhan village.
Elevation	1250 m.
Slope	6°
Parent material	Calc - schist
Land use	Sparse vegetation, grazing land

Profile Description



A	0-8 cm	10YR 4/4 (dark yellowish brown); silty loam; weak granular structure; frequent fibrous roots; occasional small bedrock fragments; dry and hard; high faunal activity; wavy boundary.
(B)	8-31 cm	10 YR 5/4 (yellowish brown); silty loam; weak angular blocky structure; occasional fibrous roots; few bedrock fragments; dry and hard; irregular boundary.
Bca	31-42 cm	10 YR 5/4 (yellowish brown); silty loam; medium angular blocky structure; occasional fibrous roots; many white (2.5YR 8/2); calcium carbonate accumulation; few bedrock fragment; dry and friable; irregular boundary.
B/C	42+ cm	10YR 6/3 (pale brown); silty loam and silt; massive and structureless; no roots; no bedrock fragments; irregular boundary.

PROFILE 13

Analytical Data

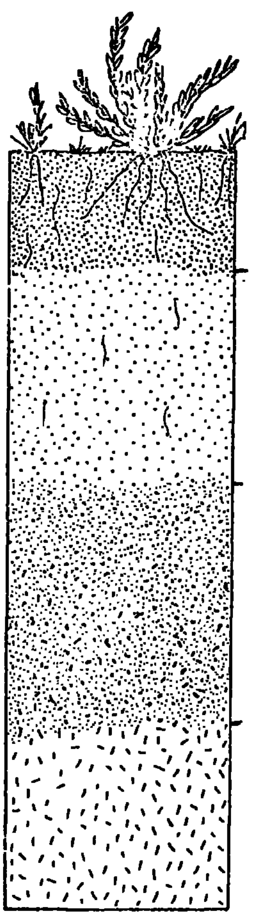
Depth CM.	Mechanical Analysis %					pH	% $CaCO_3$	% L.O.I	% Fe_2O_3 ($\times 10^{-1}$)
	Coarse SAND	Medium SAND	Fine SAND	SILT	CLAY				
0-5	9.6	2.5	5.9	71.6	10.4	8.1	30.1	-	4.9
10-15	6.1	4.9	4.3	72.5	12.2	8.2	31.4	-	3.1
20-30	7.5	2.2	5.3	65.1	19.9	8.1	26.5	-	4.4
35-40	8.1	3.6	3.7	71.3	13.3	8.4	38.0	-	5.1
45-50	9.1	2.7	3.9	68.9	15.4	8.3	30.5	-	5.1

Depth CM.	Cation Exchange Capacity m.e./100 g.					% C	% N	C/N	P_2O_5 m.e./100 g.
	Na	K	Mg	Ca	Total				
0-5	2.38	0.96	0.97	11.47	15.58	0.7	0.02	35.0	-
10-15	2.03	0.69	0.64	11.50	15.86	0.4	0.01	40.0	-
20-30	2.30	1.91	0.95	11.65	16.81	0.2	-	-	-
35-40	2.28	0.89	0.57	12.65	16.49	0.1	-	-	-
45-50	2.26	0.51	0.57	12.25	15.59	-	-	-	-

PROFILE 16

Location	near Kargabükü village;
Elevation	1200 m.
Slope	6°
Parent material	Granite
Land use	*Thymus vulgaris* and *Quercus ilex.*

Profile Description



A	0-5 cm	10YR 5/4 (yellowish brown); sandy loam; weak granular structure; frequent fibrous roots; few small granite fragments; dry and friable; wavy boundary.
(B)	5-12 cm	10YR 5/4 (yellowish brown); sandy loam; weak angular blocky structure; occasional fibrous roots; few granite fragments; dry and friablesmooth boundary.
(B)/C	12-29 cm	7.5YR 5/6 (strong brown); loamy sand; no roots; no bedrock fragments; angular blocky structure; dry and hard; smooth boundary.
C	29+ cm	7.5YR 5/4 (brown);loamy sand; massive and structureless; irregular boundary.

PROFILE 16

Analytical Data

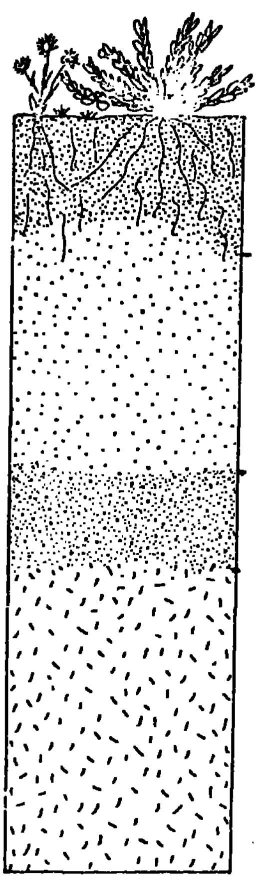
Depth CM.	Mechanical Analysis % Coarse SAND	Medium SAND	Fine SAND	SILT	CLAY	pH	% $CaCO_3$	% L.O.I	% Fe_2O_3 ($\times 10^{-1}$)
0-5	37.6	22.6	15.8	20.9	3.1	7.2	4.0	-	3.8
10-15	31.5	22.2	16.1	25.1	5.0	7.3	4.8	-	4.5
20-25	25.7	20.1	17.7	23.4	13.0	7.2	3.0	-	5.9
30-35	37.1	29.1	13.2	11.9	8.7	7.1	2.1	-	6.1

Depth CM.	Cation Exchange Capacity m.e./100 g. Na	K	Mg	Ca	Total	% C	% N	C/N	P_2O_5 m.e./100g.
0-5	0.41	0.24	0.26	3.32	4.23	0.5	0.02	25.0	-
10-15	0.58	0.24	0.38	3.25	4.45	0.3	0.01	30.0	-
20-25	0.58	0.19	0.42	3.70	4.89	0.1	-	-	-
30-35	0.54	0.41	0.38	3.37	4.70	0.1	-	-	-

PROFILE 17

Location	near Kargabükü village.
Elevation	1250 m.
Slope	8^o
Parent material	Granite
Land use	<u>Stipa juncea</u>, <u>Quercus ilex</u>.

Profile Description



A	0-3 cm	10YR 5/4 (yellowish brown); loamy sand; weak granular structure; no bedrock fragments; frequent fibrous roots; high faunal activity; dry friable; wavy boundary.
(B)	3-16 cm	10YR 5/4 (yellowish brown); loamy sand; weak small angular blocky sturucture; no roots; high faunal activity;wavy boundary.
(B)/C	16-25 cm	7.5YR 5/4 (brown); sandy loam; small angular blocky structure; no roots; dry and friable; wavy boundary.
C	25+ cm	10YR 6/4 (light yellowish brown); sandy loam; irregular boundary.

PROFILE 17

Analytical Data

Depth CM.	Mechanical Analysis % Coarse SAND	Medium SAND	Fine SAND	SILT	CLAY	pH	% $CaCO_3$	% L.O.I	% Fe_2O_3 ($\times 10^{-1}$)
0-3	35.4	24.6	16.3	20.5	3.1	7.2	2.0	-	3.9
5-10	30.9	20.7	19.0	24.9	3.3	7.1	1.5	-	4.2
20-25	30.3	26.3	12.6	23.2	18.5	7.2	2.3	-	5.1
30-35	37.5	23.2	13.9	17.6	6.8	7.1	1.8	-	3.8

Depth CM.	Cation Exchange Capacity m.e./100 g. Na	K	Mg	Ca	Total	% C	% N	C/N	P_2O_5 m.e./100 g.
0-3	0.54	0.24	0.22	2.25	3.25	0.8	0.03	26.0	-
5-10	0.44	0.12	0.15	2.62	3.33	0.4	0.01	40.0	-
20-25	0.53	0.27	0.36	3.52	4.68	0.1	-	-	-
30-35	0.54	0.19	0.34	3.12	4.19	-	-	-	-

PROFILE 18

Location near Kargabükü village.

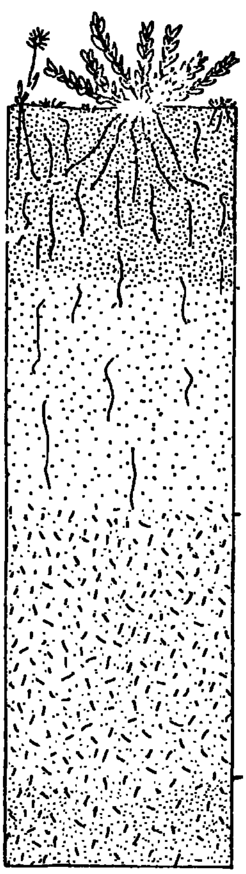
Elevation 1150 m.

Slope 0°

Parent material Granite

Land use <u>Thymus vulgaris</u>, <u>Stipa juncea</u>, <u>Quercus ilex</u>.

Profile Description



A	0-11 cm	7.5YR 5/4 (brown);loamy sand; granular structure; abundant fibrous roots; no bedrock fragments; dry and friable; wavy boundary.
(B)	11-29 cm	5YR 5/4 (reddish brown);loamy sand; fine angular blocky structure; frequent fibrous roots; no bedrock fragments; dry and friable; wavy boundary.
(B)/C	29-44 cm	5YR 5/4 (reddish brown); sandy loam or loam; medium angular blocky structure; no roots; no bedrock fragments; dry and friable; irregular boundary.
C	44+ cm	7.5YR 6/4 (light brown); sandy loam; massive and structureless; irregular boundary.

