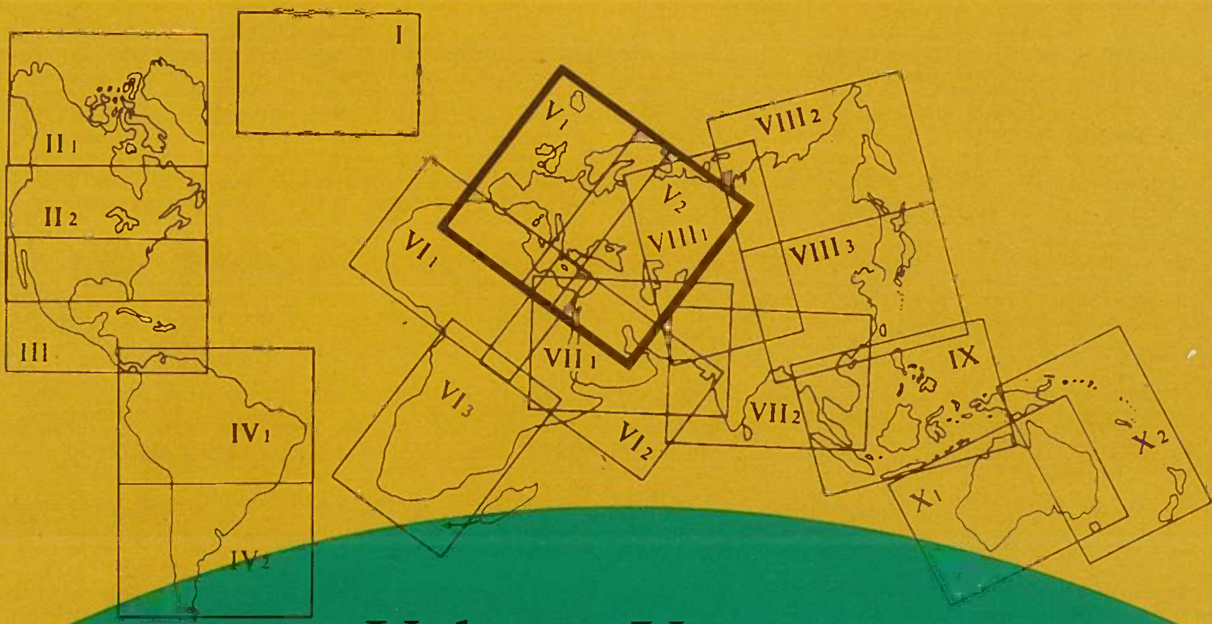
FAO-Unesco

# Soil map of the world

1:5 000 000




## Volume V
## Europe

Unesco

FAO - Unesco

Soil map of the world

1 : 5 000 000

Volume V

Europe

FAO - Unesco

Soil map of the world

| | |
|---|---|
| Volume I | Legend |
| Volume II | North America |
| Volume III | Mexico and Central America |
| Volume IV | South America |
| Volume V | Europe |
| Volume VI | Africa |
| Volume VII | South Asia |
| Volume VIII | North and Central Asia |
| Volume IX | Southeast Asia |
| Volume X | Australasia |

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS
UNITED NATIONS EDUCATIONAL, SCIENTIFIC AND CULTURAL ORGANIZATION

FAO - Unesco

# Soil map of the world

1 : 5 000 000

## Volume V
## Europe

Prepared by the Food and Agriculture Organization of the United Nations

Unesco - Paris 1981

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# PREFACE

The project for a joint FAO/Unesco Soil Map of the World was undertaken following a recommendation of the International Society of Soil Science. It is the first attempt to prepare, on the basis of international cooperation, a soil map covering all the continents of the world in a uniform legend, thus enabling the correlation of soil units and comparisons on a global scale. The project, which started in 1961, fills a gap in present knowledge of soil potentialities throughout the world and provides a useful instrument in planning agricultural and economic development programmes.

The project has been carried out under the scientific authority of an international advisory panel, within the framework of FAO and Unesco programmes. The different stages of the work included comparative studies of soil maps, field and laboratory work, and the organization of international expert meetings and study tours. The secretariat of the joint project, located at FAO Headquarters, was vested with the responsibility of compiling the technical information, correlating the studies and drafting the maps and text. FAO and Unesco shared the expenses involved in the realization of the project, and Unesco undertook publication of its results.

The present volume, covering the soils of Europe, is the fifth of a set of ten which make up the complete publication of the Soil Map of the World. The first volume records introductory information and presents the definitions of the elements of the legend which are used uniformly throughout the publication. Each of the nine following volumes comprises an explanatory text and the corresponding map sheets covering the main regions of the world.

FAO and Unesco wish to express their gratitude to the governmental institutions, the International Society of Soil Science, and the many individual soil scientists who have contributed so much to this international project.

# CONTENTS

# SUMMARY

This volume describes the European section (including all of Turkey) of the FAO-Unesco Soil Map of the World at 1 : 5 000 000. Much of the documentation necessary for the Soil Map of Europe was furnished by the European countries which had cooperated with earlier FAO projects, in particular the Soil Map of Europe at 1 : 2 500 000 and more recent efforts to draw up a map on a scale of 1 : 1 000 000.

### The maps

The two map sheets which make up the Soil Map of Europe are drawn on topographic base maps of the 1 : 5 000 000 Series of the American Geographical Society of New York. The map units are associations of soil units which were assigned the texture and slope class of the dominant soil. They are marked on the map by symbols, letters and figures. The dominant soils are shown by colours, while phase differences affecting them are shown by overprints.

A small inset map on the main map shows the reliability of soil information from which the map was compiled.

Detailed definitions of the soil units and full descriptions of all the terms used may be found in Volume I.

### The text

The first, introductory chapter describes the development of the project in Europe, linked to two other FAO projects: the Soil Maps of Europe at 1 : 2 500 000 and at 1 : 1 000 000. The second acknowledges the cooperation of the institutions and individuals contributing to the maps and the text. The third chapter summarizes Volume I as regards maps and legends.

#### Environmental conditions

Chapter 4 sets out the environmental factors that have close relationships with the pattern of soils: climate, vegetation, physiography, geology and lithology.

*Climate* is classified generally into six major regions according to the distribution of rainfall and temperatures throughout the year. This classification is outlined on four small-scale maps (Figures 1 to 4). A climatological-agricultural map of Europe appears as Figure 9.

*Vegetation* is divided into 37 major types of vegetation formations, according to their physiognomy and structure. These formations, which are situated on a small-scale map (Figure 5), delimit the major European vegetation zones.

The *physiography* of the region is described in its broad outlines. A small-scale map (Figure 6) indicates eight major physiographic and tectonic regions which constitute the principal elements of the European relief.

The *geology* of the region is discussed by major stratigraphic formations, whose *lithology* is given in particular; the major stratigraphic and lithological units are situated on a small-scale map (Figure 7). Considering the importance of the quaternary formations, the area they cover is shown on a separate map (Figure 8).

#### The soils

Chapter 5 contains an extensive table of the soil associations of Europe in the alphabetical order of their symbols. The columns of the table contain the following information:

- Complete symbol of the association and that of the dominant soil
- Associated soils
- Inclusions
- Phases
- Areas in 1 000 ha
- Climate
- Regions of occurrence by country
- Vegetation or land use
- Lithology or parent materials

The *distribution of major soils* in 17 major soil regions is shown on a small-scale map (Figure 10).

### Land use and soil suitability

Chapter 6 contains information on the distribution of soil units encountered in Europe, their current use, their limitations and the yields obtained for the major crops under current agricultural practices.

### Conclusions

In northern Europe the excessively cold and humid climate or rocky or shallow soils discourage crop-growing; this is the zone of the coniferous forest.

South of this forest region, reaching to the Mediterranean region, lies a highly diversified variety of soils, offering considerable possibilities for suitable agricultural use. By and large, farming is impossible only in the mountainous regions. In some areas, salinity or the dry climate, or both, also impose strict limitations.

On balance, it can certainly be said that, all in all, Europe is one of the most privileged regions of the world from the standpoint of the agricultural potential of its soils.

## Appendix

The Appendix contains information on the typical profiles of the major soil units: description of the site, morphology of the profile and analyses.

# RÉSUMÉ

Le présent volume de la Carte mondiale des sols FAO-Unesco au 1 : 5 000 000 est consacré à l'Europe, avec inclusion de toute la Turquie. La documentation nécessaire pour l'établissement de la carte des sols de l'Europe a été fournie en grande partie par les pays européens qui avaient collaboré à un projet antérieur de la FAO, notamment celui de la carte des sols de l'Europe au 1 : 2 500 000, et qui, plus récemment, ont déployé des efforts visant à la réalisation d'une carte à l'échelle de 1 : 1 000 000.

## Les cartes

Les deux feuilles cartographiques qui constituent la carte des sols de l'Europe ont été établies d'après le fond topographique au 1 : 5 000 000 de l'American Geographical Society. Les unités cartographiques sont des associations d'unités pédologiques auxquelles on a attribué la texture et la pente du sol dominant. Elles sont indiquées sur la carte par des symboles, lettres et chiffres. Les sols dominants sont représentés par des couleurs, alors que les différences de phases qui peuvent les affecter apparaissent en surcharge.

Une carte à petite échelle figurant en carton sur la carte principale indique les degrés de fiabilité des données pédologiques utilisées pour l'établissement de la carte.

On trouvera dans le volume I de cette série les définitions détaillées des unités pédologiques et des termes employés.

## Le texte

Le chapitre 1 fait l'historique du projet en Europe, qui a été lié à deux autres projets FAO, celui de la carte des sols de l'Europe au 1 : 2 500 000 et celui au 1 : 1 000 000. Le chapitre 2 rend hommage aux institutions et à ceux qui ont collaboré à l'établissement des cartes et du texte. Le chapitre 3 donne un résumé du volume I relatif aux cartes et aux légendes.

### Le milieu

Le chapitre 4 expose les facteurs du milieu dont dépend étroitement la répartition des sols: climat, végétation, physiographie, géologie et lithologie.

Le *climat* est décrit d'une manière générale en six grandes régions basées sur la distribution des précipitations et des températures au cours de l'année. Cette distribution est schématisée en quatre cartes à petite échelle (figures 1 à 4). Une carte agroclimatique de l'Eutope (figure 9) est également illustrée dans le chapitre 5.

La *végétation* est répartie en 37 grands types de formations végétales selon la physionomie et la structure de la végétation. Ces formations sont localisées sur une carte à petite échelle (figure 5) et délimitent les grandes zones de végétation européennes.

La *physiographie* est examinée dans ses grandes lignes. Une carte à petite échelle (figure 6) situe huit grandes régions physiographiques et tectoniques qui forment les éléments principaux du modelé européen.

La *géologie* est traitée par grandes formations stratigraphiques, dont est essentiellement donnée la *lithologie*; les grandes unités stratigraphiques-lithologiques sont localisées sur une carte à petite échellc (figure 7). Vu l'importance des formations quaternaires, leur extension est indiquée sur une carte séparée (figure 8).

### Les sols

Le chapitre 5 contient un tableau détaillé des *associations de sols* de l'Europe dans l'ordre alphabétique de leurs symboles. Les colonnes sont consacrées aux rubriques suivantes:

Symbole de l'association, y compris le sol dominant
Sols associés
Inclusions
Phases
Superficie en milliers d'hectares
Climat
Localisation par pays
Végétation ou utilisation du sol
Lithologie ou matériaux originels

La *répartition des principaux sols* est faite en 17 grandes régions pédologiques, figurées sur une carte à petite échelle (figure 10).

### Utilisation et vocation des sols

Le chapitre 6 fournit des indications sur la distribution des unités pédologiques rencontrées en Europe, leur utilisation actuelle et leurs limitations, ainsi que sur les rendements obtenus pour les cultures principales soumises aux pratiques agricoles actuelles.

### Conclusions

Dans le nord de l'Europe, le climat trop froid et trop humide, ou les sols trop caillouteux ou trop minces, ne permettent guère des spéculations agricoles; c'est le domaine de la forêt de conifères.

Au sud de cette région forestière, jusqu'en région méditerranéenne, s'étale une gamme de sols très diversifiée, qui offre des possibilités très vastes pour une affectation agricole appropriée. Il n'y a guère que les massifs montagneux où l'agriculture n'a pas sa place. Dans certains secteurs, la salinité et/ou le climat trop sec imposent également de sévères limitations.

Si l'on dresse un bilan, on peut certes affirmer que, tout compte fait, l'Europe est l'une des régions les plus favorisées du globe du point de vue du potentiel agricole de ses sols.

## Annexe

On trouvera dans l'annexe des renseignements sur les profils types des principales unités pédologiques: description du site, description morphologique du profil et données analytiques.

# РЕЗЮМЕ

Настоящий том Почвенной карты мира ФАО-ЮНЕСКО масштаб 1 : 5 000 000 посвящен Европе и включает всю Турцию. Документация, необходимая для составления почвенной карты Европы в значительной части была предоставлена Европейскими странами, которые участвовали в предыдущем проекте ФАО по составлению почвенной карты Европы в масштабе 1 : 2 500 000 и которые совсем недавно предприняли усилия к составлению карты в масштабе 1 : 1 000 000.

## Карты

Оба картографических листа, составляющих почвенную карту Европы,были составлены по топографической основе в масштабе 1: 5 000 000 американского географического общества (Нью-Йорк). Картографические единицы являются ассоциациями почвенных единиц, которые соответствуют структуре и рельефу преобладающей почвы. Они обозначены на карте символами,буквами и цифрами. Преобладающие почвы обозначены различными цветами в то время как разница в фазах их изменения обозначена надписями.

Карта малого масштаба, нанесенная на основную карту, указывает степень надежности данных почвоведения, использованных при составлении карты.

В первом томе этой серии имеются подробные определения почвенных единиц и используемых терминов.

## Текст

В первой главе описывается история осуществления проекта в Европе, который был связан с двумя другими проектами ФАО: проектом почвенной карты Европы в масштабе 1 : 2 500 000 и в масштабе 1 : 1 000 000. В главе второй отдается должное учреждениям и всем тем, кто участвовал в составлении карт и текста. В главе третьей приводится резюме первого тома, в том что касается карт и условных обозначений.

## Среда

В главе 4 дается изложение факторов среды, от которых непосредственно зависит распределение почв: климат, растительность, физиография, геология и литология.

Описание климата приводится в общем по шести крупным районам, разделенным по принципу распределения осадков и температур в течение года. Схематическое изображение этого распределения нанесено на четырех картах малого масштаба (рисунки 1-4). В главе 5 приводится также агроклиматическая карта Европы (схема 9).

Растительность делится на 37 основных видов в соответствии с внешним видом и структурой. Эти виды нанесены на карту малого масштаба (рисунок 5) и определяют границы основных зон растительности в Европе.

Физиография рассматривается в основных чертах. На карте малого масштаба (рисунок 6) нанесены восемь крупных физиографических и тектонических районов, составляющих основные элементы европейского рельефа.

Геология рассматривается по основным стратиграфическим образованиям, литология которых занимает значительное место в тексте; основные стратиграфическо-литологические единицы обозначены на карте малого масштаба (рисунок 7). Принимая во внимание важность образований четвертичного периода, их распространение обозначено на отдельной карте (рисунок 8).

## Почвы

В главе 5 содержится подробная таблица ассоциаций почв Европы в алфавитном порядке их символов. Колонки отводятся под следующие рубрики:

Символ ассоциации, включая преобладающую почву

Смешанные почвы
Включения
Фазы
Площадь в тысячах гектаров
Климат
Распределение по странам
Растительность или использование почвы
Литология или исходные породы

Распределение основных почв делается по 17 крупным почвенным районам, приведенным на карте малого масштаба (рисунок 10).

Использование и назначение почв

В главе 6 приводятся сведения о распределении почвенных единиц, встречающихся в Европе, их нынешнем использовании и их пределах, а также достигнутой урожайности при выращивании основных культур в современном сельском хозяйстве.

Заключение

На севере Европы слишком холодный и влажный климат, или почвы слишком каменисты или лежат очень тонким слоем, и они почти не позволяют вести сельское хозяйство; это – область хвойных лесов.

К югу от этого лесного района, вплоть до района Средиземноморья, распространяется область весьма разнообразных почв, представляющих очень широкие возможности для выращивания соответствующих сельскохозяйственных культур. В этих районах земледелие невозможно лишь в горных массивах. В некоторых местах высокое содержание соли в почве и/или слишком сухой климат также накладывают значительные ограничения.

Если подвести итог, то можно, безусловно, утверждать, что учитывая все факторы, Европа является одним из наиболее благоприятных регионов земного шара с точки зрения сельскохозяйственного потенциала ее почв.

Приложение

В приложении даются сведения о типовых профилях основных почвенных единиц: описание местности, морфологическое описание профиля и аналитические данные.

# RESUMEN

Este volumen del Mapa Mundial de Suelos FAO/ Unesco, a escala 1 : 5 000 000, está dedicado a Europa, e incluye también toda Turquía. La documentación necesaria para el trazado del Mapa de Suelos de Europa ha sido proporcionada, en gran parte, por los países europeos que habían colaborado en un proyecto anterior de la FAO, principalmente el del Mapa de Suelos de Europa a escala 1 : 2 500 000 y que, más recientemente, han contribuido también al trazado de un mapa a escala 1 : 1 000 000.

**Los mapas**

Las dos hojas cartográficas que forman el Mapa de Suelos de Europa se han preparado basándose en el fondo topográfico, a escala 1 : 5 000 000, de la American Geographical Society. Las unidades cartográficas están constituidas por asociaciones de unidades edafológicas, con la textura y la pendiente del suelo dominante, y se indican en el mapa con símbolos, letras y cifras. Los suelos dominantes están representados por colores, mientras que las diferencias de fases que pueden afectarles se indican con sobreimpresiones.

En un pequeño mapa de cartón, intercalado en el mapa principal, se indican los grados de fiabilidad de los datos edafológicos utilizados para el trazado del mapa.

En el Volumen I de esta serie se dan definiciones detalladas de las unidades edafológicas y de los términos empleados.

**El texto**

El Capítulo 1 es el historial del proyecto en Europa, que está vinculado a otros dos proyectos de la FAO: el del Mapa de Suelos de Europa a escala 1 : 2 500 000, y el del mapa a escala 1 : 1 000 000. En el Capítulo 2 se rinde homenaje a las instituciones y a los que han colaborado en el trazado de los mapas y en la redacción del texto. En el Capítulo 3 se hace un resumen de los mapas y leyendas del Volumen I.

El medio

En el Capítulo 4 se describen los factores del medio, de los que depende estrechamente la repartición de los suelos: clima, vegetación, fisiografía, geología y litología.

El *clima* se estudia de una manera general, haciendo una división en seis grandes regiones, basadas en la distribución de las precipitaciones y temperaturas en el curso del año. Esta distribución está esquematizada en cuatro pequeños mapas (Figuras 1 a 4). En el Capítulo 5 se presenta también un mapa agroclimático de Europa (Figura 9).

La *vegetación* se distribuye en 37 grandes tipos de formaciones vegetales, según la fisionomía y la estructura de la vegetación. Estas formaciones están localizadas en un pequeño mapa (Figura 5), y delimitan las grandes zonas europeas de vegetación.

La *fisiografía* es objeto de un examen a grandes rasgos. En un pequeño mapa (Figura 6) se sitúan ocho grandes regiones fisiográficas y tectónicas, que constituyen los elementos principales del modelo europeo.

La *geología* se estudia en sus grandes formaciones estratigráficas, de las cuales se indica esencialmente la *litología*; las grandes unidades estratigráficas-litológicas están localizadas en un mapa a pequeña escala (Figura 7). Dada la importancia de las formaciones cuaternarias, la extensión de las mismas se indica en otro mapa (Figura 8).

Los suelos

El Capítulo 5 contiene un cuadro detallado de las asociaciones de los suelos de Europa, por orden alfabético de sus símbolos. Las columnas están dedicadas a los temas siguientes:

Símbolo de la asociación, incluido el suelo dominante
Suelos asociados
Inclusiones
Fases

Superficie, en millares de hectáreas
Clima
Localización por países
Vegetación o utilización del suelo
Litología o materiales originales

Los principales suelos se reparten en 17 grandes regiones edafológicas, que se indican en un mapa a pequeña escala (Figura 10).

UTILIZACION Y APTITUD DE LOS SUELOS

En el Capítulo 6 se dan indicaciones sobre la distribución de las unidades edafológicas encontradas en Europa, sobre su utilización actual y sus limitaciones, y sobre los rendimientos obtenidos con los cultivos principales, sometidos a las prácticas agrícolas actuales.

CONCLUSIONES

En el norte de Europa, el clima, demasiado frío y demasiado húmedo, o los suelos, demasiado pedregosos o demasiado delgados, apenas permiten especulaciones agrícolas; en ellos dominan los bosques de coníferas.

Al sur de esta región forestal, hasta la región mediterránea, se extiende una gama de suelos muy diversificada, que ofrece vastísimas posibilidades para la explotación agrícola apropiada. Sólo los macizos montañosos no deben ser objeto de explotación agrícola. En ciertos sectores, la salinidad, el clima demasiado seco, o ambas cosas, imponen también fuertes limitaciones.

Si se hace un balance, puede afirmarse que, en definitiva, Europa es una de las regiones del globo más favorecidas desde el punto de vista del potencial agrícola de sus suelos.

**Apéndice**

En el Apéndice se dan informaciones sobre los perfiles tipo de las principales unidades edafológicas: descripción del lugar, descripción morfológica del perfil y datos analíticos.

# 1. INTRODUCTION

## History of the project

The preparation of the Soil Map of the World began in 1961 as a joint project of FAO and Unesco, with the support of the International Society of Soil Science. The Map is composed of 18 sheets and a legend, as well as explanatory volumes for each of the major regions of the world.

The completion of the Europe sheets was closely linked to two projects sponsored by FAO and the European Commission on Agriculture (ECA): the 1 : 2 500 000 Soil Map of Europe, initiated in 1952 and published in 1965, and the 1 : 1 000 000 Soil Map of Europe, begun in 1965 and not yet completed.

In 1952 a group of eminent soil scientists met in Ghent to discuss the unification of the different soil classification and survey systems then in use in Europe. The following countries were represented: Belgium, France, Federal Republic of Germany, Netherlands, Portugal, Spain, United Kingdom and United States. At this meeting, a Subgroup on Soil Classification and Survey was created within the framework of the Working Party on Land and Water Utilization and Conservation of ECA. In 1955 it became the Working Party on Soil Classification and Survey of the ECA Subcommission on Land and Water Use. At its first meeting at Bonn (Federal Republic of Germany) in 1957, the Working Party decided to prepare the 1 : 2 500 000 Soil Map of Europe. A Correlation Committee [1] met at Ghent in 1959 to review the material that had been assembled. After meetings at Oxford (1959), Athens (1961), Lisbon (1963) and Florence (1964), the map [2] and the explanatory text were published in 1965 and 1966 respectively.

Meanwhile, the Seventh Congress of the International Society of Soil Science, which met at Madison, Wisconsin, in 1960, had recommended that soil maps of the great regions of the world be published. Two international organizations, FAO and Unesco, were requested to carry out the project.[3] In June 1961 FAO and Unesco convened at Rome an Advisory Panel composed of eminent soil scientists from various parts of the world to study the scientific and methodological problems implicit in the preparation of a soil map of the world.[4]

At its 1965 meeting at Bonn, the ECA Working Party decided to establish a Soil Map of Europe at 1 : 1 000 000. After meetings at Montpellier (1968), Varna (1969) and Helsinki (1971), a final meeting took place at Ghent in 1973, during which draft maps of all the participating countries were submitted. This material, mostly unpublished, served as the basis for the preparation of the 1 : 5 000 000 Soil Map of Europe, originally drafted in 1976, revised in 1978 and published in 1979.

## Objectives

Knowledge and experience can be successfully transferred from one region to another only if account is taken of similarities and differences in geography, soils and climate. Further, the economic yield of different farming techniques must be evaluated on the basis of comparable data. Reliable information on the types and distribution of the major soils of the world is therefore essential. One of the principal

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[1] Composed of R. Tavernier, Chairman (Belgium); S. Hénin, R. Bétrémieux and J. Dupuis (France); E. Mückenhausen (Federal Republic of Germany); F. Mancini (Italy); D.A. Osmond (United Kingdom); and D. Luis Bramão and R. Dudal (FAO).

[2] The map covers the following countries: Albania, Austria, Belgium, Cyprus, Denmark, Finland, France, Germany (Democratic Republic), Germany (Federal Republic), Greece, Iceland, Ireland, Italy, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Spain, Sweden, Switzerland, United Kingdom and Yugoslavia, with parts of Czechoslovakia and Turkey.

[3] The history of this joint project is set out in greater detail in Volume I.

[4] The participants in this first meeting were:

*Consultants:* G. Aubert (France), M. Camargo (Brazil), J. D'Hoore (Belgium), E.V. Lobova (USSR), S.P. Raychaudhuri (India), G.D. Smith (USA), C.G. Stephens (Australia), R. Tavernier (Belgium), N.H. Taylor (New Zealand), I.V. Tiurin (USSR), F.A. van Baren (Netherlands).

*Unesco Secretariat:* V.A. Kovda, M. Batisse.

*FAO Secretariat:* D. Luis Bramão, R. Dudal, F. George.

objectives of the FAO/Unesco Soil Map of the World was to obtain this information through the preparation of regional and continental soil maps on the basis of a common legend and nomenclature, as well as through the correlation of the soil classification systems in use in different countries. At the same time it is hoped to promote agreement among the world's soil scientists on an international soil classification system.

The project is also intended to promote greater comprehension among soil scientists, planners and farmers and to provide fruitful coordination of national and international soil research and its applications at the national and international levels.

### Value and limitations of the map

The Soil Map of the World is the first world-wide inventory of soil resources, and is the result of broad international cooperation.

The systematic interpretation of the map will make it possible to appraise the distribution and the production potential of the major soils. This inventory will shed light on the limitations and potentialities of the various regions of the world for increased agricultural production and will make it possible to designate the regions to be studied as a priority matter.

Until now, such studies have been hampered by lack of uniformity in soil terminology, nomenclature and classification as well as by the lack of an overall view of the world's soil resources.

The Soil Map of the World provides a basis and framework for further regional and national soil surveys on a large scale, needed for land development and management purposes. It is also a teaching aid in geography, soil science and agronomy, and a basis for environmental studies.

It is currently being used in evaluating the production potential of the world's major agro-ecological zones, to estimate the risk of desertification, to evaluate the extent of various soil degradation phenomena, and for the transfer of experience and technology among ecologically similar countries.

Although the publication of this map and its explanatory text marks a significant step forward, it is necessary to point out its limitations. The accuracy and detail of the information which can be shown are obviously limited by the small scale of the map and by the fact that data for some areas are scarce because of the lack of direct observation. These limitations also apply to the interpretative material, which can only be as accurate as the data on which it is based.

Differences in field and laboratory techniques in use in different countries render the compilation of continental maps more complex. This difficulty is particularly evident in Europe, whose soil map is the result of the assembly of the different 1 : 1 000 000 country maps produced within the framework of the activities of the ECA Working Party on Soil Classification and Survey. Although a great deal of correlation work was carried out when the two sheets of the European map at 1 : 5 000 000 were assembled, it is clear that differing prospection and classification methods used in the European countries made compromise solutions necessary, leading to a certain degree of heterogeneity in the interpretation of certain soil units in different parts of Europe.

Despite these imperfections, the 1 : 5 000 000 Soil Map of Europe is the most recent and detailed inventory of its soil resources, based on international cooperation. Its limitations point up the necessity of intensified soil correlation and of improving our knowledge of the nature and distribution of soils for which data are lacking or incomplete.

### Use of the map and explanatory text

Against the background of the topographic base the map shows the distribution of the dominant soils, marked by different colours. Ranges of related colours have been selected to indicate similar soils, so that major soil regions can be recognized. A chart of these colours, as well as the meaning of the symbols for textural classes, slope classes and phases, overprinted in black, appears on the front of sheet V-2. The legend, which appears on the back of both sheets, includes details on the composition of the map units.

Complete definitions of all the symbols (soil units, textural classes, slopes and phases) can be found in Volume I. Chapter 4 gives data on climate, geology, present vegetation and the vegetation that has frequently disappeared to make way for agriculture. Chapter 5 shows the geographical distribution of the soils, and Table 3 indicates, for each soil unit, the phase if any, the area by country, the climate, the vegetation and the lithology. The profile descriptions and analytical data in the Appendix illustrate and clarify the definitions. Chapter 5 also contains a map of the major soil regions of Europe. Chapter 6 is given over to land use and suitability, in the alphabetical order of the soil unit symbols.

# 2. ACKNOWLEDGEMENTS

The Soil Map of Europe could only have been prepared with the cooperation of government institutions and many soil scientists who provided basic material and most of whom took an active part in the meetings, study tours and discussions which, throughout the 1 : 2 500 000 and 1 : 1 000 000 Soil Map of Europe projects, led to the completion of the 1 : 5 000 000 map and the explanatory text.

Official agencies and individuals who furnished invaluable assistance are listed below. FAO and Unesco also express their lively thanks to the members of the numerous European team of experts, all of whom it has not been possible to mention, but whose publications and data have been extremely useful sources of information.

**Official agencies**

| | |
|---|---|
| Austria | Geographisches Institut der Universität Wien and Hochschule für Bodenkultur |
| Belgium | Centre de cartographie des sols |
| Bulgaria | N. Poushkarov Soil Science Institute |
| Cyprus | Soil and Plant Nutrition Section, Department of Agriculture |
| Czechoslovakia | Research Institute for Soil Science and Agrochemistry and Research Institute for Soil Science |
| Denmark | Agricultural University of Denmark |
| Finland | Agricultural Research Centre |
| France | Institut national de la recherche agronomique (INRA), Service d'étude des sols |
| | Centre national de recherches agronomiques (INRA), Département science du sol |
| Germany (Fed. Rep.) | Institut für Bodenkunde der Rheinischen Friedrich-Wilhelms-Universität, Bonn |
| Greece | Athens Faculty of Agriculture |
| Hungary | University of Agriculture Research Institute of Soil Science and Agricultural Chemistry, Hungarian Academy of Sciences |
| Iceland | University Research Institute |
| Ireland | Agricultural Institute, National Soil Survey |
| Italy | Istituto di Geologia Applicata della Università degli Studi di Firenze |
| Luxembourg | Administration des services techniques de l'agriculture |
| Netherlands | Soil Survey Institute (Stiboka) Agricultural University |
| Norway | Norwegian Agricultural University |
| Poland | Polish Academy of Science |
| Portugal | Serviço de Reconhecimento e de Ordenamento Agrário |
| Romania | Institut d'études et de recherches pédologiques |
| Spain | Consejo Superior de Investigaciones Científicas, Instituto de Edafología, Departamento de Suelos |
| Sweden | College of Agriculture and Royal College of Forestry |
| Switzerland | Institut fédéral de recherches agricoles |
| Turkey | Ministry of Rural Affairs and Cooperatives, General Directorate of Soil Conservation and Farm Irrigation (TOPRAKSU) |
| United Kingdom | National Research Council, Soil Survey of England and Wales, Macaulay Institute for Soil Research, Department of Soil Survey |
| USSR | All-Union Society of Soil Scientists |
| Yugoslavia | Yugoslav Society of Soil Science |

**Individuals**

(By country and alphabetical order)

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|---|---|
| Austria | J. Fink, H. Nagl |
| Belgium | J. Ameryckx, R. Tavernier |
| Bulgaria | I. Garbouchev, V. Koinov |
| Cyprus | G.C. Grivas, Ch. Soteriades |
| Czechoslovakia | J. Hrasko, J. Němeček |
| Denmark | K. Rasmussen |
| Finland | O. Mäkitie, M. Sillanpää, J. Vuorinen |
| France | J. Dupuis, M. Dupuis, M. Jamagne, J. Moinereau, E. Servat, J. Servant |
| Germany (Fed. Rep.) | E. Mückenhausen |
| Greece | A. Koutalos, N. Yassouglou |
| Hungary | S. Bodolay, F. Maté, P. Stefanovits, I. Szabolcs, L. Szucs |
| Iceland | D. Johannesson |
| Ireland | M. Conry, M.J. Gardiner, J. Lee, P. Ryan |
| Italy | A. Aru, G. Fierotti, F. Mancini, A. Pietracaprina, G. Ronchetti |
| Luxembourg | J.P. Wagener |
| Netherlands | H. de Bakker, L.J. Pons, J. Schelling, R. van der Schans |
| Norway | J. Låg |
| Poland | B. Dobrzanski, F. Kuznicki |
| Portugal | J. Carvalho Cardoso |
| Romania | N. Florea, N. Ghitulescu |
| Spain | P. Gragera, A. Guerra, F. Lázaro |
| Sweden | T. Troedsson, L. Wiklander |
| Switzerland | L.F. Bonnard, E. Frei |
| Turkey | O. Akyürek, H. Nemutlu, F. Sardas |
| United Kingdom | R. Glentworth, R. Grant, D.A. Osmond |
| USSR | V.A. Kovda |
| Yugoslavia | M. Cirić, A. Skorić |

**Preparation of the map**

The first outline, shown at Adelaide in 1968, was prepared in Rome by FAO experts in collaboration with European institutes and soil scientists. The final map was prepared by J. Ameryckx, A. Pécrot and R. Tavernier.

Grateful acknowledgement is made of the permission given by the American Geographical Society of New York to use its 1 : 5 000 000 World Map as a basis for the preparation of the Soil Map of the World.

**Preparation of the explanatory text**

The explanatory text of the map was written by J. Ameryckx and A. Pécrot (FAO). For Chapter 4 (The Environment) they called for assistance upon A. Noirfalise (Vegetation), R. Tavernier (Climate and Physiography) and R. Vermeire (Geology and Lithology); for Chapter 6 (Land Use and Soil Suitability) they called upon the cooperation of J. Lee.

**Soil correlation**

The intercontinental correlation, the international legend and the definitions of soil units are the work of R. Dudal (FAO). The Working Party of ECA, under the chairmanship of R. Tavernier, took a very active part in the work of correlation for Europe.

**Financial support**

FAO and Unesco shared the costs of preparing and publishing the World Soil Map. Thanks are due to the governments of all the countries which kindly hosted the numerous sessions of the Working Party of ECA and the correlation seminars.

# 3. THE MAP

### Topographic base

The Soil Map of Europe was prepared on the basis of the 1 : 5 000 000 topographic map series of the American Geographical Society of New York. It consists of two sheets, numbered V-1 and V-2, with an overlap from the Gulf of Bothnia to the Sea of Belov in the north and from Albania to Istanbul in the south. The Miller oblated stereographic projection was used.

### Soil units

The soil units constitute the soil associations. They are indicated by one- or two-letter symbols (Table 1), defined in Volume I, *Legend.*

### Map units

The map unit consists occasionally of a single soil unit; more often, however, it consists of an association of soil units, of which one is the dominant, the others being the subdominant (covering at least 20 percent of the delimited area) and the inclusions (covering less than 20 percent of the delimited area). The map unit is further defined by the textural class or classes of the dominant soils and by its topography (slope classes). These two characteristics are shown by symbols:

- the digit 1, 2 or 3, indicating the textural class (coarse, medium and fine, respectively);
- the small letter a, b or c, indicating the slope class, corresponding respectively to level to gently undulating (slopes 0 to 8 percent), rolling to hilly (slopes 8 to 30 percent) and strongly dissected to mountainous (steep: slopes above 30 percent) reliefs.

### Cartographic representation

#### Symbols

Soil associations are shown by the symbol representing the dominant soil unit (e.g., Lo: Orthic Luvisols), followed by a number which indicates the full composition of the association (e.g., Lo74: Orthic Luvisols Lo and Luvic Phaeozems Hl, with inclusions of Eutric Regosols Re). After a dash appears a digit indicating the textural class of the dominant soil (e.g., 2: medium) and lastly a small letter indicating the slope class of the association (e.g., a: level to gently undulating). The complete symbol of the association is therefore read as follows:

Lo74-2a : Orthic Luvisols, medium textured, and Luvic Phaeozems, with inclusions of Eutric Regosols; level to gently undulating

The texture or slope classes, or both, are omitted from the symbol when data are lacking. On the contrary, two digits or two letters are used where two groups of textures or types of topography occur that cannot be delimited on the map, thus:

Bc27-2/3bc : Chromic Cambisols, medium to fine textured, and Chromic Luvisols, with inclusions of Rendzinas, Orthic Luvisols and Cambisols, rolling to steep

Associations in which Lithosols are dominant are identified by the Lithosol symbol I combined with the symbol for one or two associated soil units, with the texture and slope classes if known; inclusions are omitted:

*I-U-1/2c* : *Lithosols and Rankers, coarse to* medium textured, steep.