PROFILE 18

Analytical Data

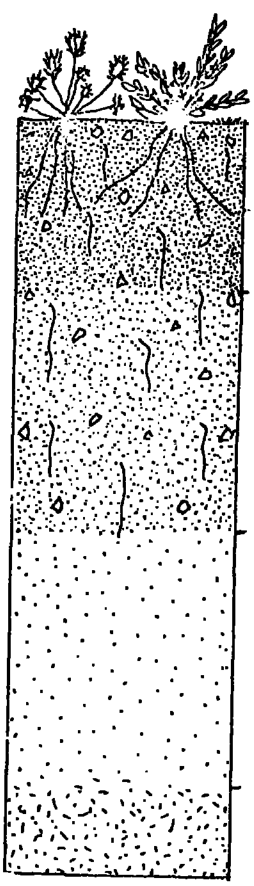
Depth CM.	Mechanical Analysis % Coarse SAND	Medium SAND	Fine SAND	SILT	CLAY	pH	% $CaCO_3$	% L.O.I	% Fe_2O_3 ×10^{-1}
0-10	35.3	18.1	13.9	26.7	5.9	7.2	3.4	-	6.0
15-20	21.2	21.2	16.5	29.5	11.5	7.2	3.6	-	8.7
25-30	19.1	22.8	16.3	25.7	16.1	7.3	4.8	-	9.0
35-45	25.0	21.9	20.9	22.6	9.5	7.1	3.0	-	8.5

Depth CM.	Cation Exchange Capacity m.e./100 g. Na	K	Mg	Ca	Total	% C	% N	C/N	P_2O_5 m.e./100g.
0-10	0.63	0.44	0.16	3.25	4.48	0.8	0.03	26.6	-
15-20	0.54	0.64	0.31	3.80	5.29	0.5	0.02	25.0	-
25-30	0.76	0.71	0.70	4.37	6.54	0.3	0.01	30.0	-
35-40	0.28	0.44	0.29	3.70	4.71	0.1	-	-	-

PROFILE 19

Location	Malacya hills.
Elevation	1250 m.
Slope	5°
Parent material	Diorite
Land use	grazing land.

Profile Description



A	0-16	cm	10YR 3/3 (dark brown); loam; medium granular structure;slightly moist and friable; abundant fibrous roots; many small bedrock fragments; wavy boundary.
B	16-39	cm	10YR 4/3 (Brown); silty loam; weak angular blocky structure; frequent fibrous roots;few small bedrock fragments; slightly moist and friable; wavy boundary.
B/C	39-55	cm	10YR 4/4 (dark yellowish brown); silty loam; weak angular blocky structure; no roots; no bedrock fragments; slightly moist; irregular boundary.
C	55+	cm	10YR 6/4 (light yellowish brown); sandy loam; massive and structureless; irregular boundary.

PROFILE 19

Analytical Data

Depth CM.	Mechanical Analysis %					pH	% $CaCO_3$	% L.O.I	% Fe_2O_3 $\times 10^{-1}$
	Coarse SAND	Medium SAND	Fine SAND	SILT	CLAY				
0-10	13.4	7.2	22.8	46.7	9.9	7.3	5.0	-	11.9
20-30	7.5	6.2	24.6	43.1	18.6	7.2	4.2	-	12.0
40-50	7.4	5.3	29.5	44.4	13.4	7.4	5.9	-	14.5
55-60	8.4	4.1	31.7	46.1	9.7	7.3	4.9	-	16.7
60-65	9.1	4.3	32.5	46.8	7.3	7.2	3.7	-	14.8

Depth CM.	Cation Exchange Capacity m.e./100 g.					% C	% N	C/N	P_2O_5 m.e./100 g.
	Na	K	Mg	Ca	Total				
0-10	1.84	0.36	0.67	4.28	7.15	1.9	0.08	23.7	-
20-30	1.86	0.41	0.69	8.46	11.42	1.4	0.04	35.0	-
40-50	1.75	0.42	0.65	5.89	8.71	0.7	0.02	35.0	-
55-60	1.79	0.39	0.66	3.54	6.38	0.4	0.01	40.0	-
60-65	1.66	0.42	0.61	2.42	5.11	0.1	-	-	-

PROFILE 20

Location Tülce tepe south face.

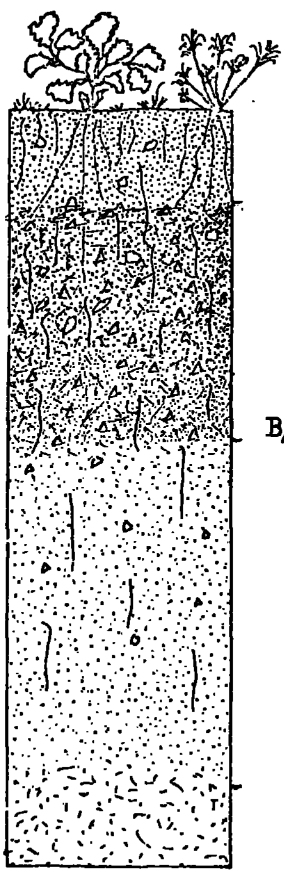
Elevation 1250 m.

Slope 22°

Parent material Gabbro

Land use Sparse vegetation.

Profile Description



A	0–6 cm	10YR 4/4 (dark yellowish brown); sandy loam; weak granular structure; abundant fibrous roots; few small bedrock fragments; wavy boundary.
(B)	6–19 cm	10YR 5/4 (yellowish brown); sandy loam; weak angular blocky structure; frequent fibreous roots; many bedrock fragments; dry and friable; irregular boundary.
B/C	19–30 cm	10YR 5/4 (yellowish brown); sandy loam; weak angular blocky structure; occasional fibrous roots; few small bedrock fragments; dry and slightly hard; irregular boundary.
C	30+ cm	Highly weathered gabbro; massive.

PROFILE 20

Analytical Data

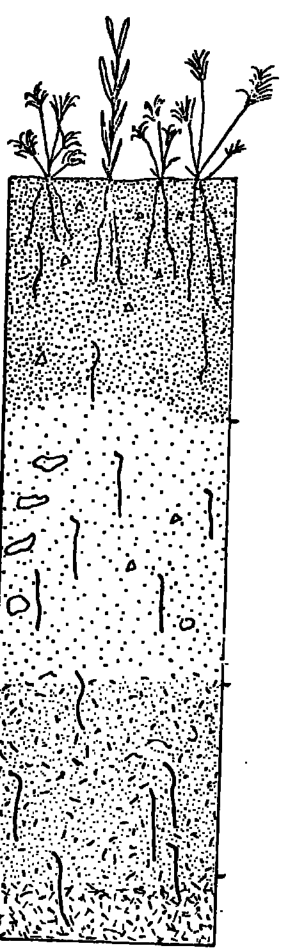
Depth CM.	Mechanical Analysis % Coarse SAND	Medium SAND	Fine SAND	SILT	CLAY	pH	% $CaCO_3$	% L.O.I	% Fe_2O_3 ($\times 10^{-1}$)
0-5	31.4	10.2	8.3	44.9	5.2	7.2	2.0	-	12.6
10-20	33.5	8.2	7.9	43.6	6.8	7.2	3.1	-	13.4
25-30	35.8	7.4	7.6	40.1	9.1	7.4	5.6	-	16.9
30-35	37.1	8.6	6.4	35.7	7.2	7.3	4.4	-	15.7

Depth CM.	Cation Exchange Capacity m.e./100 g. Na	K	Mg	Ca	Total	% C	% N	C/N	P_2O_5 m.e./100 g.
0-5	0.21	0.32	0.25	1.62	2.40	0.3	0.01	30.0	-
10-20	0.44	0.32	0.26	1.07	3.09	0.1	-	-	-
25-30	1.04	0.24	0.41	1.75	3.44	0.04	-	-	-
30-35	1.04	0.19	0.35	1.62	3.20	0.01	-	-	-

PROFILE 21

Location	Malacya hills.
Elevation	1200 m.
Slope	6°
Parent material	Diorite
Land use	grazing land.

Profile Description



A	0-14	cm	10YR 3/3 (dark brown); silty loam; small weak angular blocky structure; frequent fibrous roots; few small bedrock fragments; dry and friable; wavy boundary.
B	14-38	cm	10YR 3/4 (dark yellowish brown); silty loam; weak medium angular blocky structure; occasional fibrous roots; few bedrock fragments; dry and friable; wavy boundary.
B/C	38-58	cm	10YR 5/4 (yellowish brown); sandy loam; weak angular blocky structure; occasional fibrous roots; no bedrock fragments; dry and friable; wavy boundary.
C	58+	cm	10YR 6/4 (light yellowish brown); sandy loam; massive and structureless; smooth boundary.

PROFILE 21

Analytical Data

x 10⁻¹

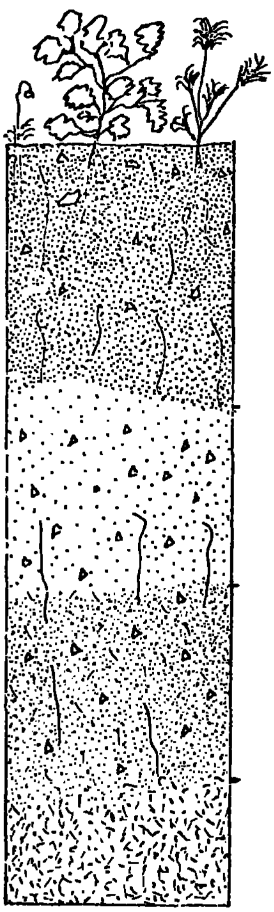
Depth CM.	Mechanical Analysis % Coarse SAND	Medium SAND	Fine SAND	SILT	CLAY	pH	% $CaCO_3$	% L.O.I	% Fe_2O_3 (x 10^{-1})
0-10	12.4	7.1	19.9	42.1	8.5	7.2	3.5	-	12.7
20-30	9.1	5.1	24.1	44.6	17.1	7.3	3.0	-	12.9
40-50	8.2	7.1	28.2	43.4	12.1	7.4	4.1	-	11.7
55-60	9.4	6.4	28.9	45.5	8.8	7.3	3.4	-	16.3
60-70	11.6	5.5	24.3	40.7	7.9	7.2	2.8	-	14.8

Depth CM.	Cation Exchange Capacity m.e./100 g. Na	K	Mg	Ca	Total	% C	% N	C/N	P_2O_5 m.e./100 g.
0-10	1.04	0.34	0.45	4.35	6.18	1.7	0.08	21.2	-
20-30	1.29	0.58	0.56	7.92	10.35	1.1	0.04	27.5	-
40-50	1.12	0.42	0.39	5.21	7.14	0.4	0.01	40.0	-
55-60	1.14	0.28	0.46	3.93	5.81	0.2	-	-	-
60-70	1.31	0.41	0.39	3.11	5.22	0.1	-	-	-

PROFILE 22

Location	Malacya hills.
Elevation	1250 m.
Slope	8^o
Parent material	Diorite
Land use	grazing land.

Profile Description



A	0–10	cm	10YR 3/3 (dark brown); loam; weak granular structure; abundant fibrous roots; many bedrock fragments; slightly moist and friable; wavy boundary.
B	10–24	cm	10YR 4/3 (brown); silty loam; weak angular blocky structure; frequent fibrous roots; few bedrock fragments; slightly moist and friable; wavy boundary.
B/C	24–44	cm	10YR 5/4 (yellowish brown); silty loam; medium angular blocky structure; occasional fibrous roots; few bedrock fragments; dry and friable; wavy boundary.
C	44+	cm	10YR 6/4 (light yellowish brown); sandy loam; massive structureless; no roots; no bedrock fragments; wavy boundary.

PROFILE 22

Analytical Data

Depth CM.	Mechanical Analysis %					pH	% $CaCO_3$	% L.O.I	% Fe_2O_3 ($\times 10^{-1}$)
	Coarse SAND	Medium SAND	Fine SAND	SILT	CLAY				
0-10	12.5	9.4	29.4	41.3	7.4	7.2	2.5	-	12.7
20-25	7.2	4.1	29.8	43.6	15.3	7.2	2.5	-	14.3
30-40	10.1	6.4	31.6	42.2	9.7	7.3	3.6	-	16.0
45.50	10.4	5.2	34.3	44.7	5.4	7.4	4.1	-	17.4
50-55	11.5	5.6	35.1	44.1	3.7	7.2	3.1	-	19.1

Depth CM.	Cation Exchange Capacity m.e./100 g.					% C	% N	C/N	P_2O_5 m.e./100 g.
	Na	K	Mg	Ca	Total				
0-10	0.71	0.38	0.71	4.01	5.81	1.4	0.05	28.0	-
20-25	0.88	0.76	0.94	5.80	8.18	0.7	0.02	35.0	-
30-40	0.82	0.39	0.88	2.37	4.46	0.3	0.01	30.0	-
45-50	0.82	0.32	0.29	1.95	3.38	0.1	-	-	-
50-55	0.60	0.38	0.41	1.50	2.69	0.1	-	-	-

PROFILE 23

Location	2 km. north of Erçene village
Elevation	1200 m.
Slope	8^{o}
Parent material	Calc - schist.
Land use	sparse vegetation, grazing land.

Profile Description

A	0-6 cm	10YR 5/3 (brown); silty loam; weak granular structure; abundant fibrous roots; many bedrock fragments; dry and very friable; high faunal activity;wavy boundary.
(B)	6-19 cm	10YR 5/4 (yellowish brown); silt; weak angular blocky structure; frequent fibrous roots; many bedrock fragments; dry and very friable; high faunal activity; wavy boundary.
B ca	19-25 cm	10YR 6/4 (light yellowish brown);silt; medium angular blocky structure; occasional fibrous roots; many bedrock fragments; many white (2.5YR 8/2) calcium carbonate accumulation; dry and slightly hard; wavy boundary.
C	25+ cm	10YR 7/4 (very pale brown); silt; massive and structureless; no roots; no bedrock fragments; dry and very hard; abrupt boundary.

PROFILE 23

Analytical Data

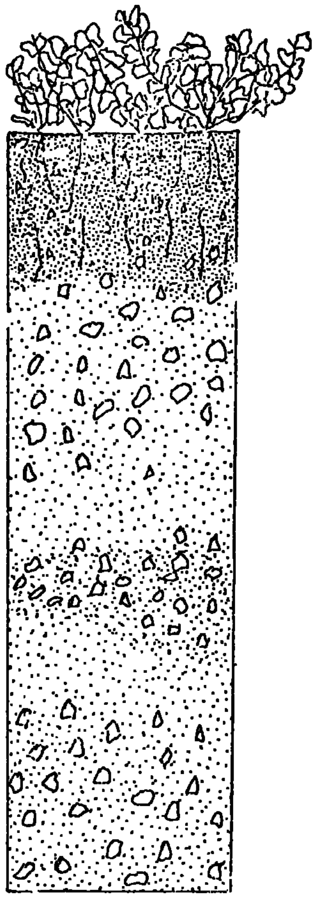
Depth CM.	Mechanical Analysis % Coarse SAND	Medium SAND	Fine SAND	SILT	CLAY	pH	% $CaCO_3$	% L.O.I	% Fe_2O_3 $\times 10^{-1}$
0-5	8.4	2.8	5.4	75.0	9.4	8.1	29.0	-	5.0
10-15	8.7	2.4	4.9	73.8	10.2	8.2	26.5	-	4.2
15-20	8.3	2.1	4.4	67.4	17.7	8.2	25.0	-	5.6
25-30	6.1	3.2	4.7	71.6	13.3	8.4	35.0	-	5.2
30-35	9.5	2.1	5.1	72.4	10.9	8.2	29.4	-	4.3

Depth CM.	Cation Exchange Capacity m.e./100 g. Na	K	Mg	Ca	Total	% C	% N	C/N	P_2O_5 m.e./100 g.
0-5	2.41	0.96	0.50	10.25	14.12	0.6	0.02	30.0	-
10-15	2.97	0.71	0.35	10.50	14.53	0.3	0.01	30.0	-
15-20	2.86	0.67	0.85	11.25	15.63	0.1	-	-	-
25-30	2.08	0.51	0.66	11.70	14.95	-	-	-	-
30-35	2.86	0.41	0.54	11.12	14.93	-	-	-	-

PROFILE 27

Location	near Karaelbistan village.
Elevation	1150 m.
Slope	1^{o}
Parent material	Calcareous alluvial deposits
Land use	green - beans cultivation.

Profile Description



0-46 cm 5YR 3/3 (dark reddish brown); silty clay; medium angular blocky structure; abundant fibrous roots; many small limestone fragments; slightly moist and friable; wavy boundary.

46-108 cm 5YR 4/4 (reddish brown); silty clay; no roots; many limestone fragments; slight calcium carbonate accumulation below 100 cm; moist and friable; smooth boundary.

108+ cm 5YR 4/4 (reddish brown); silty clay; massive structureless; no roots; many small limestone fragments; moist and slightly sticky; smooth boundary.

PROFILE 27

Analytical Data

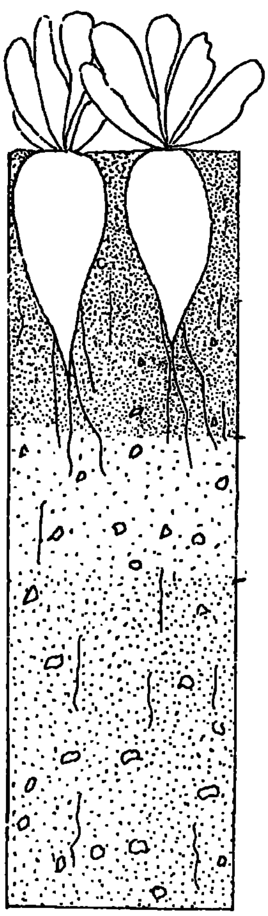
Depth CM.	Mechanical Analysis % Coarse SAND	Medium SAND	Fine SAND	SILT	CLAY	pH	% $CaCO_3$	% L.O.I	% Fe_2O_3 ($\times 10^{-1}$)
0-10	10.7	8.4	11.2	37.2	32.5	7.5	32.4	-	5.8
20-30	7.4	5.4	10.5	40.1	36.6	7.6	29.6	-	6.1
30-40	7.6	6.5	6.0	38.5	41.4	7.9	31.5	-	6.3
60-70	5.2	3.5	4.1	36.8	50.4	8.0	35.5	-	7.6
80-90	3.2	2.4	4.3	38.6	51.5	8.0	35.5	-	7.4
110-120	5.2	2.2	2.4	37.9	52.3	7.1	41.5	-	7.8
130-140	3.3	3.2	3.2	39.7	50.6	7.9	36.8	-	8.1
140-150	4.0	2.4	3.1	40.1	50.4	7.8	33.4	-	8.1

Depth CM.	Cation Exchange Capacity m.e./100 g. Na	K	Mg	Ca	Total	% C	% N	C/N	P_2O_5 m.e./100 g.
0-10	1.44	2.35	0.86	13.47	18.12	4.5	0.28	16.0	-
20-30	1.46	2.31	0.84	15.80	20.41	4.1	0.21	19.5	-
30-40	1.36	1.86	0.88	18.36	22.46	2.9	0.12	24.2	-
60-70	1.48	1.81	0.94	24.11	28.34	1.8	0.08	22.5	-
80-90	1.57	1.72	0.93	25.21	29.43	1.4	0.04	35.0	-
110-120	1.61	1.66	0.94	25.87	30.08	0.9	0.02	45.0	-
130-140	1.66	1.54	0.96	24.95	29.11	0.6	0.01	60.0	-
140-150	1.62	1.38	0.92	24.24	28.16	0.4	-	-	-

PROFILE 28

Location	near Akveran village.
Elevation	1150 m.
Slope	0°
Parent material	Calcareous alluvial deposits.
Land use	Sugar - beet cultivation.