#### Map colours

The soil associations have been coloured according to the dominant soil unit (see Sheet 1, Analytic Colour Chart). The distinction between map units having the same dominant (e.g., Gh) is shown by a number (e.g., Gh22, Gh23, Gh24).

Associations dominated by Lithosols (e.g., I-Be-2c) are shown by grey stripes (basic colour for Lithosols) alternating with coloured stripes (colour of the associated soil or soils); when the map unit consists

TABLE 1. - SOIL UNITS FOR EUROPE

| | |
|---|---|
| J | FLUVISOLS |
| Je | Eutric Fluvisols |
| Jc | Calcaric Fluvisols |
| Jd | Dystric Fluvisols |
| Jt | Thionic Fluvisols |
| G | GLEYSOLS |
| Ge | Eutric Gleysols |
| Gc | Calcaric Gleysols |
| Gd | Dystric Gleysols |
| Gm | Mollic Gleysols |
| Gh | Humic Gleysols |
| Gx | Gelic Gleysols |
| R | REGOSOLS |
| Re | Eutric Regosols |
| Rc | Calcaric Regosols |
| Rd | Dystric Regosols |
| Rx | Gelic Regosols |
| I | LITHOSOLS |
| Q | ARENOSOLS |
| Qc | Cambic Arenosols |
| Ql | Luvic Arenosols |
| E | RENDZINAS |
| U | RANKERS |
| T | ANDOSOLS |
| To | Ochric Andosols |
| Tm | Mollic Andosols |
| Th | Humic Andosols |
| Tv | Vitric Andosols |
| V | VERTISOLS |
| Vp | Pellic Vertisols |
| Vc | Chromic Vertisols |
| Z | SOLONCHAKS |
| Zo | Orthic Solonchaks |
| Zm | Mollic Solonchaks |
| Zg | Gleyic Solonchaks |
| S | SOLONETZ |
| So | Orthic Solonetz |
| Sm | Mollic Solonetz |
| Sg | Gleyic Solonetz |
| Y | YERMOSOLS |
| Yk | Calcic Yermosols |
| X | XEROSOLS |
| Xh | Haplic Xerosols |
| Xk | Calcic Xerosols |
| Xy | Gypsic Xerosols |
| Xl | Luvic Xerosols |
| K | KASTANOZEMS |
| Kh | Haplic Kastanozems |
| Kk | Calcic Kastanozems |
| Kl | Luvic Kastanozems |
| C | CHERNOZEMS |
| Ch | Haplic Chernozems |
| Ck | Calcic Chernozems |
| Cl | Luvic Chernozems |
| Cg | Glossic Chernozems |
| H | PHAEOZEMS |
| Hh | Haplic Phaeozems |
| Hc | Calcaric Phaeozems |
| Hl | Luvic Phaeozems |
| Hg | Gleyic Phaeozems |
| M | GREYZEMS |
| Mo | Orthic Greyzems |
| B | CAMBISOLS |
| Be | Eutric Cambisols |
| Bd | Dystric Cambisols |
| Bh | Humic Cambisols |
| Bg | Gleyic Cambisols |
| Bk | Calcic Cambisols |
| Bc | Chromic Cambisols |
| Bv | Vertic Cambisols |
| L | LUVISOLS |
| Lo | Orthic Luvisols |
| Lc | Chromic Luvisols |
| Lk | Calcic Luvisols |
| Lv | Vertic Luvisols |
| Lf | Ferric Luvisols |
| La | Albic Luvisols |
| Lg | Gleyic Luvisols |
| D | PODZOLUVISOLS |
| De | Eutric Podzoluvisols |
| Dd | Dystric Podzoluvisols |
| Dg | Gleyic Podzoluvisols |
| P | PODZOLS |
| Po | Orthic Podzols |
| Pl | Leptic Podzols |
| Ph | Humic Podzols |
| Pp | Placic Podzols |
| Pg | Gleyic Podzols |
| W | PLANOSOLS |
| We | Eutric Planosols |
| Wd | Dystric Planosols |
| A | ACRISOLS |
| Ao | Orthic Acrisols |
| Af | Ferric Acrisols |
| Ah | Humic Acrisols |
| O | HISTOSOLS |
| Oe | Eutric Histosols |
| Od | Dystric Histosols |
| Ox | Gelic Histosols |

of more than 80 percent Lithosols (e.g., I-2bc), the grey colour is applied uniformly over a horizontally striped pattern.

### Phases

Phases are indicated by black overprints on the colour of the association.

The *stony* phase marks areas where the presence of gravels, stones, boulders or rock outcrops makes the use of mechanized agricultural equipment impracticable. In associations having dominant Lithosols, this phase is naturally understood.

The *lithic* phase marks the presence of continuous, coherent hard rock within 50 cm of the surface; the definition of Lithosols implies this.

The *petrocalcic* phase shows the occurrence of a petrocalcic horizon within 100 cm of the surface (e.g., certain Bk, Lc and Xk associations in the Mediterranean region).

The *phreatic* phase is used for soils whose watertable lies between 3 and 5 m from the surface; it has been observed in several large depressions in Central Europe.

The *fragic* phase shows the presence of fragipan within 100 cm of the surface. This phase has been observed only in a few units; it doubtless covers larger areas, in which lack of data has prevented its observation.

The *saline* phase soils have in some part of the soil, within 100 cm from the surface, a conductivity greater than 4 mmhos/cm. This phase concerns certain soils in Central Europe, especially in Hungary, and in some estuaries; the Solonchaks are saline by definition.

The *sodic* phase is used for soils which have more than 6 percent saturation with sodium in some part of the soil within 100 cm from the surface. The phase concerns large areas in Central Europe and, even more, in the USSR, bordering on the Black and Caspian Seas. The Solonetz are sodic by definition.

### Miscellaneous land units

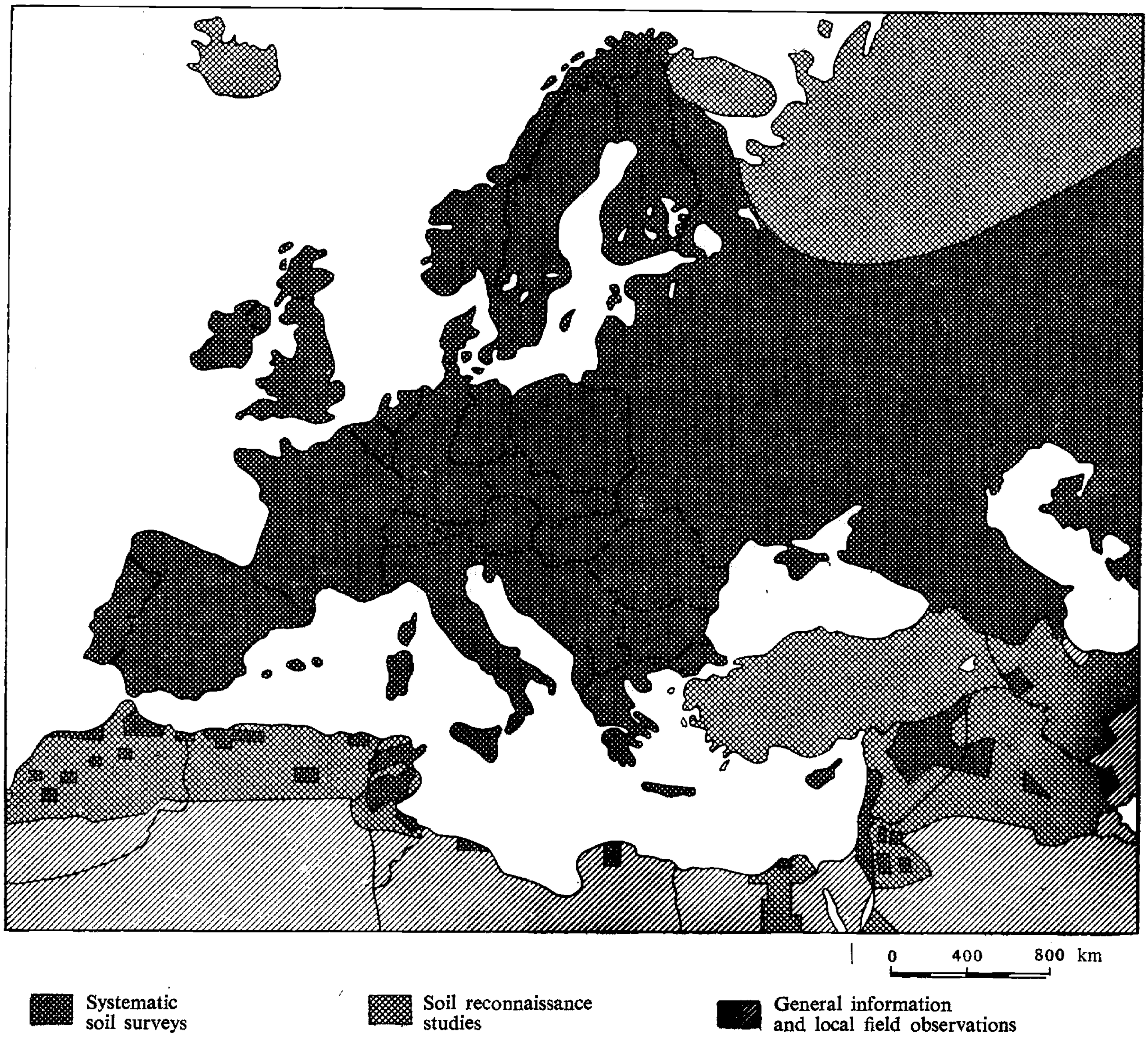
Miscellaneous land units are land areas on which no soil exists. In Europe the expression applies to mountain glaciers and snow-caps (e.g., in the Alps and Scandinavia) and to a large area of dunes and shifting sands northwest of the Caspian Sea in the USSR.

## Sources of information

A map showing the sources of information is shown as an inset in the soil map. A distinction is made among areas compiled from systematic soil surveys (Class I), soil reconnaissance studies (Class II) and general information with local field observations (Class III).

Most of the European region has been covered by systematic soil surveys. Only Iceland, the northern parts of Finland and the USSR and Turkey in Asia are covered by soil reconnaissance alone. The bibliography below includes the main soil maps that were used to prepare the Soil Map of Europe. The maps of certain countries (e.g., Austria, Finland, Greece, Hungary, Norway, Sweden and Switzerland) were drawn to a scale of 1 : 1 000 000 within the framework of the activities of the Working Party on Soil Classification and Survey of ECA, but are as yet unpublished.

Sources of information



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# 4. ENVIRONMENTAL CONDITIONS

This chapter outlines briefly the four most important aspects of the environment in the development of soils: climate, vegetation, physiography and lithology. The small-scale maps appearing at the end of the volume indicate the location and nature of the major regions among which important variations of climate, vegetation, landscape and rock types occur.

## Climate *

The climate of Europe results from the interaction of three main factors. First, *latitude*, which determines, *inter alia*, the length of the days and nights during the different seasons. By its latitude, Europe belongs for the most part to the northern sector of the temperate zone. The southernmost peninsula still lies more than 12$^0$ north of the Tropic of Cancer, while the northernmost land masses lie well above the Arctic Circle. The second factor is the *position of Europe with respect to the continental and ocean masses*. The form of Europe, with its very long sea coast and its surrounding Mediterranean, Black and Baltic Seas, allows oceanic influences to penetrate to the interior of the continent. Further, the western coastline is bathed by the warm currents of the Gulf Stream system, and their effect is enhanced by the prevailing westerly winds, carrying the ocean's moisture and warmth over the continent. The final factor is the *relief*, the position and alignment of the mountain chains. Although certain mountain zones lie near the western coasts, there is no continuous coastal chain, and the Atlantic air masses reach the heart of the continent. In Central and Southern Europe, on the other hand, where the relief is very irregular, climatic conditions display considerable local variations.

Three main air-pressure zones influence the European climate.

1. The high-pressure area over the Azores.
2. The Asian winter anticyclone.
3. The low-pressure area over Iceland.

* Text by Professor R. Tavernier, Université de l'Etat, Ghent, Belgium.

The high-pressure area over the Azores is most active during the summer, when it lies near 35$^0$ North latitude and reaches as far as the Mediterranean basin, where it brings hot, sunny weather, almost without rainfall. At times it can also determine the weather in Western Europe.

The Asian winter anticyclone lies over Central Europe during the winter and at times reaches as far as Western Europe, bringing periods of severe cold with northeast winds.

The low-pressure area over Iceland persists throughout almost the entire year, but is most active during the winter. For most of the year it influences the Atlantic coast and Northern, Western and even Central Europe. During the winter the rainy low-pressure areas associated with it reach as far as the Mediterranean region, while during the summer it often determines the weather as far as Eastern Europe. Generally speaking, it brings variable weather, very often with rain.

### Rainfall

The mean annual rainfall levels of Europe are shown in Figure 1. The low-pressure fronts from the Atlantic bring moist air masses over the continent. However, the westerly winds are irregular, crossing the continent in a series of cyclones and anticyclones, and rainfall is therefore generally high along the Atlantic coast, particularly where it is bordered by mountain or highland zones. The high mountains (Alps and Carpathians) in the interior also receive much rain (1 000 to 3 000 mm), while rainfall is less in the basins between the mountains (Spain, Hungary and Turkey). Rainfall is also low (under 500 mm) in northern Iceland, the northern plains of peninsular Europe and the northern reaches of the Black and Caspian Seas.

The seasonal distribution of rainfall varies considerably. In Western Europe rainfall is distributed fairly evenly throughout the year. Farther east, annual mean rainfall decreases slowly, and maximum rainfall occurs during the summer. In the Mediterranean regions rain falls almost exclusively during the winter and spring.

### Temperature

Mean annual temperatures (Figure 2) depend on latitude and altitude. In the great European plain the temperature rises gradually from —8°C in northern Russia to 12°C along the Black Sea, and the isotherms run more or less horizontally. The highest means, above 20°C, are met with along the Mediterranean coast, in the southern parts of Spain, Italy, Greece and Turkey.

The mean January temperature (Figure 3) drops to — 24°C in northeastern Europe, while it remains above 8°C in the southwest of the Iberian peninsula. The January isotherms tend to run diagonally from northwest to southeast.

The mean July temperature (Figure 4) is below 12°C in Northern Europe but exceeds 30°C on the Caspian Sea and on the Mediterranean coasts of Spain, Italy, Greece and Turkey. The July isotherms tend to run diagonally from southwest to northeast. The distribution of natural vegetation displays the influence of the summer temperatures.

### Climatic regions

The rainfall and temperature patterns define several climatic regions in Europe. In general, the transition from one to another is gradual, especially in the plains areas. Furthermore, in a single climatic region there are often important variations as a result of exposure and the relief.

The Arctic region is characterized by long, cold winters with temperatures below —10°C and short summers with temperatures usually below 10°C. Rainfall, very often as snow, is relatively slight (under 500 mm), except in the high mountains. The area of the Arctic region in Europe is fairly small (Iceland, Scandinavia, the Arctic Ocean coast and the high mountains of Central and Southern Europe).

The cold northern temperate region also has cold winters, which are shorter however than in the Arctic region. Summers are still relatively short, but maximum temperatures can exceed 15°C. Rainfall, usually above 500 mm, is distributed fairly regularly, but much of it falls as snow.

The maritime temperate region is characterized by a rainfall of about 750 to 1 000 mm, distributed regularly throughout the year. The winters are relatively mild, and the mean temperature of the coldest month is generally above zero, while summers are fairly cool.

The subcontinental temperate region has colder winters and hotter summers than the maritime temperate region. Toward the east, rainfall declines from 750 to 500 mm, with maxima in early summer. This region is transitional between the maritime temperate and continental regions.

The continental temperate region has severe winters and hot summers. Rainfall, of about 500 mm, shows a pronounced peak in early summer. Toward the Caspian Sea, the annual mean rainfall declines rapidly and the climate gradually becomes of the desert type.

The Mediterranean region is characterized by hot, dry summers and generally rainy winters, often with maximum rainfall in the autumn. Owing to the relief, often very sharp because of the mountain chains, rainfall and temperature vary considerably, depending on the exposure and the relief itself. In the mountainous regions annual rainfall usually exceeds 1 000 mm, and sometimes even 2 000 mm. In the intermountain basins, on the contrary, the annual rainfall may be below 500 mm, and the summers are very hot (over 20°C).

## Vegetation

The outline vegetation map (Figure 5) is based on the distribution of the potential natural vegetation which would make up the greater part of the landscape, under present soil and climatic conditions, had man not transformed it for economic purposes. In many regions only rare evidence of such vegetation subsists, as virgin or only slightly modified forests, national parks or similar reserves. However, the many European studies on regressive and progressive plant sequences make it possible to reach reliable conclusions on the basis of present vegetation.

This section is based to a great extent on national vegetation maps and, for Western Europe, on the recent map prepared under the sponsorship of the Council of Europe.

The geobotanical structure of the continent can be summarized as a series of bioclimatic belts from north to south, and this is the first criterion that has been adopted here. On the other hand, the continental nature of the climate superimposes on these belts, from the Atlantic to the Urals, another gradient which has been brought out in the analysis of the vegetation areas. The overall result is a varied system of units, becoming increasingly complex in the Mediterranean region in particular.

These units are as shown on the following page.

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Arctic and sub-arctic belt

1. Arctic tundra
2. Sub-arctic birch formation

Boreal and sub-boreal coniferous belt

3. Fennoscandian boreal forest
   a. Southern sector
4. Russian boreal forest
   a. Southern sector
5. Mixed coniferous/deciduous boreal forest
6. Sub-boreal oak and pine forests
7. Boreo-atlantic oak/Norway pine forest

Mesothermic temperate forest belt

8. Boreo-atlantic oak/birch forest
9. Boreo-atlantic oak/holly forest
10. Atlantic beech forests
11. Sub-atlantic beech forests
12. Baltic beech forests
13. Sub-atlantic oak/hornbeam forest
14. Central European oak/hornbeam forest
15. Baltic oak/hornbeam forest
16. Montane beech/fir forest
17. Alpine forest complex

Thermophilous temperate forest belt

18. Franco-atlantic oak forests
19. Ibero-atlantic oak forests
20. Insubrian oak forests
21. Pannonian oak forest
22. Illyrian oak forest
23. Balkan oak forest

Temperate steppe belt

24. Danubian steppes
25. Russian steppes
   a. Silvo-steppe
   b. Grassy steppe
   c. Sodic steppe
26. Caspian steppes

Mediterranean belt

27. Thermomediterranean level
28. Xeromediterranean level
29. Mesomediterranean cork-oak level
30. Mesomediterranean holm-oak level
31. Supramediterranean level
32. Oromediterranean level

Pontic belt

33. Colchian forest
34. Pontic forest
35. Substeppe oak forests
36. Orocaucasian forests
37. Anatolian steppe

## ARCTIC AND SUBARCTIC BELT

### 1. *Arctic tundra*

The distribution of vegetation on the tundra depends on the extent to which plants are protected by snow cover during the winter. In the best protected areas the natural vegetation consists of a scrub made up of *Betula nana*, *Juniperus* and *Salix*. Where there is less snow, heath with *Vaccinium* spp., moss and lichen replace the dwarf birch, and in extreme situations only isolated patches of moss and lichen subsist. Carex and cotton-grass swamps and peat bogs on hillocks resulting from the cold, of the palsa type, cover the Histosols of low-lying areas watered by the thaw.

The montane tundra on the higher reaches of the Urals, the Scandinavian chain and Iceland show similar belts according to the elevation: birch and dwarf willow scrub, heath with *Vaccinium* spp. and *Empetrum hermaphroditum* or *Dryas octopetala* (on schists and calcareous soils), low-growing heather with *Cassiope* and *Arctostaphylos* and, at the level below the snow, where solifluctional soils are dominant, rush and lichen patches.

In summer the European tundra is grazed by reindeer herds that feed mainly on a lichen, *Cladonia rangiferina*. The survival of these feeding areas implies either a very low animal population (0.5 to 1 head per 100 ha) or very long fallow periods (10 to 15 years). Overgrazing can lead to the appearance of a carex/cotton-grass cover of low grazing value.

### 2. *Subarctic birch formation*

The coastal fjord region of northern Norway and Iceland is characterized by natural growths of *Betula tortuosa* and *Cornus suecica* (Corno-Betuletum) whose height does not exceed 8 metres. These growths have usually been degraded to grazing lands with *Vaccinium* spp., *Empetrum nigrum* and, in Iceland, *Calluna vulgaris*. In Norway, elevations above the birch growths carry a level of Norway pine with abundant moss (Bazzanio-Pinetum).

The economy is based exclusively on fishing and grazing.

## BOREAL AND SUB-BOREAL CONIFEROUS BELT

### 3. *Fennoscandian boreal forest*

The natural forest of sandy or stony Podzols is dominated by the Norway pine, with an undergrowth made up of lichen and *Calluna* (Cladonio-Pinetum), while the deeper Podzols, with better water retention, are covered by spruce fir (*Picea abies*), the undergrowth being made up of *Vaccinium* spp. (Vaccinio-

Piceetum). Herbaceous undergrowth also appears on colluvial slopes (Melico-Piceetum). Birch woods (*Betula tortuosa* in the north, *B. pubescens* elsewhere) are frequently encountered in certain areas; some are secondary (fire, former clearings). The Histosol bogs of Finland (aapa or reticulate bogs) are covered in part by birch and pine (Ledo-Pinetum).

The southern zone of this forest (3a) is characterized, around 65° North latitude, by the appearance of temperate deciduous species: hazel (*Corylus avellana*), elm (*Ulmus glabra*), lime (*Tilia cordata*), Norway maple (*Acer platanoides*), oak (*Quercus robur*), and alder (*Alnus incana*) along the streams. Scattered throughout the coniferous forest, these species also form islands of deciduous trees on the more fertile soils of the lake regions of Finland and Kopparberg.

### 4. *Russian boreal forest*

In addition to the Siberian species *Picea obovata* and *Larix sibirica* (var. *russica*), the Russian boreal forest, or taiga, includes, beginning at the Onega basin, *Abies sibirica* east of the Dwina and *Pinus cembra* in the foothills of the Urals. The larch/pine association is frequent on well-drained Podzols and the spruce/pine association on Gleyic Podzols. Between 65 and 62° North latitude (4a) appear, scattered, the same deciduous species as in the Fennoscandian forest.

The taiga is inhabited and worked primarily in its southern sector (4a — Dystric Podzoluvisols), where it is appreciably more productive than in the north. It displays different soil/vegetation profiles, which are listed in order of decreasing productivity: herbaceous cover on alluvial or colluvial soil; *Vaccinium* spp., mosses and oxalis cover on normally drained soils; *Polytrichum* and *Equisetum sylvaticum* cover on poorly drained soils; peat cover on boggy soils. The pine forests, prevalent especially in the west, have similar soil covers.

The forest of the Urals differs from the taiga only by the presence of stands of *Pinus cembra*. On the high plateaux it ends with a horizon of *Alnus viridis* ssp. *fruticosa*.

Farming in the taiga is based on the spring grains (barley and oats), potatoes and feed crops. The rural landscape is often characterized by secondary deciduous stands of birch and aspen, growing on former clearings or burned-over land or exploited for wood.

### 5. *Mixed coniferous/deciduous boreal forest*

This zone extends southward to the beech limit in Scandinavia, the hornbeam limit in the Balto-Russian Plain and the silvo-steppe limit in central Russia. It corresponds roughly to the zone of the Eutric Podzoluvisols. The potential natural forest combines coniferous and deciduous species (elm, lime, Norway maple, aspen, birch, hazel). The spruce is dominant on humid, siliceous soils, pine on the dry siliceous soils and the deciduous trees on the better soils, which have generally been cleared. Most of the surviving forests have been converted into pure spruce or pine stands, the former being frequent in southern Sweden and western Russia (Valdai Plateau), the latter in the Baltic states and the Volga basin, where birch, aspen and linden forests are grown for exploitation. The *Alnus glutinosa* forest constitutes the natural vegetation of the valleys and low-lying marshlands.

Agriculture is based on grains (rye, oats, barley), potatoes and feed crops. Flax cultivation is a very old tradition in the Baltic states.

### 6. *Sub-boreal oak and pine forests*

This zone covers Belorussia and Poland as far as the eastern limit of the beeches. The potential natural forest on the Cambisols and Luvisols is basically oak, associated with hornbeam, lime, maple, elm, ash, aspen, birch and hazel, with a herbaceous undergrowth of temperate species (Tilio-Carpinetum); isolated spruce survive. The virgin forest of Bialowieza, Poland, displays typical examples of this vegetation.

The sandy Podzols, which occur in broad areas of central Poland, are covered by enormous cultivated pine forests derived from a natural forest made up of oak, Norway pine and *Betula verrucosa*, with an undergrowth of *Vaccinium* spp. and Pyrolaceae.

Broad forests of *Alnus glutinosa*, interrupted by peat bogs and reed stands, make up the primary landscape of the Pripet marshes.

The agriculture of the area is based on rye, barley, oats, potatoes and the exploitation of the humid prairies in the broad, flat valleys of the region.

### 7. *Boreo-atlantic oak/Norway pine forest*

The natural forest of this completely podzolized zone was made up of pedunculate oak, sessile oak, Norway pine, birch (*Betula verrucosa*, *B. pubescens*) and rowan (*Sorbus aucuparia*). It has, however, been replaced everywhere by grazing land covered by *Calluna vulgaris*, *Erica cinerea*, *E. tetralix*, *Empetrum nigrum* and *Arctostaphylos uva-ursi*.

The Histosols that cover the coastal relief of western Scotland and the Anglo-Danish islands bear extensive blanket bogs, probably climactic. Their flora also includes many arctic species, associated with atlantic species.

Agriculture is limited to the coastal strip (barley, feed crops), and traditional grazing remains the principal activity.

### Mesothermic temperate forest belt

#### 8. *Boreo-atlantic oak/birch forest*

This area of sandy ferro-humic Podzols was formerly covered by moors with *Calluna*, *Empetrum nigrum* (east of the Rhine), *Genista anglica* and *G. pilosa* (Calluno-Genistetum), but it has now been reforested everywhere with Norway pine or converted to agricultural use. The natural forest, of which only sparse stands remain, was constituted of pedunculate oak, birch and aspen (Querco-Betuletum), sessile oak (*Quercus petraea*) and beech also occurring on sandy or stony hillocks (Fago-Quercetum).

Grazing survives only on the Lüneburg heath (natural reserve). The principal agricultural uses are rye, potatoes, feed crops and temporary pasture.

The depeated plains (Histosols) and coastal polders (Calcic and Eutric Fluvisols) are mainly given over to permanent grassland.

#### 9. *Boreo-atlantic oak/holly forest*

This zone covers the greater part of the British Isles and includes two main types of natural forest.

A mixed oak forest with ash, elm, lime, hazel and holly (Corylo-Fraxinetum), with an undergrowth of *Endymion non scriptum* or *Primula elatior* and *P. vulgaris*, covered the Luvisols and clayey Cambisols and Gleysols of the English Midlands and central Ireland; it has now been mostly cleared. A mixed oak forest with sessile oak, *Betula verrucosa*, rowan and holly (*Ilex aquifolium*), with an undergrowth of honeysuckle (*Lonicera periclymenum*), bilberry and ferns (Blechno-Quercetum), corresponds to the Dystric Cambisols and the Luvisols; its potential area is very extensive in the hills and on the relief of Cornwall, Wales, the Pennines, Scotland and the Irish coast. Large areas have been replaced by moors on which the heathers (*Calluna*, *Erica cinerea*) are associated with several types of furze: *Ulex gallii* in the west, *U. minor* in the east, and *U. europaeus* everywhere. In the Pennines and Scotland, however, furzes are present only as synanthropic species.

Agriculture is cereal-based (wheat, barley, potatoes, sugar beet) in the fertile plains, given over to feed crops in the west and the clayey plains, and devoted to grazing on the moors.

#### 10. *Atlantic beech forests*

The cool, moist climate of this zone (700 to 1 200 mm of rainfall) is very favourable for beech forests. Several soil/vegetation profiles exist: acidophilous beech forest with holly (Ilici-Fagetum) on the Dystric Cambisols and the acid Luvisols with silicic clay; from neutrophilous beech forest with *Melica uniflora*, *Asperula odorata* and *Endymion non scriptum* (Endymio-Fagetum) on the Eutric Cambisols and the loessic Luvisols on calcareous or chalky deposits; and alkaliphilous beech forests with yew (*Taxus baccata*) on calcareous or chalk outcroppings. The sandy hills or granitic mountains carry much poorer oak/beech forests, with a bilberry undergrowth (Fago-Quercetum). The Podzols of the London basin and Brittany have long been overtaken by heather/furze moorland.

The beech resists less well on clay-marl soils and loessic Luvisols with a clay substratum; the forest is then replaced by mixed oak forest with ash, hornbeam and hazel, with an undergrowth of *Primula elatior*, *P. vulgaris* and *Endymion non scriptum* (Endymio-Carpinetum).

Intensive grain and sugar beet cultivation prevails on the plains and the loessic plateaux, and cattle-raising in the wooded districts of England, Normandy and Brittany. Silviculture is generally based on native species. The Norway pine has been introduced onto the sandy soils, the silver fir (*Abies alba*) in the Norman hills and the western American conifers for the afforestation of the Breton moors.

#### 11. *Sub-atlantic beech forests*

This zone covers an area of hills and plateaux whose altitude varies between 200 and 800 metres. The cool, humid climate (800 to 1 200 mm of rainfall) contributes to making it an excellent zone for beech. The Dystric Cambisols that cover broad areas on primary siliceous rock and Triassic sandstone carry an acidophilous beech forest with *Luzula nemorosa* and *Calamagrostis arundinacea* (Luzulo-Fagetum), replaced above 500 m by a mountain type with *Polygonatum verticillatum*. The Eutric Cambisols of the calcareous or chalky zones are covered by a neutrophilous and very productive beech forest with *Melica uniflora* and *Asperula odorata* (Melico-Fagetum), replaced at higher altitudes by a mountain type with *Dentaria bulbifera*. The calcareous outcroppings carry patches of beech with orchidaceous plants (Cephalanthero-Fagetum).

The loose sandy or sand-silt formations (siliceous Luvisols) carry more or less acidophilous oak/beech forests (Milio-Fagetum, Fago-Quercetum), while the schistic clays, the Lias marls and the alluvial soils have a sub-atlantic oak/hornbeam forest (Stellario-Carpinetum).

The entire zone is used for agriculture and forestry, with a tree cover of between 30 and 80 percent.

Many forests have however been modified by the system of coppices, replaced, on the siliceous plateaux, by grazing land with *Vaccinium* spp., or reafforested with spruce. At lower altitudes, agriculture is cereal-based; higher up, fodder is grown.

### 12. *Baltic beech forests*

Owing to its maritime climate the western rim of the Baltic is very favourable for beech, and the Dystric and Eutric Cambisols carry the same beech forests as in the preceding zone. Acidophilous oak/beech forests predominate, however, on the Luvisols of the old moraine. The sub-boreal nature of the zone becomes more marked toward the east, in the Leptic Podzols of Pomerania, where oak/beech forests with pine have generally been transformed into cultivated pine stands. Agriculture is cereal-based, with fodder crops predominating in the coastal areas.

### 13. *Sub-atlantic oak/hornbeam forest*

The natural forest is a mixed oak forest with pedunculate and sessile oak, hornbeam, ash, wild cherry, beech, lime and white-beam (*Sorbus torminalis*), with an undergrowth of sub-atlantic and Central European species (Pulmonario-Carpinetum). Beech becomes more abundant in the hills, at altitudes above 400 metres. Tongues of *Quercus lanuginosa* forest with *Buxus sempervirens*, *Acer monspessulanum* and *Colutea arborescens* already appear in the southern Jura, the department of Côte d'Or and here and there along the Rhine as far as Mainz, box not reaching beyond the Basel area.

The natural forest of the broad alluvial plains of the Rhine and Saône is still well preserved in Alsace and Baden. It consists of river forests of white willow (*Salix alba*) and black poplar (*Populus nigra*), swampy alder forests and alluvial forests with pedunculate oak, ash, *Ulmus carpinifolia*, *U. effusus* and *Prunus padus* (Alno-Padion).

Agriculture is essentially cereal-based, but vineyards cover considerable areas on the sunny slopes of Champagne, Burgundy, Alsace and the Rhineland, corresponding to original stands of *Quercus lanuginosa* and its associated flora.

### 14. *Central European oak/hornbeam forest*

The natural forest, of oak and hornbeam, is similar to the preceding one, but is richer in lime (Galio-Carpinetum) and has a well-defined Central European flora (*Anemone hepatica*, *Asarum europaeum*, *Lilium martagon*, *Melica nutans*, *Festuca heterophylla*, *Convallaria majalis* and *Galium sylvaticum*). At higher altitudes, above 400 m, greater quantities of beech appear, forming a transitional stage with the beech/fir mountain forests.

The warmer, drier enclaves of Bavaria, Bohemia and Moravia are characterized by xerophilous pedunculate oak forests with *Potentilla alba* (Potentillo-Quercetum) on loess, *Quercus lanuginosa* with *Dictamnus albus* (Dictamno-Quercetum) on calcareous rocks, sessile oak, lime, *Aira flexuosa* and broom (Genisto-Quercetum) on acid rocks. These xerophilous forests have often been degraded to scrub or pre-steppe meadow, when *Stipa pennata* is present, or reafforested with Norway pine and, on calcareous rocks, black Austria pine.

The Norway pine is native to the entire zone, on the gravels of the river banks, on the steep sandstone slopes and on the sandy Podzols of the Palatinate, Bavaria and the Linz area. The stands have been considerably expanded by afforestation, together with spruce, on the Bavarian plateau, in the foothills of the Austrian Alps and on the plateaux surrounding the Bohemian basin.

Agriculture everywhere is based on cereals and potatoes and, at the beech forest level, on grazing.

### 15. *Baltic oak/hornbeam forest*

The plain of the old moraine (Brandenburg, Prignitz), where the beech still occurs but without forming true natural beech forests, is characterized, on the fertile Luvisols, by forests of sessile oak with lime, hornbeam, beech, pine and *Melica nutans*, and on the Dystric Cambisols and the Podzols by acidophilous oak/pine forests (Querco-Pinetum, Molinio-Pinetum), which have themselves often been transformed into cultivated pure pine stands.

To the south (Thuringia, Saxony, Silesia) the potential forest of the loessic soils is an oak/hornbeam forest with lime, ash, wild cherry, Norway maple and sycamore (Tilio-Carpinetum); the beech reappears only at about 500 m, to form subcontinental beech forests with *Lathyrus niger* (Lathyro-Fagetum), particularly in the Thuringian Forest.

The principal crops are cereals and sugar beet.

### 16. *Montane beech/fir forest*

The reliefs lying in the oak/hornbeam forest belt are capped with beech/fir forests, beginning at about 500 to 600 m, after a submontane horizon of beech/oak stands. With the exception of the Franco-Swiss Jura, these massifs are constituted of crystalline or siliceous rocks, and the forests vary according to the exposure, beech prevailing on the more humid western slopes, while fir prevails on the drier inner slopes.

The beech/fir level ends, at about 1 100 m, in a horizon of subalpine beech spinneys and grasslands (nard, *Vaccinium* spp.). On the summits, *Pinus mugo* is occasionally found.

The Norway pine and spruce are native to certain massifs, but their area has been much expanded by planting.

A forest economy prevails throughout the zone, and grazing has declined considerably in favour of reafforestation.

17. *Alpine forest complex*

The high chains of the Alpine system (Pyrenees, Alps, Tatras, Carpathians, Balkan chains) have a very complex geobotanical structure that can be summarized as a series of three levels (montane, subalpine and alpine), which are themselves differentiated between a moist series in the massifs exposed to the oceanic winds and a dry series in the central valleys and on the lee slopes.