Profile Description



0-53	cm	10YR 4/2 (dark grayish brown); silty clay loam; coarse granular structure; no fragments; common earthworms; moist and slightly sticky; wavy boundary.
53-81	cm	10YR 4/4 (dark yellowish brown); clay loam; occasional fibrous roots; coarse angular blocky structure; few limestone fragments; common earthworms; moist and sticky; wavy boundary.
81+	cm	10YR 5/2 (grayish brown); silty loam; massive and structureless; occasional fibrous roots; few small limestone fragments; moist and sticky; irregular boundary.

PROFILE 28

Analytical Data

x 10⁻¹

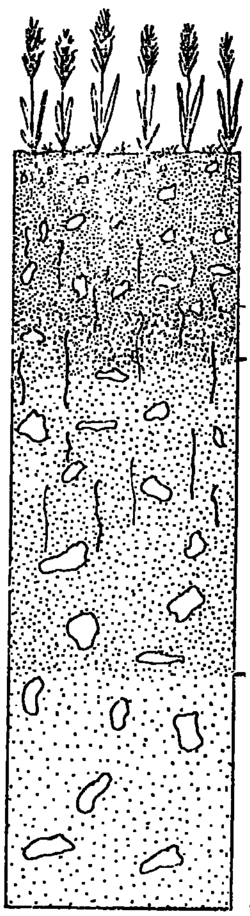
Depth CM.	Mechanical Analysis % Coarse SAND	Medium SAND	Fine SAND	SILT	CLAY	pH	% $CaCO_3$	% L.O.I	% Fe_2O_3
0-10	11.5	5.6	7.0	41.6	34.3	7.7	24.5	-	5.4
20-30	10.5	5.4	8.2	42.7	33.2	7.7	25.6	-	6.8
40-50	8.1	4.5	6.6	44.1	36.8	7.8	27.9	-	8.1
60-70	6.4	4.2	4.8	45.9	39.7	7.9	28.8	-	8.8
70-80	6.2	2.1	5.4	49.1	38.2	8.0	32.1	-	9.4
80-90	6.1	2.4	4.5	46.3	40.7	8.1	33.7	-	7.1
90-100	6.2	4.4	5.7	47.1	36.6	8.2	36.8	-	6.8
100-110	6.4	2.2	4.4	45.3	41.7	8.1	35.2	-	9.4

Depth CM.	Cation Exchange Capacity m.e./100 g. Na	K	Mg	Ca	Total	% C	% N	C/N	P_2O_5 m.e./100 g.
0-10	1.73	4.26	0.47	11.66	18.12	5.1	0.28	18.2	-
20-30	1.76	4.12	0.43	11.60	17.91	4.3	0.21	22.4	-
40-50	1.84	3.26	0.61	13.55	19.26	3.4	0.13	26.1	-
60-70	1.96	3.11	0.66	15.23	21.06	1.9	0.08	23.8	-
70-80	2.24	2.61	0.54	15.08	20.43	1.6	0.06	26.7	-
80-90	2.16	1.94	0.71	16.60	22.41	1.1	0.02	55.0	-
90-100	1.76	1.72	0.38	14.30	18.16	0.7	-	-	-
100-110	2.38	1.86	0.77	18.15	23.16	0.5	-	-	-

PROFILE 29

Location	near Güvercinlik village.
Elevation	1150 m.
Slope	3^0
Parent material	Calcareous alluvial deposits.
Land use	Wheat cultivation.

Profile Description



0–36 cm 5YR 3/3 (dark reddish brown); silty loam; medium granular structure; abundant fibrous roots; many small limestone fragments; high faunal activity ants common; dry and friable; wavy boundary.

36–59 cm 5YR 4/3 (reddish brown); silty loam: fine angular blocky structure; frequent fibrous roots; many limestone fragments; occasional lime pockets; high faunal activity; dry and friable; wavy boundary.

59+ cm 5YR 5/4 (reddish brown); silty clay loam; massive structureless; no roots ; occasional limestone fragments; slightly moist and sticky; irregular boundary.

PROFILE 29

Analytical Data

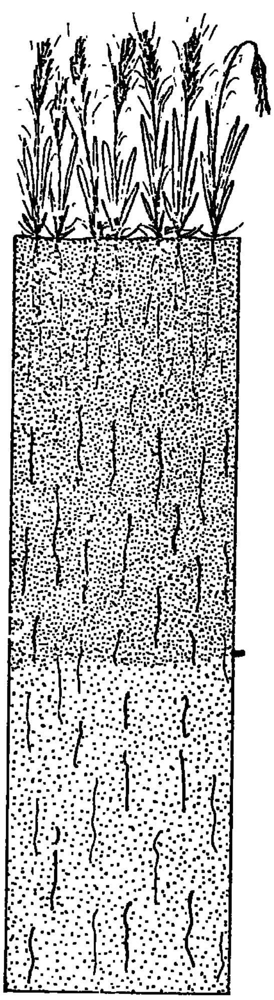
Depth CM.	Mechanical Analysis % Coarse SAND	Medium SAND	Fine SAND	SILT	CLAY	pH	% $CaCO_3$	% L.O.I	% Fe_2O_3 ($\times 10^{-1}$)
0-10	4.8	5.2	5.4	57.9	26.7	8.2	28.0	-	4.6
20-30	5.7	5.7	5.7	52.6	30.2	8.2	24.5	-	5.1
40-50	4.3	3.1	5.1	59.1	29.4	8.3	42.5	-	7.9
50-60	4.0	3.9	5.6	54.8	31.7	8.4	42.6	-	6.7
60-70	4.1	3.6	5.1	54.6	32.6	8.4	41.5	-	6.6
70-80	4.1	3.2	4.9	55.1	32.7	8.4	41.1	-	6.1

Depth CM.	Cation Exchange Capacity m.e./100 g. Na	K	Mg	Ca	Total	% C	% N	C/N	P_2O_5 m.e./100g.
0-10	1.78	1.73	0.17	8.17	11.85	2.4	0.08	30.0	-
20-30	2.13	1.47	0.18	8.87	12.65	1.3	0.04	32.5	-
40-50	2.21	0.64	0.16	9.75	12.76	1.1	0.03	36.6	-
50-60	2.58	0.60	0.15	9.87	13.20	0.8	0.02	40.0	-
60-70	2.38	0.61	0.16	10.11	13.26	0.3	-	-	-
70-80	2.46	0.66	0.18	10.12	13.42	0.2	-	-	-

PROFILE 30

Location	near Güvercinlik village.
Elevation	1150 m.
Slope	0°
Parent material	Calcareous alluvial deposits.
Land use	Rice cultivation.

Profile Description



0–53 cm 10YR 4/2 (dark grayish brown); silty clay; medium granular structure; abundant fibrous roots; no fragments;moist and sticky; wavy boundary.

53–80 cm 10YR 5/2 (grayish brown); silty clay loam; small angular blocky structure; frequent fibrous roots; brownish yellow (10YR 6/6) mottles; moist and sticky; wavy boundary.

80+ cm 10YR 5/2 (grayish brown); silty loam; massive structurelees; no roots; many brownish yellow (10YR 6/6) mottles; moist and sticky; irregular boundary.

PROFILE 30

Analytical Data

Depth CM.	Mechanical Analysis % Coarse SAND	Medium SAND	Fine SAND	SILT	CLAY	pH	% $CaCO_3$	% L.O.I	% Fe_2O_3 $\times 10^{-1}$
0-10	12.5	2.4	6.5	30.5	48.2	7.6	15.1	-	6.9
20-30	11.5	4.1	6.4	31.4	46.6	7.7	16.8	-	5.9
40-50	6.4	5.8	8.1	35.6	44.1	7.8	18.4	-	6.4
50-60	5.2	5.6	8.9	33.8	46.3	8.0	20.2	-	7.8
60-70	6.1	4.3	9.6	31.4	48.6	8.1	22.5	-	12.1
70-80	4.8	5.4	8.1	30.2	51.5	8.2	25.8	-	14.6

Depth CM.	Cation Exchange Capacity m.e./100 g. Na	K	Mg	Ca	Total	% C	% N	C/N	P_2O_5 m.e./100 g.
0-10	2.14	4.74	0.76	18.52	26.16	6.2	0.24	25.8	-
20-30	2.16	4.56	0.81	16.73	24.26	5.1	0.16	31.9	-
40-50	2.24	4.18	0.84	15.92	23.18	2.9	0.08	36.3	-
50-60	2.38	3.11	0.77	19.12	25.38	1.1	0.04	27.5	-
60-70	3.41	2.18	0.86	19.41	25.86	0.5	0.01	50.0	-
70-80	3.46	1.36	0.88	21.41	27.11	0.2	-	-	-

PROFILE 32

Location near Iğde village.

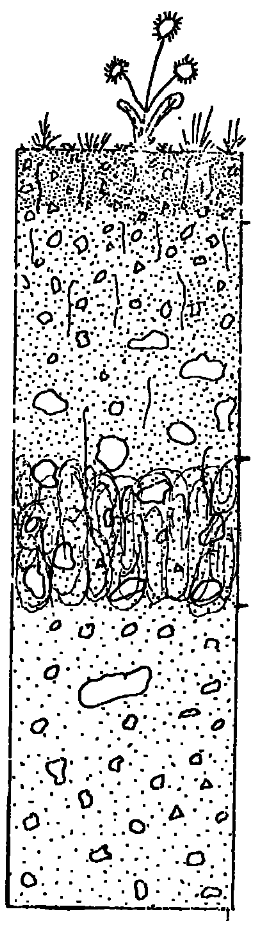
Elevation 1250 m.

Slope 6°

Parent material Palaeozoic limestone.

Land use <u>Artemisia terrae albae</u>, <u>Artiplex cana</u>.

Profile Description



A 0-9 cm 5YR 3/3 (dark reddish brown); silty loam; medium granular structure; abundant fibrous roots; many limestone fragments; dry and slightly hard; wavy boundary.

B 9-39 cm 5YR 5/4 (reddish brown); silty loam; weak prismatic and medium angular blocky structure; frequent fibrous roots; many limestone fragments; dry and slightly hard; wavy boundary;

Bca 39-59 cm 7.5YR 5/4 (brown); silty loam; coarse angular blocky structure; many small powdery lime pockets; no roots; many limestone fragments; dry and friable; wavy boundary.

B/C 59+ cm 7.5YR 5/6 (strong brown); silty loam; massive and structureless; no roots; many limestone fragments; dry friable; wavy boundary.

PROFILE 32

Analytical Data

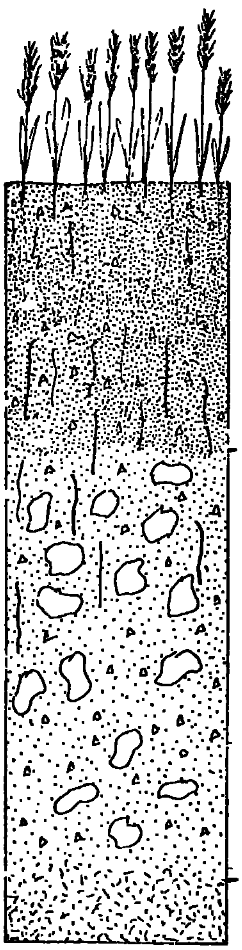
Depth CM.	Mechanical Analysis % Coarse SAND	Medium SAND	Fine SAND	SILT	CLAY	pH	% $CaCO_3$	% L.O.I	% Fe_2O_3 $\times 10^{-1}$
0-5	14.0	16.6	15.3	42.2	14.9	7.9	36.6	-	7.7
10-20	14.3	14.6	13.4	42.6	18.1	8.0	41.8	-	9.4
20-30	11.5	10.0	14.8	43.6	25.1	8.1	37.4	-	8.1
50-60	13.4	11.2	12.7	46.3	16.4	8.4	55.1	-	8.8
60-65	13.5	10.1	12.8	46.1	17.5	8.2	51.3	-	6.7

Depth CM.	Cation Exchange Capacity m.e./100 g. Na	K	Mg	Ca	Total	% C	% N	C/N	P_2O_5 m.e./100 g.
0-5	1.39	1.21	0.47	11.17	14.24	1.5	0.07	21.4	-
10-20	1.39	1.12	0.16	11.50	14.17	1.1	0.04	27.5	-
20-30	1.26	1.13	0.26	12.90	15.55	0.7	0.02	35.0	-
50-60	1.19	1.12	0.17	12.00	14.48	0.3	0.01	30.0	-
60-65	1.63	2.34	0.30	10.62	14.89	0.1	-	-	-

PROFILE 33

Location	near Yarbasi village.
Elevation	1140 m.
Slope	3°
Parent material	Calcareous alluvial deposits.
Land use	Wheat cultivation.

Profile Description



0–38	cm.	10YR 4/3 (brown); silty loam; weak angular blocky structure;abundant fibrous roots; many small limestone fragments; dry and friable; irregular boundary.
38–80	cm	10YR 5/2 (grayish brown); silty loam small angular blocky structure;frequent fibrous roots; many limestone fragments; dry friable; wavy boundary.
80+	cm	10YR 5/2 (grayish brown); silty loam; massive and structureless; no roots; many limestone fragments; dry and slightly hard; wavy boundary.

PROFILE 33

Analytical Data

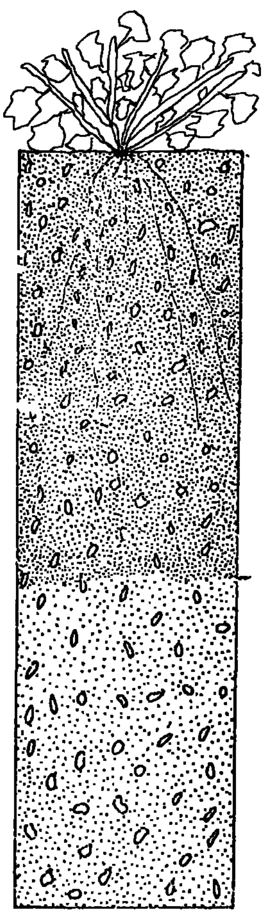
Depth CM.	Mechanical Analysis % Coarse SAND	Medium SAND	Fine SAND	SILT	CLAY	pH	% $CaCO_3$	% L.O.I	% Fe_2O_3 $\times 10^{-1}$
0-10	5.5	5.5	6.4	55.1	25.5	8.3	31.7	-	4.3
20-30	5.1	3.7	4.0	60.5	26.5	8.4	36.4	-	4.3
40-50	2.1	3.9	7.9	55.5	29.6	8.5	48.5	-	4.0
50-60	2.3	5.3	8.6	60.2	27.6	8.6	51.4	-	3.1
70-80	2.2	4.3	8.4	59.8	25.3	8.6	53.7	-	3.9
80-90	2.2	4.6	8.3	61.4	23.5	8.7	59.6	-	4.6

Depth CM.	Cation Exchange Capacity m.e./100 g. Na	K	Mg	Ca	Total	% C	% N	C/N	P_2O_5 m.e./100 g.
0-10	1.19	2.65	0.57	15.25	19.66	1.6	0.09	17.8	-
20-30	2.04	2.16	0.93	16.30	21.43	1.4	0.06	23.3	-
40-50	2.21	2.08	0.95	24.50	29.74	1.1	0.04	27.5	-
50-60	1.26	2.33	0.93	27.00	31.52	0.7	0.02	35.0	-
70-80	1.28	2.36	0.82	27.41	31.87	0.4	0.01	40.0	-
80-90	1.24	2.41	0.71	28.10	32.46	0.2	-	-	-

PROFILE 34

Location	near Kargabükü village.
Elevation	1150 m.
Slope	3°
Parent material	Granite .
Land use	Vineyard cultivation

Profile Description



0-34 cm 10YR 4/4 (dark yellowish brown); loamy sand; small granular structure; frequent roots; many small bedrock fragments; dry and friable; wavy boundary.

34-56 cm 10YR 5/4 (yellowish brown); loamy sand; small angular blocky structure; no roots; many small bedrock fragments; dry and friable; wavy boundary.

56+ cm 10YR 5/4 (yellowish brown); sandy loam; structureless; dry and friable; wavy boundary.

PROFILE 34

Analytical Data

Depth CM.	Mechanical Analysis % Coarse SAND	Medium SAND	Fine SAND	SILT	CLAY	pH	% $CaCO_3$	% L.O.I	% Fe_2O_3 x10[-1]
0-10	22.1	10.3	20.8	28.4	18.4	7.1	2.4	-	5.4
20-30	21.7	11.7	21.4	26.7	18.5	7.1	2.6	-	6.8
30-40	21.8	10.7	22.3	29.4	15.8	7.1	2.5	-	7.2
40-50	21.6	16.2	23.1	26.5	12.6	7.2	2.9	-	8.6
50-60	24.4	17.8	23.8	21.7	12.3	7.2	3.1	-	9.4
60-70	25.8	16.4	25.4	20.9	11.5	7.2	3.8	-	9.1

Depth CM.	Cation Exchange Capacity m.e./100 g. Na	K	Mg	Ca	Total	% C	% N	C/N	P_2O_5 m.e./100g.
0-10	1.26	0.96	0.86	3.06	6.14	1.2	0.04	30.0	-
20-30	1.24	0.93	0.84	3.70	6.71	0.8	0.02	40.0	-
30-40	1.28	0.91	0.76	2.87	5.82	0.5	0.01	50.0	-
40-50	1.31	0.88	0.74	2.68	5.61	0.3	-	-	-
50-60	1.31	0.81	0.81	2.39	5.32	0.1	-	-	-
60-70	1.38	0.77	0.81	2.25	5.21	-	-	-	-

PROFILE 35

Location near Deveboynu village.

Elevation 1250 m.

Slope 2^{o}

Parent material Gabbro.

Land use Wheat cultivation.

Profile Description

0-35 cm 10YR 3/3 (dark brown); silty loam; medium granular structure; abundant fibrous roots; many small bedrock fragments; dry and friable; wavy boundary.

35-61 cm 10YR 3/4 (dark yellowish brown); silty loam; medium angular blocky structure; frequent fibrous roots; many small bedrock fragments; dry and friable wavy boundary.

61+ cm 10YR 5/3 (brown); silty loam; structureless; occasional fibrous roots; few small bedrock fragments; dry and friable; wavy boundary.