In the moist massifs the montane level is made up of beech/pine forest with silver fir (*Abies alba*) and islands of Norway spruce (*Picea abies*). This level is particularly well developed on the western and southern faces of the Alps, in the Carpathians and in the Balkan chains.

The subalpine level is made up of Norway spruce topped by a horizon of *Pinus mugo*, and grasslands with *Vaccinium* spp. and *Rhododendron*.

In the drier massifs of the central Alps, the montane level is made up of Norway pine, spruce and larch, and the subalpine level of *Pinus cembra* and *Larix decidua*, with a final horizon of *Pinus mugo* and alpine grasslands.

At both ends of the chain (Pyrenees, Rhodope and Balkan) the beech and fir forests are generally separated into two levels. In the Pyrenees the subalpine level is constituted by *Pinus uncinata*, while in the eastern chains (southern Yugoslavia, Balkan, Rhodope) it consists of spruce accompanied by endemic conifers (*Pinus peuce*, *P. leucodermis*, *Picea omorika*), with a terminal horizon of juniper and occasionally *Alnus viridis* (Rhodope).

The economy is based on migratory grazing of cattle and sheep in the pastures of the montane level and the nard fields of the subalpine level.

THERMOPHILOUS TEMPERATE FOREST BELT

18. *Franco-atlantic oak forests*

The thermophilous temperate forests are characterized by the appearance of submediterranean species and endemic oak, dependent upon warmer, drier summers than those in the mesothermic belt.

This is already true of the Franco-atlantic oak forests, which on Dystric Cambisols are made up of sessile oak, white-beam (*Sorbus torminalis*) and fruit trees (*Pyrus*, *Malus*), with undergrowth of holly and butcher's broom (*Ruscus aculeatus*); on the Eutric Cambisols by mixed oak forests of pedunculate oak, ash, sessile oak and *Quercus lanuginosa*, according to the humidity of the soil; and on the calcareous soils by forests of *Q. lanuginosa* and box (*Buxus sempervirens*).

The Podzols that cover large areas on the diluvial sands of the Loire region (Sologne, Brenne) and Aquitania have everywhere been occupied by moors with heather, *Erica cinerea*, *E. ciliaris*, *E. scoparia* (Aquitania) and reeds (*Ulex*). In Aquitania these moors have to a great extent been reafforested with the indigenous *Pinus maritima* in the belt of dunes, where cork oak (*Quercus suber*) is also occasionally spontaneous.

Agriculture is based on wheat and maize and on pasture grazing near the coast (Charente, Vendée) and in regions with clayey soils (Nivernais). Vineyards are to be found in the Loire valley and the Bordeaux area.

19. *Ibero-atlantic oak forests*

The dominant natural forest of the foothills of the Pyrenees and the Cantabrian mountains, on siliceous soils, is made up of pedunculate and sessile oak and *Quercus pyrenaica*, chestnut (*Castanea vesca*) having also been introduced at an early date. This forest runs along the mountain border of Old Castile as far as northern Portugal. Heath and grazing lands, with a wide variety of *Erica* and *Ulex*, also cover large areas in this zone. Patches of Mediterranean forest (*Quercus ilex*, *Laurus nobilis*, *Arbutus unedo*) appear here and there along the Galician coast.

Beech appears at 800 to 1 000 m altitude in the Cantabro-Pyrenean chain, this level terminating on the summits in beech thicket, sometimes with a horizon of *Betula celtiberica*. In the sierras of Castile, beech is replaced by Norway pine.

The economy is based on wheat and maize and on grazing. Reafforestation with *Pinus maritima*, *P. radiata* and *Eucalyptus* spp. has been undertaken in Galicia and northern Portugal.

20. *Insubrian oak forests*

In the Italian foothills of the Alps, where siliceous soils dominate as far as Lake Como, the forest is made up of pedunculate and sessile oak, *Quercus cerris* and chestnut, the latter everywhere introduced in ancient times and often dominant. The undergrowth is characterized in particular by

*Luzula nivea* and *Erythronium dens-canis*. The mildness of the climate around the major lakes has made it possible to introduce an exotic vegetation of palms, magnolias and camelias. To the east, where the climate is drier and warmer and the soils generally calcareous, an oak forest with *Quercus lanuginosa* and *Ostrya carpinifolia* is dominant, and black and Norway pine forests also occur. Olive groves, atypical of the zone, and patches of holm-oak begin to appear in the best protected sites.

The vast plain of the Po, devoted to intensive agriculture (cereals, maize, irrigated rice, orchards) and poplar plantations, originally bore a mosaic of alluvial oak forests with *Quercus robur*, *Q. cerris* and *Fraxinus ornus* and river-bank forests of willow and white and black poplar. The sandy Adriatic coast carries submediterranean formations of *Pinus pinea* and *Quercus ilex* in the environs of Ravenna.

### 21. *Pannonian oak forest*

The Pannonian plain corresponds to the area of a thermophilous oak forest with *Quercus cerris*, *Q. lanuginosa*, *Fraxinus ornus*, *Sorbus torminalis*, *Pyrus pyraster* and *Prunus mahaleb* alternating, in cooler exposures and on the more humid plateaux, with an oak/hornbeam forest of *Carpinus betulus*, *Fraxinus excelsior* and *Corylus avellana*. These forests continue up to 400 to 500 m, and then become a submontane beech forest with *Carex pilosa* and *Asperula odorata* on calcareous soils and *Luzula nemorosa* and *Melica uniflora* on siliceous soils.

*Quercus frainetto* appears in the eastern part of the zone, forming large stands in Transylvania with *Tilia argentea* and *Acer tataricum*.

Agriculture is based mainly on cereals (wheat, maize, sunflower, sugar beet) and fodder crops. Vineyards occur in western Hungary and the Vienna basin.

### 22. *Illyrian oak forest*

The Illyrian oak forest corresponds to a cooler, damper climate (700 to 1 000 m) and is characterized, in the Yugoslav karst, by oak/hornbeam forests with *Quercus cerris*, *Q. lanuginosa*, *Q. petraea*, *Fraxinus ornus*, *Carpinus betulus*, *C. orientalis* and *Ostrya carpinifolia*, with enclaves of black pine, which is often used for reafforestation. Chestnut is frequent in siliceous areas, particularly in Bosnia. Beyond 500 m, the oak forest becomes an oak/beech forest with *Carex pilosa* and *Erythronium dens-canis*, and this, in turn, becomes beech/fir forest beyond 800 to 1 000 m.

Agriculture is poor and not very intensive; the forests have suffered heavily from grazing.

The same zone may be considered to include the appreciably more fertile plains of the Sava and the Drava, whose Gleyic Luvisols carry a natural mixed oak forest renowned for its oak stands; it is made up of *Quercus robur*, *Carpinus betulus*, *Ulmus carpinifolia*, *Fraxinus oxyacarpa* and *Alnus glutinosa*.

### 23. *Balkan oak forest*

The Balkan forest is made up of the same varieties as the Illyrian, but includes numerous *Quercus frainetto*, *Tilia cordata*, *T. argentea* and various fruit trees (*Pyrus*, *Malus*, *Sorbus*), *Acer tataricum* being also present in Romania. The walnut (*Juglans regia*) appears here and there. On the calcareous soils, the forest is characterized by *Quercus lanuginosa*, *Acer monspessulanum* and *Fraxinus ornus*, but it is often degraded to xerophilous thicket with *Cotinus coggygria*. On the calcareous slopes of Serbia occur natural formations with lilac (*Syringa vulgaris*), *Acer monspessulanum* and *Euonymus verrucosa*.

Beech forest appears at about 600 m and then becomes beech/fir forest. In the foothills of the Rhodope and Balkan chain it includes stands of European beech and *Fagus moeasiaca* of hybrid origin.

## TEMPERATE STEPPE BELT

### 24. *Danubian steppes*

These steppes occupy the Hungarian or Pannonian plain (*puszta*) and the Romanian and Moldavian plain (*stepa*). The soils are Chernozems or Phaeozems in Hungary and Calcic Chernozems in the lower Danube basin. With a rainfall of 500 to 600 mm, the two areas form part of the silvo-steppe.

The natural vegetation is a prairie with *Festuca sulcata*, *Andropogon ischaemum*, *Agropyron cristatum*, *Koeleria gracilis*, *Stipa joannis* and *S. capillata*, to which should be added, in the Romanian and Moldavian plain, *Stipa lessingiana* and *Andropogon gryllus*. Natural wooded areas also subsist; they are characterized by pedunculate oak (*Quercus robur*, *Q. pedunculiflora* in the lower Danube basin), English elm (*Ulmus campestris*), ash, hornbeam and, in Romania, *Quercus lanuginosa* and *Q. frainetto*. The undergrowth is made up of thorny plants (*Malus*, *Crataegus*); *Acer tataricum* is also present in Romania. The saline steppes (Solonetz) east of Tisza are characterized by *Festuca pseudovina*, *Artemisia maritima*, *Aster pannonicus* and *Achillea setacea*. They are still grazed by traditional bovine and ovine breeds of the *puszta* (Hortobagy National Park).

The entire region is intensively cultivated with wheat, maize, sugar beet, sunflower and fodder crops.

25. *Russian steppes*

This steppe covers vast areas in southeastern Russia; it can be divided into three subzones.

The silvo-steppe (25a) (500 to 400 mm of rainfall) of leached Luvic Chernozems forms an ecotone with the temperate forest and still includes isolated stands of pedunculate oak, English elm, lime, maples (*Acer platanoides, A. tataricum*), aspen, birch and pine, with an undergrowth with *Anemone sylvestris;* the variety of trees decreases farther to the east. The Kuban silvo-steppe also includes *Acer campestre* and common ash, while that of the Baku basin is characterized by *Quercus lanuginosa, Carpinus orientalis, Pistacia mutica* and *Paliurus spina-christi*.

The grassy steppe (25b) (400 to 300 mm of rainfall) is without trees and carries only thickets of *Prunus divaricata* and *Amygdalus nana.* It corresponds in general to Haplic Chernozems.

The steppe proper is a prairie with *Festuca sulcata, Andropogon gryllus, Agropyron cristatum, Koeleria gracilis* and varieties of *Stipa: S. joannis, S. lessingiana, S. capillata* and *S. stenophylla.* Numerous small geophytes flower immediately after the spring thaw (*Iris, Gagea, Hyacinthus, Tulipa*), while many dicotyledons flower at the end of the spring (*Potentilla, Astragalus, Salvia, Campanula*, etc.). At their maximum, the grasses reach a height of 50 to 100 cm, according to the quantity of thaw and rain water.

The sodic Kastanozems of the southern plains of the Dnieper, the Don and the Volga (25c) (300 to 275 mm of rainfall) are characterized by slightly saline steppe, generally grazed, on which *Festuca sulcata, Poa bulbosa* and *Artemisia austriaca* dominate.

The steppes whose fertility is due to the Chernozems are cultivated widely (wheat, maize, sunflower, sugar beet); grazing subsists on the steppes with a sodic phase.

26. *Caspian steppes*

The saline plains exposed by the recession of the Caspian Sea (Solonetz and Haplic Xerosols) are covered by an open, interrupted steppe whose grassy constituents play only a secondary role, yielding to halophytes of the genera *Artemisia, Atriplex, Kochia, Limonium, Suaeda* and *Salicornia* as the salinity increases.

The economy is based on nomadic grazing.

MEDITERRANEAN BELT

Owing to its complicated physiography and a pronounced insular and peninsular endemicity, the Mediterranean region is a highly complex entity, which can best be defined on the basis of the levels that constitute it.

27. *Thermomediterranean level*

This level is essentially North African; in Europe it is coastal only, except for a major extension in southern Spain (Andalusia). Its potential natural vegetation would be a low, sclerophyllous forest with carob (*Ceratonia siliqua*), wild olive (*Olea oleaster*) and *Pistacia lentiscus* (Oleo-Ceratonion).

It is found at present only as coastal brush with *Euphorbia dendroides, Calycotome* and *Chamaerops humilis* in the west, and with *Euphorbia acanthothalamus, Genista anthoclada* and *Sarcopoterium spinosum* (phrygana) in the east of the Mediterranean basin.

The thermomediterranean belt is the best suited for olive-growing and, under irrigation, citriculture. In places sugar cane and even date palms (Elche, Spain) are grown.

28. *Xeromediterranean level*

This level constitutes only limited enclaves in Spain, in the Ebro basin (Xerosols) and in La Mancha. This present vegetation is a brush made up of *Quercus coccifera, Rhamnus lycioides* and junipers (*Juniperus phoenicea* and *J. thurifera*). The Aleppo pine (*Pinus halepensis*) is often also present. Certain North African *Stipae*, particularly *S. tenacissima* (esparto grass), are also found.

Pronounced extremes of temperature are observed, and the rainfall is below 500 millimetres.

29. *Mesomediterranean cork-oak level*

The sclerophyllous cork-oak (*Quercus suber*) forest occupies, in Europe, only a limited area on the Cambisols and siliceous Luvisols of the crystalline rocks of the Guadiana basin and the Corsican coast, with two enclaves in the Costa Brava and the Estérel massif of southern France.

Everywhere improved for cork-growing, it is characterized by an undergrowth of *Erica arborea, E. multiflora, E. scoparia* and *Cistus* spp., making it very vulnerable to fire.

The Podzols of the Setubal plain in southern Portugal belong to this zone; they are covered with subtropical grasslands with *Corema album.*

30. *Mesomediterranean holm-oak level*

The potential natural forest of this level is composed of evergreen holm-oak (*Quercion ilicus*), the species being distributed as follows: *Quercus rotundifolia* in the Iberian peninsula, *Q. ilex* in southern France and Italy, and *Q. calliprinos* in mainland Greece, the Aegean Islands, Asia Minor and Crimea. The undergrowth is always roughly the same: *Vibur-*

*num tinus*, *Rhamnus alaternus*, *Pistacia terebinthus*, *Arbutus unedo* (in the west), *A. andrachne* (in the east), *Ruscus aculeatus*, and the creepers *Lonicera etrusca*, *Clematis flammula*, *Smilax aspera*, and *Rubia peregrina*. The soils are for the most part brown or red Mediterranean soils (Eutric and Chromic Cambisols, Chromic Luvisols).

Very often the forest is replaced by stages of degraded bush (*Olea*, *Pistacia*, *Jasminum*, *Rhamnus*, *Arbutus*, *Smilax*, *Rubia*) or coppice with kermes oak (*Quercus coccifera*), cistes, junipers and Labiatae (*Rosmarinus*). These secondary formations have been afforested or reafforested by Aleppo pine and, in Asia Minor, by *Pinus brutia*.

The zone is given over to olives, grapes, almonds, figs, irrigated fruit and vegetable crops.

### 31. *Supramediterranean level*

This level lies between 400 and 1 000 m altitude, and its potential natural vegetation corresponds with deciduous oak forests, associated with maples (*Acer monspessulanum*, *A. opalus*, *A. campestre*), *Sorbus torminalis*, *S. domestica*, *Celtis australis*, *Cornus mas*, *Amelanchier ovalis*, *Colutea arborescens*, *Viburnum lantana*, *Ruscus aculeatus* and *Coronilla emerus*. The chestnut has been planted on the siliceous soils since an early date. The degraded surfaces are prairie with hemixylous Labiatae (*Lavandula*, *Rosmarinus*, *Thymus*). Endemic strains of Attic pine are associated with oak, mostly *Quercus lanuginosa*, which however is not found in the Iberian peninsula. Also occur, from west to east, *Quercus faginea* (Spain and Portugal) with *Pinus sylvestris* and *P. clusiana* (Sierra Nevada) (31a); *Quercus lanuginosa* and *Pinus salzmanni* (southern France) (31b); *Quercus cerris*, *Fraxinus ornus* and *Ostrya carpinifolia* (Ligurian pre-Alps, Apennines and Sardinia), with *Pinus heldreichii* in Calabria (31c); *Quercus frainetto*, *Q. cerris*, *Q. trojana*, *Carpinus orientalis* and *Pinus pallesiana* (Greece and Asia Minor) (31d); *Quercus lanuginosa*, *Carpinus orientalis*, *Pistacia mutica*, *Juniperus excelsa* and *J. foetidissima* (Crimea) (31e); *Quercus pseudocerris*, *Ostrya carpinifolia*, *Carpinus orientalis* and *Pinus pallesiana* (Taurus) (31f).

The economy is based on cereals, grazing and forestry.

### 32. *Oromediterranean level*

The oromediterranean level begins at about 1 000 m altitude, when beech appears on the northern face of the Mediterranean basin: *Fagus sylvatica* in the west (Cévennes, Maritime and Ligurian Alps, Corsica, Apennines), *F. moeasiaca* in the east (Greece, Bulgaria), and *F. moeasiaca* and *F. taurica* in Crimea. Strains of black pine (*Pinus nigra*) also form stands on the steep slopes of Corsica, Calabria, Dalmatia, Bulgaria and Crimea, penetrating considerably into the supramediterranean level.

When the altitude allows, firs can form a subalpine level in the humid massifs between 1 500 and 1 800 m: *Abies alba* in the Cévennes, Corsica and the Apennines (with several islands of *Picea abies* and *Pinus mugo* in the central Apennines), *Abies pinsapo* in the Sierra Nevada of Andalusia, *A. nebrodensis* in Sicily, *A. borisii-regis* in norhern Greece, *A. cephalonica* in southern Greece and the Peloponnesian peninsula, *A. bormülleriana* south of the Dardanelles and *A. cilicica* in the Taurus.

In the massifs farther to the south, fir is replaced by cypress (*Cupressus sempervirens*), e.g., in Greece, Crete and Cyprus, and sometimes by cedar (*Cedrus libani*), of which islands subsist in the Taurus, on Cyprus and in Lebanon. The cedar forest level is, however, well developed only in North Africa (*Cedrus atlantica*).

The alpine level is often characterized by thorny thicket.

## Pontic belt

Lying in the same latitudes as the Mediterranean region, the temperate domain of the Pontic vegetation is closely linked to the Asian and, as bounded here, its structure is highly heterogeneous.

### 33. *Colchian forest*

This forest occupies the eastern coastal areas of the Black Sea and enjoys a warm, humid climate which makes possible the survival of a luxuriant endemic forest of the ombrophilous temperate type. It is characterized by Euxino-Hyrcanian varieties: *Fagus orientalis*, *Castanea vesca*, *Zelkova crenata*, *Acer laetum*, *A. campestre*, *A. platanoides*, *Diospyros lotus*, *Carpinus betulus*, *C. orientalis* and *Corylus colurna*. The undergrowth is made up of evergreen bushes: holly, box, cherry, laurel, *Rhododendron ponticum* and *R. flavum*. The alluvial forests of *Alnus barbata* and *Pterocarpa fraxinifolia* are rich in creepers (*Hedera colchica*, *Vitis sylvestris*, *Periploca graeca*, *Smilax*, *Humulus*, etc.).

The Colchian forest is related to the Caspian or Hyrcanian forest.

### 34. *Pontic forest*

The northern face of the Pontic chain carries a lower coastal level of oak forest with *Ostrya carpinifolia* and *Carpinus orientalis*, related to the Balkan forest.

At the montane level it is replaced by beech forests of *Fagus orientalis*, which disappear as soon as the inner face of the chain is reached.

35. *Substeppe oak forests*

The southern face of the Pontic chain is characterized by often degraded forests of *Quercus anatolica*, *Carpinus orientalis* and *Sinus sylvestris*. This formation continues on the relief of Georgia, Armenia and Azerbaijan, where the oak is associated with *Carpinus orientalis*, *Pistacia mutica* and *Paliurus spina-christi* (schibljak forest). At higher altitudes, thin stands of endemic pines and junipers dominate.

36. *Orocaucasian forests*

The massif of the Caucasus and its Pontic prolongation are covered with beech/fir forests with *Abies nordmanniana*, which continue to an altitude of 2 000 m; the zone also contains stands of *Pinus sylvestris* and of *Picea orientalis*.

The subalpine level, affected by the climate of the steppe, carries oak/pine and juniper forests with *Quercus pontica* in the west and *Q. iberica*, *Q. macranthera* and *Juniperus excelsa* in the east.

37. *Anatolian steppe*

The Anatolian steppe of the central depression (Tuz Göl region; Lycaonia) is related to the Irano-Turanian steppe; it carries *Artemisia fragrans*, *Astragalus*, *Acantholimon* and various Chenopodiaceae. The surrounding plateaux and eastern Anatolia, on the contrary, are covered by a more or less highly degraded silvo-steppe, with islands of caducifoliate oak (*Quercus anatolica*, *Q. look*) and, at higher altitudes, orophilous junipers, particularly *Juniperus excelsa*.

In the Euphrates basin, nearing the Syrian border, the steppe becomes semi-desert, with a considerable number of Saharo-Syrian species.

## Physiography *

Europe is not a separate land mass, but should be considered as a large peninsula of the great Eurasian continent, reaching westward with many promontories between the Arctic Ocean on the north, the Atlantic on the west and the Mediterranean on the south. Toward Asia, the medium-sized Urals and the chain of the Caucasus are generally considered to be its natural boundaries. Europe is therefore surrounded by water everywhere except to the east, and has a longer coastline for its size than any other continent. In addition to a large number of islands, Europe also includes several inland seas and many lakes, most of which are situated on the moraine of the northern lowlands.

About two thirds of Europe consist of a large plain stretching between the Scandinavian mountains, the Scottish and Irish highlands and the mountain system of the Alpine complex and its Hercynian extension. There are several smaller, but important, plains, several of which form part of the great central plain.

In the legend of Figure 6 the order of presentation of these units has been modified in order to demonstrate stratigraphic age and, therefore, does not correspond exactly with the text.

1. Huronian peneplain (Baltic or Fennoscandian Shield)
2. Russo-Siberian shelf
3. Caledonian mountain system
4. Hercynian mountain system
5. Secondary shelves and tabular regions
6. Alpine mountain system
7. Basins partially filled with Quaternary deposits
8. Volcanic massifs, active volcanoes

— — — Boundaries of the last and maximum glaciations

▬▬ Fold axes

### Lowlands

The greater part of the European plain lies toward the east and includes the vast continental area of the USSR. To the west, one branch extends around the Gulf of Bothnia and the Swedish coast of the Baltic, while another arm makes up northern Germany and Denmark, reaching into the lowlands of the Netherlands, Belgium and western France, where it follows the line of the Bay of Biscay to the Pyrenees.

Among the more isolated European plains, the two largest lie in the Danube basin, being separated by the gorges of the Iron Gate. The upper plain, surrounded by mountains, is the Hungarian *puszta*, while the lower, which is a southern extension of the Russian lowland, is the Romanian plain, passing into the reed swamps of the Danubian delta. Southern Europe has only one large plain: that of Lombardy, including the Po valley. The southern mountain chain contains several smaller plains, particularly in Spain; these include the valleys of the Ebro and of the Guadalquivir. Most of the intermontane basins of southern Europe, although filled with

* Text by Professor R. Tavernier, Université de l'Etat, Ghent, Belgium.

Tertiary and Quaternary deposits, lie at relatively high altitudes, as for example the plateaux of Old and New Castile.

The lowlands are formed of materials of different origin and composition. Four main structural types of morphology can be identified: the Huronian peneplain, the Russo-Siberian shelf, the shelves and tabular regions of secondary deposits and the basins partially filled in with Tertiary and Quaternary sediments.

*The Huronian peneplain*, generally known as the Baltic or Fennoscandian Shield, comprises mainly Sweden, Finland, and extreme northwestern Russia. It is Precambrian in origin, and its altitude is generally less than 300 metres.

*The Russo-Siberian shelf* is the southern continuation of the Baltic Shield. The formations of the Shield are covered by subhorizontal deposits, mainly Palaeozoic, and the altitude of this great plain, generally below 200 m and rarely higher than 300 m, makes the development of large river systems possible.

*Shelves and tabular regions* of secondary deposits constitute the western extension of the Russo-Siberian shelf north of the Carpathians, occupying the greatest part of Poland and all of Denmark and northern Germany and reaching into southern Germany and France. They also occupy large areas in southeastern England and southern France, where the relief is slightly rolling.

*Basins* partially filled with Tertiary and Quaternary deposits, as a result of later subsidence, occur in both plain and intermontane situations. The lowland basins are those of the Thames and the central part of the Parisian basin, as well as the basins of the lower Meuse and Rhine, the Caspian, the lower Danube and the Garonne, the two latter being partially surrounded by mountains and lying, in part, at somewhat higher altitudes. The great depression of central Danube (Hungarian *puszta* and Transylvanian depression), the Lombardy plain, the upper Rhine valley and the depression of Bohemia-Moravia are regarded as intermontane basins. The basins of the Iberian peninsula and Anatolia generally lie at relatively high altitudes.

### HIGHLANDS AND MOUNTAINS

Three systems of highlands and mountains can be identified in Europe: the Caledonian, the Hercynian and the Alpine, corresponding to different geological periods of folding. Older orogenies are responsible for the formation of the Baltic Shield, which is composed of strongly metamorphosed rocks. The Huronian orogeny, also of the Precambrian period, has left only a few traces in northern Norway, the Lofoten Islands and the Outer Hebrides.

*The Caledonian system* extends from Ireland and Wales, through Scotland, to Scandinavia and Spitzbergen. Traces of the Caledonian orogeny also survive in Western Europe (Brabant massif, Ardennes, etc.). This system originated in the Silurian period, but was gradually eroded so that finally the landforms have lost most of their sharp profile. The system is not a well-defined mountain chain, but rather a series of broad plateaux interrupted by narrow, deep valleys (fjords) due to an uplift running northeast to southwest. The largest of the renewed Caledonian folds forms the Scandinavian mountains bordering the Huronian peneplain along the Atlantic.

*The Hercynian system* was formed at the end of the Carboniferous period. Two distinct arcs are apparent: the western, or Armorican, arc, running WNW-ESE, and the eastern, or Variscan, arc, running NE-SW. Southern Ireland, south Wales, Devon, Cornwall, Brittany and the western part of the French Massif Central belong to the Armorican arc, while the Variscan arc dominates in the eastern part of the Massif Central and in the Ardennes, the Rhine upland, the Vosges, the Black Forest, the Harz and the Bohemian mountains. The Urals, the western part of the Iberian peninsula, Sardinia and Corsica are also outliers of the Hercynian system.

The Hercynian system, after its uplift in the late Palaeozoic, was largely eroded, base-levelled and partly covered by Mesozoic and Cenozoic sediments. The remains can be identified only where blocks of the Hercynian floor have been raised again and stripped of their covering. Some blocks, such as the Massif Central, emerged relatively early. These Hercynian massifs constitute an important, repeated feature of the landscape. Usually they are smooth, level upland surfaces rather than true mountains, and often attain altitudes above 1 000 m. They consist mainly of hardened sediments that resist weathering and stand as medium-sized mountains, while the intervening zones of younger sedimentary rocks tend to give a lower, more uniform profile to the landscape.

*The alpine folds* form a complex series of mountains, mostly of the Tertiary period, that occupy southern Europe and border the Mediterranean from Spain to Turkey. Beginning in the west with the Sierra Nevada, the Catalan mountains and the Pyrenees, they culminate, beyond the Gulf of Lions, in the majestic arc of the Alps, curving from WSW to ENE. From the western end of the arc an extension swings first southward, then eastward in the Maritime Alps and finally toward the southeast, to traverse Italy as the Apennines, curving westward again through the toe of the Italian "boot" into Sicily. From the eastern end of the Alps two main branches fork off, one to the southeast where, as the Dinaric Alps, it runs into the Balkan peninsula, while the other runs northeast beyond the Danube and continues in a long S curve to form the Carpathians, the Transylvanian Alps and the Balkan mountains; the high mountains of the Caucasus and the chains of Asia Minor continue the Balkan formations.

To the northwest, parallel to the main chains of the Alps, lies the small range of the Jura mountains.

The alpine chains reach very high altitudes: 3 480 m in the Sierra Nevada; 3 404 m in the Pyrenees; 4 810 m (Mont Blanc), 4 638 m (Monte Rosa), and 4 275 m (Finsteraarhorn) in the western Alps; 4 052 m (Pic Bernina), 3 902 m (Ortler) and 3 798 m (Grossglockner) in the eastern Alps; 2 921 m in the Apennines; 2 663 m in the Carpathians; 2 925 m in the Balkans; 5 630 m in the Caucasus; and 2 918 m in the Dinaric Alps.

*Ice fields* and *glaciers* cover only a very limited area, except in Iceland and Norway, although during the Pleistocene icecaps covered Iceland, Fennoscandia, most of the British Isles and large parts of central and eastern Europe. These masses of ice had a profound influence on the surface of the land over which they moved. When the ice retreated, areas with a typically glacial landform, with lake-filled hollows, drumlins and accumulations of boulders or sand and clay, were left behind. Around the ice sheet, aeolian sand and silt were deposited, and these deposits are extremely important for the composition of the soils since they often mantle the older rocks.

*Volcanic massifs* are not very extensive in Europe, except in Iceland where volcanic activity is still very strong and the entire country is covered by comparatively recent volcanic sediments. But Iceland, rather than belonging to the Europe of the older geological epochs, forms part of the Atlantic volcanic belt, one of the great volcanic regions of the earth. There is still a group of active volcanoes (Etna, Vesuvius, Stromboli) in Italy.

Extinct volcanoes exist in many parts of Europe: the Auvergne province of France, the west coast of Scotland and northeastern Ireland, the Eifel and Vogelsberg in Germany, Bosnia in Central Europe, the Carpathians, Turkey, Greece (the Cyclades), Italy (Latium), Sardinia and Portugal.

## Geology and lithology *

It is no easy matter to give an overall view of European geology and lithology in a few pages. In the first place, there are wide differences in the quantity of data available: for some countries they are plentiful, while for others they are relatively scarce. Second, the very complexity of the subject often makes it necessary to resort to excessive generalizations. Finally, the very small scale of the map in Figure 7 has led inevitably to combining certain well-defined units into heterogeneous groups.

In Figure 7, which is the result of several compromises, emphasis is placed on outcrops, classified by their geological age, their lithology being specified to the extent possible. It is therefore a map of surface geology and lithology, in which aspects have sometimes been grouped together for convenience, while an effort has been made to show a maximum of information. Rock types indicated are those most representative of the map unit; other rock types occur within the areas delineated, but they are relatively inextensive.

The Quaternary cover is shown on a separate map (Figure 8).

The geological formations dealt with are:

1. Precambrian
2. Palaeozoic
   - 2.1 Cambrian
   - 2.2 Silurian and Ordovician
   - 2.3 Devonian
   - 2.4 Carboniferous
   - 2.5 Permian
3. Mesozoic (not specified)
   - 3.1 Triassic
   - 3.2 Jurassic
   - 3.3 Cretaceous
4. Tertiary
   - 4.1 Palaeocene
   - 4.2 Neocene
5. Quaternary (not specified)
6. Volcanic rocks (not specified)

### 1. Precambrian

The substratum of the Precambrian is made up of the Archean; its rocks are essentially metamorphic (gneiss, micaschist, amphibolite, phyllite, etc.), with frequent intrusions of plutonic rock (particularly granite).

The Algonquian, which forms the crown of the Precambrian, often covers the Archean in an irregular manner; it is characterized by sedimentary rocks, especially conglomerates, sandstones, limestones and schists.

*Text by Dr R. Vermeire, Université de l'Etat, Ghent, Belgium.

In Europe, important Precambrian outcrops occur in the Baltic or Fennoscandian Shield, which includes southern Norway, Sweden, Finland and the northwest of the USSR (Kola Peninsula and Karelia). To the southeast, in the outlier of this shield, the Sarmatian Shield, the Precambrian rocks are mantled by Quaternary sediments west and southwest of Kiev and north of the Sea of Azov.

The Precambrian outcrops in the Hebrides and in northern Ireland and Scotland. The Hebrides and northwest and northeast Scotland are constituted of gneiss, while southeastern Scotland and northern Ireland are made up of micaschists, phyllites and quartzites. The Grampian Hills form the southern boundary of the Scottish Precambrian.

Much of the Armorican massif in western France, chiefly the granites and metamorphic rocks such as phyllites and quartzites, is also Precambrian.

It is now generally agreed that much of the metamorphic rock of the Massif Central and the Vosges is of Precambrian origin.

Lastly, Archean Precambrian rock is found in Bohemia, and Algonquian schists and sandstones in the Prague area.

## 2. Palaeozoic

### 2.1 *Cambrian*

The nature of the Cambrian outcroppings varies considerably according to whether the rocks were formed in an epicontinental or a geosynclinal zone.

Northern Europe, and especially the Fennoscandian Shield, the Hebrides and northwest Scotland, make up an epicontinental zone, in which the abrasion of the Precambrian massifs left neritic and littoral formations of conglomerates, arkoses and coarse sandstone.

In northern Norway the principal outcrops are conglomerates and arkoses, while in southern and southeastern Finland and the Oslo area coarse sandstones predominate. In the Hebrides and northwestern Scotland conglomerates, coarse sandstones and Dolomitic limestones are found. Basic Cambrian conglomerates outcrop in eastern Ireland and Wales.

During the Cambrian period, most of Western Europe formed a large geosyncline which received deposits, several thousands of metres thick, made up of very fine sediments that often were subsequently metamorphosed. These are the fine sandstones, schists and phyllites that are found on the Norwegian coast, where they are difficult to distinguish from similar rocks of the Ordovician and Silurian. The same rocks are found in Wales.

In the Ardennes, around Rocroi, Serpont and Stavelot, a few small Cambrian outcrops are found, mostly of schists and slates.

In France the Cambrian rocks of the Montagne Noire are sandstones, schisty sandstones, limestone schists and limestone. In the Armorican massif the Cambrian forms synclines that show outcroppings of conglomerates, red and green schists, limestones and arkoses. Cambrian schists and limestones exist in southern and eastern Sardinia.

Cambrian rocks (conglomerates, sandstones, limestones, quartzites and gneiss) outcrop in the northwestern Iberian peninsula. Plutonic rocks, chiefly granites dating from the Cambrian to the Permian, cover large areas there and in central Spain.

### 2.2 *Silurian and Ordovician*

It is often very difficult to distinguish between these two formations, and for this reason they are grouped together in the text and in Figure 7.

The Silurian and Ordovician are important principally in southern Scotland, northern England and Wales, where four lithological types can be distinguished: black schists with intercalations of phtanites, autochthonous schisty sandstones, volcanic basalts and tuffs and neritic limestones. These units form long outcrops running parallel to the folds of the Caledonian orogeny, i.e., southwest to northeast.

The Silurian and Ordovician rocks border the Fennoscandian plain. To the west the outcrops are mostly neritic rocks (coarse sandstones) that are often difficult to distinguish from other Cambrian rocks; farther to the northwest, much of Norway is covered principally with Silurian metamorphic rocks, at times associated with plutonic rocks (granites and gabbros). In southern Sweden, at the rim of the Fennoscandian Shield, schists and limestones appear, while in the northwestern USSR only limestones are found.

Much of the Urals is made up of Silurian and Ordovician rocks, chiefly sandstones, often associated with Palaeozoic volcanic and plutonic rocks, both acid (granite) and basic (gabbro).

In Western and Central Europe Silurian rocks cover a relatively limited area: there are sandstones and schists in Brittany and Normandy, schists in the Boulogne area, the Ardennes, and the massifs of the Rhine and Thuringia, and schists and limestones in Bohemia.

In Southern Europe these formations are found scattered in the northwest and centre of the Iberian peninsula, the Pyrenees, the Montagne Noire, the eastern Alps and Sardinia. They are mainly schists, occasionally limestones and only exceptionally sandstones, often metamorphic.

In northern and eastern Turkey there are outcrops of Silurian schists, often metamorphosed into slates. For lack of data on the age of these rocks, they have been grouped with similar rocks of other periods of the Palaeozoic.

### 2.3 *Devonian*

The seas of the Devonian covered vast areas of western, southern and eastern Europe.

Their lithology is highly uniform in southern Sweden, in Norway and in the British Isles, except for southern England: the outcrops are conglomerates and particularly red sandstones. This is also true of much of the northwestern USSR, where the sandstones have been mantled by glacial till and outwash.

The Ardennes, the Eifel and the schisty Rhine massif are, from the point of view of their lithology, highly diversified, the most important rocks being conglomerates, sandstones, arkoses, greywackes, psammites and limestones. The same variety is found in the Harz Mountains and in Bohemia.