PROFILE 35

Analytical Data

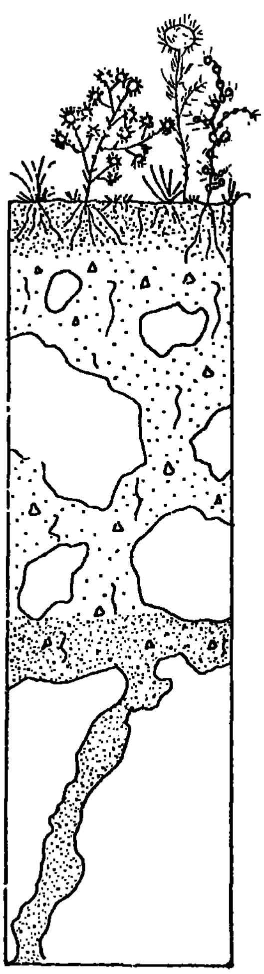
Depth CM.	Mechanical Analysis % Coarse SAND	Medium SAND	Fine SAND	SILT	CLAY	pH	% $CaCO_3$	% L.O.I	% Fe_2O_3 $\times 10^{-1}$
0–10	7.2	10.6	22.4	43.4	16.4	7.3	1.5	-	11.4
20–30	7.1	6.9	24.6	43.8	17.6	7.5	2.5	-	11.6
40–50	6.8	4.8	26.1	46.1	16.2	7.4	1.5	-	11.8
50–60	6.2	3.1	27.8	45.6	14.3	7.4	1.6	-	12.3
70–80	5.4	11.6	28.1	42.8	12.1	7.4	1.4	-	13.1
80–90	5.6	9.6	28.8	44.4	11.6	7.3	1.1	-	13.6

Depth CM.	Cation Exchange Capacity m.e./100 g. Na	K	Mg	Ca	Total	% C	% N	C/N	P_2O_5 m.e./100g.
0–10	0.82	0.78	0.46	5.57	7.63	1.6	0.08	20.0	-
20–30	0.65	0.65	0.49	6.57	8.36	1.3	0.06	21.7	-
40–50	0.65	0.59	0.51	6.47	8.22	0.9	0.04	22.5	-
50–60	0.74	0.61	0.54	6.51	8.26	0.6	0.02	30.0	-
70–80	0.71	0.66	0.61	6.76	8.65	0.3	-	-	-
80–90	0.76	0.69	0.63	6.79	8.87	0.1	-	-	-

PROFILE 36

Location	4.5 km east of Elbistam Town.
Elevation	1250 m.
Slope	2°
Parent material	Grayish blue crystalline limestone.
Land use	Some short grasses and scattered oak trees.

Profile Description



0–6 cm 5YR 4/4 (reddish brown); silty clay; weak granular structure; abundant fibrous roots; few very small limestone fragments; dry and slightly hard; high faunal activity; wavy boundary.

6–51 cm 2.5YR 5/8 (red); clay; medium blocky structure; occasional fibrous roots; clay skins very common; dry and very hard; few small limestone fragments; rests sharply on crystalline limestone.

51+ cm. hard crystalline limestone.

PROFILE 36

Analytical Data

Depth CM.	Mechanical Analysis % Coarse SAND	Medium SAND	Fine SAND	SILT	CLAY	pH	% $CaCO_3$	% L.O.I	% Fe_2O_3 ($\times 10^{-1}$)
0-5	4.2	4.3	4.0	~~35.6~~ 37.6	~~52.9~~ 50.2	7.6	4.0	-	6.0
10-20	7.5	2.7	2.4	33.3	54.1	7.5	3.2	-	7.0
30-40	4.6	3.7	2.6	~~32.3~~ 29.3	~~56.8~~ 59.8	7.5	3.6	-	8.1
~~30.60~~ 40.50	4.2	4.1	2.5	~~32.2~~ 29.4	~~57.0~~ 59.9	7.4	3.6	-	9.6

Depth CM.	Cation Exchange Capacity m.e./100 g. Na	K	Mg	Ca	Total	% C	% N	C/N	P_2O_5 m.e./100 g.
0-5	1.08	0.70	1.38	30.87	34.03	1.5	0.08	18.7	-
10-20	1.78	0.81	1.98	32.27	36.84	0.6	0.04	15.0	-
~~20-30~~ 30-40	0.86	0.83	1.50	33.12	36.31	0.4	0.02	20.0	-
~~30-40~~ 40-50	0.85	0.90	1.61	36.58	39.94	0.2	0.01	20.0	-

PROFILE 37

Location near Kotüre village.

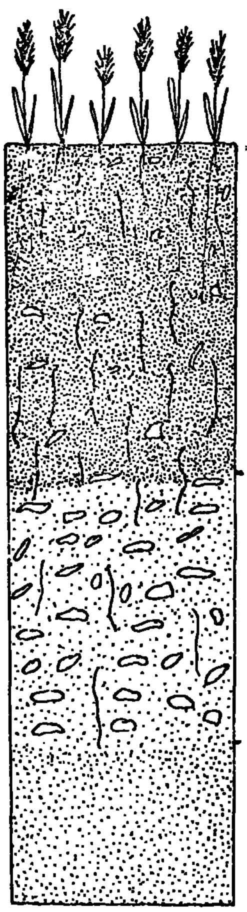
Elevation 1250 m.

Slope 4^{o}

Parent material Non-calcare0us alluvial deposits.

Land use Wheat cultivation.

Profile Description



0-46 cm 5YR 3/3 (dark reddish brown); silty loam; medium granular structure; abundant fibreous roots; few small bedrock fragments; dry and friable; wavy boundary.

46-72 cm 5YR 4/4 (reddish brown); silty loam; medium angular blocky structure; occasional fibrous roots; many bedrock fragments; dry and slightly hard; wavy boundary.

72+ cm 5YR 4/4 (reddish brown); silty loam; structureless; no roots; no bedrock fragments; dry and slightly hard; wavy boundary.

PROFILE 37

Analytical Data

Depth CM.	Mechanical Analysis % Coarse SAND	Medium SAND	Fine SAND	SILT	CLAY	pH	% $CaCO_3$	% L.O.I	% Fe_2O_3 $\times 10^{-1}$
0-10	8.5	7.6	28.1	40.1	15.7	7.4	4.9	-	14.6
20-30	8.9	7.9	28.9	34.8	19.5	7.5	6.0	-	15.7
50-60	7.1	7.6	28.0	32.6	14.7	7.6	6.6	-	19.4
60-70	4.1	4.3	35.8	41.4	14.4	7.4	5.2	-	21.4
75-85	4.2	4.6	34.6	42.8	13.8	7.3	4.6	-	26.2
85-95	4.8	4.2	36.1	42.1	12.8	7.3	4.1	-	26.4

Depth CM.	Cation Exchange Capacity m.e./100 g. Na	K	Mg	Ca	Total	% C	% N	C/N	P_2O_5 m.e./100 g.
0-10	1.08	1.85	0.20	4.45	7.58	1.4	0.06	23.3	-
20-30	1.26	1.60	0.18	5.87	8.91	1.3	0.04	32.5	-
50-60	0.95	1.51	0.13	5.55	8.14	0.7	0.02	35.0	-
60-70	1.52	0.70	0.15	6.12	8.49	0.5	0.01	50.0	-
75-85	1.56	0.61	0.18	5.84	8.19	0.3	-	-	-
85-95	1.61	0.58	0.16	5.96	8.31	0.1	-	-	-

PROFILE 38

Location near Poskoflu village.

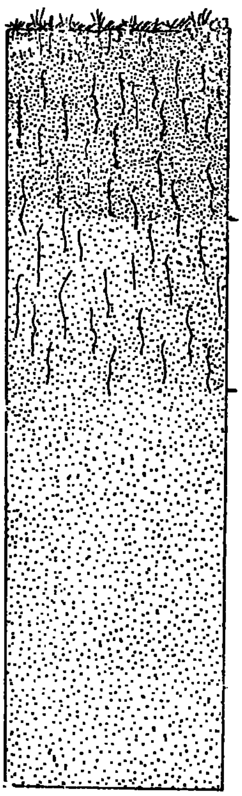
Elevation 1150 m.

Slope 1^{o}

Parent material Non-calcareous alluvial deposits.

Land use grazing land.

Profile Description



A	0-26	cm	10YR 3/3 (dark brown); silty loam; medium granular structure;abundant fibrous roots; no bedrock fragments; slightly moist and friable;wavy boundary.
(B)/C	26-59	cm	10YR 3/4 (dark yellowish brown); silty loam; frequent fibrous roots; slightly moist and friable; wavy boundary.
C	59+	cm	10YR 4/3 (brown); silty loam; structureless; no roots; slightly moist and friable; wavy boundary.

PROFILE 38

Analytical Data

×10⁻¹

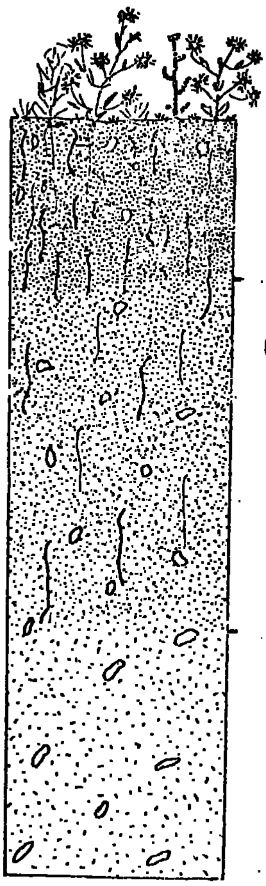
Depth CM.	Mechanical Analysis % Coarse SAND	Medium SAND	Fine SAND	SILT	CLAY	pH	% $CaCO_3$	% L.O.I	% Fe_2O_3 (×10⁻¹)
0-10	14.3	10.5	28.6	36.7	9.9	7.1	1.8	-	6.5
20-30	12.5	7.9	29.5	39.4	10.7	7.2	2.0	-	6.9
30-40	11.4	5.1	31.4	41.6	10.5	7.2	2.2	-	7.4
40-50	6.2	5.2	33.2	43.5	11.9	7.2	2.7	-	8.1
50-60	8.4	9.1	30.7	42.2	9.4	7.1	2.5	-	9.6
60-70	8.4	6.9	34.2	41.5	9.0	7.1	2.0	-	9.4
70-80	7.5	6.3	36.7	40.9	8.6	7.0	1.7	-	9.5
80-90	7.5	5.4	37.2	41.5	8.4	7.0	1.3	-	9.8

Depth CM.	Cation Exchange Capacity m.e./100 g. Na	K	Mg	Ca	Total	% C	% N	C/N	P_2O_5 m.e./100g.
0-10	1.49	0.75	0.45	6.03	8.72	3.5	0.11	31.8	-
20-30	1.46	0.74	0.41	3.80	6.41	2.4	0.08	30.0	-
30-40	1.38	0.66	0.39	6.53	8.96	1.9	0.07	27.1	-
40-50	1.72	0.52	0.44	4.80	7.48	1.1	0.04	27.5	-
50-60	1.84	0.48	0.36	4.18	6.86	0.8	0.07	40.0	-
60-70	1.71	0.56	0.24	2.65	5.16	0.4	-	-	-
70-80	1.76	0.71	0.21	2.44	5.12	0.2	-	-	-
80-90	1.85	0.68	0.19	2.13	4.85	0.6	-	-	-

PROFILE 39

Location	near Kalealti village
Elevation	1150 m.
Slope	3°
Parent material	Calcareous alluvial deposits.
Land use	grazing land.

Profile Description



A	0-11	cm	5YR 4/4 (reddish brown);silty loam; weak granular structure;abundant fibrous roots; many small limestone fragments; dry and slightly hard; wavy boundary.
(B)/C	11-48	cm	5YR 5/4 (reddish brown); silty loam; medium angular and weak prismatic structure; frequent fibrous roots; small limestone fragments; dry and slightly hard; wavy boundary.
C	48+	cm	5YR 5/4 (reddish brown); silty loam; structureless; no roots; few limestone fragments; dry and very hard; wavy boundary.

PROFILE 39

Analytical Data

x 10^{-1}

Depth CM.	Mechanical Analysis %					pH	% $CaCO_3$	% L.O.I	% Fe_2O_3
	Coarse SAND	Medium SAND	Fine SAND	SILT	CLAY				
0-10	11.3	8.2	10.4	49.5	20.6	8.1	34.5	-	4.9
15-20	11.1	6.4	9.2	51.8	21.5	8.1	36.1	-	4.6
20-30	7.1	5.9	5.1	53.4	28.5	8.3	41.9	-	5.1
30-40	3.4	3.2	3.0	~~56.8~~ 54.2	33.6	8.3	44.7	-	6.0
40-50	5.1	4.5	5.6	54.2	30.6	8.5	48.5	-	6.2
60-70	5.6	4.8	4.7	54.5	30.4	8.6	46.2	-	6.1

Depth CM.	Cation Exchange Capacity m.e./100 g.					% C	% N	C/N	P_2O_5 m.e./100g.
	Na	K	Mg	Ca	Total				
0-10	1.29	0.85	0.65	16.86	19.65	1.5	0.04	37.5	-
15-20	1.35	0.84	0.69	16.93	19.81	1.1	0.63	55.0	-
20-30	1.31	0.88	0.76	16.98	19.93	0.9	0.02	45.0	-
30-40	1.81	0.76	0.96	18.29	21.82	0.6	0.01	60.0	-
40-50	1.76	0.69	0.74	17.06	20.25	0.3	-	-	-
60-70	1.68	0.81	0.71	16.96	20.16	0.1	-	-	-

PROFILE 41

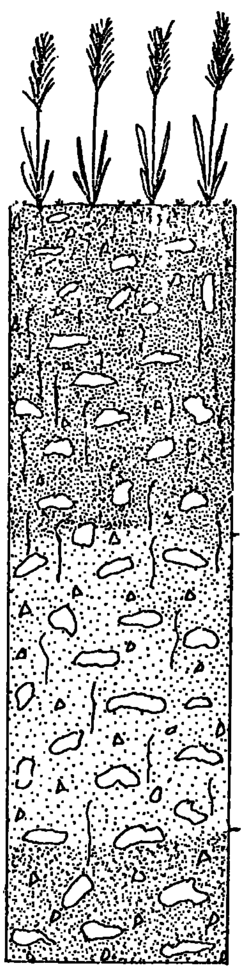
Location near Ciğilhan village.

Elevation 1200 m.

Slope 3°

Parent material Calcareous alluvial deposits.

Land use Wheat cultivation.



Profile Description

0-44 cm 5YR 3/4 (dark reddish brown); silty loam; medium granular structure; abundant fibrous roots; many limestone fragments; dry and friable; wavy boundary.

44-81 cm 5YR 4/4 (reddish brown); silty loam: medium angular blocky structure; frequent fibrous roots; many small limestone fragments; dry and slightly hard; irregular boundary.

81+ cm 5YR 4/6 (yellowish red); silty clay loam; structureless; no roots; few limestone fragments; dry and hard; wavy boundary.

PROFILE 41

Analytical Data

Depth CM.	Mechanical Analysis % Coarse SAND	Medium SAND	Fine SAND	SILT	CLAY	pH	% $CaCO_3$	% L.O.I	% Fe_2O_3 $\times 10^{-1}$
0-10	12.8	6.8	8.9	49.1	22.4	8.1	23.4	-	5.7
20-30	10.8	7.3	9.0	46.3	26.6	8.1	24.1	-	6.0
50-60	13.4	6.7	8.5	41.1	27.3	8.2	34.1	-	6.0
60-70	13.1	6.6	8.8	43.2	28.3	8.2	32.4	-	6.4
70-80	11.3	7.4	8.1	44.3	28.9	8.4	36.7	-	6.1
80-90	11.6	7.2	9.1	43.8	28.3	8.4	37.4	-	6.4

Depth CM.	Cation Exchange Capacity m.e./100 g. Na	K	Mg	Ca	Total	% C	% N	C/N	P_2O_5 m.e./100g.
0-10	1.08	1.75	0.74	8.87	12.44	1.4	0.08	17.5	-
20-30	1.04	1.10	0.81	10.61	13.56	1.1	0.06	18.3	-
50-60	1.39	1.44	0.87	10.37	14.07	0.6	0.03	20.0	-
60-70	1.41	1.46	0.94	11.38	15.19	0.4	0.01	40.0	-
70-80	1.46	1.54	0.96	11.64	15.60	0.2	-	-	-
80-90	1.41	1.51	0.96	11.67	15.55	0.1	-	-	-

PROFILE 42

Location near Poskoflu village.

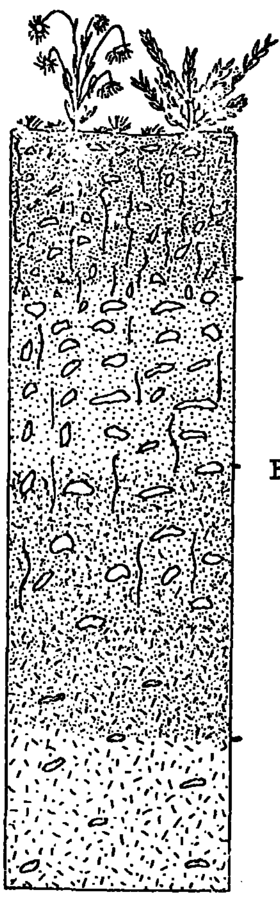
Elevation 1150 m.

Slope 2^{o}

Parent material Diorite.

Land use grazing land

Profile Description



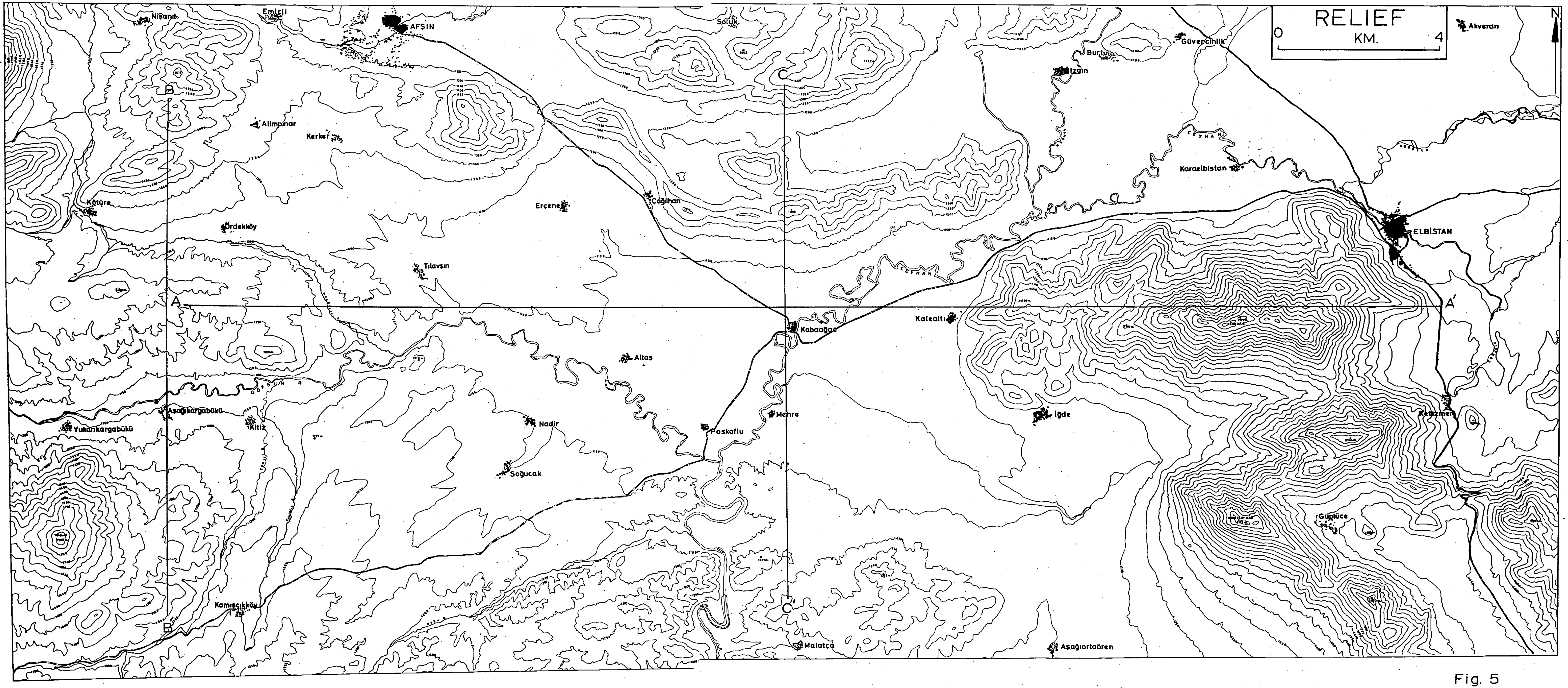
A	0-25	cm	10YR 3/3 (dark brown); silty loam; medium granular structure; abundant fibrous roots; many small bedrock fragments; slightly moist and friable;wavy boundary.
B	25-58	cm	10YR 4/4 (dark yellowish brown); sandy clay loam; medium angular blocky structure; frequent fibrous roots; many bedrock fragments; slightly moist and friable; smooth boundary.
B/C	58-79	cm	10YR 4/4 (dark yellowish brown); sandy loam; weak angular blocky structure; occasional fibrous roots; many small bedrock fragments; moist and friable; wavy boundary.
C	79+	cm	10YR 5/4 (yellowish brown); sandy loam; structureless;no roots; occasional small bedrock fragments; moist and friable; irregular boundary.