In the area of Boulogne, in France, the rocks are conglomerates, sandstones and limestones, whereas in Brittany they are chiefly limestones, schists and metamorphic sandstones.

In the Pyrenees, the western Iberian peninsula and Sardinia, the outcrops are mostly schists, sandstones and limestones, often metamorphosed into slates, quartzites and marble respectively.

The Devonian outcrops in large areas of the Urals as schists and sandstones.

Volcanic activity was relatively strong in Scotland, Sweden and the Urals during this period, and intrusions of volcanic rock are found there.

### 2.4. *Carboniferous*

The seas of the Carboniferous covered much of Western Europe and the eastern part of European USSR.

These formations outcrop in northern and western England and in Ireland. They are composed essentially of limestones, sandstones, arkoses and schists, with productive coal seams intercalated between the sandstones and the schists. In some areas granites formed by magmatic action metamorphosed some of the surrounding sediments.

In the Franco-Belgian sector, outcrops appear in the Namur and Dinant basins; these are mostly limestones and schists, with productive coal seams between series of schisty sandstone. The same structure is observed in the Ruhr, where the Carboniferous is equally important.

Continental deposits (thick series of schists, sandstones and conglomerates, with intercalated coal seams) are found in the Saar.

In Brittany the Carboniferous appears as a facies of flysch, composed of heterogeneous formations of schists, sandstones and conglomerates. This is also true of most of the Carboniferous outcrops of the Pyrenees and the Alps. The Vosges and the Massif Central also have a facies of flysch, but volcanic activity has led to the intercalation of magmatic rocks.

In southwestern Spain and southern Portugal the Carboniferous outcrops consist of marine sediments (schists and limestones) or continental sediments (conglomerates and sandstones), with intrusions of coal. In these areas the Carboniferous rocks are often associated with granitic plutonic rocks, which have metamorphosed them.

The Carboniferous in central Russia is composed of limestones that have been mantled by Quaternary deposits. The Ural contains limestones, but also flysch, both often associated with volcanic rocks.

### 2.5 *Permian*

Permian rocks are abundant in Eastern Europe, and especially in the USSR, where they outcrop over large areas or are covered by Quaternary deposits. West of the Urals, they are mostly of marine origin (limestones and dolomites). Elsewhere they tend to be continental or to have been formed in shallow seas, being sandstones, schisty sandstones, clays and marl.

In Germany the Permian is found near Erfurt and south of the schisty Rhine massif; the formations are partly marine and partly continental, consisting of red sandstones, conglomerates, schists, dolomitic limestones, gypsum and anhydrite.

In France continental formations in Normandy, the Vosges, the Alps and the Pyrenees consist of red sandstones. Sandstones and schists are found in the Massif Central.

The Permian rocks of central England are associated with the Carboniferous: conglomerates and red sandstones, schists, limestone and marl.

Continental Permian rocks have been reported in the Salamanca area, while in southern Spain rocks of the same period, but with a facies of flysch, outcrop east of Cádiz.

In Yugoslavia and southern Turkey the Permian sediments are mostly of marine origin (limestones and dolomites).

## 3. MESOZOIC

### 3.1 *Triassic*

Southern, southeastern and part of Central Europe were submerged during the Triassic, while on the rest of the continent erosion was strong and autochthonous sediments were deposited.

The Triassic is particularly extensive in central Germany, where it is partly marine and partly continental in origin. The continental sedimentation is composed of clays, schists and particularly sandstones; the marine deposits consist of different limestones, marls and occasional sandstones. The same structure is observed in the Vosges, the eastern and northeastern borders of the Parisian basin and in southern France.

In central England the Triassic covers a relatively large area with continental sandstone and lacustrine marl deposits.

In the Pyrenees the Triassic outcrops rarely; its rocks are primarily limestones and sandstones.

A very large area of the central USSR consists of a sandy continental Triassic mantled by Quaternary deposits.

In Southern and southeastern Europe the Triassic is of marine origin. It covers a large part of the Alps. In the western Alps the structure is fairly complex, with coarse sandstones, dolomites, schists and limestones, metamorphosed in some places to quartzites, marble, slates, phyllites and gneiss. In the eastern Alps the Triassic structure is much simpler, consisting mostly of limestones and dolomites, with secondary series of schists and sandstones outcropping in southern Germany, Austria, northern Italy and Yugoslavia. Minor outcrops of these rocks are also found in Corsica, Sardinia, Sicily, southern Italy, southern Greece, the island of Crete, Cyprus, the Balkans, western Turkey and the Caucasus.

### 3.2 *Jurassic*

Jurassic outcrops are numerous in Western Europe, while in Central and Eastern Europe the Jurassic is for the most part covered by Quaternary deposits.

The Jurassic is of great importance in France, England and Germany. In France it appears in the Jura, on the northern and western borders of the Parisian basin, in Aquitania and in the Alps as various limestones and also marls, clays and sandier sediments. Some of these deposits, e.g., on the eastern border of the Parisian basin, are rich in iron ore. In the French and Swiss Alps, the Jurassic includes schists and dolomites in addition to the limestones, and these rocks are often metamorphosed into marbles and mica schists (*schistes lustrés*).

In England and Germany the Jurassic outcrops are for the most part limestones, but they also contain sandstones and calcareous sandstones.

In the Pyrenees, eastern Spain and western Portugal the Jurassic is composed of limestones, calcareous schists and dolomites, and the same is true for the Balearic Islands, Sardinia, Sicily and central and southern Italy. In northern Italy, Yugoslavia, Greece, Bulgaria and the Caucasus, the Jurassic is represented almost entirely by limestones.

In northern Poland and central Russia, it is primarily clayey.

### 3.3 *Cretaceous*

The seas of the Cretaceous covered all Europe except Scandinavia and northwestern USSR, so that rocks of this period are found as more or less extensive outcrops in most countries of the continent. Unlike the rocks of the Upper Cretaceous, those of the Lower Cretaceous are chalky.

Zones of Lower Cretaceous with almost identical lithological structures are found in southeastern England, northern France, Belgium, northern Germany, Poland and central Russia; they are composed of sands, clays, marls and limestone marls to which, in Russia, should be added phosphatic sandstones.

In the Parisian basin and the Jura the Lower Cretaceous is made up of limestones, clays, marls and greensand. In the western Alps marls and limestones predominate, while farther east the limestone schists are more abundant.

All these Lower Cretaceous formations also outcrop in the Pyrenees, western Portugal, eastern Spain, Yugoslavia, the Carpathians, the Balkan massif and the Caucasus.

The Upper Cretaceous constitutes much of the Parisian basin, where its structure is fairly varied, being primarily chalky but also containing marls, limestones and sands. These formations are also found in England, Belgium and the Netherlands.

In Germany, northern Denmark and southern Sweden the pattern is still more varied, with sands, sandstones, limestone marls, marls, and chalks. These rocks, often with greensand, cover large areas of central USSR, Czechoslovakia and Poland, mantled in many places by Quaternary sediments.

In the Mediterranean region the Upper Cretaceous generally presents a facies of flysch, made up of a combination of sandy, schisty and calcareous sediments. These formations also outcrop in the Pyrenees, eastern Spain, southern Italy, western Yugoslavia, Greece and Turkey. In the latter country they are often associated with volcanic rocks of the same period.

## 4. Tertiary

### 4.1 *Palaeocene*

During the Palaeocene the sea covered much of Europe, but not Scandinavia, the northern USSR, Ireland, Scotland and parts of Central Europe and Spain.

In France the Palaeocene is most apparent in the Parisian and Aquitanian basins. In the former, it appears as marine sediments, saline or fresh, in a very diversified structure: sands, sandstones, clays, travertines, limestones and various marls. In Aquitania the sediments are marine and continental, being composed for the most part of sandstones, limestones, marls and conglomerates. In the French Alps are found scattered remains of Palaeocene rocks as marine or continental formations or flysch.

In southeastern England, Belgium, northern Germany and northeastern Denmark the Palaeocene is made up of series of sands and clays, often with greensand; in Germany, limestones are found in association with these.

In northern and central Spain the Palaeocene is both marine and continental, appearing as limestones, marls and sandstones. In southern Spain and in central and southern Italy it has a facies of flysch made up of heterogeneous sediments, mostly limestones and shales. This is also true of the Carpathians, central Yugoslavia, Greece and northern Turkey, the flysch being composed of heterogeneous schists and sandstones.

In western and southern USSR the Palaeocene sediments, covered by Quaternary deposits, are primarily clays and sands (including greensand), sandstones and marls.

In western Turkey volcanic rocks of the Palaeocene period cover large areas.

### 4.2 *Neocene*

The Neocene is an important period for Southern Europe. All the areas around the Mediterranean were submerged, so that marine sediments were deposited. From the Carpathians to the Urals lacustrine rocks were formed.

Farther north this period appears as marine transgressions in northwestern France, northern Belgium, the Netherlands, northern Germany and southern Denmark. The other Neocene formations are all of continental origin. These sediments appear as repetitive series of sand and clay; in most cases they have been covered by a Quaternary deposit.

In Southern Europe the diversity of the lithological pattern is relatively great. In the Aquitanian basin, western Portugal and southern Spain, conglomerates, sandstones, sands and limestones are found, while north of the Alps, in Switzerland, southern Germany and Austria, the formations are molasse, particularly greensand limestones. Gravels are also often found, and in southern Germany and Austria marls and limestones appear as well.

Conglomerates, sandstones, and marls were formed in Italy, north of the Apennines; in the centre and south of the peninsula, flysch and limestones are found.

In Eastern Europe the Neocene can be both marine and continental. The marine rocks are mostly limestones, marls and sandstones, while the continental deposits are gravels, sands and clays. In this region the Neocene is often covered by a Quaternary layer.

Large masses of volcanic rock were formed in several places in Europe during the Neocene: Iceland, France, Italy, northern Ireland, northwestern Scotland, Germany and Turkey.

## 5. Quaternary

This most recent of the geological periods has left its mark on almost all of Europe. The influence of the sea has been slight, and clayey marine deposits are to be found only on the Belgian, Netherlands and German coasts. North of the Caspian Sea lies a large area of Pleistocene marine clay.[1]

All the other Quaternary formations are continental. They are of the greatest importance for the soils, because they often furnish the original soil material, and for this reason among others the Quaternary sediments have been shown on a separate map (Figure 8). The most common are of glacier, outwash and wind origin. Sand, loess, glacial till and gravels mantle vast areas of Western, Northern and Central Europe. River, drift and colluvial deposits are everywhere present, but altogether they do not cover a large area except probably in the region southwest and south of the Urals.[2]

During the Quaternary period volcanic activity has been particularly active in central France, Germany (the Eifel), Italy, southern Greece, central and eastern Turkey and Iceland.[3]

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[1] Except for these marine alluvia (area 5), the other Quaternary formations are not shown on Figure 7.

[2] Shown as "Unspecified Quaternary sediments" on the map of Quaternary sediments.

[3] In Figure 7, all volcanic rocks are shown under 6, without distinctions of age.

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# 5. THE SOILS OF EUROPE

The Soil Map of Europe includes several hundred map units, the vast majority of which are composed of several soils occupying characteristic positions in the landscape. All the soil associations are listed in Table 3, which gives the following information:

*Map symbol.* The map symbol of the dominant soil, followed by a digit specifying the composition of the soil association, a dash, a second digit (or pair of digits) indicating the textural class, and a small letter (or two letters) indicating the slope class of the soil association. Textural class numbers are: (1) coarse, (2) medium and (3) fine. Slope class letters are: (a) level to undulating, (b) rolling to hilly and (c) steeply dissected to mountainous.

*Associated soils.* Soils with an extension of more than 20 percent of the mapping unit.

*Inclusions.* Soils with an extension of less than 20 percent of the mapping unit.

*Phase.* Stony, lithic, petrocalcic, phreatic, with fragipan (fragic), saline or sodic phases may be indicated.

*Extension.* An estimate of the area of the unit in thousands of hectares.

*Climate.* The symbol of the climate, according to Table 2 and Figure 9.[1]

*Occurrence.* The country or countries of occurrence.

*Vegetation or utilization.* The natural vegetation or, in most cases, the predominant utilizations.[2]

*Lithology.* The predominant lithology of the association.

[1] According to the classification of Papadakis; see Papadakis, J. *Climates of the world and their agricultural potentialities.* Buenos Aires, 1966.

[2] The utilizations are indicated as follows: Agriculture: field crops; Pasture: permanent or temporary prairie (pastures, grasses, etc.); Horticulture; Fruit crops: orchards; Forestry: forest, oak forest (often cork-oak); Special crops: vineyards, almonds, etc.; Open pasture: very extensive pasture for sheep, reindeer, etc.

Utilizations are shown in the order of their importance. Some, which relate to limited areas only, are shown where possible in brackets, particularly when they are important for the local economy (horticulture, orchards, vineyards) or ecology (uncultivated).

**Major soil regions. Distribution of major soils**

Europe includes several major soil regions, i.e., areas dominated by a few kinds of soils; they are shown in Figure 10 and numbered arbitrarily.

The boundaries of the soil regions may, but need not necessarily, coincide with the boundaries of the major zones of vegetation, climate, physiography or lithology, since the major map units are the resultant of all these factors. They may in fact be identified at different longitudes, latitudes and altitudes.

An agroclimatic map of Europe (Figure 9), established on the basis of the Papadakis classification of world climates, provides an overview of the distribution of European climates and their influence on the distribution of the main crops and the production potential of the various climatic zones.

Each of the zones shown on the map is designated by a number representing the climatic type. Table 2 shows the characteristics of the agroclimatic zones in terms of temperature and humidity patterns, defined in their turn on the basis of agriculturally important criteria such as the length and severity of winters, the length and heat of summers, as well as rainfall and its distribution.

The table of soil associations shows the climatic type of each map unit.

The major soil regions examined are the following:

1. Fluvisols
2. Gleysols
3. Regosols
   - 3.1 Eutric and Calcaric Regosols
   - 3.2 Gelic Regosols
4. Lithosols
5. Rendzinas
6. Solonetz
7. Xerosols
   - 7.1 Haplic and Luvic Xerosols
   - 7.2 Calcic Xerosols
8. Kastanozems

TABLE 2. – CLIMATIC CHARACTERISTICS

| Map symbol | Climate | Temperature | Humidity | Principal regions |
|---|---|---|---|---|
| | MEDITERRANEAN | | | |
| 6.1 | Subtropical mediterranean | SU Su | ME Me | Mediterranean islands and southern coasts of Portugal, Spain, Italy, Greece and Turkey |
| 6.2 | Marine mediterranean | MA Mm | ME Me | Coasts of Portugal, northeastern Spain and Gulf of Genoa |
| 6.5 | Temperate mediterranean | TE | ME Me | Spain, southeastern France, central Italy |
| 6.6 | Cold mediterranean | Te te | ME Me | Eastern Turkey |
| 6.7 | Continental mediterranean | CO Co co | ME Me | Turkey, Greece, southern Yugoslavia, Po Valley |
| 6.8 | Semi-arid subtropical mediterranean | SU Su MA | me | Southeastern Spain |
| 6.9 | Continental semi-arid mediterranean | te | me | Southeastern Spain and southeastern USSR |
| | MARINE | | | |
| 7.1 | Warm marine | MA Mm | HU Hu | Northern coast of Spain |
| 7.2 | Cool marine | Ma | HU Hu | Ireland, England, northwestern France, western Belgium, western Netherlands |
| 7.3 | Cold marine | ma | HU | Scotland, southwestern Norway, coasts of Iceland |
| 7.5 | Warm temperate | TE | HU Hu | Central and southern France |
| 7.6 | Cool temperate | Te | HU Hu | Germany, Czechoslovakia, Poland, western USSR, southern Sweden and eastern Austria |
| 7.7 | Cold temperate | te | HU | Central Sweden, southern Finland and western USSR; mountain regions of Austria, Switzerland and Romania |
| | CONTINENTAL | | | |
| 8.2 | Semi-warm continental | Co | Hu HU | Yugoslavia, eastern France, southwestern USSR |
| 8.3 | Cold continental | co | Hu | Northwestern USSR |
| | STEPPE | | | |
| 9.1 | Warm steppe | CO | St | Southeastern USSR |
| 9.2 | Semi-warm steppe | Co | St | Southern USSR, Romania, Bulgaria, Massif Central |
| 9.3 | Cold steppe | co | St | Eastern USSR |
| 9.4 | Temperate steppe | Te te | St | West central USSR, Poland and Czechoslovàkia |
| 9.7 | Semi-arid continental | CO Co co te Po | si | Southeastern USSR |
| | POLAR | | | |
| 10.1 | Taiga | Po | Hu HU | Northern USSR, central and northern Finland, central and northern Sweden, central and northern Norway |
| 10.2 | Tundra | po | Hu | Far northern USSR |
| 10.4 | Ice-cap | | | Iceland |
| 10.5 | Alpine | al | Hu HU | Alps |

KEY TO TABLE 2

| Temperature patterns | Winter type | Summer type | Temperature patterns | Winter type | Summer type |
|---|---|---|---|---|---|
| SUBTROPICAL | | | CONTINENTAL | | |
| SU (hot subtropical) | Ci Av | G | CO (warm continental) | Av or cooler | g G |
| Su (semi-hot subtropical) | Ci | g | Co (semi-warm continental) | Ti or cooler | M O |
| | | | co (cold continental) | pr Pr | t |
| MARINE | | | | | |
| Mm (typical marine) | Ci | T | | | |
| MA (warm marine) | Ci | O M | POLAR | | |
| Ma (cool marine) | av | T | | | |
| ma (cold marine) | av Ti | P | Po (taiga) | ti or colder | P |
| | | | po (tundra) | ti or colder | p |
| TEMPERATE | | | | | |
| TE (warm temperate) | av Av | M | ALPINE | | |
| Te (cool temperate) | ti Ti | T | | | |
| te (cold temperate) | ti Ti | t | al (high altitudes) | Pr ti Ti | a |

KEY TO CLIMATIC SYMBOLS

WINTER TYPES

| | |
|---|---|
| Ci | Possibility of frost, but warm enough for citrus and cool enough for cryophilic plants |
| Av | Too cold for citrus but warm enough for winter oats |
| av | The same, but with heavier frosts |
| Ti | Colder, but mild enough for winter wheat |
| ti | The same, but a little colder |
| Pr | Too cold for winter wheat; all crops sown in the spring |
| pr | The same, but cooler springs |

SUMMER TYPES

| | |
|---|---|
| G | Warm enough for cotton; summer days very hot |
| g | The same, but with milder summer days |
| O | Hot enough for rice but not for cotton |
| M | Milder; warm enough for maize but not for rice |
| T | Milder; warm enough for wheat but not for maize |
| t | The same, but with a shorter frost-free season |
| P | Warm enough for forest (taiga) but not for wheat |
| p | Warm enough for tundra but not for forest or prairie |
| a | Warm enough for prairie but possibility of frost all year round |

HUMIDITY REGIMES

| | |
|---|---|
| HU | Ever humid |
| Hu | Humid, but with drier periods |
| ME | Humid mediterranean |
| Me | Dry mediterranean |
| me | Semi-arid mediterranean |
| St | Steppe |
| si | Semi-arid (too dry for steppe) |

NOTE: The detailed definitions of types of winter and summer and humidity patterns are those of Papadakis, 1966.

TABLE 3. – SOIL ASSOCIATIONS AND RELATED INFORMATION

| Map symbol | Associated soils | Inclusions | Phase | Extension (1 000 ha) | Climate | Occurrence | Vegetation | Lithology |
|---|---|---|---|---|---|---|---|---|
| Ao102-2c | I | Lc | Lithic | 268 | 6.1 | Turkey | Forest; open pasture (field crops) | Schist |
| Ao110-2a | Lc | | | 634 | 7.5-7.6 | USSR[1] | Field crops; prairie; orchards | Limestone; schist; sandstone |
| Ao111-2bc | Bd | Bk I E | | 1 367 | 7.5-7.6-6.7 | Turkey | Forest; open pasture; hazel nuts | Schist; sandstone limestone |
| Ao112-2bc | Bd Bh U | I | | 1 885 | 7.5-7.6 | Turkey | Forest; open pasture (orchards; field crops) | Andesite; sandstone; sandstone limestone |
| Ao112-2bc | Bd Bh U | I | | 16 | 7.6 | USSR | Forest; open pasture (orchards; field crops) | Andesite; sandstone; sandstone limestone |
| Bc27-2/3bc | Lc | E Lo B | | 45 | 7.5 | Italy | Forest; field crops; prairie | Limestone; dolomite |
| Bc27-2/3bc | Lc | E Lo B | | 2 245 | 8.2-7.6-7.5 | Yugoslavia | Forest; field crops; prairie | Limestone; dolomite |
| Bc27-2/3bc | Lc | E Lo B | | 48 | 6.7 | Albania | Forest; field crops; prairie | Limestone; dolomite |
| Bc27-2/3bc | Lc | E Lo B | | 617 | 7.6-8.2-9.2 | Hungary | Field crops; vineyards; orchards; forest; prairie | Loess; andesitic colluvium; sand |
| Bc46-3a | Ge | | | 1 164 | 9.2-9.1-6.9 | USSR | Field crops; prairie; open pasture | |
| Bc48-3ab | Lc | E Be | | 7 | 7.6 | Luxembourg | Field crops; vineyards | Limestone |
| Bc48-3ab | Lc | E Be | | 3 570 | 7.5-7.6 | France | Field crops; vineyards | Limestone |
| Bc51-3ab | E | Lc Lo | | 371 | 7.5 | France | Field crops; prairie | Limestone; marl |
| Bd42-1/2bc | Bg G | B L | | 10 | 7.5 | France | Forest; prairie; field crops | Stony silt from weathering of schist and phyllite |
| Bd42-1/2bc | Bg G | B L | | 3 698 | 7.2-7.3 | United Kingdom | Field crops; prairie (forest) | Shale; slate; sandstone; moraine |
| Bd42-1/2bc | Bg G | B L | | 294 | 7.6 | Austria | Forest; field crops; prairie | Sandstone; marl |
| Bd42-1/2bc | Bg G | B L | | 191 | 7.6 | Belgium | Forest; prairie; field crops | Stony silt from weathering of schist and phyllite |
| Bd42-1/2bc | Bg G | B L | | 417 | 7.6-7.7 | Switzerland | Prairie; forest; field crops | Sandstone; conglomerate; acid rock |
| Bd66-1/2bc | | B Po U | | 176 | 7.6 | Czechoslovakia | Forest; prairie; field crops | Granite; schist; Tertiary volcanic and sedimentary rock |
| Bd66-1/2bc | | B Po U | | 5 465 | 8.2-9.2-6.7-6.5 | Yugoslavia | Prairie; field crops; forest | Schist; granite; sandstone |

[1] Including only European USSR. For Asiatic USSR see Volume VIII.

TABLE 3. – SOIL ASSOCIATIONS AND RELATED INFORMATION *(continued)*

| Map symbol | Associated soils | Inclusions | Phase | Extension (1 000 ha) | Climate | Occurrence | Vegetation | Lithology |
|---|---|---|---|---|---|---|---|---|
| Bd66-1/2bc | | B Po U | | 31 | 6.5 | Albania | Prairie; field crops; forest | Schist; granite; sandstone |
| Bd66-1/2bc | | B Po U | Stony | 687 | 7.6 | Yugoslavia | Prairie; field crops; forest | Schist; granite; sandstone |
| Bd66-1/2bc | | B Po U | Stony | 242 | 7.6 | Austria | Forest; prairie; field crops | Granite; schist; Tertiary volcanic and sedimentary rock |
| Bd66-1/2bc | | B Po U | Stony | 910 | 7.6 | Czechoslovakia | Forest; prairie; field crops | Granite; schist; Tertiary volcanic and sedimentary rock |
| Bd66-1/2bc | | B Po U | Stony | 2 859 | 7.7-9.1-9.2 | Romania | Forest; prairie | Acid metamorphic and eruptive rock |
| Bd66-1/2bc | | B Po U | Stony | 119 | 7.6 | Poland | Forest; prairie; field crops | Acid rock |
| Bd66-1/2bc | | B Po U | Stony | 123 | 7.6 | Germany (Fed. Rep.) | Forest; prairie; field crops | Granite; schist |
| Bd66-1/2bc | | B Po U | Stony | 91 | 7.6 | Germany (Dem. Rep.) | Forest; prairie; field crops | Granite; schist |
| Bd66-1/2bc | | B Po U | Stony | 1 411 | 7.7-7.6 | USSR | Forest; prairie | Acid metamorphic and eruptive rock |
| Bd66-1/2bc | | B Po U | Stony | 87 | 7.7 | Switzerland | Forest; prairie | Conglomerate; acid rock |
| Bd67-2b | | Bg Lg Gd P | | 406 | 7.6 | Germany (Fed. Rep.) | Forest; prairie; field crops | Sandstone; greywacke; phyllite; sandstone conglomerate |
| Bd67-2b | | Bg Ld Gd P | | 4 551 | 7.6 | Germany (Dem. Rep.) | Forest; prairie; field crops | Glacial outwash |
| Bd67-2b | | Bg Lg Gd P | Lithic | 2 995 | 7.6 | Germany (Fed. Rep.) | Forest; prairie; field crops | Glacial outwash |
| Bd67-2b | | Bg Lg Gd P | Lithic | 109 | 7.6 | France | Forest; prairie; field crops | Stony silt from weathering of schist and phyllite |
| Bd67-2b | | Bg Lg Gd P | Lithic | 99 | 7.6 | Luxembourg | Forest; prairie; field crops | Stony silt from weathering of schist and phyllite |
| Bd67-2b | | Bg Lg Gd P | Lithic | 29 | 7.6 | Germany (Dem. Rep.) | Forest; prairie; field crops | Shale; greywacke; phyllite; sandstone |
| Bd67-2b | | Bg Lg Gd P | Lithic | 414 | 7.6 | Belgium | Forest; prairie; field crops | Stony silt from weathering of schist and phyllite |
| Bd67-2b | | Bg Lg Gd P | Stony | 243 | 7.6 | Germany (Fed. Rep.) | Forest; prairie; field crops | Shale; phyllite; greywacke; sandstone; conglomerate |
| Bd67-2b | | Bg Lg Gd P | Stony | 416 | 7.6 | Austria | Forest; prairie; field crops | Acid rock |

TABLE 3. – SOIL ASSOCIATIONS AND RELATED INFORMATION *(continued)*

| Map symbol | Associated soils | Inclusions | Phase | Extension (1 000 ha) | Climate | Occurrence | Vegetation | Lithology |
|---|---|---|---|---|---|---|---|---|
| Bd67-2b | | Bg Lg Gd P | Stony | 2 226 | 7.6 | Czechoslovakia | Forest; field crops | Granite |
| Bd67-2b | | Bg Lg Gd P | Stony | 185 | 7.6 | Germany (Dem. Rep.) | Forest; field crops | Granite |
| Bd67-2b | | Bg Lg Gd P | Stony | 56 | 7.6 | Poland | Forest; field crops | Granite |
| Bd68-2bc | Be | I | | 2 667 | 6.5-6.7-6.1-6.6 | Italy | Forest; prairie | Eruptive and metamorphic rock |
| Bd68-2bc | Be | I | Lithic | 960 | 7.5-7.6 | Italy | Forest; prairie; orchards | Sandstone; eruptive rock |
| Bd68-2bc | Be | I. | Lithic | 17 | 7.6 | Switzerland | Forest; prairie; orchards | Sandstone; eruptive rock |
| Bd68-2bc | Be | I | Stony | 237 | 9.2 | Yugoslavia | Forest; open pasture | Schist; granite; rhyolite |
| Bd68-2bc | Be | I | Stony | 737 | 7.5-9.2 | Bulgaria | Forest; open pasture | Schist; granite; rhyolite |
| Bd69-2b | U | Bg Po | | 113 | 7.5 | France | Prairie; forest; field crops | Eruptive and metamorphic rock |
| Bd69-2b | U | Bg Po | Stony | 762 | 7.6-10.1-7.5 | France | Prairie; forest; field crops | Eruptive and metamorphic rock |
| Bd69-2b | U | Bg Po | Stony | 28 | 7.6 | Austria | Forest; prairie; field crops (vineyards) | Shale; phyllite; greywacke; sandstone; schist; acid igneous rock |
| Bd69-2b | U | Bg Po | Stony | 24 | 7.6 | Switzerland | Forest; prairie; field crops (vineyards) | Shale; phyllite; greywacke; sandstone; schist; acid igneous rock |
| Bd69-2b | U | Bg Po | Stony | 2 337 | 7.6 | Germany (Fed. Rep.) | Forest; prairie; field crops (vineyards) | Shale; phyllite; greywacke; sandstone; schist; acid igneous rock |
| Bd70-2a | Qc | | | 349 | 7.6 | Germany (Fed. Rep.) | Forest; field crops (horticulture) | Silt; sand |
| Bd71-1/2b | U I | B L | | 931 | 7.5-6.7 | Yugoslavia | Prairie; field crops; uncultivated | Schist; sandstone; granite |
| Bd71-1/2b | U I | B L | | 227 | 7.5 | Bulgaria | Prairie; field crops; uncultivated | Schist; sandstone; granite |
| Bd71-1/2b | U I | B L | | 285 | 6.7 | Greece | Forest; prairie | Schist; gneiss; granite |
| Bd71-1/2b | U I | B L | Stony | 296 | 7.6 | Czechoslovakia | Prairie; forest | Igneous and metamorphic rock; conglomerate; flysch |
| Bd71-1/2b | U I | B L | Stony | 53 | 5.4 | Spain | Field crops; forest | Granite |
| Bd71-1/2b | U I | B L | Stony | 606 | 7.6 | Poland | Prairie; forest | Igneous and metamorphic rock; conglomerate; flysch |

TABLE 3. — SOIL ASSOCIATIONS AND RELATED INFORMATION *(continued)*

| Map symbol | Associated soils | Inclusions | Phase | Extension (1 000 ha) | Climate | Occurrence | Vegetation | Lithology |
|---|---|---|---|---|---|---|---|---|
| Bd71-1/2b | U I | B L | Stony | 298 | 7.6-6.5-6.2 | France | Forest: scrub; vineyards | Eruptive and metamorphic rock |
| Bd71-1/2b | U I | B L | Lithic | 57 | 6.7 | Spain | Field crops: forest (oak. chestnut): vineyards; olives | Granite |
| Bd71-1/2b | U I | B L | Lithic | 244 | 6.1-6.5 | Portugal | Field crops: forest (oak. chestnut): vineyards; olives | Granite |
| Bd72-2b | Be | Lg U I | | 2 339 | 9.4-7.6 | Czechoslovakia | Field crops: forest | Granite: schist |
| Bd72-2b | Be | Lg U I | | 62 | 7.6 | Austria | Forest: prairie: field crops | Acid rock |
| Bd72-2b | Be | Lg U I | Lithic | 30 | 7.6 | France | Prairie: forest | Stony silt from weathering of schist. psammite and limestone |
| Bd72-2b | Be | Lg U I | Lithic | 201 | 7.6 | Belgium | Prairie: forest | Stony silt from weathering of schist. psammite and limestone |
| Bd72-2b | Be | Lg U I | Stony | 319 | 7.6 | USSR | Field crops: forest | Granite: schist |
| Bd72-2b | Be | Lg U I | Stony | 316 | 7.6 | Czechoslovakia | Fields crops: forest | Granite: schist |
| Bd72-2b | Be | Lg U I | Stony | 1 157 | 7.6 | Poland | Prairie: forest | Igneous rock: metamorphic rock: conglomerate: flysch |
| Bd73-2b | | Po G I | Stony | 1 859 | 7.7-7.6-10.5 | Austria | Forest | Acid rock |
| Bd73-2b | | Po G I | Stony | 31 | 10.5 | Switzerland | Forest | Acid rock |
| Bd74-2ab | Po | Od G | | 391 | 7.7-10.1 | Finland | Field crops: forest | Glacial till |
| Bd75-2ab | Gd | Gh P1 | | 251 | 7.2-7.3 | Ireland | Field crops: prairie; forest | Moraine (shale) |
| Bd75-2ab | Gd | Gh P1 | | 563 | 7.2-7.3 | United Kingdom | Field crops: prairie: forest | Moraine (shale) |
| Bd76-2ab | P1 | P Gd Od Lo | | 1 170 | 7.2-7.3 | Ireland | Field crops: prairie: forest | Moraine (shale; sandstone): granite |
| Bd77-1/2bc | U I | | | 679 | 6.1-6.5-6.2 | France | Forest: uncultivated | Eruptive and metamorphic rock |
| Bd77-1/2bc | U I | | | 117 | 6.2-6.5 | Spain | Oak forest: prairie | Granite: diorite |
| Bd77-1/2bc | U I | | Stony | 2 318 | 7.5-7.6-10.1-6.5 | France | Uncultivated: forest | Eruptive and metamorphic rock |
| Bd77-1/2bc | U I | | Stony | 17 | 7.6 | Spain | Oak forest: prairie | Granite: diorite |
| Bd77-1/2bc | U I | | Lithic | 1 943 | 6.5-6.7-6.1 | Spain | Oak forest: prairie | Granite: diorite |

TABLE 3. — SOIL ASSOCIATIONS AND RELATED INFORMATION *(continued)*

| Map symbol | Associated soils | Inclusions | Phase | Extension (1 000 ha) | Climate | Occurrence | Vegetation | Lithology |
|---|---|---|---|---|---|---|---|---|
| Bd77-1/2bc | U I | | Lithic | 281 | 6.7-6.5 | Portugal | Oak forest; prairie | Granite; diorite |
| Bd78-2b | Lo Lg | O I | | 1 921 | 7.5-7.6 | France | Prairie; forest; field crops | Eruptive and metamorphic rock; residual silt |
| Bd78-2b | Lo Lg | O I | Lithic | 156 | 7.6 | Belgium | Field crops; prairie; forest | Stony silt from weathering of schist; limestone and schisty sandstone; loess |
| Bd79-2ab | Lg Dd | Wd Po | | 1 497 | 7.2-7.5 | France | Forest; prairie; field crops | Eruptive and metamorphic rock; loess; residual silt |
| Bd80-1/2b | Po | U I | Stony | 1 788 | 7.6-10.1 | France | Prairie; forest | Granite |
| Be96-2ab | Bd | | | 398 | 7.3-7.2 | United Kingdom | Field crops; prairie; forest | Limestone; breccia; moraine; sandstone |
| Be115-2/3c | I | Lc U | Lithic/stony | 1 624 | 6.6-6.7 | Turkey | Open pasture; forest (field crops) | Andesite; basalt |
| Be117-2/3bc | I | Re Vc | Lithic | 222 | 6.1 | Cyprus | Open pasture; forest; field crops | Basic and calcareous rocks |
| Be120-2bc | U | I | Lithic | 668 | 7.6 | Czechoslovakia | Forest; prairie; vineyards | Igneous rock |
| Be120-2bc | U | I | Stony | 23 | 6.1 | Portugal | Field crops; olives; oak forest; forest | Shale |
| Be120-2bc | U | I | Stony | 6 911 | 6.7-6.1-6.5-6.8 | Spain | Field crops; olives; oak forest; forest | Shale |
| Be121-2bc | Bg | Lg E Bd | | 724 | 7.6 | Czechoslovakia | Forest; prairie; orchards; vineyards | Tertiary sedimentary rock (flysch); igneous rock; limestone |
| Be122-2bc | Bd I | L | Stony | 5 687 | 6.7-6.5-6.1-9.4-9.2 | Turkey | Forest; field crops; open pasture | Schist; limestone schist |
| Be122-2bc | Bd I | L | Stony | 26 | 7.7 | USSR | Forest; prairie (field crops; orchards) | Schist; conglomerate; clay |
| Be122-2bc | Bd I | L | Stony | 673 | 6.5 | Bulgaria | Forest | Limestone; marl; schist; granite; rhyolite |
| Be122-2bc | Bd I | L | Stony | 687 | 9.2 | Yugoslavia | Forest | Limestone; marl; schist; granite; rhyolite |
| Be122-2bc | Bd I | L | Stony | 2 025 | 9.2-9.1-7.7 | Romania | Forest; prairie (field crops; orchards) | Schist; conglomerate; clay |
| Be123-2b | Lo | Rc Bg E | | 70 | 7.6 | Yugoslavia | Forest; prairie (field crops; orchards) | Schist; conglomerate; clay |
| Be123-2b | Lo | Rc Bg E | | 590 | 7.6 | Poland | Field crops; prairie | Loess; consolidated sedimentary rock; clastic rock |

TABLE 3. – SOIL ASSOCIATIONS AND RELATED INFORMATION *(continued)*

| Map symbol | Associated soils | Inclusions | Phase | Extension (1 000 ha) | Climate | Occurrence | Vegetation | Lithology |
|---|---|---|---|---|---|---|---|---|
| Be123-2b | Lo | Rc Bg E | | 107 | 7.6 | Austria | Field crops; vineyards; forest | Tertiary sediment |
| Be123-2b | Lo | Rc Bg E | Stony | 1 637 | 9.2-9.1-7.7 | Romania | Forest; prairie; field crops; orchards | Marl; clay; alluvium |
| Be124-2/3b | Bh | Rc Lc Hh U | | 132 | 8.2-9.2 | Hungary | Field crops; vineyards; orchards | Loess; Tertiary deposits; granite; tuff |
| Be125-2b | Ge | Bg Lg E U | | 1 386 | 7.6-7.7 | Germany (Fed. Rep.) | Field crops; forest; prairie | Marl; calcareous clayey sandstone; silty colluvium |
| Be125-2b | Ge | Bg Lg E U | | 45 | 7.6-7.7 | Austria | Field crops; forest; prairie | Marl; calcareous clayey sandstone; silty colluvium |
| Be126-2/3ab | Lo | E De Lc | | 196 | 7.2 | United Kingdom | Field crops; prairie | Glacial outwash; limestone |
| Be126-2/3ab | Lo | E De Lc | | 3 623 | 7.5-7.6 | France | Field crops; prairie; forest | Limestone; marl; pelite |
| Be126-2/3ab | Lo | E De Lc | | 60 | 7.6 | Denmark | Field crops; prairie; forest | Glacial till |
| Be126-2/3ab | Lo | E De Lc | | 13 | 7.6 | Spain | Field crops; prairie; forest | Limestone; marl; pelite |
| Be126-2/3ab | Lo | E De Lc | | 600 | 7.6 | Poland | Field crops; prairie (forest) | Clay; glacial till |
| Be126-2/3ab | Lo | E De Lc | | 35 | 7.6 | Switzerland | Field crops; prairie; forest | Limestone; marl; pelite |
| Be126-2/3ab | Lo | E De Lc | | 83 | 7.6 | Germany (Fed. Rep.) | Field crops; prairie (forest) | Clay; glacial till |
| Be127-2ab | | E Lo | | 708 | 7.6 | Sweden | Forest; field crops; prairie | Glacial till; glacial and postglacial sediment |
| Be127-2ab | | E Lo | | 488 | 9.2 | Yugoslavia | Field crops; prairie; orchards; forest | Glacial outwash; alluvium |
| Be127-2ab | | E Lo | | 1 755 | 7.6-7.5-10.1-6.5 | France | Field crops; prairie | Limestone; marl |
| Be127-2ab | | E Lo | Stony | 170 | 6.1-6.7 | Italy | Olives | Miocene marl and limestone |
| Be128-2/3bc | E Lo | Rc I | Lithic | 4 070 | 7.5-7.6-6.7-6.5-6.6-6.1 | Italy | Forest; field crops; prairie | Limestone; dolomite |
| Be128-2/3bc | E Lo | Rc I | Stony | 1 093 | 7.6-6.5-6.7-8.2 | France | Forest; prairie; vineyards | Limestone; marl; sandstone |
| Be128-1/2b | Je Re | E | | 807 | 7.5-6.7-6.5 | Italy | Field crops; vineyards | Calcareous moraine and terrace |
| Be129-1/2b | Je Re | E | | 115 | 6.5 | Greece | Field crops; prairie; scrub | Quaternary alluvium; Tertiary deposit |

TABLE 3. – SOIL ASSOCIATIONS AND RELATED INFORMATION *(continued)*

| Map symbol | Associated soils | Inclusions | Phase | Extension (1 000 ha) | Climate | Occurrence | Vegetation | Lithology |
|---|---|---|---|---|---|---|---|---|
| Be130-2/3bc | Re | Lo I | Stony | 35 | 7.5-7.6 | Yugoslavia | Field crops; prairie; scrub | Quaternary alluvium; Tertiary deposit |
| Be130-2/3bc | Re | Lo I | Stony | 3 543 | 6.2-6.5-6.1-6.7-7.5-7.6 | Italy | Forest; prairie; field crops | Tertiary stony clay and sand |
| Be131-1/2bc | Lo | I | Stony | 2 106 | 6.7-6.5-6.1 | Italy | Forest; prairie (vineyards) | Eruptive and metamorphic rock |
| Be133-2/3a | Je | Ge Bg Bc | | 1 767 | 6.7-7.5-6.1 | Italy | Field crops; horticulture; prairie | Alluvium |
| Be134-1/2a | Oe Po | Ge | | 292 | 10.1 | Sweden | Forest; prairie; field crops | Glacial till; moraine; esker |
| Be135-2ab | Bd I | | | 176 | 7.6 | Sweden | Forest; praire; field crops | Moraine; esker; postglacial sediment |
| Be136-1/2ab | Po Bd | O | | 2 538 | 7.7-7.6 | Sweden | Forest; prairie; field crops | Moraine; glacial till; esker; postglacial sediment |
| Be136-1/2ab | Po Bd | O | | 189 | 7.6 | Denmark | Field crops; forest | Moraine (sand; clay) |
| Be136-1/2ab | Po Bd | O | Stony | 638 | 7.6-7.7 | Sweden | Forest; prairie; field crops | Moraine; esker |
| Be137-2a | I | E Po | Lithic | 222 | 7.6 | Sweden | Forest; prairie; field crops | Glacial till; limestone; shale |
| Be138-2a | Oe | E Po | Lithic | 179 | 7.6 | Sweden | Forest: prairie; field crops | Glacial till; limestone |
| Be139-2ab | E | L | | 214 | 7.2 | United Kingdom | Field crops; prairie | Chalk; aeolian sediment |
| Be139-2ab | E | L | | 218 | 7.2 | Ireland | Field crops; prairie; forest | Limestone |
| Be139-2ab | E | L | | 762 | 7.5 | France | Field crops; forest; prairie | Limestone; marl; pelite |
| Be140-2a | Qc Ge | Po | | 52 | 7.2 | United Kingdom | Field crops; horticulture; forest | Alluvium; terrace gravel; glacial sand |
| Be141-2/3b | Bc | Rc E | | 470 | 7.6-10.1-10.5 | France | Prairie; field crops; vineyards | Limestone; schist; clay |
| Be142-2/3ab | Bc Lo | Po E | | 633 | 7.6-7.5 | France | Field crops; prairie; forest | Limestone; marl; pelite |
| Be143-2/3ab | Lg | E Po | | 1 484 | 7.5-9.2 | France | Field crops; prairie; forest | Limestone; marl; loess; residual clay |
| Be144-2/3a | Bg | Gm L Re | | 156 | 7.6 | USSR | Field crops; prairie | Silt |
| Be144-2/3a | Bg | Gm L Re | | 710 | 7.2 | United Kingdom | Field crops; prairie | Limestone; clay |
| Be144-2/3a | Bg | Gm L Re | | 494 | 7.6 | Poland | Field crops; prairie | Silt |
| Be145-2ab | E | L Hc Dg | | 265 | 7.6-7.5 | France | Field crops; prairie; forest | Limestone; marl; pelite |

TABLE 3. — SOIL ASSOCIATIONS AND RELATED INFORMATION *(continued)*

| Map symbol | Associated soils | Inclusions | Phase | Extension (1 000 ha) | Climate | Occurrence | Vegetation | Lithology |
|---|---|---|---|---|---|---|---|---|
| Be146-2ab | Lo | Po | | 830 | 7.6 | Denmark | Field crops; forest | Glacial till |
| Be147-2a | Gc | Rd Rc | | 44 | 7.6 | Denmark | Field crops | Glacial marine clay |
| Bg9-2b | Be | Lg Gd Po | | 402 | 7.6 | Austria | Field crops; prairie (forest) | Marl; Tertiary sediment; sand; silt |
| Bg9-2b | Be | Lg Gd Po | | 17 | 7.6 | Hungary | Field crops; prairie (forest) | Marl; Tertiary sediment; sand; silt |
| Bg10-2a | Bk | Lc | | 2 137 | 6.5-5.4-6.9-6.2 | Spain | Field crops; horticulture; orchards (irrigated) | Fluvial and marine terrace |
| Bg11-3ab | Ge | Bh | | 683 | 7.2 | United Kingdom | Prairie; field crops | Secondary clay and limestone |
| Bg12-2ab | Be Ge | | | 1 056 | 7.2-7.3 | United Kingdom | Prairie; field crops; forest | Moraine; secondary clay; limestone |
| Bh25-2bc | U | I Bd | Stony | 2 386 | 6.5-6.2-6.1 | Portugal | Forest; field crops; prairie; vineyards | Granite: syenite |
| Bh25-2bc | U | I Bd | Stony | 453 | 7.5-6.5 | Bulgaria | Prairie | Acid or calcareous rock |
| Bh25-2bc | U | I Bd | Stony | 3 | 7.6 | Andorra | Forest; prairie | Shale; sandstone; granite |
| Be25-2bc | U | I Bd | Stony | 5 450 | 6.5-6.6-7.1-7.2-7.6-5.4-6.1 | Spain | Forest; prairie | Shale; sandstone: granite |
| Bh26-1b | Q I | | | 642 | 7.3-10.2 | Iceland | Open pasture; uncultivated | Basalt |
| Bh27-1/2bc | Th | | | 262 | 10.1-7.6 | France | Prairie: uncultivated | Crystalline. metamorphic and volcanic rock |
| Bk32-2/3c | Rc | Vp Be | Lithic | 353 | 6.7 | Italy | Field crops; vineyards; horticulture | Calcareous clay and marl |
| Bk35-2/3ab | | Bv Vc | Lithic | 225 | 6.1 | Cyprus | Forest; field crops | Limestone |
| Bk45-2bc | E I | Hc K | | 5 883 | 6.7-6.5-7.6-7.5 | Turkey | Forest; field crops; open pasture | Schist; limestone; marl |
| Bk45-2bc | E I | Hc K | Stony | 9 844 | 6.5-5.4-6.6-7.2-7.1-7.6-6.1-6.2-6.9 | Spain | Forest; prairie; field crops; vineyards; horticulture; olives; almonds | Calcareous sandstone; sandstone; marl; shale |
| Bk45-2bc | E I | Hc K | Stony | 40 | 7.6 | France | Forest; prairie; field crops; vineyards; horticulture: olives; almonds | Calcareous sandstone; sandstone; marl; shale |
| Bk46-2a | | Lc | Petrocalcic | 1 254 | 6.5-6.9-6.7-6.1-5.4 | Spain | Field crops; vineyards: olives | Limestone |
| Bk47-2/3b | Rc B | E L | | 443 | 6.2-6.1 | Portugal | Field crops; vineyards; olives; forest | Marl; limestone; chalk; sandstone |

TABLE 3. – SOIL ASSOCIATIONS AND RELATED INFORMATION *(continued)*

| Map symbol | Associated soils | Inclusions | Phase | Extension (1 000 ha) | Climate | Occurrence | Vegetation | Lithology |
|---|---|---|---|---|---|---|---|---|
| Bk47-2/3b | Rc B | E L | Stony | 10 164 | 6.5-5.4-6.2-6.1-6.8-6.7-6.6 | Spain | Field crops; olives | Marl |
| Bk48-2/3b | Zg | Zo Rc | Saline | 1 869 | 6.5-5.4-6.1 | Spain | Field crops (irrigated); olives | Gypseous marl; marl; gypsum; calcareous sandstone |
| Bk49-2c | I Lc | E | Lithic/stony | 2 936 | 9.2-9.4-7.6-7.5-6.7 | Turkey | Forest; open pasture (orchards; field crops) | Schist; limestone; sandstone |
| Bv18-3a | | E Lo | | 974 | 7.6 | Germany (Fed. Rep.) | Prairie; forest | Clay; marl |
| Bv21-3a | Po Bg | O | | 58 | 7.3 | Norway | Field crops; prairie | Glacial and postglacial sediment |
| Bv21-3a | Po Bg | O | | 1 395 | 7.7 | Finland | Field crops; forest | Glacial sediment |
| Bv22-2a | Be Bd | | | 1 717 | 7.6-7.7 | Sweden | Forest; field crops; prairie | Glacial and postglacial clay; moraine; esker |
| Bv23-2a | I Be | Bd | | 404 | 7.6 | Sweden | Forest; prairie; field crops | Postglacial sediment; moraine; esker |
| Bv23-2a | I Be | Bd | Lithic | 274 | 7.6 | Sweden | Forest; prairie; field crops | Postglacial sediment; moraine; esker |
| Ch5-2a | | H L R So | | 17 771 | 9.2-9.3-9.4-7.6-7.3-8.3-7.7 | USSR | Field crops (prairie) | Silty sediment |
| Ch5-2a | | H L R So | Sodic | 620 | 9.2 | Yugoslavia | Field crops (prairie) | Loess |
| Ch5-2a | | H L R So | Sodic | 4 617 | 9.3-7.3-9.2 | USSR | Field crops (prairie) | Silty sediment |
| Ch21-2ab | Cl | Rc H | | 426 | 7.6 | Austria | Field crops; vineyards | Loess |
| Ch21-2ab | Cl | Rc H | | 674 | 9.4 | Czechoslovakia | Field crops | Loess; flysch; marl |
| Ch22-2a | Ck | | | 29 739 | 9.2-9.3-9.4-9.1 | USSR | Field crops; prairie | Silty sediment |
| Ch23-2a | Cl Be E | Rc H | | 103 | 7.6 | Germany (Fed. Rep.) | Field crops | Loess |
| Ch23-2a | Cl Be E | Rc H | | 923 | 7.6 | Germany (Dem. Rep.) | Field crops | Loess |
| Ck9-2a | H | Zo Rc | | 14 | 9.2 | Yugoslavia | Field crops; prairie; orchards | Loess |
| Ck9-2a | H | Zo Rc | | 693 | 9.2 | Hungary | Field crops; prairie; orchards | Loess |
| Ck10-2ab | | Gm Sg E Rc | | 70 | 9.2 | Yugoslavia | Field crops; forest | Loess; marl |
| Ck10-2ab | | Gm Sg E Rc | | 1 703 | 9.2 | Bulgaria | Field crops; forest | Loess; marl |
| Ck10-2ab | | Gm Sg E Rc | | 325 | 9.2 | Romania | Field crops; forest | Loess |
| Ck10-2ab | | Gm Sg E Rc | Phreatic | 379 | 9.2 | Bulgaria | Field crops; forest | Loess; marl |

TABLE 3. – SOIL ASSOCIATIONS AND RELATED INFORMATION *(continued)*

| Map symbol | Associated soils | Inclusions | Phase | Extension (1 000 ha) | Climate | Occurrence | Vegetation | Lithology |
|---|---|---|---|---|---|---|---|---|
| Ck10-2ab | | Gm Sg E Rc | Phreatic | 2 253 | 9.2 | Romania | Field crops | Loess |
| Ck10-2ab | | Gm Sg E Rc | Saline | 218 | 9.2 | Romania | Field crops | Loess |
| Ck10-2ab | | Gm Sg E Rc | Saline | 1 213 | 9.2 | USSR | Field crops; prairie; orchards | Loess |
| Ck11-2ab | Ch | H Rc C1 | Saline | 256 | 7.6-9.2-9.4 | Czechoslovakia | Field crops | Loess; alluvium; aeolian sand |
| Cl1-3a | | | | 104 | 8.3-9.1-6.9 | USSR | Field crops; prairie | Moraine; loess |
| Cl12-2ab | | Ch Gm Mo | | 50 | 7.6 | Poland | Field crops; prairie (forest) | Moraine; loess |
| Cl12-2ab | | Ch Gm Mo | | 29 638 | 9.2-9.3-9.4-7.3-8.3-7.6-7.7 | USSR | Field crops; prairie (forest) | Moraine; silty sediment; loess |
| Cl12-2ab | | Ch Gm Mo | | 35 | 9.2 | Romania | Field crops; prairie (forest) | Moraine; silty sediment; loess |
| Cl13-2a | Sm | | Sodic | 6 165 | 9.2-9.1-9.4 | USSR | Field crops; prairie | Fluvial and marine alluvia |
| Dd6-1/2a | Lg Pg | Od | | 1 396 | 7.6 | Germany (Fed. Rep.) | Field crops; forest; prairie | Aeolian sand; loess; outwash |
| Dd7-1ab | Lo | G Pl | | 169 | 7.6 | Poland | Field crops; forest | Glacial till; sand with pebbles |
| Dd8-1ab | P1 | Lo Gh De | | 252 | 7.6-9.4 | Poland | Field crops; forest | Sand with pebbles |
| Dd9-2ab | Lo Dg | P | | 452 | 7.6-7.2 | Belgium | Field crops; prairie; horticulture; orchards | Sandy loess; Tertiary greensand |
| Dd9-2ab | Lo Dg | P | | 76 | 7.2 | France | Field crops; prairie; horticulture; orchards | Sandy loess; Tertiary greensand |
| Dd13-2ab | P Gh | Od | | 32 080 | 8.3-10.1 | USSR | Forest; field crops; prairie | Moraine |
| De13-1ab | P1 | Lo G Be | | 1 034 | 7.6-9.4 | Poland | Field crops; forest | Sand with pebbles |
| De14-1ab | Lo | Lg G Be | | 643 | 7.6 | Poland | Field crops; forest | Sand with pebbles |
| De17-1/2a | Lg Pg | Od | | 3 626 | 8.3-7.6 | USSR | Forest; field crops; open pasture | Moraine |
| De18-1a | | | | 80 | 7.6 | Poland | Field crops; prairie; forest | Moraine; silty sediment |
| De18-1a | | | | 16 495 | 8.3-7.7-7.6-7.3 | USSR | Field crops; prairie; forest | Moraine; silty sediment |
| De18-2a | | | | 93 | 7.6 | Poland | Field crops; prairie; forest | Moraine; silty sediment |

TABLE 3. – SOIL ASSOCIATIONS AND RELATED INFORMATION *(continued)*

| Map symbol | Associated soils | Inclusions | Phase | Extension (1 000 ha) | Climate | Occurrence | Vegetation | Lithology |
|---|---|---|---|---|---|---|---|---|
| De18-2a | | | | 73 589 | 8.3-7.7-7.6-7.3 | USSR | Field crops; prairie; forest | Moraine; silty sediment |
| De19-1a | Pg Lg | Gh | | 13 748 | 8.3-7.7-7.6-7.3 | USSR | Field crops; prairie; forest | Moraine; silty sediment |
| De19-2a | Pg Lg | Gh | | 11 891 | 7.7-7.6 | USSR | Field crops; prairie; forest | Moraine; silty sediment |
| De20-2ab | Bd La | Gd | | 3 307 | 7.6 | USSR | Field crops; prairie; forest | Outwash |
| Dg5-1ab | De | Lg Gh | | 1 481 | 7.6 | Poland | Field crops; prairie | Sand with pebbles |
| Dg6-2ab | Lg | Lo Wd | | 582 | 8.2 | Yugoslavia | Field crops; forest; prairie | Pleistocene silt and clay |
| E22-2/3b | Be Lc | Lo | | 309 | 8.3 | USSR | Field crops; prairie | Limestone |
| E22-2/3b | Be Lc | Lo | | 348 | 7.6 | Germany (Dem. Rep.) | Field crops; prairie | Chalk; silty and sandy aeolian sediment |
| E22-2/3b | Be Lc | Lo | | 673 | 7.2 | United Kingdom | Field crops; prairie | Chalk; silty and sandy aeolian sediment |
| E22-2/3b | Be Lc | Lo | | 13 | 7.6 | Germany (Fed. Rep.) | Field crops; forest; prairie | Limestone; dolomite |
| E22-2/3b | Be Lc | Lo | Lithic | 98 | 7.6 | Germany (Dem. Rep.) | Field crops; forest; prairie | Limestone; dolomite |
| E22-2/3b | Be Lc | Lo | Lithic | 1 499 | 7.6 | Germany (Fed. Rep.) | Field crops; forest; prairie | Limestone; dolomite |
| E22-2/3b | Be Lc | Lo | Lithic | 275 | 7.6 | Poland | Field crops; prairie | Limestone; dolomite |
| E22-2/3b | Be Lc | Lo | Stony | 199 | 7.6 | France | Prairie; forest | Limestone |
| E22-2/3b | Be Lc | Lo | Stony | 278 | 7.6 | Switzerland | Forest; prairie (field crops) | Hard and soft limestone |
| E22-2/3b | Be Lc | Lo | Stony | 23 | 7.6 | Germany (Fed. Rep.) | Forest; prairie (field crops) | Hard and soft limestone |
| E23-2bc | I | Be | Lithic | 53 | 10.5 | France | Prairie | Limestone |
| E23-2bc | I | Be | Lithic | 35 | 9.2-7.5 | Bulgaria | Prairie; forest | Limestone; dolomite |
| E23-2bc | I | Be | Lithic | 211 | 7.6-10.5 | Austria | Prairie; uncultivated; forest; brush (vineyards) | Limestone; dolomite; marl |
| E23-2bc | I | Be | Lithic | 1 877 | 7.6-6.5-10.5 | Italy | Prairie | Limestone; dolomite |
| E23-2bc | I | Be | Lithic | 976 | 7.6-6.7-9.2 | Yugoslavia | Prairie; forest | Limestone; dolomite; marl |

TABLE 3. — SOIL ASSOCIATIONS AND RELATED INFORMATION *(continued)*

| Map symbol | Associated soils | Inclusions | Phase | Extension (1 000 ha) | Climate | Occurrence | Vegetation | Lithology |
|---|---|---|---|---|---|---|---|---|
| E23-2bc | I | Be | Lithic | 14 | 7.6 | Switzerland | Prairie; forest; uncultivated | Limestone |
| E23-2bc | I | Be | Stony | 132 | 7.6 | France | Prairie | Limestone |
| E23-2bc | I | Bc | Stony | 31 | 7.6 | Hungary | Forest; prairie; field crops; uncultivated | Limestone; dolomite; crystalline rock |
| E23-2bc | I | Be | Stony | 117 | 6.5 | Turkey | Brush; prairie; field crops | Soft limestone |
| E23-2bc | I | Be | Stony | 624 | 7.6-9.4 | Czechoslovakia | Forest; prairie; field crops; uncultivated | Limestone; dolomite; crystalline rock |
| E23-2bc | I | Be | Stony | 16 | 7.6 | Liechtenstein | Prairie; uncultivated; brush | Limestone; dolomite; marl |
| E23-2bc | I | Be | Stony | 1 582 | 7.7-7.6-10.5 | Austria | Prairie; uncultivated; forest; brush (vineyards) | Limestone; dolomite; marl |
| E23-2bc | I | Be | Stony | 644 | 7.7-10.5-7.6 | Switzerland | Prairie; forest; uncultivated | Limestone |
| E23-2bc | I | Be | Stony | 180 | 7.6 | Germany (Fed. Rep.) | Prairie; forest; uncultivated | Limestone |
| E24-2c | I Bc | Bh Hh Lc | Lithic | 136 | 6.5 | Albania | Forest; prairie | Limestone; dolomite; marl |
| E24-2c | I Bc | Bh Hh Lc | Lithic | 104 | 9.2 | Hungary | Forest; prairie; vineyards | Limestone; dolomite; basaltic tuff |
| E24-2c | I Bc | Bh Hh Lc | Lithic | 2 070 | 8.2-6.5 | Yugoslavia | Forest; prairie | Limestone; dolomite; marl |
| E25-2/3ab | Be | I Bc | | 2 716 | 7.5-6.5-8.2-7.6-7.2 | France | Arable land; vineyards | Chalky and marly limestone |
| E26-2/3ab | I | Bc | | 17 | 6.1 | France | Uncultivated; vineyards; prairie | Limestone |
| E26-2/3ab | I | Bc | Stony | 639 | 6.5-7.6-6.7 | France | Uncultivated; vineyards; prairie | Limestone |
| E27-2a | Gm Oe | | | 3 570 | 7.7 | USSR | Field crops; prairie (forest) | Limestone; glacial till; lacustrine and glacial sediment |
| Gd30-3bc | | Gh O Pg Bd | Stony | 174 | 7.7 | Switzerland | Forest; prairie; uncultivated | Flysch; moraine |
| Gd31-2/3a | Po | Od I B | | 310 | 7.7 | Finland | Field crops; uncultivated | Postglacial sediment |
| Gd32-2/3b | Bd | Bg Gh Pl | | 886 | 7.2 | Ireland | Prairie; forest; field crops | Shale; sandstone; moraine |
| Gd32-2/3b | Bd | Bg Gh Pl | | 603 | 7.2 | United Kingdom | Prairie; forest | Shale; sandstone; moraine |

TABLE 3. – SOIL ASSOCIATIONS AND RELATED INFORMATION *(continued)*

| Map symbol | Associated soils | Inclusions | Phase | Extension (1 000 ha) | Climate | Occurrence | Vegetation | Lithology |
|---|---|---|---|---|---|---|---|---|
| Gd33-3b | Gh | | | 542 | 7.2 | Ireland | Prairie; forest | Shale |
| Ge35-3ab | Be | Lo | | 16 | 6.7 | USSR | Prairie; field crops | Alluvium |
| Ge64-1/2a | Bg | Be | | 377 | 7.2 | United Kingdom | Field crops | Aeolian sand; glacial till |
| Ge65-3a | Bg | Bd | | 1 806 | 7.2-7.3 | United Kingdom | Prairie; field crops | Shale; calcareous clay |
| Ge66-2/3a | Lg | Gh | | 569 | 7.2 | United Kingdom | Prairie; field crops; forest | Eocene clay and silt |
| Ge67-2b | Lg | Bg | | 1 561 | 7.2-7.3 | United Kingdom | Prairie; field crops | Moraine (sandstone, shale) |
| Ge68-1/2a | Lo | Po | | 245 | 7.2 | United Kingdom | Field crops | Aeolian and outwash sand; lacustrine deposit; terrace gravel |
| Ge69-2/3a | Je Be | | | 405 | 6.7 | Italy | Prairie | Alluvium |
| Ge70-2/3a | Gd | Bd | | 325 | 7.6 | Germany (Dem. Rep.) | Prairie | Alluvium |
| Ge70-2/3a | Gd | Bd | | 710 | 7.2-7.3 | United Kingdom | Field crops; prairie (forest) | Moraine (schist, igneous rocks, sandstone); lacustrine deposit |
| Ge71-2/3a | | G Wd | | 157 | 8.2-9.2 | Yugoslavia | Prairie; forest | Alluvium |
| Gh22-2/3a | Hg Q | H Sm | | 201 | 9.2 | Hungary | Field crops; prairie; orchards; vineyards; forest | Clayey alluvium; Pleistocene sand and silt |
| Gh23-3a | G Oe | Je Wd Sm | | 69 | 9.2 | Hungary | Field crops; prairie; forest | Recent alluvium; peat |
| Gh23-3a | G Oe | Je Wd Sm | | 117 | 9.2 | USSR | Field crops; prairie; forest | Recent alluvium; peat |
| Gh23-3a | G Oe | Je Wd Sm | | 45 | 9.2 | Romania | Field crops; prairie; forest | Recent alluvium; peat |
| Gh24-2b | Od | Bg Gd Pp | | 460 | 7.2-7.3 | Ireland | Prairie | Micaschist; gneiss |
| Gh24-2b | Od | Bg Gd Pp | | 903 | 7.2-7.3 | United Kingdom | Prairie; forest | Micaschist; gneiss |
| Gh25-2b | Pp | | | 92 | 7.2 | United Kingdom | Prairie; forest | Sandstone; shale |
| Gm14-2/3a | | H | | 133 | 7.6 | Poland | Field crops; prairie | Loess |
| Gm14-2/3a | | H | | 2 631 | 7.6-9.2-9.7 | USSR | Field crops; prairie | Loess; fluvial and marine alluvium |
| Gm14-2/3a | | H | | 59 | 8.2-9.2 | Yugoslavia | Field crops; prairie (forest) | Alluvium |
| Gm14-2/3a | | H | Sodic | 237 | 9.2 | Yugoslavia | Field crops; prairie (forest) | Alluvium |
| Gm14-2/3a | | H | Sodic | 138 | 9.2 | Romania | Field crops; prairie | Alluvium |

TABLE 3. – SOIL ASSOCIATIONS AND RELATED INFORMATION *(continued)*

| Map symbol | Associated soils | Inclusions | Phase | Extension (1 000 ha) | Climate | Occurrence | Vegetation | Lithology |
|---|---|---|---|---|---|---|---|---|
| Gm29-2/3a | | O Jc Gh | | 102 | 7.6 | Netherlands | Field crops; prairie; horticulture | Alluvium |
| Gm29-2/3a | | O Jc Gh | | 101 | 7.2 | United Kingdom | Field crops; prairie | Fluvial and marine alluvium |
| Gm30-2/3a | Cg Sg | Zg | | 289 | 9.2-9.3 | USSR | Field crops; prairie (marshland) | Fluvial and marine alluvium |
| Gm30-2/3a | Cg Sg | Zg | Sodic | 127 | 9.2 | USSR | Field crops; prairie (marshland) | Fluvial and marine alluvium |
| Gm31-2/3a | Ch | Sm | Sodic | 390 | 9.2-9.4-9.1 | USSR | Saline steppe; field crops; prairie | Fluvial and marine alluvium |
| Gm32-2/3a | E | | | 3 739 | 8.3-7.7-7.6 | USSR | Field crops; prairie; marshland | Fluvial, lacustrine and glacial alluvium |
| Hc2-2a | | Rc Gm | | 326 | 7.6 | Czechoslovakia | Horticulture; field crops; prairie; forest | Old calcareous alluvium |
| Hc2-2a | | Rc Gm | | 69 | 9.2 | Hungary | Horticulture; field crops; prairie; forest | Old calcareous alluvium |
| Hc3-2a | Hg | Jc Rc | | 73 | 9.2 | Yugoslavia | Field crops; prairie; horticulture | Alluvium and colluvium |
| Hc3-2a | Hg | Jc Rc | | 253 | 7.6 | Austria | Field crops; prairie; horticulture | Alluvium and colluvium |
| Hc3-2a | Hg | Jc Rc | | 343 | 7.6-9.2 | Hungary | Field crops; prairie | Loess; alluvium |
| Hc4-1a | Gh | Zo Rc | Saline | 516 | 9.2 | Yugoslavia | Field crops; prairie | Loess |
| Hc4-1a | Gh | Zo Rc | Saline | 443 | 9.2 | Hungary | Orchards; vineyards; field crops | Pleistocene loess and sand |
| Hc5-2/3a | | H S Ck | Sodic | 225 | 9.2 | Romania | Field crops; prairie | Loess; alluvium |
| Hc5-2/3a | | H S Ck | Sodic | 911 | 9.2 | Hungary | Field crops; prairie | Loess; alluvium |
| Hg7-3a | G | V O B | | 375 | 9.4-7.6-9.2 | Czechoslovakia | Field crops; prairie; horticulture; forest | Old alluvium; sand; marl (flysch) |
| Hg7-3a | G | V O B | | 88 | 9.2 | USSR | Prairie; field crops | Alluvium |
| Hg7-3a | G | V O B | | 391 | 9.2-7.6 | Hungary | Prairie; field crops | Alluvium |
| Hg8-3a | Vp | Sm H | Sodic | 270 | 9.2 | Hungary | Prairie; field crops | Alluvium |
| Hg9-2/3a | Lg | Be Ge Lo | | 160 | 7.6-9.4 | Poland | Field crops; prairie | Glacial till; clay; silt |
| Hg10-2a | | Zo Hc Gh | Saline | 206 | 9.2 | Yugoslavia | Field crops | Loess; alluvium |
| Hh23-3a | | Vp Bv Hg | | 126 | 9.4 | Czechoslovakia | Field crops | Calcareous clay; marl |
| Hh24-2/3a | B | Qc Rc | | 27 | 7.6 | Czechoslovakia | Field crops; forest | Loess; sand (terrace) |

TABLE 3. — SOIL ASSOCIATIONS AND RELATED INFORMATION *(continued)*

| Map symbol | Associated soils | Inclusions | Phase | Extension (1 000 ha) | Climate | Occurrence | Vegetation | Lithology |
|---|---|---|---|---|---|---|---|---|
| Hh24-2/3a | B | Qc Rc | | 106 | 7.6 | Poland | Field crops; forest | Loess; sand (terrace) |
| Hh24-2/3a | B | Qc Rc | | 880 | 9.2-7.6 | Hungary | Field crops; orchards; vineyards | Pleistocene loess and sand |
| Hh25-1/3ab | | Sg Vp Gm | | 883 | 9.2 | Romania | Field crops (forest) | Loess |
| Hh25-1/3ab | | Sg Vp Gm | Sodic | 284 | 9.2 | Romania | Field crops (forest) | Loess |
| Hh26-2ab | Mo Be | Lo | | 73 | 7.6 | Poland | Field crops | Loess |
| Hl45-1/3ab | Rc | C L Gm | | 407 | 9.2 | Bulgaria | Field crops; forest | Loess; Pleistocene clay |
| Hl45-1/3ab | Rc | C L Gm | | 1 215 | 9.2-9.1 | Romania | Field crops; forest; prairie | Loess; clay; marl |
| Hl45-1/3ab | Rc | C L Gm | Phreatic | 450 | 9.2 | Romania | Field crops; forest; prairie | Loess; clay; marl |
| Hl46-2a | Be E | Hh Rc | | 121 | 9.2 | Romania | | |
| I-2bc | | | | 516 | 6.1 | Portugal | Field crops; oak forest (forest) | |
| I-2bc | | | | 4 468 | 10.2-7.3 | Iceland | Open pasture; uncultivated | Basalt; rhyolite; moraine |
| I-Bc-c | | | Rock debris | 1 271 | 6.5-6.7-6.2-6.9 | USSR | Forest; open pasture; uncultivated | |
| I-Bc-c | | | Stony | 91 | 6.5-6.7 | USSR | Forest; open pasture; uncultivated | |
| I-Bc-2c | | | | 270 | 7.6-9.2-9.1 | USSR | Forest; open pasture; uncultivated | |
| I-Bc-2c | | | Rock debris | 696 | 9.2-9.1 | USSR | Forest; open pasture; uncultivated | |
| I-Bc-Lc-2b | | | | 2 440 | 6.5-6.7-6.2-7.5 | Yugoslavia | Forest; prairie | Limestone; dolomite |
| I-Bc-Lc-2b | | | | 225 | 6.5-6.7 | Albania | Forest; prairie | Limestone; dolomite |
| I-Bc-Lc-2b | | | | 35 | 9.2 | Bulgaria | Forest; prairie | Limestone; dolomite |
| I-Bc-Lc-2b | | | | 861 | 6.5-7.6 | France | Scrub; vineyards; olives | Limestone |
| I-Bd-1/2a | | | | 61 | 7.6 | Sweden | Forest; prairie | Limestone |
| I-Bd-2c | | | | 134 | 7.6-9.2 | Turkey | Forest; open pasture; brush | Granite; syenite |
| I-Bd-2c | | | | 1 431 | 9.2-7.6 | USSR | Forest; open pasture; brush | Granite; syenite |
| I-Be-c | | | Stony | 7 576 | 6.6-9.3-6.7-6.2-6.9-6.1-6.3 | Turkey | Open pasture; forest; brush | Limestone; schist |