PROFILE 42

Analytical Data

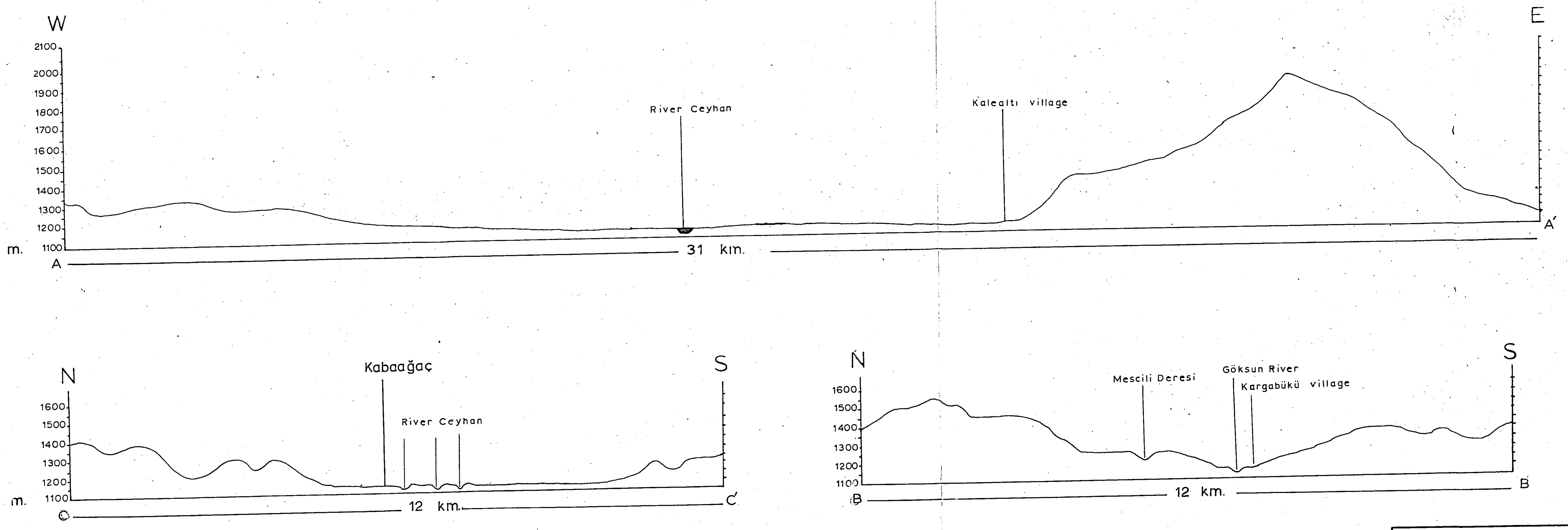
Depth CM.	Mechanical Analysis %					pH	% $CaCO_3$	% L.O.I	% Fe_2O_3 $\times 10^{-1}$
	Coarse SAND	Medium SAND	Fine SAND	SILT	CLAY				
0–10	7.4	4.5	26.7	43.5	17.9	7.2	1.9	-	15.1
10–20	6.2	3.9	27.1	41.4	21.4	7.1	1.5	-	17.0
30–40	3.4	2.1	27.4	38.7	28.4	7.3	2.6	-	18.4
60–70	6.4	3.5	29.5	39.9	20.7	7.2	2.1	-	16.5
80–90	6.8	4.1	30.6	44.7	13.8	7.1	1.4	-	19.6
90–100	5.9	3.3	31.4	46.8	12.6	7.2	1.8	-	15.8

Depth CM.	Cation Exchange Capacity m.e./100 g.					% C	% N	C/N	P_2O_5 m.e./100 g.
	Na	K	Mg	Ca	Total				
0–10	1.86	0.75	0.41	9.22	12.24	4.2	0.18	23.3	-
10–20	1.82	0.66	0.36	8.85	11.69	2.8	0.11	25.4	-
30–40	1.88	0.68	0.42	10.65	14.63	1.4	0.06	23.3	-
50–60	1.84	0.71	0.38	8.99	11.32	1.1	0.04	27.5	-
60–70	1.86	0.66	0.24	7.42	10.18	0.3	0.01	30.0	-
80–90	1.84	0.59	0.26	5.62	8.21	0.2	-	-	-
90–100	1.76	0.31	0.19	4.42	6.68	0.1	-	-	-



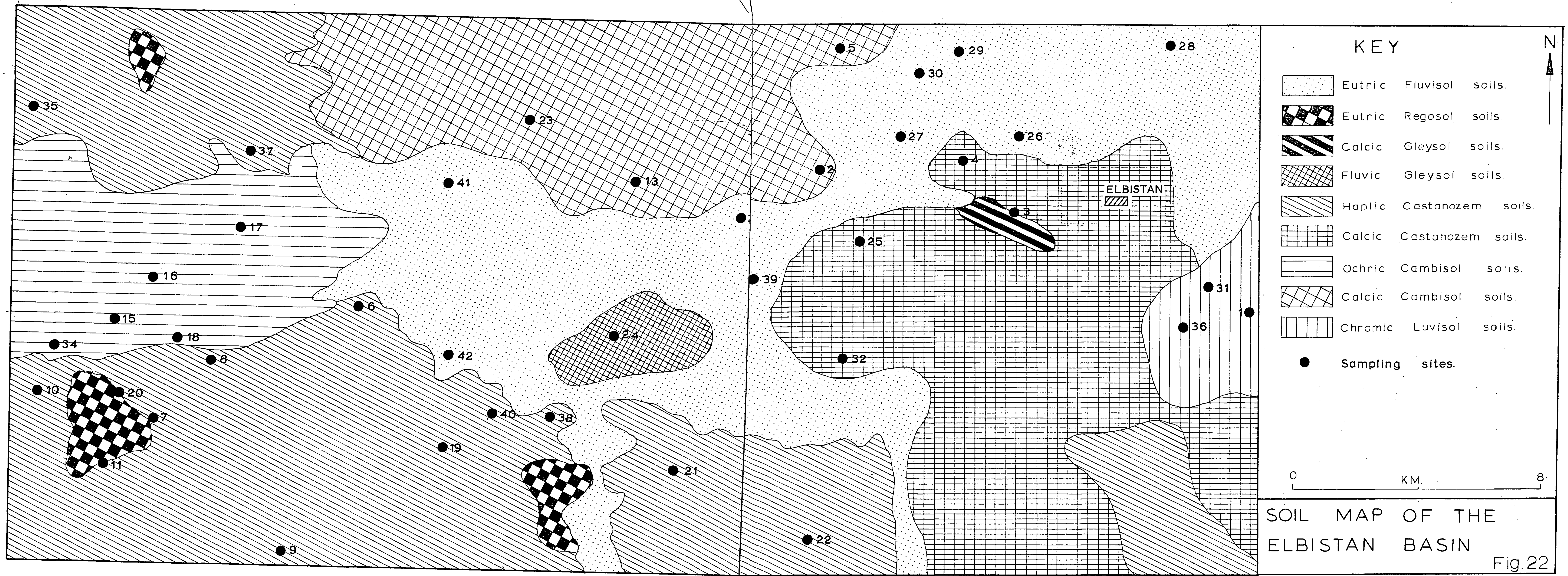
RELIEF
0 KM. 4
N
AFŞIN
ELBİSTAN
Nisanlı
Emirli
Soluk
Akveran
Güvercinlik
Burtul
Izgin
Karaelbistan
CEYHAN
Alimpınar
Kerker
Kötüre
Ördekköy
Ercene
Çağılhan
Tılavsın
Kalealtı
Kabaağaç
Altaş
Mehre
Poskoflu
İğde
Nadir
Soğucak
Aşağıkargabükü
Yukarıkargabükü
Kitiz
GÖKSUN R.
Kamışcıkköy
Malatça
Aşağıortaören
Güplüce
Tepe

Fig. 5



Cross sections from various parts of the basin

Fig. 6



SOIL MAP OF THE ELBISTAN BASIN

Fig. 22