TABLE 3. – SOIL ASSOCIATIONS AND RELATED INFORMATION *(continued)*

| Map symbol | Associated soils | Inclusions | Phase | Extension (1 000 ha) | Climate | Occurrence | Vegetation | Lithology |
|---|---|---|---|---|---|---|---|---|
| I-Be-c | | | Stony | 1 070 | 6.5-6.7 | USSR | Open pasture; forest; brush | Limestone; schist |
| I-Be-2c | | | | 34 | 9.3 | Turkey | Open pasture; forest; brush | Limestone; schist |
| I-Be-2c | | | | 3 379 | 9.3-9.2-7.6-9.1-10.5 | USSR | Open pasture; forest; brush | Limestone; schist |
| I-Be-2c | | | Stony | 878 | 9.1-9.2-9.3-10.5 | USSR | Open pasture; forest; brush | Limestone; schist |
| I-Be-E-c | | | | 2 462 | 6.5-6.7-6.6-6.1 | Turkey | Brush; open pasture; prairie (field crops) | Limestone |
| I-Bh-c | | | Stony | 989 | 6.7-6.2-6.5 | USSR | Forest; open pasture | Acid rock |
| I-Bh-2c | | | Stony | 416 | 9.3 | USSR | Forest; open pasture | Acid rock |
| I-Bh-U-c | | | | 735 | 7.6-9.2 | Turkey | Brush; forest; open pasture | Granite; syenite |
| I-Bh-U-2-c | | | | 141 | 9.3 | Turkey | Brush; forest; open pasture | Granite; syenite |
| I-Bh-U-2c | | | | 3 414 | 10.5-9.3-9.2-7.6-6.7 | USSR | Brush; forest; open pasture | Granite; syenite |
| I-Bh-U-2c | | | Rock debris | 1 008 | 10.5-9.3-9.2 | USSR | Brush; forest; open pasture | Granite; syenite |
| I-Bk-E-c | | | | 341 | 6.1 | Cyprus | Forest; open pasture | Limestone; lava; sediment |
| I-Bk-Kk-2bc | | | | 182 | 9.2 | Turkey | Open pasture; brush (field crops) | Limestone |
| I-C-c | | | Stony | 644 | 6.7 | USSR | Forest; prairie | Schist; sandstone; limestone; volcanic rock |
| I-C-2c | | | | 839 | 9.2-9.3-10.5-9.4 | USSR | Forest; prairie | Schist; sandstone; limestone; volcanic rock |
| I-Dd-Pl-2bc | | | | 2 071 | 10.1-8.3 | USSR | Forest; open pasture | Schist; sandstone |
| I-E-2c | | | | 17 | 10.5-7.7 | Austria | Uncultivated | Limestone |
| I-E-2c | | | | 47 | 7.6-7.7 | Germany (Fed. Rep.) | Open pasture; uncultivated | Limestone; dolomite |
| I-E-2c | | | | 358 | 9.4-9.1 | USSR | Forest; prairie | Limestone |
| I-E-Xk-bc | | | | 14 | 6.7 | Turkey | Forest; open pasture | Limestone |
| I-K-c | | | Stony | 348 | 6.2-6.7 | USSR | Forest; open pasture; uncultivated | Limestone; marl |
| I-K-2c | | | | 114 | 9.2 | USSR | Forest; open pasture; uncultivated | Limestone; marl |

TABLE 3. — SOIL ASSOCIATIONS AND RELATED INFORMATION *(continued)*

| Map symbol | Associated soils | Inclusions | Phase | Extension (1 000 ha) | Climate | Occurrence | Vegetation | Lithology |
|---|---|---|---|---|---|---|---|---|
| I-L-2/3bc | | | | 120 | 6.1 | Spain | Field crops; oak; olives; vineyards; almonds (forest) | Shale; greywacke; schist; quartzite |
| I-L-2/3bc | | | | 1 368 | 6.1-6.7-6.5 | Portugal | Field crops; oak; olives; vineyards; almonds (forest) | Shale; greywacke; schist; quarzite |
| I-Lc-3c | | | | 5 159 | 6.1-6.5-6.7 | Greece | Uncultivated; brush | Limestone; schist |
| I-Lc-3c | | | | 105 | 6.7 | Albania | Uncultivated; brush | Limestone; schist |
| I-Lc-E-2bc | | | | 3 956 | 6.5-6.7-6.1 | Turkey | Open pasture; field crops; forest | Limestone |
| I-Lc-E-2bc | | | | 1 138 | 7.6-7.5-9.2-9.1 | USSR | Field crops; prairie; forest | Limestone |
| I-Lo-Bc-2ab | | | | 629 | 7.5-7.6-10.1-6.5 | France | Prairie; field crops | Limestone |
| I-Mo-2bc | | | | 192 | 8.3 | USSR | Forest; open pasture; field crops | Schist; sandstone |
| I-Po-1/2b | | | | 1 197 | 7.3-7.7 | Norway | Open pasture; forest (field crops) | Moraine |
| I-Po-1/2b | | | | 1 142 | 7.7 | Finland | Forest; open pasture (field crops) | Moraine |
| I-Po-1/2b | | | | 2 146 | 10.2-10.1 | USSR | Tundra; forest | Moraine |
| I-Po-Od-1/2b | | | | 2 851 | 10.1-9.5 | Sweden | Uncultivated; open pasture | Moraine |
| I-Po-Od-1/2b | | | | 113 | 7.2 | Ireland | Prairie | Granite |
| I-Po-Od-1/2b | | | | 140 | 7.3 | Faroe Is. | Open pasture | Acid rock |
| I-Rc-Xk-c | | | Stony | 3 245 | 6.7-6.3-6.9 | Turkey | Open pasture; forest | Limestone; marl; schist |
| I-Rc-Xk-2c | | | | 348 | 7.6-9.2-7.5 | USSR | Open pasture; forest | Limestone; marl; schist |
| I-Rc-Xk-2c | | | Stony | 1 913 | 6.7-9.4 | Turkey | Open pasture; forest | Limestone; marl; schist |
| I-Re-Rx-1b | | | | 5 332 | 10.1-10.2-7.3 | Norway | Uncultivated; open pasture | Moraine |
| I-Re-Rx-1b | | | | 3 495 | 10.1 | Sweden | Uncultivated; open pasture | Moraine |
| I-Re-Rx-1b | | | | 60 | 10.1 | Finland | Uncultivated; open pasture | Moraine |
| I-Re-X-c | | | Stony | 120 | 6.7-6.9 | USSR | Open pasture; forest; uncultivated | |
| I-Re-Yh-c | | | Stony | 58 | 6.2-6.9 | Turkey | Open pasture; forest; uncultivated | Limestone |

TABLE 3. — SOIL ASSOCIATIONS AND RELATED INFORMATION *(continued)*

| Map symbol | Associated soils | Inclusions | Phase | Extension (1 000 ha) | Climate | Occurrence | Vegetation | Lithology |
|---|---|---|---|---|---|---|---|---|
| I-Re-Yh-c | | | Stony | 46 | 6.7 | USSR | Open pasture; forest; uncultivated | Limestone |
| I-Rx-Ox-2bc | | | | 328 | 10.2 | USSR | Tundra | Limestone; dolomite; moraine |
| I-U-1/2c | | | | 42 | 7.6 | Andorra | Uncultivated; forest; prairie | Eruptive and metamorphic rock |
| I-U-1/2c | | | | 1 225 | 7.6-10.5 | France | Uncultivated; forest; prairie | Eruptive and metamorphic rock |
| I-U-1/2c | | | | 70 | 7.6 | Czechoslovakia | Uncultivated; open pasture | Igneous rock |
| I-U-1/2c | | | | 17 | 7.6 | Poland | Forest; open pasture; uncultivated | Granite; limestone |
| I-U-1/2c | | | | 256 | 10.5-7.7 | Austria | Uncultivated | Acid rock |
| I-U-1/2c | | | | 884 | 10.5 | Switzerland | Uncultivated | Acid rock |
| I-U-1/2c | | | | 515 | 6.7-7.6 | Spain | Uncultivated | Granite |
| I-U-1/2c | | | | 741 | 10.5-7.6 | Italy | Uncultivated | Acid rock |
| I-Xk-2c | | | Stony | 10 | 6.7 | Turkey | Open pasture; forest | Limestone |
| Jc1-1/2a | | | | 619 | 7.2-7.6 | Netherlands | Field crops; horticulture; orchards; prairie | Recent marine alluvium |
| Jc1-1/2a | | | | 32 | 7.2-7.6 | Belgium | Field crops; prairie (orchards) | Recent marine alluvium |
| Jc36-2/3a | | Bk Z G | Saline | 45 | 6.7 | Turkey | Field crops | Fluvial alluvium |
| Jc49-1/3a | Je G | B | | 1 590 | 6.1-6.5-6.7-7.5 | Turkey | Field crops; orchards; uncultivated | Fluvial and marine alluvia |
| Jc49-1/3a | Je G | B | | 124 | 7.6 | Germany (Dem. Rep.) | Prairie; field crops | Fluvial alluvium |
| Jc49-1/3a | Je G | B | | 136 | 7.6 | Germany (Fed. Rep.) | Prairie; field crops | Fluvial alluvium |
| Jc49-1/3a | Je G | B | | 1 779 | 9.2 | Romania | Field crops; forest; prairie | Fluvial and occasionally marine alluvia |
| Jc49-1/3a | Je G | B | | 1 901 | 7.5-6.5-9.2-6.7-7.6 | France | Field crops; prairie | Fluvial alluvium |
| Jc49-1/3a | Je G | B | | 429 | 9.2 | USSR | Field crops; forest; prairie | Fluvial alluvium |
| Jc49-1/3a | Je G | B | | 125 | 6.1 | Greece | Field crops; prairie | Fluvial alluvium |
| Jc49-1/3a | Je G | B | | 35 | 6.5 | Yugoslavia | Field crops; prairie | Fluvial alluvium |
| Jc49-1/3a | Je G | B | | 350 | 6.7 | Albania | Field crops; prairie | Fluvial alluvium |
| Jc49-1/3a | Je G | B | | 358 | 7.6 | Poland | Field crops; prairie | Fluvial alluvium |

TABLE 3. – SOIL ASSOCIATIONS AND RELATED INFORMATION *(continued)*

| Map symbol | Associated soils | Inclusions | Phase | Extension (1 000 ha) | Climate | Occurrence | Vegetation | Lithology |
|---|---|---|---|---|---|---|---|---|
| Jc49-1/3a | Je G | B | | 347 | 9.2 | Bulgaria | Field crops; forest; prairie | Fluvial alluvium |
| Jc49-1/3a | Je G | B | Saline | 497 | 6.1-6.7 | Greece | Field crops | Fluvial alluvium |
| Jc49-1/3a | Je G | B | Saline | 93 | 6.7 | Turkey | Field crops | Fluvial alluvium |
| Jc57-1/2a | Gh | Sm Hc | | 83 | 9.2-8.2 | Hungary | Field crops; prairie | Fluvial alluvium |
| Jc57-1/2a | Gh | Sm Hc | | 1 568 | 8.2-9.2 | Yugoslavia | Field crops; prairie | Fluvial alluvium |
| Jc57-1/2a | Gh | Sm Hc | | 135 | 9.2 | Romania | Field crops; prairie | Fluvial alluvium |
| Jc57-1/2a | Gh | Sm Hc | Sodic | 100 | 9.2-7.6 | Czechoslovakia | Field crops; prairie; orchards; forest | Fluvial alluvium |
| Jc57-1/2a | Gh | Sm Hc | Sodic | 173 | 9.2 | Hungary | Field crops; prairie; orchards; forest | Fluvial alluvium |
| Jc58-2/3a | Zo | Gc | Saline | 31 | 6.7 | Greece | Field crops; unculti-vated | Fluvial alluvium; Ter-tiary deposit |
| Jc59-2/3a | Je | Oe G | | 61 | 7.2 | United Kingdom | Field crops; horticul-ture | Fluvial and marine al-luvia |
| Jc59-2/3a | Je | Oe G | | 632 | 7.6 | Germany (Fed. Rep.) | Prairie; field crops | Marine alluvium |
| Jc59-2/3a | Je | Oe G | | 423 | 7.6 | Netherlands | Field crops; prairie | Marine alluvium |
| Jc59-2/3a | Je | Oe G | | 80 | 7.2 | Belgium | Field crops; prairie | Marine alluvium |
| Jc59-2/3a | Je | Oe G | | 411 | 7.2-7.5-7.6 | France | Field crops; prairie | Marine alluvium |
| Jc59-2/3a | Je | Oe G | | 19 | 7.6 | Denmark | Field crops; prairie | Marine alluvium |
| Jc60-3a | L | Kk V We So | Sodic | 296 | 6.7 | Greece | Field crops | Fluvial alluvium; Ter-tiary sediment |
| Jc61-a | Rc | Zg | Saline | 260 | 9.2 | Romania | Salt prairie; marshland | Marine alluvium |
| Je74-2/3a | Hh | Gh Sm V | Sodic | 336 | 9.2 | Hungary | Field crops; prairie; orchards | Fluvial alluvium |
| Je86-2/3a | Be | | | 40 | 7.6 | Germany (Fed. Rep.) | Prairie; field crops | Fluvial alluvium |
| Je86-2/3a | Be | | | 382 | 7.6 | Netherlands | Prairie; field crops; orchards | Fluvial and marine al-luvia |
| Je86-2/3a | Be | | Saline | 412 | 6.7 | Italy | Prairie | Marine alluvium |
| Je87-2/3a | G | J | | 251 | 7.2 | United Kingdom | Prairie; field crops | Fluvial and marine al-luvia |
| Je87-2/3a | G | J | | 33 | 7.6 | Czechoslovakia | Horticulture; field crops; prairie; forest | Fluvial alluvium |
| Je87-2/3a | G | J | | 399 | 7.6 | Germany (Fed. Rep.) | Field crops; prairie; forest | Fluvial alluvium |

TABLE 3. — SOIL ASSOCIATIONS AND RELATED INFORMATION *(continued)*

| Map symbol | Associated soils | Inclusions | Phase | Extension (1 000 ha) | Climate | Occurrence | Vegetation | Lithology |
|---|---|---|---|---|---|---|---|---|
| Je87-2/3a | G | J | | 101 | 7.6 | Switzerland | Field crops: horticulture | Fluvial alluvium |
| Je87-2/3a | G | J | | 1 266 | 7.6-9.4 | Poland | Field crops: prairie: forest | Fluvial and marine alluvia |
| Je87-2/3a | G | J | | 484 | 7.6 | Germany (Dem. Rep.) | Field crops: prairie: forest | Fluvial and marine alluvia |
| Je87-2/3a | G | J | | 49 | 6.1 | Portugal | Field crops (irrigated) | Fluvial and marine alluvia |
| Je87-2/3a | G | J | | 1 271 | 6.1-6.7-6.5-5.4-6.8-6.2 | Spain | Horticulture: orchards: field crops (irrigated) | Fluvial and marine alluvia |
| Je87-2/3a | G | J | | 132 | 7.6-8.2 | France | Field crops: prairie: forest | Fluvial alluvium |
| Je87-2/3a | G | J | | 20 996 | 9.2-9.7-8.3-7.3-9.3-9.4-10.2-10.1-7.6-7.7-3.7 | USSR | Forest: prairie; field crops | Fluvial alluvium |
| Je87-2/3a | G | J | Saline | 1 112 | 9.7 | USSR | Field crops: forest | Fluvial alluvium |
| Je88-1a | Od Gh | J Ph | | 251 | 7.6 | Denmark | Field crops: prairie: uncultivated | Postglacial maritime sand |
| Kh1-2a | | | | 696 | 6.9-9.1 | USSR | Field crops: prairie: open pasture | Loess |
| Kh1-2a | | | Sodic | 9 875 | 9.2 | USSR | Field crops: prairie: open pasture | Loess |
| Kh1-2a | | | Saline | 276 | 9.7 | USSR | Field crops: prairie: open pasture | Loess |
| Kh1-2ab | | | Sodic | 1 886 | 9.2 | USSR | Field crops: prairie: open pasture | Loess |
| Kh1-2ab | | | Lithic | 2 535 | 6.6-6.2-6.7-9.2-9.3-6.9 | Turkey | Open pasture: field crops: forest (orchards) | Marl; clay: limestone; andesite: basalt |
| Kh1-2ab | | | Lithic | 696 | 6.2-6.7 | USSR | Open pasture; field crops: forest (orchards) | Marl: clay: limestone: andesite: basalt |
| Kh31-2a | | Sm | Sodic | 38 | 9.2 | Romania | Field crops; prairie: orchards | Loess: silty sediment |
| Kh31-2a | | Sm | Sodic | 17 874 | 9.2-9.1 | USSR | Field crops: prairie; orchards | Loess; silty sediment |
| Kh32-2a | Zm | | Saline | 189 | 9.2 | USSR | Field crops; prairie; orchards | Loess; silty sediment |

TABLE 3. – SOIL ASSOCIATIONS AND RELATED INFORMATION *(continued)*

| Map symbol | Associated soils | Inclusions | Phase | Extension (1 000 ha) | Climate | Occurrence | Vegetation | Lithology |
|---|---|---|---|---|---|---|---|---|
| Kh33-2a | Sm | | Sodic | 1 935 | 9.2 | USSR | Field crops; prairie; orchards | Loess; silty sediment |
| Kh34-2a | | Zm | Saline | 2 728 | 9.2 | USSR | Field crops; prairie; orchards | Loess; silty sediment |
| Kh35-2ab | Kk | | | 515 | 9.2 | Turkey | Field crops; open pasture | Marl; sandy clay |
| Kh35-2ab | Kk | | | 3 053 | 9.2-9.4 | USSR | Field crops; prairie | Loess |
| Kk16-2b | Xk X1 | Gc Rc | | 2 085 | 6.7 | Turkey | Field crops; open pasture | Marl; clay; limestone |
| Kk17-2a | Kh | E Rc | Saline | 381 | 9.2 | Romania | Field crops | Loess |
| Kk18-2a | Sm Zm | | Sodic | 4 097 | 9.2-9.7 | USSR | Field crops; open pasture | Loess |
| Kk19-2/3b | I Rc | Jc Gm | | 161 | 9.4-9.2 | Turkey | Open pasture; forest; uncultivated | Clay; marl |
| Kl6-2a | | Sm | Sodic | 426 | 9.7 | USSR | Field crops; prairie; uncultivated | Marine and fluvial alluvia |
| Kl45-2a | S X | | Saline | 114 | 9.7 | USSR | Field crops; prairie; uncultivated | Marine and fluvial alluvia |
| Kl45-2a | S X | | Sodic | 5 232 | 9.7 | USSR | Field crops; prairie; uncultivated | Marine and fluvial alluvia |
| Kl46-2a | Sg | | Saline | 478 | 9.2-9.7 | USSR | Field crops; prairie; uncultivated | Marine and fluvial alluvia |
| Lc46-2/3b | Bc | | | 171 | 7.5 | Yugoslavia | Vineyards; orchards; field crops | Limestone; dolomite |
| Lc46-2/3b | Bc | | | 31 | 7.6 | Austria | Field crops; forest; vineyards | Loess; Pleistocene sand; Tertiary sediment; Permian sandstone |
| Lc63-3bc | Bk I | Rc | Stony | 2 727 | 6.7-6.3 | Turkey | Open pasture; field crops; forest (orchards) | Limestone; clay; marl |
| Lc69-3a | Lk | I | | 172 | 6.7 | Turkey | Open pasture; field crops; forest (orchards) | Limestone; clay; marl |
| Lc76-3b | Bc | I | | 264 | 6.1 | Turkey | Open pasture; field crops; forest (orchards) | Limestone; conglomerate |
| Lc102-3b | Lo E | | | 456 | 7.6 | Germany (Fed. Rep.) | Field crops; forest; prairie | Limestone |
| Lc103-2ab | Lo Re | | | 1 084 | 9.2 | Bulgaria | Field crops; forest; prairie | Loess; Pleistocene clay; marl; limestone; calcareous sandstone |

TABLE 3. – SOIL ASSOCIATIONS AND RELATED INFORMATION *(continued)*

| Map symbol | Associated soils | Inclusions | Phase | Extension (1 000 ha) | Climate | Occurrence | Vegetation | Lithology |
|---|---|---|---|---|---|---|---|---|
| Lc104-2/3bc | I B | | | 136 | 6.1 | Greece | Forest; brush; prairie | Limestone; schist; flysch; granite; Tertiary and Quaternary sediment |
| Lc104-2/3bc | I B | | Stony | 4 269 | 6.5-6.1-6.7 | Greece | Forest; brush; prairie | Limestone; schist; flysch; granite; Tertiary and Quaternary sediment |
| Lc104-2/3bc | I B | | Stony | 463 | 6.1 | Portugal | Field crops; oak forest; olives; vineyards; almonds | Schist; shale; dolerite; sandstone; limestone |
| Lc104-2/3bc | I B | | Stony | 107 | 7.1-7.6 | Spain | Forest; prairie; orchards | Calcareous sandstone; limestone |
| Lc104-2/3bc | I B | | Stony | 2 111 | 7.5-9.2-6.5 | Bulgaria | Forest; prairie; field crops | Stony silt; schist; andesite; rhyolite; calcareous sandstone; limestone |
| Lc104-2/3bc | I B | | Stony | 1 524 | 6.5-6.7-6.1 | Albania | Forest; brush; prairie | Limestone; schist; flysch; Tertiary and Quaternary deposit |
| Lc104-2/3bc | I B | | Stony | 711 | 6.7-6.5 | Turkey | Forest; prairie; field crops | Gneiss; schist; amphibolite; granite; limestone; marl; shale; sandstone |
| Lc104-2/3bc | I B | | Stony | 1 372 | 6.1-6.5-6.7-6.2 | Italy | Forest; olives | Triassic, Cretaceous and Cenozoic limestone |
| Lc104-2/3bc | I B | | Stony | 24 | 6.7 | Yugoslavia | Forest; olives | Triassic, Cretaceous and Cenozoic limestone |
| Lc105-2/3ab | | B I E | | 32 | 6.1 | Malta | Field crops; orchards (open pasture) | Limestone |
| Lc105-2/3ab | | B I E | | 424 | 6.7 | Greece | Forest; brush; prairie | Flysch; schist; granite; limestone |
| Lc105-2/3ab | | B I E | | 288 | 6.5-7.5-6.1 | France | Field crops; vineyards | Old alluvium |
| Lc105-2/3ab | | B I E | | 677 | 6.5-7.5 | Turkey | Forest; open pasture | Clayey schist |
| Lc105-2/3ab | | B I E | | 701 | 7.5-9.2 | Bulgaria | Forest; field crops | Clayey silt; andesite; schist; rhyolite; calcareous sandstone; limestone |
| Lc105-2/3ab | | B I E | Stony | 106 | 9.2 | Bulgaria | Forest; field crops | Clayey silt; andesite; schist; rhyolite; calcareous sandstone; limestone |
| Lc105-2/3ab | | B I E | Stony | 104 | 6.7 | Greece | Field crops; prairie; forest | Clayey and sandy Tertiary sediment; marl; gneiss; amphibolite; quartzite; marble |

TABLE 3. – SOIL ASSOCIATIONS AND RELATED INFORMATION *(continued)*

| Map symbol | Associated soils | Inclusions | Phase | Extension (1 000 ha) | Climate | Occurrence | Vegetation | Lithology |
|---|---|---|---|---|---|---|---|---|
| Lc105-2/3ab | | B I E | Stony | 687 | 6.7 | Turkey | Field crops; prairie; forest | Clayey and sandy Tertiary sediment; marl; gneiss; amphibolite; quartzite; marble |
| Lc106-2b | Bk | | Petrocalcic | 746 | 6.7-6.2-6.5 | Spain | Field crops; olives; vineyards | Limestone |
| Lc107-2/3a | So | Zg V W | Sodic | 149 | 9.2 | Bulgaria | Forest; field crops | Clayey silt; andesite; schist; rhyolite; calcareous sandstone; limestone |
| Lc108-2b | Ah | Bd Dd | | 338 | 7.6-8.2 | Yugoslavia | Prairie; field crops; forest | Silt; limestone |
| Lc109-2b | Be | | | 736 | 6.7-6.5 | Spain | Field crops; olives; prairie; oak forest | Shale; diorite; arkose |
| Lc109-2a | Be | | | 526 | 7.2-7.3 | United Kingdom | Field crops; prairie; forest | Aeolian plateau sediment; flinty clay |
| Lc110-2a | Lo Ge | E | | 40 | 7.2 | United Kingdom | Field crops; prairie | Sandy glacial till; Tertiary sand and clay |
| Lc111-2ab | | Je | Petrocalcic | 45 | 6.1 | Italy | Field crops; vineyards | Pleistocene calcareous terrace sediment |
| Lc111-2ab | | Je | Phreatic | 329 | 9.2 | Romania | Field crops; forest | Loess |
| Lf97-2/3bc | Lo Lc | Af | Stony | 397 | 6.1 | Portugal | Field crops; oak forest (irrigated horticulture) | Shale; schist; conglomerate; marl |
| Lg40-2ab | La | Lo Be De | Fragic | 349 | 7.6 | Czechoslovakia | Field crops; forest; orchards | Loess; outwash silt |
| Lg40-2ab | La | Lo Be De | Fragic | 36 | 7.6 | Poland | Field crops; forest; orchards | Loess; outwash silt |
| Lg40-2ab | La | Lo Be De | Stony | 575 | 6.7-7.5 | Italy | Vineyards; field crops; prairie; forest | Pleistocene fluvial sediment |
| Lg41-2/3ab | Lo | B We G | | 63 | 7.6 | Czechoslovakia | Field crops; orchards; forest | Loess; outwash silt; Tertiary calcareous sediment |
| Lg41-2/3ab | Lo | B We G | | 805 | 7.6 | Poland | Field crops; forest | Glacial till |
| Lg41-2/3ab | Lo | B We G | | 280 | 7.6 | USSR | Field crops; forest | Glacial till |
| Lg41-2/3ab | Lo | B We G | | 297 | 6.1 | Portugal | Field crops; oak forest; olives | Arkose; conglomerate; marl; chalk; shale; gneiss; clayey sandstone |
| Lg41-2/3ab | Lo | B We G | Fragic | 17 | 7.6 | Hungary | Field crops; orchards; forest | Loess; outwash silt; Tertiary calcareous sediment |
| Lg41-2/3ab | Lo | B We G | Fragic | 183 | 7.6 | Czechoslovakia | Field crops; orchards; forest | Loess; outwash silt; Tertiary calcareous sediment |

TABLE 3. – SOIL ASSOCIATIONS AND RELATED INFORMATION *(continued)*

| Map symbol | Associated soils | Inclusions | Phase | Extension (1 000 ha) | Climate | Occurrence | Vegetation | Lithology |
|---|---|---|---|---|---|---|---|---|
| Lg41-2/3ab | Lo | B We G | Phreatic | 4 741 | 9.1-9.2-7.7 | Romania | Field crops; forest (orchards) | Loess; sediments |
| Lg41-2/3ab | Lo | B We G | Phreatic | 55 | 9.2 | USSR | Field crops; forest (orchards) | Loess; sediments |
| Lg41-2/3ab | Lo | B We G | Phreatic | 66 | 9.2 | Yugoslavia | Field crops; forest (orchards) | Loess; sediments |
| Lg42-2b | Bk | Bd Vc | | 648 | 8.2 | Yugoslavia | Vineyards; field crops; forest | Marl; flysch; silty clay |
| Lg43-2ab | D | Lo B | | 1 087 | 8.2 | Yugoslavia | Field crops; forest; prairie | Pleistocene silt and clay |
| Lg43-2ab | D | Lo B | | 3 015 | 7.6-9.4 | Poland | Field crops; prairie | Glacial till |
| Lg44-2/3ab | Bg | G | | 246 | 7.6 | Austria | Field crops; forest | Loess |
| Lg45-2/3b | | G Lo B | | 249 | 8.2 | Hungary | Field crops; forest; prairie | Pleistocene clay; rhyolite |
| Lg45-2/3b | | G Lo B | | 187 | 7.6 | Austria | Field crops; forest; prairie | Pleistocene clay; rhyolite |
| Lg45-2/3b | | G Lo B | Lithic | 92 | 7.6 | Belgium | Field crops; prairie; forest | Marl; macigno |
| Lg45-2/3b | | G Lo B | Lithic | 13 | 7.6 | France | Field crops; prairie; forest | Marl; macigno |
| Lg45-2/3b | | G Lo B | Lithic | 109 | 7.6 | Luxembourg | Field crops; prairie; forest | Marl; macigno |
| Lg45-2/3ab | | G Lo B | Lithic | 20 | 7.6 | Germany (Fed. Rep.) | Field crops; prairie; forest | Marl; macigno |
| Lg46-2ab | Bd Be Lo | I Ph | Lithic | 27 | 7.6 | Netherlands | Prairie; orchards; forest | Loess; schist; limestone |
| Lg46-2ab | Bd Be Lo | I Ph | Lithic | 35 | 7.6 | Belgium | Prairie; orchards; forest | Loess; schist; limestone |
| Lg47-2/3ab | Dd E | Po Wd | | 434 | 7.5 | France | Field crops; prairie; forest; vineyards | Loess; limestone |
| Lg48-2/3a | | B Gd We | | 342 | 9.4 | Czechoslovakia | Forest; prairie; field crops | Outwash silt; Tertiary sandy silt |
| Lg49-1/2ab | G Pl | | | 169 | 7.6 | Germany (Dem. Rep.) | Prairie; field crops; forest | Glacial till |
| Lg51-2/3a | Dd | Wd Po | | 10 | 7.6 | Switzerland | Field crops; prairie; forest | Loess; stony sand and clay |
| Lg51-2/3a | Dd | Wd Po | | 6 570 | 7.5-7.6-8.2-7.2-9.2 | France | Field crops; prairie; forest | Loess; stony sand and clay |
| Lg52-2a | Gm | | | 198 | 9.1-9.2 | USSR | Field crops; prairie | Outwash |

TABLE 3. – SOIL ASSOCIATIONS AND RELATED INFORMATION *(continued)*

| Map symbol | Associated soils | Inclusions | Phase | Extension (1 000 ha) | Climate | Occurrence | Vegetation | Lithology |
|---|---|---|---|---|---|---|---|---|
| Lg53-2ab | Wd | Be Lo | | 440 | 7.6-7.5 | France | Field crops; prairie; forest | Loess; limestone; marl |
| Lg54-1a | Pl Po | | | 4 260 | 7.6-7.7-7.3-9.2 | USSR | Prairie; field crops; forest | Outwash sand |
| Lg54-1a | Pl Po | | | 93 | 7.6 | Poland | Prairie; field crops; forest | Outwash sand |
| Lg55-1a | Pl Pg | Od | | 11 198 | 7.6 | USSR | Prairie; field crops; forest | Outwash sand |
| Lg55-1a | Pl Pg | Od | | 33 | 7.6 | Poland | Prairie; field crops; forest | Outwash sand |
| Lo64-3c | Be I | | Lithic/ stony | 1 793 | 6.7-6.6 | Turkey | Field crops; open pasture; forest | Andesite; basalt |
| Lo69-2ab | Be | Lg G O E | | 223 | 8.2-9.2 | Yugoslavia | Vineyards; prairie; forest; field crops | Tertiary sediment; outwash |
| Lo69-2ab | Be | Lg G O E | | 1 176 | 7.6-9.4 | Poland | Field crops; prairie; forest | Glacial till |
| Lo69-2ab | Be | Lg G O E | | 149 | 7.6 | Austria | Prairie; field crops; forest | Glacial till; moraine |
| Lo69-2ab | Be | Lg G O E | | 33 | 7.6-9.4 | Czechoslovakia | Prairie; field crops; forest | Glacial till; moraine |
| Lo69-2ab | Be | Lg G O E | | 3 935 | 7.6-7.2-7.5 | France | Field crops | Loess; limestone |
| Lo69-2ab | Be | Lg G O E | | 1 022 | 7.6 | Denmark | Field crops; forest | Glacial till |
| Lo69-2ab | Be | Lg G O E | | 800 | 7.6 | Switzerland | Field crops; horticulture; forest | Moraine; Tertiary sandstone; terrace gravel; aeolian sand and silt |
| Lo69-2ab | Be | Lg G O E | | 795 | 7.6 | Germany (Fed. Rep.) | Field crops; prairie; forest | Glacial till; moraine; limestone |
| Lo69-2ab | Be | Lg G O E | Stony | 69 | 7.6 | Austria | Field crops; prairie; forest | Glacial till; moraine; limestone |
| Lo69-2ab | Be | Lg G O E | Stony | 731 | 7.6 | Germany (Fed. Rep.) | Field crops; prairie; forest | Glacial till; moraine; limestone |
| Lo71-3ab | Be | Je | | 1 628 | 6.7-7.5-6.1 | Italy | Field crops | Pleistocene terrace and moraine |
| Lo72-2b | Bd | Lg Po | | 3 878 | 7.5-7.6-7.2 | France | Prairie; field crops; uncultivated | Crystalline and metamorphic rock; residual silt |
| Lo73-2ab | Lg | Dd Be | | 1 676 | 7.5-7.2-7.6 | France | Field crops; prairie | Loess; stony sand and clay |

TABLE 3. — SOIL ASSOCIATIONS AND RELATED INFORMATION *(continued)*

| Map symbol | Associated soils | Inclusions | Phase | Extension (1 000 ha) | Climate | Occurrence | Vegetation | Lithology |
|---|---|---|---|---|---|---|---|---|
| Lo73-2ab | Lg | Dd Be | | 2 102 | 7.2 | Ireland | Field crops; prairie; forest | Limestone; moraine |
| Lo73-2ab | Lg | Dd Be | | 10 | 7.6 | Switzerland | Field crops; prairie; forest | Loess; silty sediment |
| Lo73-2ab | Lg | Dd Be | | 128 | 7.6 | Austria | Field crops; prairie; forest | Loess; silty sediment |
| Lo73-2ab | Lg | Dd Be | | 1 032 | 7.2 | United Kingdom | Field crops; prairie; forest | Sedimentary rock; marl; moraine; terrace and plateau gravel |
| Lo73-2ab | Lg | Dd Be | | 2 237 | 7.6 | Germany (Fed. Rep.) | Field crops; prairie; forest | Loess; silty sediment |
| Lo73-2ab | Lg | Dd Be | | 191 | 7.6 | Belgium | Field crops; prairie; forest | Loess; Tertiary sand and clay |
| Lo73-2ab | Lg | Dd Be | | 2 406 | 7.6 | Germany (Dem. Rep.) | Field crops; prairie | Loess (south); glacial till (north) |
| Lo74-2a | Hl | Re | | 255 | 7.6-8.2 | France | Field crops | Loess (south); glacial till (north) |
| Lo74-2a | Hl | Re | | 14 | 7.6 | Switzerland | Field crops | Loess |
| Lo74-2a | Hl | Re | | 864 | 7.6 | Germany (Fed. Rep.) | Field crops | Loess |
| Lo75-2ab | R Be | Lg E | | 368 | 7.6 | Austria | Field crops (forest) | Loess; gravel; limestone |
| Lo75-2ab | R Be | Lg E | | 1 363 | 7.6 | Germany (Fed. Rep.) | Field crops; prairie | Loess |
| Lo75-2ab | R Be | Lg E | | 242 | 7.6 | Belgium | Field crops; prairie; orchards | Loess; Tertiary sand and clay |
| Lo75-2ab | R Be | Lg E | | 286 | 7.6 | Germany (Dem. Rep.) | Field crops; prairie | Glacial till |
| Lo75-2ab | R Be | Lg E | | 34 | 7.6 | Netherlands | Field crops; prairie; orchards | Loess |
| Lo75-2ab | R Be | Lg E | | 159 | 9.2 | Bulgaria | Field crops; forest | Loess |
| Lo76-2/3b | Bc | R Lc G | | 991 | 8.2-9.2-7.6 | Hungary | Field crops; forest; prairie | Loess; Tertiary silt and clay; granite; andesitic tuff |
| Lo76-2/3b | Bc | R Lc G | | 83 | 7.6 | Czechoslovakia | Field crops; forest; prairie | Loess; Tertiary sand and clay; granite; andesitic tuff |
| Lo77-2bc | W | I E Be | Stony | 761 | 7.5-9.2 | Bulgaria | Forest; prairie | Stony silt; Pleistocene clay; granite; sandstone; andesite |
| Lo78-1/2a | Lg | Dg G | | 114 | 7.6 | Germany (Dem. Rep.) | Field crops; prairie | Loess |
| Lo78-1/2a | Lg | Dg G | | 104 | 7.6 | USSR | Field crops; forest; prairie | Glacial till; Pleistocene sand |

TABLE 3. – SOIL ASSOCIATIONS AND RELATED INFORMATION *(continued)*

| Map symbol | Associated soils | Inclusions | Phase | Extension (1 000 ha) | Climate | Occurrence | Vegetation | Lithology |
|---|---|---|---|---|---|---|---|---|
| Lo78-1/2a | Lg | Dg G | | 2 353 | 7.6-9.4 | Poland | Field crops; forest; prairie | Glacial till; Pleistocene sand |
| Lo79-2a | Pl | De | | 176 | 9.4 | Poland | Field crops; forest | Silts |
| Lo80-2b | Lg | B | | 272 | 9.2-8.2 | Yugoslavia | Field crops; prairie; forest | Silt; schist |
| Lo80-2b | Lg | B | | 343 | 9.2 | Romania | Forest; field crops; orchards | Loess; sediments |
| Lo80-2b | Lg | B | Lithic | 33 | 7.6 | France | Field crops; prairie; forest | Loess; limestone; psammite |
| Lo80-2b | Lg | B | Lithic | 156 | 7.6 | Belgium | Field crops; prairie; forest | Loess; limestone; psammite |
| Lo81-1a | Pl | Qc | | 457 | 7.6 | Poland | Field crops; forest | Pleistocene sand |
| Lo82-1a | Oe | Je | | 232 | 7.2 | Ireland | Field crops; prairie; forest | Limestone; moraine |
| Lo83-2bc | Be I | Lc | | 56 | 6.7 | Greece | Forest | Flysch |
| Lo83-2bc | Be I | Lc | | 10 | 6.7 | Albania | Forest | Flysch |
| Lo83-2bc | Be I | Lc | Lithic | 20 | 6.1 | Spain | Field crops; oak forest; olives; almonds; vineyards (forest) | Shale; quartz diorite; granite; schist; porphyry; gneiss; conglomerate |
| Lo83-2bc | Be I | Lc | Lithic | 592 | 6.1 | Portugal | Field crops; oak forest; olives; almonds; vineyards (forest) | Shale; quartz diorite; granite; schist; porphyry; gneiss; conglomerate |
| Lo84-2b | Ph | Be Dd Q | | 191 | 7.6 | Belgium | Field crops; prairie; forest | Loess; Tertiary sand and clay |
| Lo84-2b | Ph | Be Dd Q | | 17 | 7.6 | France | Field crops; prairie; forest | Loess; Tertiary sand and clay |
| Lo85-2b | Vc | I Bd | | 237 | 6.7-6.5 | Turkey | Field crops; prairie | Conglomerate; sandstone; marl; shale |
| Lo86-1/2a | Po Lg Gh | | | 196 | 7.6 | Netherlands | Field crops; prairie; forest | Pleistocene fluvial alluvium; Pleistocene aeolian and outwash sand; preglacial coarse fluvial alluvium |
| Lo86-1/2a | Po Lg Gh | | | 499 | 7.6 | Germany (Fed. Rep.) | Field crops; prairie; forest | Pleistocene fluvial alluvium; Pleistocene aeolian and outwash sand; preglacial coarse fluvial alluvium |
| Lo87-3b | Bh E | | | 490 | 7.6 | France | Forest; prairie | Limestone |

TABLE 3. — SOIL ASSOCIATIONS AND RELATED INFORMATION *(continued)*

| Map symbol | Associated soils | Inclusions | Phase | Extension (1 000 ha) | Climate | Occurrence | Vegetation | Lithology |
|---|---|---|---|---|---|---|---|---|
| Lo88-2/3b | Bh | Be | | 387 | 7.6 | France | Forest; prairie; field crops | Limestone; glacial deposit; residual clay |
| Lo88-2/3b | Bh | Be | | 35 | 7.6 | Switzerland | Forest; prairie; field crops | Limestone; glacial deposit; residual clay |
| Lo89-2a | Mo | | | 26 052 | 7.3-8.3-9.3-7.7-7.6-9.2-9.4 | USSR | Field crops; prairie; forest | Moraine; silt; loess |
| Lo90-2ab | E Be | | | 755 | 7.5 | France | Field crops | Loess; limestone |
| Lo91-2bc | Ao I | Be H | Lithic/stony | 3 596 | 6.7-6.5-6.1 | Turkey | Forest; open pasture | Andesite; granite; schist |
| Lo92-2b | Rc | Be Bv | | 1 063 | 9.4-7.6 | Czechoslovakia | Field crops (forest) | Loess |
| Lv7-3ab | Lk | I Bk So | Lithic | 34 | 6.1 | Cyprus | Field crops | Sediments, esp. calcareous |
| Lv8-2ab | Be | Re Wd | | 1 140 | 6.5-6.7 | Spain | Field crops; vineyards; olives | Arkose |
| Mo1-2ab | | | | 5 993 | 7.3-8.3-9.3-7.7-7.6-9.2 | USSR | Field crops; prairie; forest | Moraine; loess |
| Od22-a | | Pg Gd | | 277 | 7.6 | Netherlands | Field crops; prairie (uncultivated) | Peat; Pleistocene aeolian sand |
| Od22-a | | Pg Gd | | 313 | 7.6 | Germany (Fed. Rep.) | Prairie; field crops; uncultivated | Peat; Pleistocene aeolian sand |
| Od22-a | | Pg Gd | | 276 | 7.3 | United Kingdom | Prairie; forest | Peat |
| Od22-a | | Pg Gd | | 41 | 9.2 | Romania | Marshland; prairie; forest | Peat |
| Od22-a | | Pg Gd | | 6 406 | 10.1-8.3-7.7-7.6-9.2-10.2-7.5 | USSR | Marshland; prairie; forest | Peat |
| Od22-a | | Pg Gd | | 455 | 9.7 | USSR | Field crops; prairie; forest | Peat |
| Od23-a | Oe Po | | | 2 468 | 10.1 | USSR | Open pasture; marshland; forest | Peat |
| Od23-a | Oe Po | | | 6 735 | 10.1-7.7 | Finland | Marshland; open pasture; forest | Peat |
| Od24-a | | Oe P | | 340 | 10.1 | Finland | Marshland; open pasture; forest | Peat |
| Od24-a | | Oe P | | 191 | 7.3 | Iceland | Open pasture; tundra | Peat |
| Od24-a | | Oe P | | 1 876 | 10.2-10.1 | USSR | Open pasture; tundra | Peat |
| Od25-a | Oe Gm | | | 122 | 7.2 | United Kingdom | Field crops; horticulture; prairie | Peat |

TABLE 3. – SOIL ASSOCIATIONS AND RELATED INFORMATION *(continued)*

| Map symbol | Associated soils | Inclusions | Phase | Extension (1 000 ha) | Climate | Occurrence | Vegetation | Lithology |
|---|---|---|---|---|---|---|---|---|
| Od26-a | Gd Pp | | | 306 | 7.3-7.2 | United Kingdom | Prairie; forest | Peat; schist; shale; greywacke |
| Od27-a | Pp I | Gd | | 2 293 | 7.3 | United Kingdom | Prairie; forest | Peat; metamorphic rock |
| Oe13-a | Od | | | 66 | 8.2 | France | Prairie; horticulture | Peat |
| Oe13-a | Od | | | 239 | 7.6 | Germany (Fed. Rep.) | Prairie; field crops | Peat |
| Oe13-a | Od | | | 254 | 7.6 | Germany (Dem. Rep.) | Prairie; field crops | Peat |
| Oe14-a | Ge | P | | 471 | 7.6 | Poland | Prairie; field crops | Peat |
| Oe14-a | Ge | P | | 203 | 7.6 | Netherlands | Prairie (horticulture) | Peat; recent marine and fluvial alluvia; Pleistocene aeolian sand |
| Oe15-a | | Lo Ge Be | | 123 | 7.2 | Ireland | Field crops; horticulture | Peat; limestone; moraine |
| Ox7-a | Od | | | 8 226 | 10.2-10.1 | USSR | Tundra | Peat |
| Pg5-2c | Gh | I | Stony | 52 | 7.7 | Austria | Forest; open pasture | Molasse |
| Pg5-2c | Gh | I | Stony | 108 | 7.7 | Switzerland | Forest; prairie | Conglomerate; clay; schist |
| Pg6-2a | Gh Od | | | 8 558 | 10.1 | USSR | Open pasture (forest; prairie) | Moraine; outwash sediment |
| Pg7-2a | Gh | Od | | 9 560 | 10.1-10.2 | USSR | Forest (open pasture; prairie) | Moraine; outwash sediment |
| Pg8-2a | Gh | | | 3 411 | 10.1 | USSR | Forest (open pasture; field crops) | Moraine; outwash sediment |
| Pg9-1/2a | Po Od | Gh | | 13 536 | 10.1-10.2 | USSR | Forest; open pasture (field crops) | Moraine; outwash sediment |
| Ph14-1/2c | Bd I | U E | Stony | 76 | 7.6 | Czechoslovakia | Forest; prairie; uncultivated | Igneous rock |
| Ph15-1a | Pg | G Q O | | 3 | 7.6 | Germany (Dem. Rep.) | Field crops; prairie; forest (moor) | Pleistocene aeolian sand |
| Ph15-1a | Pg | G Q O | | 1 133 | 7.6 | Netherlands | Prairie; field crops; forest (moor) | Pleistocene aeolian sand |
| Ph15-1a | Pg | G Q O | | 236 | 7.6 | Belgium | Prairie; field crops; forest (moor) | Pleistocene aeolian sand |
| Ph15-1a | Pg | G Q O | | 443 | 7.6 | Denmark | Field crops; forest (moor) | Outwash sand |
| Ph15-1a | Pg | G Q O | | 2 161 | 7.6 | Germany (Fed. Rep.) | Field crops; prairie; forest (moor) | Pleistocene aeolian sand |
| Ph16-1a | | Dd Lo | | 971 | 7.6 | Germany (Fed. Rep.) | Forest; field crops (moor) | Pleistocene aeolian sand |

TABLE 3. – SOIL ASSOCIATIONS AND RELATED INFORMATION *(continued)*

| Map symbol | Associated soils | Inclusions | Phase | Extension (1 000 ha) | Climate | Occurrence | Vegetation | Lithology |
|---|---|---|---|---|---|---|---|---|
| Ph16-1a | | Dd Lo | | 10 | 7.6 | Germany (Dem. Rep.) | Forest; field crops (moor) | Pleistocene aeolian sand |
| Ph17-1a | Q | Gd | | 216 | 7.6-7.2 | Belgium | Field crops; prairie; forest | Pleistocene aeolian sand |
| Ph18-1ab | | Rd Gd | | 14 | 7.6 | Netherlands | Forest; moor; field crops; prairie | Pleistocene gravelly terrace sand |
| Ph19-1ab | Po Pg | Od | | 1 093 | 7.5 | France | Forest; moor | Aeolian sand; sandstone |
| Ph19-1ab | Po Pg | Od | | 183 | 7.6 | Netherlands | Forest; moor | Pleistocene aeolian and outwash sand; preglacial fluvial alluvium |
| P15-1ab | Po | Qc D | | 397 | 7.6 | Germany (Dem. Rep.) | Forest; field crops | Outwash sand |
| P15-1ab | Po | Qc D | | 9 513 | 7.6-9.4 | Poland | Forest; field crops | Outwash sand |
| P15-1ab | Po | Qc D | | 605 | 7.6 | USSR | Forest; field crops | Outwash sand |
| P16-1ab | Lo Qc | D G | | 152 | 7.6 | Poland | Forest; field crops | Outwash sand; sand with pebbles |
| P17-1bc | Po Bh | I O | Stony | 1 146 | 7.7 | Romania | Forest; prairie | Eruptive and metamorphic rock; conglomerate; sandstone; schist |
| P17-1bc | Po Bh | I O | Stony | 62 | 7.7 | USSR | Forest; prairie | Eruptive and metamorphic rock; conglomerate; sandstone; schist |
| P18-1/2bc | U D | Po Od | | 166 | 10.1-7.6 | France | Prairie; forest; uncultivated | Crystalline and metamorphic rock |
| Po2-1ab | Od | | Stony | 12 | 10.1 | Norway | Forest; prairie; field crops | Moraine; esker; peat |
| Po2-1ab | Od | | Stony | 3 902 | 10.1 | Sweden | Forest; prairie; field crops | Moraine; esker; peat |
| Po2-1ab | Od | | Stony | 78 | 10.1 | Finland | Forest; prairie; field crops | Moraine; esker; peat |
| Po2-1b | Od | | | 1 784 | 7.3-10.2 | Iceland | Open pasture | Basalt |
| Po2-1b | Od | | Stony | 3 124 | 10.1-7.7 | Sweden | Forest; prairie; field crops (south) | Moraine; esker; peat |
| Po28-1bc | Bd I | | | 281 | 7.6-6.5 | Italy | Forest; prairie | Acid eruptive and metamorphic rock; sandstone |
| Po28-1bc | Bd I | | Stony | 202 | 7.6-10.5 | Switzerland | Forest; open pasture; brush | Acid eruptive and metamorphic rock; sandstone |
| Po28-1bc | Bd I | | Stony | 924 | 10.5-7.7-7.6 | Austria | Forest; open pasture | Acid rock |

TABLE 3. – SOIL ASSOCIATIONS AND RELATED INFORMATION *(continued)*

| Map symbol | Associated soils | Inclusions | Phase | Extension (1 000 ha) | Climate | Occurrence | Vegetation | Lithology |
|---|---|---|---|---|---|---|---|---|
| Po28-1bc | Bd I | | Stony | 1 448 | 7.6-10.5 | Italy | Forest; prairie | Acid eruptive and metamorphic rock; sandstone |
| Po29-1b | Be | B Pg | | 420 | 6.1-6.2 | Portugal | Field crops; forest; oak forest | Sand; sandstone |
| Po29-1b | Be | B Pg | Stony | 991 | 6.1-6.2 | Portugal | Field crops; forest; oak forest | Sand; sandstone |
| Po30-1ab | Pg | Q G Od | | 106 | 7.6-9.4 | Czechoslovakia | Forest (field crops) | Sand; sandstone |
| Po30-1ab | Pg | Q G Od | | 1 799 | 7.6-9.4 | Poland | Forest; field crops; prairie | Outwash sand; dune sand |
| Po30-1ab | Pg | Q G Od | | 32 | 7.6 | Germany (Dem. Rep.) | Forest; field crops; prairie | Outwash sand; dune sand |
| Po30-1ab | Pg | Q G Od | | 1 322 | 7.3-7.2 | United Kingdom | Forest; prairie; field crops | Sandstone; glacial sand; moraine |
| Po30-1ab | Pg | Q G Od | | 38 | 7.6 | Belgium | Field crops; prairie; forest | Pleistocene aeolian sand; Tertiary green-sand |
| Po30-1ab | Pg | Q G Od | | 686 | 7.5-7.2 | France | Forest; prairie; marsh-land | Tertiary stony sand and clay; siliceous rock |
| Po31-1b | U | Bd | Stony | 5 825 | 10.1-7.7-7.3 | Norway | Uncultivated; forest (field crops) | Moraine |
| Po31-1b | U | Bd | Stony | 52 | 7.6 | Germany (Dem. Rep.) | Forest | Sandstone; quartzite; acid sedimentary rock |
| Po31-1b | U | Bd | Stony | 156 | 7.6 | France | Forest | Sandstone; crystalline rock |
| Po32-1/2ab | Od | Ph I | | 4 777 | 7.7-10.1 | Finland | Forest; marshland (field crops) | Glacial till; peat |
| Po32-1/2ab | Od | Ph I | | 13 588 | 10.1-10.2 | USSR | Forest; tundra; open pasture | Glacial till; peat |
| Po32-1/2ab | Od | Ph I | Stony | 13 966 | 10.1-7.7 | Sweden | Forest; prairie; field crops | Moraine; esker; post-glacial sediment; peat |
| Po32-1/2ab | Od | Ph I | Stony | 8 960 | 10.2-10.1 | Norway | Uncultivated; forest (field crops) | Moraine; peat |
| Po32-1/2ab | Od | Ph I | Stony | 6 720 | 10.1 | Finland | Forest; marshland (field crops) | Glacial till; peat |
| Po32-1/2ab | Od | Ph I | Stony | 6 714 | 10.1-10.2 | USSR | Forest; marshland (field crops) | Glacial till; peat |
| Po33-1/2ab | Bd | O G | | 930 | 7.7 | Sweden | Forest; prairie; field crops | Moraine; postglacial sediment |
| Po33-1/2ab | Bd | O G | | 43 | 7.6-7.7 | Norway | Forest; prairie; field crops | Moraine; postglacial sediment |

TABLE 3. – SOIL ASSOCIATIONS AND RELATED INFORMATION *(continued)*

| Map symbol | Associated soils | Inclusions | Phase | Extension (1 000 ha) | Climate | Occurrence | Vegetation | Lithology |
|---|---|---|---|---|---|---|---|---|
| Po33-1/2ab | Bd | O G | | 7 998 | 7.7 | Finland | Forest; marshland; field crops | Glacial till |
| Po33-1/2ab | Bd | O G | | 5 407 | 7.7-8.3 | USSR | Forest; uncultivated (field crops; prairie) | Glacial till |
| Po34-1/2ab | Od Oe | Bd | | 3 755 | 7.7-10.1 | Finland | Forest; marshland; field crops | Glacial till |
| Po34-1/2ab | Od Oe | Bd | | 1 463 | 7.7-10.1 | USSR | Forest; marshland (field crops; prairie) | Glacial till |
| Po35-1b | I Bd | O U B | Stony | 9 447 | 10.1-7.3-7.6-7.7 | Norway | Uncultivated; forest (field crops) | Moraine; peat |
| Po36-1ab | Ph Od I | U | Stony | 936 | 10.1 | Norway | Uncultivated; forest (field crops) | Moraine; peat |
| Po37-1ab | Od B | | Stony | 3 710 | 7.7-7.6 | Sweden | Forest; prairie; field crops | Moraine; esker; post-glacial sediment; peat |
| Po38-1a | Od | B | Stony | 1 437 | 10.1-7.6 | Sweden | Forest; prairie; field crops | Moraine; esker; post-glacial sediment; peat |
| Po39-1ab | Be Bd | Od | | 1 580 | 7.7 | Sweden | Forest; prairie; field crops | Moraine; postglacial sediment |
| Po39-1ab | Be Bd | Od | | 1 242 | 7.6 | Denmark | Field crops; forest | Moraine (sand) |
| Po39-1ab | Be Bd | Od | Stony | 2 279 | 7.7-7.6 | Sweden | Forest; prairie; field crops | Moraine; postglacial sediment |
| Po40-1ab | I B | O | Lithic | 467 | 7.6 | Norway | Forest; field crops; prairie (uncultivated) | Moraine |
| Po40-1ab | I B | O | Lithic | 492 | 7.6 | Sweden | Forest; prairie; field crops | Moraine; postglacial sediment |
| Po42-1a | La | Od | | 7 329 | 8.3-10.1 | USSR | Forest (field crops; open pasture) | Outwash |
| Po42-2ab | La | Od | | 2 400 | 8.3 | USSR | Forest (field crops; open pasture) | Outwash |
| Po43-1a | Pg | Od | | 10 974 | 10.1 | USSR | Forest; uncultivated; open pasture | Outwash |
| Po44-1/2ab | Rx Ox | | | 2 972 | 10.2 | USSR | Tundra | Outwash |
| Po45-1ab | Ox | Od | | 4 812 | 10.2-10.1 | USSR | Tundra | Moraine |
| Pp3-1b | Od | Bd Gh | | 591 | 7.3-7.2 | United Kingdom | Prairie; forest; field crops | Greywacke; shale; slate; moraine; peat |
| Pp4-1b | Od | Gd I | | 1 359 | 7.3-7.2 | United Kingdom | Prairie; forest; field crops | Metamorphic rock; granite; sandstone; moraine; peat |

TABLE 3. – SOIL ASSOCIATIONS AND RELATED INFORMATION *(continued)*

| Map symbol | Associated soils | Inclusions | Phase | Extension (1 000 ha) | Climate | Occurrence | Vegetation | Lithology |
|---|---|---|---|---|---|---|---|---|
| Pp4-1b | Od | Gd I | | 931 | 7.3-7.2 | Ireland | Prairie | Granite; sandstone; peat |
| Pp5-2b | U Bd | Be | Lithic | 150 | 7.3-7.2 | United Kingdom | Prairie; forest | Shale; sandstone; moraine |
| Qc61-1a | Bd | Hg Po | | 223 | 9.4 | Czechoslovakia | Forest; field crops | Pleistocene sand; gravelly terrace sand |
| Qc62-1a | Ql | P | | 775 | 7.6-9.4 | Poland | Forest; field crops | Sand with pebbles |
| Qc62-1a | Ql | P | | 465 | 6.5-6.1-6.7 | Spain | Forest; eucalyptus; vineyards | Sand |
| Qc63-1a | Ql Be | E Po | | 664 | 7.2 | United Kingdom | Field crops; horticulture | Aeolian calcareous sand; sand; sandstone; limestone |
| Ql27-1ab | Qc | Gh Re Hh Be | | 409 | 8.2-9.2 | Hungary | Orchards; vineyards; field crops; prairie; forest | Pleistocene sand |
| Ql28-1b | | Lo Ph I | Lithic | 35 | 7.6 | Belgium | Forest; field crops; prairie | Sandstone |
| Ql28-1b | | Lo Ph I | Lithic | 44 | 7.6 | Luxembourg | Forest; field crops; prairie | Sandstone |
| Rc33-3bc | I Yk | Zo | Stony | 26 | 6.9 | USSR | Open pasture; field crops | — |
| Rc47-1b | | Re Rd | | 29 | 7.2 | Belgium | Uncultivated; brush (horticulture) | Recent dune sand |
| Rc47-1b | | Re Rd | | 78 | 7.6 | Netherlands | Brush; forest | Recent dune sand |
| Rc47-1b | | Re Rd | | 189 | 7.5-7.2 | France | Forest; vineyards; horticulture | Recent dune sand |
| Rc47-1b | | Re Rd | | 207 | 7.6 | Denmark | Forest; uncultivated | Recent dune sand |
| Rc48-1ab | G Re | Ql | | 301 | 9.2 | Hungary | Prairie; forest; field crops; orchards | Sand |
| Rc48-1ab | G Re | Ql | | 135 | 9.2 | Romania | Prairie; forest; field crops; orchards | Sand |
| Rc49-2ab | Lc Lv | E B V | | 667 | 6.7-6.1 | Greece | Field crops; prairie; brush | Quaternary alluvium; Tertiary deposit |
| Rc52-2/3bc | B | L | | 14 | 6.7 | Albania | Prairie; brush; forest | Quaternary alluvium; Tertiary deposit; limestone |
| Rc52-2/3bc | B | L | | 511 | 6.7-6.1-6.5 | Greece | Prairie; brush; forest | Quaternary alluvium; Tertiary deposit; limestone |
| Rc52-2/3bc | B | L | Sodic | 572 | 6.7 | Yugoslavia | Vineyards; orchards; prairie; forest | Flysch; sandstone; limestone; marl |

TABLE 3. – SOIL ASSOCIATIONS AND RELATED INFORMATION *(continued)*

| Map symbol | Associated soils | Inclusions | Phase | Extension (1 000 ha) | Climate | Occurrence | Vegetation | Lithology |
|---|---|---|---|---|---|---|---|---|
| Rc52-2/3bc | B | L | Stony | 320 | 6.7 | Greece | Vineyards; orchards; prairie; forest | Flysch; sandstone; limestone; marl |
| Rc52-2/3bc | B | L | Stony | 361 | 6.5-6.7 | Albania | Vineyards; orchards; prairie; forest | Flysch; sandstone; limestone; marl |
| Re84-1ab | Po | Be Lg Pg Gd | | 159 | 6.2-6.1 | Portugal | Forest; field crops (prairie; oak forest) | Dune sand; sandstone; sand |
| Re85-2b | Be | Lo | | 499 | 6.5-6.2-6.7-6.1 | Italy | Vineyards; olives; field crops | Pliocene and Pleistocene marine sand |
| Re86-2/3b | Be Vc | Je | | 2 373 | 6.7-6.5-6.1-6.2 | Italy | Field crops; prairie | Pliocene marine clay and Miocene marl |
| Re87-1bc | T | | | 172 | 6.7 | Turkey | Field crops; open pasture | Andesitic tuff |
| Rx5-1/2a | Gx Ox | | | 13 782 | 10.2-10.1 | USSR | Tundra | Moraine |
| Sm15-3a | So | Vp Zo Hh | | 506 | 9.2 | Hungary | Field crops; prairie | Alluvium; loess |
| Sm15-3a | So | Vp Zo Hh | | 90 | 9.2 | Romania | Field crops; prairie | Alluvium; loess |
| So3-2/3a | Kl | | | 166 | 9.7 | USSR | Open pasture (field crops) | Marine alluvium |
| So16-2/3a | | | | 2 045 | 9.7-9.2 | USSR | Open pasture (field crops) | Marine alluvium |
| So30-2/3a | Sm Xl | | | 3 125 | 9.7-9.2 | USSR | Open pasture (field crops) | Marine and fluvial alluvia |
| So31-2/3a | Xl | | | 1 584 | 9.7-9.2 | USSR | Open pasture (field crops) | Marine and fluvial alluvia |
| So32-2/3a | Sm | | | 390 | 9.2 | USSR | Field crops; prairie (open pasture) | Fluvial alluvium |
| Th20-2bc | To | Bd Po I | Stony | 438 | 7.7-7.6 | Romania | Forest; prairie | Volcanic |
| Tm25-2bc | Lc T | I | Lithic | 1 153 | 6.5-6.7-6.1-6.2 | Italy | Field crops; horticulture; vineyards; prairie; forest | Pyroclastic and eruptive rock |
| To3-2/3c | Be Lc | I | | 101 | 6.1-6.7 | Greece | Forest; prairie; brush | Volcanic rock |
| Tv33-1ab | Re | | | 2 158 | 10.2 | Iceland | Open pasture; uncultivated | Basalt; andesite |
| Tv39-2b | I | Th Vc | Lithic | 208 | 6.7-6.1-6.5 | Italy | Prairie; forest | Lava flow |
| U3-2c | Bd | Rd Po | Stony | 488 | 8.2-9.2-6.7-6.5 | Yugoslavia | Forest; prairie | Sandstone; granite; peridotite; schist; eruptive and metamorphic rock |

TABLE 3. – SOIL ASSOCIATIONS AND RELATED INFORMATION *(continued)*

| Map symbol | Associated soils | Inclusions | Phase | Extension (1 000 ha) | Climate | Occurrence | Vegetation | Lithology |
|---|---|---|---|---|---|---|---|---|
| U3-2c | Bd | Rd Po | Stony | 71 | 6.5 | Albania | Forest; prairie | Sandstone; granite; peridotite; schist; eruptive and metamorphic rock |
| U4-2bc | Bh I | | Stony | 2 086 | 6.6-6.5-7.2-7.1 | Spain | Forest; prairie | Shale; sandstone; granite |
| U4-2bc | Bh I | | Stony | 129 | 6.5 | Portugal | Forest; prairie; field crops | Shale; quartzite; granite; greywacke |
| U5-1bc | P I | Od | Stony | 276 | 7.3 | United Kingdom | Uncultivated | Sedimentary metamorphic and igneous rock; sandstone |
| Vc1-3a | | | | 137 | 6.7 | Turkey | Field crops; open pasture | Basalt |
| Vc14-3a | Re | | | 468 | 6.1 | Spain | Field crops | Marl |
| Vc47-3b | Bk Bv | I Lc | Stony | 34 | 6.7 | Turkey | Field crops; open pasture | Basalt |
| Vc50-3ab | Xk | | | 24 | 6.7 | Turkey | Field crops; open pasture | Basalt |
| Vc56-3a | Bk Gm | Jc Zg | | 1 288 | 6.1-6.7-6.3 | Turkey | Field crops; orchards; horticulture | Alluvium |
| Vc58-3ab | I So Zg | Bk | | 103 | 6.1 | Cyprus | Field crops; orchards; open pasture | Limestone; marl; tuff; shale; sandstone |
| Vc60-3a | Vp | Bc Lc | | 42 | 6.7 | Greece | Field crops; prairie | Quaternary alluvium; Tertiary deposit |
| Vc60-3a | Vp | Bc Lc | | 83 | 6.1 | Portugal | Field crops; olives | Marl; chalk; diorite; gabbro |
| Vc62-3a | Lc | Jc E | | 127 | 6.7 | Turkey | Field crops (open pasture) | Tertiary clay |
| Vp68-3a | | R L B We | | 277 | 6.1 | Spain | Field crops | Marl |
| Vp68-3a | | R L B We | | 56 | 6.7 | Greece | Field crops | Quaternary alluvium; Tertiary sediment |
| Vp68-3a | | R L B We | | 1 024 | 9.2 | Bulgaria | Field crops; forest | Plio-Pleistocene clay |
| Vp68-3a | | R L B We | | 700 | 9.2 | Yugoslavia | Prairie; forest; field crops; orchards | Alluvium; clay; marl; andesite |
| Vp68-3a | | R L B We | | 273 | 9.2 | Romania | Field crops | Clay |
| Vp69-3a | Sm | So W | Sodic | 312 | 9.2 | Hungary | Field crops; prairie | Alluvium |
| Vp69-3a | Sm | So W | Sodic | 45 | 9.2 | Romania | Field crops; prairie | Alluvium |
| Vp70-3a | We | Bv Je Lg | | 423 | 6.7 | Italy | Field crops; horticulture; vineyards | Holocene and Pleistocene clay; Miocene marl |

TABLE 3. – SOIL ASSOCIATIONS AND RELATED INFORMATION *(continued)*

| Map symbol | Associated soils | Inclusions | Phase | Extension (1 000 ha) | Climate | Occurrence | Vegetation | Lithology |
|---|---|---|---|---|---|---|---|---|
| Vp72-3a | Vc Jc | | | 440 | 6.7 | Turkey | Field crops; prairie | Clayey and sandy sediment; marl |
| Wd4-2ab | | Lg Lo | | 523 | 8.2-9.2-7.6 | Yugoslavia | Field crops; prairie; forest | Plio-Pleistocene silt and clay |
| Wd4-2ab | | Lg Lo | | 14 | 7.6 | Austria | Field crops; prairie; forest | Plio-Pleistocene silt and clay |
| Wd5-1a | Gd | | | 786 | 6.7-6.1 | Spain | Field crops; vineyards; oak forest (irrigated) | Gravelly sand |
| We21-2ab | Lg Lo | Re | | 69 | 9.2 | Romania | Forest; prairie; field crops | Clay; silt |
| We21-2ab | Lg Lo | Re | | 111 | 9.2 | USSR | Forest; prairie; field crops | Clay; silt |
| We21-2ab | Lg Lo | Re | Fragic | 374 | 9.2 | Romania | Forest; prairie; field crops | Clay; silt |
| Xh2-1a | | | | 1 106 | 9.7 | USSR | Open pasture | Marine and fluvial alluvia |
| Xh2-2a | | | | 2 214 | 9.7-6.9-3.7 | USSR | Open pasture | Marine and fluvial alluvia |
| Xh31-3a | Gc Rc | Zo | | 268 | 6.7 | Turkey | Open pasture; field crops (orchards) | Fluvial alluvium |
| Xh31-3a | Gc Rc | Zo | | 719 | 6.9 | USSR | Open pasture; field crops (orchards) | Fluvial and marine alluvia |
| Xh47-2ab | Rc Xl | I Hh | | 337 | 6.7-6.6 | Turkey | Open pasture; field crops | Fluvial and marine alluvia |
| Xh50-2a | Zo | | Saline | 1 184 | 9.7 | USSR | Open pasture; field crops | Fluvial and marine alluvia |
| Xk4-2b | | | | 358 | 6.9-9.2-6.7 | USSR | Field crops; orchards; open pasture | Marine alluvium |
| Xk9-2/3a | Xy | | | 134 | 6.7 | Turkey | Field crops; open pasture | Marl; clay; limestone |
| Xk26-2/3a | | Rc Vc | | 350 | 6.7 | Turkey | Field crops; open pasture | Marl; clay; limestone |
| Xk27-2ab | Xl | Rc I | Petrocalcic | 100 | 6.7 | Turkey | Field crops; open pasture | Marl; clay; limestone |
| Xk51-3a | Ge | So Zo | | 1 535 | 6.9 | USSR | Field crops; open pasture; prairie | Fluvial and marine alluvia |
| Xk52-2/3b | Xy Rc | | Lithic/stony | 405 | 9.4 | Turkey | Field crops; open pasture (orchards) | Clay; marl |
| Xk53-2/3bc | I | Rc Xh | Lithic/stony | 2 335 | 6.7-6.6-9.4 | Turkey | Field crops; open pasture (orchards) | Clay; marl; limestone |

TABLE 3. — SOIL ASSOCIATIONS AND RELATED INFORMATION *(concluded)*

| Map symbol | Associated soils | Inclusions | Phase | Extension (1 000 ha) | Climate | Occurrence | Vegetation | Lithology |
|---|---|---|---|---|---|---|---|---|
| Xk54-3ab | I Lc | | | 804 | 6.7 | Turkey | Field crops; open pasture (orchards) | Clay; marl; limestone |
| Xk55-3ab | Lc Rc | I Vc | | 2 198 | 6.7-6.3 | Turkey | Field crops; open pasture (orchards) | Clay; marl; limestone |
| Xk56-2/3ab | Xh | Rc I | | 8 891 | 6.7 | Turkey | Field crops; open pasture (orchards) | Clay; marl; limestone |
| Xk57-2/3b | I | Xy E Rc | Stony | 435 | 6.8-6.5 | Spain | Field crops; olives; vineyards | Marl; limestone; calcareous sandstone |
| Xk59-2/3a | Jc Gm | Zg Vc | Saline | 1 140 | 6.7 | Turkey | Field crops; open pasture | Silt-clay sediment |
| Xl16-2b | | | | 1 964 | 6.1-6.9-9.2 | USSR | Open pasture; field crops | Fluvial and marine alluvia |
| Xl21-2a | So | | Sodic | 2 637 | 9.7 | USSR | Field crops | Fluvial and marine alluvia |
| Xl24-2bc | I Nh | Re | Lithic/stony | 574 | 6.7 | Turkey | Open pasture; field crops | Andesitic and granitic lava; tuff |
| Xy4-2/3a | Xk | Rc I | Stony | 48 | 6.7 | Turkey | Open pasture; field crops | Marl; clay; limestone |
| Xy6-2/3b | Zg | Zo Rc | Saline | 331 | 5.4 | Spain | Field crops; olives (irrigated) | Gypseous marl; gypsum |
| Zg6-3a | | | | 415 | 6.1-6.7 | Spain | Prairie; rice | Alluvium |
| Zg6-3a | | | | 152 | 6.5-7.5 | France | Prairie; uncultivated | Marine alluvium |
| Zg6-3a | | | | 829 | 9.7-6.9-6.7-3.7 | USSR | Open pasture; field crops; uncultivated | Fluvial and marine alluvia |
| Zg15-3a | G | Xk | | 137 | 6.7 | Turkey | Open pasture; field crops; uncultivated | Marine alluvium |
| Zg18-2a | Zo G | | | 104 | 9.2 | Hungary | Prairie | Alluvium |
| Zg19-2/3a | Jt | | | 53 | 6.1-6.2 | Portugal | Prairie (field crops) | Alluvium |
| Zo31-2/3a | So | | | 618 | 9.2-9.7 | USSR | Prairie; field crops | Fluvial alluvium |
| Ice caps | | | | 145 | 10.1 | Norway | — | — |
| Ice caps | | | | 244 | 10.5-7.7 | Switzerland | — | — |
| Ice caps | | | | 201 | 10.5 | Italy | — | — |
| Ice caps | | | | 1 057 | 10.4 | Iceland | — | — |
| Ice caps | | | | 17 | 10.5-7.7 | Austria | — | — |
| Shifting sand | | | | 6 845 | 9.7-9.2 | USSR | — | Aeolian sand |

9. Chernozems
   9.1 Haplic Chernozems
   9.2 Calcic Chernozems
   9.3 Luvic Chernozems
10. Phaeozems
11. Cambisols
   11.1 Eutric Cambisols
   11.2 Dystric Cambisols
   11.3 Humic Cambisols
   11.4 Calcic Cambisols
   11.5 Chromic Cambisols
   11.6 Vertic Cambisols
   11.7 Cambisol Complex
12. Luvisols
   12.1 Orthic Luvisols
   12.2 Chromic Luvisols
   12.3 Gleyic Luvisols
13. Podzoluvisols
   13.1 Eutric Podzoluvisols
   13.2 Dystric Podzoluvisols
14. Podzols
   14.1 Orthic Podzols
   14.2 Leptic Podzols
   14.3 Humic Podzols
   14.4 Placic Podzols
   14.5 Gleyic Podzols
15. Acrisols
16. Histosols
17. Dune or Shifting Sand Complex

## 1. Fluvisols

Although Fluvisols are everywhere present in Europe, it would not be possible to show them in Figure 10. One small, but exceptional, region of coastal Fluvisols has however been included. It covers the coast of the North Sea from Calais, France, along the coast of Belgium, the Netherlands and the Federal Republic of Germany to Tönder, Denmark. This is the polder region, where alluvial land has been reclaimed from the sea by dike-building and drainage over the past thousand years. The soils are highly fertile, and field crops and animal husbandry flourish.

## 2. Gleysols

Gleysols are found in all European countries, in situations where the groundwater table lies near the surface. However, they are extensive and continuous only in a few places: northern Ireland, the English Midlands and the Baltic states south of Riga.

In the British Isles, the Gleysols are Humic, Dystric and Eutric and are associated with many different, but often hydromorphic, soils: Cambisols, Luvisols, Histosols, Podzols, etc. South of Riga, Mollic Gleysols are found, generally associated with Rendzinas. These soils are for the most part very heavy, having developed often from pelitic rocks or clayey sediments.

Gleysols are normally used for grazing, but after drainage they are perfectly suitable for the usual crops of the region. Forestry is also practised.

## 3. Regosols

### 3.1 *Eutric and Calcaric Regosols*

These Regosols are found in particular along the coasts where, as dunes, they border the beaches. Elsewhere they are often symptomatic of intense erosion, even in only gently undulating landforms. Some areas, especially in Sicily, may be isolated on highly erodable clays and Plio-miocene marls. Field crops predominate.

### 3.2 *Gelic Regosols*

These very cold soils are found in the permafrost region of the far northern USSR, associated with Gleysols and Gelic Histosols. This is the tundra zone, suitable only for raising reindeer, the excessively severe climate precluding all other agricultural activity.

## 4. Lithosols

The major Lithosol associations are found at high, and sometimes moderate, altitudes, with strongly dissected topography. They cover most of the major mountain chains and massifs: Iceland, the Scandinavian chain, the Urals, the Alps, the Pyrenees, the Caucasus, the Taurus, Armenia, and the massifs and chains of Yugoslavia, Albania and Greece. Their appearance at moderate altitudes in Portugal may be due to intense erosion.

Outcrops of bare rock and debris are of frequent occurrence in Lithosols, which can be associated with many different soils according to the place: in Iceland with Podzols and Andosols; in Scandinavia with Podzols, Regosols and Histosols; in the Urals with Regosols and Gelic Gleysols in the north, Podzoluvisols in the centre, and Greyzems in the south; in the Alps with Rankers and Podzols; in the Pyrenees with Rankers; in the Caucasus with Rankers, Cambisols and Luvisols; in the massifs bordering the Adriatic and the Mediterranean with Chromic Cambisols and Luvisols; in the Taurus with Rendzinas, Cambisols and Luvisols; on the Armenian high plateau with Cambisols, Chernozems and Kastanozems; and in Portugal with Luvisols.

The Lithosol massifs also include areas of permanent snow cover and glaciers. The permanent snow cover line lies between 2 500 and 3 000 m in the Alps, at about 1 800 m in southern Scandinavia, and at about 600 m in northern Norway and northwestern

Iceland. In the Alps about 3 500 km² are covered by glaciers, the largest of which are the Aletsch, the Rhone, the Mer de Glace and the Aar glaciers. The Scandinavian chain includes about 2 300 km² of glaciers, among which is the Josteldalsbrä, the largest glacier in continental Europe. In Iceland they cover 11 800 km², the largest being the Vatnajökull.

The parent materials are a wide variety of rocks.

Lithosols are covered with a pioneer vegetation or tundra. In general, the poor soil quality and severe climate make agricultural or forestry activity unprofitable.

## 5. Rendzinas

A typical intrazonal soil, the Rendzina is found everywhere in Europe, in the presence of carbonate rocks. Several important areas, not all of which could be shown on the map, are found in France (the Champagne region and the southeast), in a circle around the Alps and the Dinaric chains, in central Germany, in Czechoslovakia (White Carpathians and Tatra) and in the USSR (Estonia).

At low altitudes the Rendzinas are associated with Eutric Cambisols and Chromic Luvisols, and at high altitudes with Lithosols and Cambisols.

The soils are used for agriculture or forestry, depending on the climate. In the mountains, grazing and forestry are dominant. At low altitudes in the southern Alps grapes are grown; in France, too, Rendzinas carry famous vineyards.

## 6. Solonetz

Orthic Solonetz associated with Luvic Kastanozems, Haplic Xerosols and some Solonchaks extend in a circle around the desert of shifting sand northwest of the Caspian Sea. The texture of Solonetz is silty to clayey, while that of the other soils is silty to sandy.

The soil and the arid climate permit little more than extensive open pasturing, mostly of sheep.

The Solonetz of the Hungarian *puszta*, although important, could not be shown on the map.

## 7. Xerosols

### 7.1 *Haplic and Luvic Xerosols*

Around the Volga delta lies a complex of Haplic and Luvic Xerosols, with a silty to sandy texture and a sodic phase. They are used mostly for open pasture.

### 7.2 *Calcic Xerosols*

Calcic Xerosols, with a medium or fine texture, are very extensive in the western half of Turkey, where they are associated with Regosols, Cambisols and Lithosols. In the extreme southeastern part of the USSR lies a much smaller zone of Calcic Xerosols associated with Luvic Xerosols and Gleyic Solonchaks.

The vegetation is typically xerophilous: scattered shrubs with deep roots, and low grasses. It is given over to the grazing of sheep, and is often seriously overgrazed.

## 8. Kastanozems

A relatively homogeneous zone of Haplic Kastanozems lies along both banks of the Sea of Azov, extending into a large arc around the Caspian depression. These soils are the forerunners of the semidesert with its saline soils, and they themselves often have a saline or sodic phase and include Solonetz. The parent material is loess. A small zone of Haplic and Calcic Kastanozems with a medium texture, lying around Lake Van in eastern Turkey, is almost completely surrounded by Lithosols.

Agriculture is obliged to face dryness, which is the limiting factor. The principal crop is wheat; open pasture subsists in the sodic steppes.

## 9. Chernozems

The Chernozems cover a continuous zone running from the foot of the southern Urals to Ukraine, whence it passes through Moldavia, narrows in the Danube basin and finally spreads through Central Europe, where the Chernozems are associated with numerous other soils. The Chernozem area farther west that is large and homogeneous enough to be shown on the map lies in the German Democratic Republic and is represented by the well-known black soils of Magdeburg. Still farther west, Chernozems occur in certain associations which reach as far as central France (the black earth of Limagne).

### 9.1 *Haplic Chernozems*

The flat, grassy, treeless steppe zone of the " true " Chernozems is by far the most extensive and homogeneous. Calcic Chernozems, reflecting drier climatic conditions typical of the Kastanozems, occur in association. The parent material is a thick, continuous layer of loess.

The natural vegetation of tall grasses has yielded to a varied, intensive agriculture. These soils have been cultivated from prehistoric times, because of their high natural fertility, their good workability and their flat topography. The principal crops are wheat, sugar beet and maize; in addition, orchards, vineyards, etc., are also found.

The Haplic Chernozem zone of the Magdeburg Plain is much more heterogeneous, including among others numerous Phaeozems and luvic dark earths.

### 9.2 *Calcic Chernozems*

These soils form a vast unit in the steppe of the Moldavian Plain, reaching into the Lower Danubian valley in Bulgaria. In the USSR they have a saline phase, while in Romania, in a circle around the Danube delta, their phase is phreatic. The parent material is loess. As a result of their undulating landform, they may be somewhat eroded, and this accounts for the presence of a network of Regosols in tree patterns.

### 9.3 *Luvic Chernozems*

In the USSR these soils form a relatively heterogeneous strip in association with Orthic Luvisols and Greyzems in particular. This is the zone of transition (silvo-steppe) between the deciduous forest of the north and the true Russian steppe in the south. The parent material is loess. The association of Luvic Chernozems east of the Sea of Azov has a sodic phase; it includes Mollic Solonetz.

This is a region of intensive cultivation of a wide variety of crops, with grains predominant; the sodic steppes are used for grazing.

## 10. Phaeozems

Different varieties of Phaeozems (Haplic, Gleyic, Calcaric, Luvic) are distributed throughout Central Europe, on loose sediments in which loess predominates, but they do not constitute a continuous and relatively homogeneous zone. A large area corresponding roughly to the Hungarian Plain (*puszta*), and a smaller one in the Lower Danubian plain in Romania, is shown on the map. The soils are highly heterogeneous and form a complex pattern in which Phaeozems are very important but not dominant. They are associated with Luvisols, Chernozems, Cambisols, Vertisols, Planosols and Gleysols. In the Hungarian Plain, Mollic Solonetz and Gleyic Solonchaks also form part of the association. The parent materials range from sand to clay.

The wide variety of agricultural uses reflects the complexity of the soils. Only the saline soils create serious problems.

## 11. Cambisols

The Cambisols are by far the most widely distributed soils in Western and Central Europe, where they are dominant in numerous associations and occur in many others. In the north and in the USSR they are comparatively rare. The parent rocks are highly varied. They are found at low, medium and high altitudes and, less often, in the plains.

### 11.1 *Eutric Cambisols*

These soils are found in many different climates, in the Mediterranean region as well as in southern Scandinavia.

In Spain the parent material is shale and the soils are associated with Rankers and Lithosols. These stony, shallow soils are covered by forest (cork-oak, among others) or used for field crops. In the mountains they are highly susceptible to erosion and this explains the fact that their area stops short at the Portuguese border, where the sudden change to Lithosols is probably due to severe erosion.

In southwestern France, on limestone and marl, they are associated in particular with Luvisols; field crops predominate.

In Italy these soils are dominant, in association with a wide variety of others (Regosols, Andosols, Dystric Cambisols, Podzols, Orthic and Chromic Luvisols, etc.). Developed from eruptive and metamorphic rock as well as carbonate rock and even Tertiary sediments, they are often stony. In the mountains they are generally forested, but on more suitable landforms field crops are also grown. It should be noted in particular that the soils of the vast alluvial Po Valley have been mapped as Eutric Cambisols developed from silt and clay, on flat terrain, in association with Fluvisols and, to a lesser extent, hydromorphic soils. They are very fertile and are used for field crops, horticulture and occasionally poplar.

In southern Sweden they are found on moraine formations, in association with Podzols, Dystric and Vertic Cambisols, Luvisols and Rendzinas, under forest or cultivated.

### 11.2 *Dystric Cambisols*

Dystric Cambisols are dominant in a great number of soil associations. Accordingly, they cover an enormous area in Western and Central Europe, constituting vast complexes at low and medium altitudes in France, Belgium, Luxembourg, Germany, Austria, Switzerland, Czechoslovakia, Poland, Romania and Ireland. They are developed from a wide variety of rocks, are associated with many different soils and are found in all landforms.

Although their natural forest vegetation predominates in most regions, field crops are also common.

### 11.3 *Humic Cambisols*

Humic Cambisols cover the northwest corner of the Iberian peninsula, associated in particular with Rankers and, to a lesser extent, with Lithosols and Dystric Cambisols. They were developed from a variety of acid rocks (granite, schist, shale, sandstone, quartzite, etc.) in an Atlantic climate and show a relatively dissected landform.

These stony, often shallow, soils are generally covered by forest, at times reforested with *Pinus* and *Eucalyptus*. Agriculture is generally limited to areas surrounding villages.

### 11.4 *Calcic Cambisols*

These soils cover most of Spain and a zone in Turkey running in an arc from the Aegean to the Black Sea. They include a few areas of Chromic and Vertic Luvisol associations. When developed from hard calcareous rock they are associated with Rendzinas and Lithosols and tend to be stony and shallow; some have a petrocalcic horizon. Forests, often of holm-oak, predominate, although a variety of field crops are grown and horticulture also exists, sometimes irrigated.

When developed from soft limestone (marl), these soils are associated with Eutric Cambisols and Regosols; field crops predominate.

An enclave of Gypsic Xerosols, a very rare soil in Europe, exists in the Ebro Valley, near Saragossa.

### 11.5 *Chromic Cambisols*

The Chromic Cambisols are dominant in two areas, bordering on massifs of Rendzinas.

In France, where they have sometimes been classified as red Rendzinas, they extend from Metz to Bourges, on limestone, in association with Chromic Luvisols and Rendzinas. Field crops predominate, but vineyards are not uncommon.

In Yugoslavia, from Ljubljana to Sarajevo, in the foothills of the Dinaric Alps, they are also found on carbonate rocks, associated with Chromic and Orthic Luvisols and with Rendzinas. They are covered with forest, field crops and prairie according to the topography.

### 11.6 *Vertic Cambisols*

Two areas of Vertic Cambisols have been identified in southern Finland, on glacial deposits. Although they are small, they are particularly interesting for agriculture in this country of Podzols and conifers.

### 11.7 *Cambisol Complex*

In southern United Kingdom it has been necessary to indicate a zone of a very diversified nature in which Cambisols are slightly dominant but are followed very closely by Luvisols, Gleysols and Rendzinas.

## 12. Luvisols

Luvisols play an important role throughout Europe, from west to east, except in excessively cold regions. They are always found in different forms which are best described separately.

### 12.1 *Orthic Luvisols*

These generally silty soils extend, in plains and low mountain areas, from Ireland to the Urals, normally on loess but also on residual silts from hard rock and on moraine deposits. In the USSR, on flat land, they form a transition between the Podzoluvisols to the north and the Chernozems to the south. In Central and Western Europe they are found on flat or undulating terrain on loess, glacial till or residual silts from various rocks. The associated soils are Gleyic Luvisols, Podzoluvisols and Eutric Cambisols; the presence of Regosols indicates areas from which they have been reduced by erosion.

The natural vegetation is deciduous forest, often beech, but much of this has been replaced by field crops, profitable because these soils are very fertile.

In Turkey the Orthic Luvisols are shallow and stony. Found in association with Acrisols and Lithosols, they are clearly not as valuable as the similar, but more fertile, soils elsewhere in Europe.

### 12.2 *Chromic Luvisols*

These soils, which have often been classified as "Mediterranean" (red Mediterranean soils, *terra rossa, terra fusca*, etc.) are indeed found for the most part in Spain, southern France, Italy, Yugoslavia, Bulgaria, Turkey and Greece. Only in the four last-named countries, however, do they cover continuous areas large enough to be shown in Figure 10. Generally they are found on limestone, but they can also be developed from other rocks; of the two profiles in the Appendix, one is on limestone and the other on shale. They are associated in particular with Cambisols, Rendzinas and Lithosols, and consequently they are often stony.

Forests predominate where stoniness is excessive or the soil is shallow. Often, on sharply dissected terrain, these soils have been considerably reduced by erosion. Elsewhere, under more favourable conditions, field crops predominate, and where the climate is suitable, profitable special crops such as grapes, olives, almonds and early vegetables are grown.

### 12.3 *Gleyic Luvisols*

These soils are the hydromorphic variant, on flat terrain, of the Orthic Luvisols, and the parent materials are often the same. Large areas have been identified in France, Central Europe and particularly in Belorussia, on sand. They are associated with various soils: Gleysols, Podzoluvisols, Planosols, Podzols, etc.

Agriculture, especially animal husbandry, is predominant.

## 13. Podzoluvisols

Podzoluvisols are reported from several parts of Eastern and Central Europe, but they are particularly important only in the USSR, in a zone nearly 2 500 km long and 500 to 700 km broad, running from the Baltic Sea to the foothills of the Urals.

### 13.1 *Eutric Podzoluvisols*

This zone, 2 500 km long and 500 km broad, crosses the immense Russian plain from west to east, roughly between 54° and 60° N latitude. The parent materials are loose glacial deposits with a silty or sandy texture. The associated soils are Luvisols, Podzols, Gleysols and Histosols.

The natural vegetation is a mixed boreal forest with conifers and deciduous species, the former predominating especially on the sands. In cleared areas a varied agriculture exists, grains being predominant but grazing also common.

### 13.2 *Dystric Podzoluvisols*

The Dystric Podzoluvisols cover the southern part of the Taiga, the Russian boreal forest in which conifers predominate strongly. They are associated with Podzols and Gleysols, and their parent materials are of glacial origin.

## 14. Podzols

The Podzols cover large areas throughout Europe, particularly in the north. In cold, humid climates they are found in the plains as well as in the high mountains, in different forms: hydromorphic, Humic, humo-ferric, or with more or less developed, thick or thin, eluvial horizons. In addition to their spodic B horizon, almost all have one common characteristic: their sandy texture.

### 14.1 *Orthic Podzols*

Orthic Podzols with a humo-ferric B horizon cover most of Northern Europe, both in mountains and in plains: Scandinavia, Finland, and a discontinuous zone in the USSR that interrupts the Gleyic Podzols to the north and the Dystric Podzoluvisols to the south. In Scandinavia and Finland they are associated with Histosols, Rankers and Lithosols, and in the south with Dystric Cambisols. In the USSR the associations are with gelic soils in the Tundra and with Albic Luvisols and Histosols in the Taiga. The parent materials are mostly sands of glacial origin.

In Western Europe Orthic Podzols are found in many associations, especially at high altitudes. Large areas have been identified in Denmark (associated with Cambisols; parent material: moraine) and in Portugal (associated with Cambisols; parent materials: sandstone and sand).

In the north these acid, often stony, soils are covered with coniferous forests, agricultural activity being strictly limited by the harsh climate. In Denmark and Portugal they are sometimes used for field crops but are most often forested with conifers or, in Portugal, with oak.

### 14.2 *Leptic Podzols*

On the map of the major soil regions much of Poland appears to be covered by Leptic Podzols. This is of course an over-simplification, but at this scale it is inevitable. The associated soils play an important role: Orthic Podzols, Arenosols, Podzoluvisols, Luvisols, etc. The parent material is a sandy to silty outwash.

Forests, with conifers predominating, cover large areas, although field crops are also common, especially on the associated soils.

### 14.3 *Humic Podzols*

A zone of Humic Podzols coincides with the low-lying plain of Pleistocene sands that runs near the North Sea from Denmark, through the Federal Republic of Germany and the Netherlands, to Belgium. The water table lying relatively high, the associated soils are Gleyic Podzols, Gleysols and Histosols; many dune areas are shown as Arenosols. *Plaggen* soils,[3] which bear witness to the considerable efforts of man to improve these poor and acid soils, cover about 20 percent of this unit but are not included in the legend.

Although these soils were originally covered by grazing meadow, they are now cultivated for the most part, although pine forest areas are not negligible. Some areas of heather (among others in the Lüneburg heath in Germany) are still found and are very worthy of being protected and preserved.

Humic Podzols on sand and sandstone, associated with Orthic and Gleyic Podzols, are also found, mostly under conifers, south of Bordeaux.

### 14.4 *Placic Podzols*

Scotland and Ireland may be said to have a monopoly of Placic Podzols, which are developed from acid rocks in a humid ocean climate. The presence of the impermeable thin iron pan is the cause of surface hydromorphism and explains the nature of the associated soils: mostly Histosols with some Gleysols. In Ireland, the Placic Podzols cover a few areas too small to be shown in Figure 10, but they are also found in the Dystric Cambisol association.

Prairies predominate, followed by forests. Field crops are not very extensive.

### 14.5 *Gleyic Podzols*

These hydromorphic Podzols are extensive in the Russian taiga in association with Humic Gleysols, Dystric Histosols and Orthic Podzols. The parent materials are sands, sometimes silty, of fluvio-glacial origin.

This zone forms part of the Russian boreal forest, in which conifers are by far predominant.

[3] The use of *plaggen* on the very poor sandy soils of Western Europe was very common from the Middle Ages to the nineteenth century. *Plagger* are thin sods removed from meadows or forests, used as stable litter and then spread out on the land. Since this organic fertilizer also contained sandy particles, the original soils were gradually buried, over the centuries, under a sandy, humic layer 0.5 to 1 m thick.

## 15. Acrisols

The only Acrisols area of any importance lies in Turkey, on the southern coast of the Black Sea. It consists of Orthic Acrisols, associated with Cambisols, Rankers and Lithosols, and on hilly to strongly dissected reliefs it is highly susceptible to erosion. The parent materials consist of a variety of mainly acidic rocks.

Because of the dissected topography and humid climate the original vegetation is mixed forest. Large stretches have been cut over or burned to make way for marginal agriculture. In the coastal areas, however, intensive cultivation is practised, the zone being well known for its production of hazelnuts.

## 16. Histosols

The Histosols are by their nature linked to conditions of extreme hydromorphism. The major Histosol regions lie in northern Finland (Ounasselkä: Dystric Histosols associated with Orthic Podzols), in the tundra of the USSR (Gelic Histosols) and on the west coast of Scotland (Dystric Histosols in association with Placic Podzols). Areas of importance, but too small to be shown in Figure 10, exist, among others, in the north of the Netherlands and of Federal Republic of Germany and in the northern half of the USSR.

In the far north, Histosols form vast marshes or grazing land for reindeer, or carry sparse forests. In Scotland they are suitable for prairie and forestry. Exceptionally (e.g., in the English fens and in the Netherlands) highly specialized horticulture and agriculture are possible. The peat cover has been widely used for fuel both in Northern and in Western Europe.

## 17. Dune or Shifting Sands Complex

An extensive sandy desert region lies northwest of the Caspian Sea.

# 6. LAND USE AND SOIL SUITABILITY *

The continent of Europe has a wide range of soils, climate,[1] vegetation and topography and a corresponding wide range in land-use suitability. The utilized agricultural area is approximately 50 percent of the total land area, ranging from 89 percent in Ireland to 3 percent in Norway. In contrast, land under forest ranges from 4 percent in Ireland to 64 percent in Sweden. Scandinavia, Finland and northern USSR have large tracts of continuous boreal forests of conifers and birch. The other major forest concentrations are in the Alpine, Carpathian and Caucasus mountain ranges. Woodlands interspersed with arable and pasture land are widespread in Central European countries and also in the Apennines and the Iberian Peninsula.

The agro-ecological environment of northwest Europe, which is characterized by a relatively high rainfall, is conducive to high pasture productivity, especially on the Luvisols and Cambisols. In this zone a relatively high proportion of the utilized agricultural area is under permanent pastures. In the Mediterranean zone and in much of continental Europe, moisture stress is a limiting factor and agricultural land use has a large arable cropping component. In the Mediterranean zone citrus, viticulture and fruit production are important enterprises. Maize and wheat are particularly concentrated in the semi-warm steppe climatic zone of Hungary, Yugoslavia, Romania, Bulgaria and the USSR. Chernozems are extensive in this zone, especially in the USSR. Under the cold temperate conditions of the Scandinavian region and the cool marine conditions of northwest Europe, barley with a shorter growing season than wheat is the dominant cereal. In Poland rye is the most extensively cultivated cereal on the coarse-textured Leptic Podzols there. In general, cereals are important crops in Europe and account for over 30 percent of the utilized agricultural area in most countries.

Cattle are particularly highly concentrated in northwest Europe, while sheep tend to be more concentrated in the drier Southern European regions, particularly in the Balkans. In the Caspian and Black Sea regions, dominated by Kastanozems, Xerosols and Solonetz, agricultural production is limited by severe moisture stress and desertification hazard is high. Livestock raising on semi-arid rough grazings and dryland arable cropping are the main enterprises. Irrigation is practised in some of these regions, particularly in the Lenkoran plain of Azerbaijan, for the cultivation of crops including tea, cotton and rice.

Land use and soil suitability by soil units is discussed in detail in the following sections. The soil units are arranged in alphabetical order of symbols for easy reference.

### A. Acrisols

#### Ao. Orthic Acrisols

The Orthic Acrisols are confined mainly to the Black Sea zone of northern Turkey. In this zone, topography is rolling to mountainous and climate is Warm Temperate with a high annual rainfall of 1 000-2 000 mm. In the coastal zone there is a high proportion of arable cropping comprising mainly cereals and maize, especially in the eastern component where fruits and vines are also cultivated. In addition, cotton, tobacco and sugar beet are produced. Forests and rough grazing, devoted mainly to cattle and some sheep, are the major land uses in the strongly sloping zones, which are susceptible to erosion.

These soils also occur on level topography in the Black Sea hinterland of Georgia in the USSR, extending northward into Krasnodar. They are devoted largely to arable use in these areas and a Warm Temperate climate enables crops such as rice and tobacco to be cultivated in addition to tea and citrus

*Text by Dr J. Lee, Agricultural Institute, Dublin, Ireland.
[1] In Chapter 6, climatic designations are those defined by J. Papadakis in *Climates of the world and their agricultural potentialities*, Buenos Aires, 1966, and shown in Table 2 and Figure 9.

crops. A lithic phase occurs in the Mediterranean region of southern Turkey where a large proportion of the unit is afforested and devoted to rough grazing. Olives and grapes are also cultivated in this region.

## B. Cambisols

### Bc. CHROMIC CAMBISOLS

These soils occur mainly in France on level to hilly topography, with associated Chromic Luvisols. They occur under cool temperate conditions. In Poitou-Charentes, on the Atlantic Ocean, under a mean annual rainfall of 600-800 mm and an annual maximum precipitation deficit of 300-400 mm, they are devoted largely to arable cropping with some vines and livestock production. In the Champagne, Lorraine and Bourgogne regions they are devoted to arable cropping and livestock production with some areas afforested. Soil moisture-holding capacity is high which, combined with an annual rainfall of 800-1 000 mm, enables pasture yields of 10 t DM[2]/ha to be achieved.

They also occur extensively in the mountainous region of Yugoslavia and to a small extent in the Transdanubian region in western Hungary. In Yugoslavia, where mean annual rainfall is 1 000-2 000 mm, land use consists mainly of forestry and cattle and sheep production from low-yielding mountain pastures. Arable cropping including vines occurs to a small extent.

In Hungary, where the mean annual rainfall is 550-700 mm, cereal production and maize are important in accessible zones in addition to some market gardening and vines. Dairy farming is also important. The soils are medium to fine textured and topography is the major limitation. These soils occur on level topography in Azerbaijan and Dagestan in the Caspian Sea zone under a mean annual rainfall of 500 mm and they also occur in east Georgia. They constitute highly important soils in these zones where they are devoted largely to cereal cropping and pastures. Parts are afforested in east Georgia. Crops such as cotton and vines are also cultivated.

### Bd. DYSTRIC CAMBISOLS

These soils occur extensively throughout Europe under climatic conditions ranging from cool marine in Ireland to temperate Mediterranean in Italy. They are largely associated with hilly to mountainous topography and are coarse to medium textured. In Ireland they are associated with gently undulating and hilly topography, and they occur on level topography in the south-centre of the central uplands of Germany and also in Finland.

In the United Kingdom they are most extensive in Wales and in Devon and Cornwall and also in the southern uplands of Scotland and in Aberdeenshire. Land use consists of pastures, rough grazings and forestry. Mean annual rainfall is 1 000-1 500 mm and precipitation deficits are minimal. Dairy and beef production are major enterprises and pasture production potential in the better areas is 11-15 t DM/ha with intensive fertilization. Mixed stocking of sheep and cattle under intensive management is capable of achieving an output of 1 t liveweight/ha/year. In Aberdeenshire, where a high proportion is devoted to arable cropping, cereals are intensively cultivated.

In Ireland they occur under a mean annual rainfall of 1 000 mm. They are devoted largely to livestock production from pastures and also to arable cropping. Pasture production potential under intensive fertilization is 12-15 t DM/ha and stocking rates of 250 LU[3]/ha 100 are attainable. Barley and wheat yields of 7.5 t/ha and sugar beet and potato yields of 50 t and 40 t/ha are readily attainable. They occur to a minor extent in Finland under Taiga conditions and are devoted to forestry and grazing.

They occur extensively in the Czechoslovakian hill and mountain zones. Depending on geographic location, there are varying proportions devoted to pasture production, arable cropping and afforestation. Fertilized pastures yield up to 10 t DM/ha under a mean annual rainfall of 800 mm.

They occur on rolling to hilly topography in the Limousin area of France (mean annual rainfall 800 mm). They are devoted mainly to arable crops and livestock production on good-quality pastures, and rough grazing. There is some small-scale production of fruit and vines. Pasture production potential is approximately 10 t DM/ha with current stocking rates of 75-125 LU/100 ha UAA.[4] A stony phase on hilly topography occurs in the Massif Central in France where agricultural land use consists mainly of livestock production from pastures capable of yielding 10 t DM/ha under a mean annual rainfall in excess of 1 000 mm. Parts are devoted to arable cropping with the more difficult areas being devoted to forestry. Stony and lithic phases on hilly to mountainous topography also occur in the Massif Central and Pyrenees regions. In the latter zone, land use is restricted to livestock production from rough grazing and to afforestation.

[2] DM: dry matter.

[3] LU: livestock unit.

[4] UAA: utilized agricultural area.

In Yugoslavia land use consists of forestry and livestock production from rough grazing with small areas devoted to arable cropping. In Macedonia, where mean annual rainfall is 400-800 mm, a relatively high proportion of these soils is devoted to arable use. In central Macedonia unirrigated fertilized lucerne hay yields 5.9 t/ha compared with 15.4 t/ha under irrigation. In southeast Macedonia, on rolling to hilly topography under Continental Mediterranean conditions, land use comprises arable cropping, livestock raising and afforestation. Cotton and vegetables are also cultivated in addition to tobacco.

In the northern Italian Apennines the Dystric Cambisols are devoted to arable farming, livestock raising on rough grazing, and afforestation. Annual maximum precipitation deficit is 300-400 mm and pasture yield is equivalent to only 800 kg/ha hay with cattle livestock densities of 25 LU/100 ha UAA. In the southern Apennine zone, land use is mainly arable with some forestry, rough grazing and vine cultivation.

The Dystric Cambisols are very extensive in Corsica and are devoted largely to rough grazing and forestry. Annual maximum precipitation deficit is 400-600 mm and pasture yields are severely restricted. Erosion is a major problem.

Stony and lithic phases on rolling to hilly topography occur extensively in the Federal Republic of Germany and are susceptible to erosion. Mean annual rainfall is 600-800 mm and land use comprises varying proportions of arable, pasture, forestry and rough grazing. Cattle stocking rates vary from 50-125 LU/100 ha UAA. With intensive fertilization, including an application of 220 kg nitrogen (N)/ha, stocking rates of 200 LU/100 ha are possible. Barley, wheat and potatoes are the main arable crops. In the German Democratic Republic these soils occur largely on rolling to hilly topography under a mean annual rainfall of 400-600 mm and an annual maximum precipitation deficit of 200 mm. A high proportion of the soils is under arable cropping, including barley, wheat, rye, potatoes and some market gardening, vines and fruits. Meadows and pastures are also important with forestry occupying the steeper zones.

The Belgian Ardennes and Luxembourg are largely characterized by lithic phases of these soils. They are devoted mainly to afforestation, livestock production and some arable cropping consisting of cereals with some root crops. Mean annual rainfall is 1 000-1 200 mm and pasture production potential is approximately 8 000 kg DM/ha. Exceptionally high cattle stocking rates are associated with the better pasture zones. Soil moisture stress is a limitation.

In the Alpine and Alpine Foreland regions of Austria these soils occur on rolling to hilly topography and are devoted mainly to forestry and rough grazing on Alpine pastures with small areas devoted to cereals. In the Plateau region of northern Switzerland, where mean annual rainfall is 1 000-1 600 mm, they occur on mountainous topography and are devoted to forestry, rough grazing, and arable cropping to a small extent.

A stony phase is extensive in the Carpathian and Transylvanian Alps region of Romania extending through west Ukraine and into southeast Poland. Mean annual rainfall is 800-1 000 mm and land use consists mainly of forestry together with improved and rough grazing. In west Ukraine there is some arable cultivation with small amounts of fruit. Under intensive fertilization, pastures in Poland are capable of yielding 50 t/ha of fresh herbage.

Lithic and stony phases of these soils occur on hilly to mountainous topography under an annual maximum precipitation deficit of 600 mm in the Meseta region of Spain on the Portuguese border and in the Beira Baxa region of central Portugal. Land use consists mainly of extensive livestock raising on arid pastures, arable cropping and some fruit and vine cultivation. The lithic phase also occurs in the Alpine foothills in the Piedmont region of Italy and is devoted to arable and cattle farming with small-scale vine cultivation.

### Be. EUTRIC CAMBISOLS

These soils occur extensively in Southern Europe, particularly in Spain, Italy, Turkey and France, mostly under Mediterranean climatic conditions but they also occur as far north as the United Kingdom on a small scale and in southern Sweden under Cool Marine and Cool Temperate conditions.

They occur on level topography in the Po Valley in Italy; the Suffolk, Cotswold and Lincolnshire regions in the United Kingdom and a lithic phase occurs in Gotland. Arable cropping is the major use. In the Po Valley (mean annual rainfall 400-600 mm) maize, wheat and sugar beet are intensively cultivated with irrigated forage maize capable of yielding 18 t DM/ha. Vines and fruits are also produced. In Suffolk market gardening is important. In the Cotswold region, land use is mainly arable cropping and livestock production. Annual rainfall in this region is 1 000 mm and pasture yields of 12 t DM/ha and sugar yields of 7.5 t/ha are feasible. In Lincolnshire, cereals are intensively cultivated and barley yields of 7 t/ha are common. These soils also occur in the Yorkshire, Derbyshire, Nottinghamshire areas where dairying and livestock production are important enterprises, with some arable cropping. In Gotland arable cropping is extensive and also cattle raising.

Eutric Cambisols on rolling to hilly topography occur in Denmark, the United Kingdom, Sweden, France, Ireland and also in Yugoslavia. Climate is mainly cool temperate or cool marine with the exception of parts of France where it is warm Temperate and Yugoslavia where it is semi-warm steppe. They are devoted largely to arable farming.

In east Denmark fodder root crops are capable of yielding 11-12.5 t DM/ha (roots) and 4.2-4.8 t DM/ha (tops). Sugar yields of 7-9 t/ha and pasture yields of 10 t DM/ha are feasible under a mean rainfall of 750 mm. In the Perth-Dundee region of Scotland, grain yields of 7.5 t/ha are attainable from wheat and barley and pasture yield potential is 12 t DM/ha with intensive fertilization under a mean rainfall of 1 000 mm. In southern Sweden spring barley yields 3.2-4.6 t/ha. Over the 1970-73 period, the oat crop yielded 4.2 t/ha. In Ireland grassland farming is important with arable cropping as a secondary enterprise. Pasture potential is 12 t DM/ha and sugar beet yields of 45 t/ha are readily attainable.

In the Basse-Normandie region of France, pasture production is important with stocking rates of 125 LU/100 ha UAA, whereas in the east Aquitaine/south Pyrenees region arable cropping with fruit and vine cultivation is important, with livestock production from improved and rough pastures assuming a secondary role. Under the warm temperate conditions of the latter region, irrigation is required for maximum yields. In this environment, forage crops such as lucerne and sorghum are capable of yielding 13 t DM/ha under rainfed conditions. Maize is extensively cultivated. Under the semi-warm continental conditions of the centre region in France cereal production and animal husbandry are major enterprises. These soils are important in the Massif Central where they are devoted largely to arable cropping and livestock production. They are also important in the Bordeaux-south Aquitaine region of France where fruit cropping and vines are intensively cultivated in addition to cereals and maize under warm temperate conditions.

In the Pannonian plain in Yugoslavia, the Eutric Cambisols are largely devoted to arable cropping including maize, cereals, sugar beet and some fruit. In north Poland arable cropping and livestock production are major enterprises.

They occur on rolling to hilly topography in the Federal Republic of Germany, southeast Poland and a stony phase on the same topography occurs in the Transylvanian region of Romania. In Germany land use consists of arable cropping and forestry. Barley yields of 5.5 t/ha are common. In Poland arable cropping is also important including wheat, barley, rye and potatoes. In the latter country varying proportions of these soils are devoted to arable, forestry and pasture uses, depending on location. The southern components have a high proportion allocated to crops such as maize, wheat and sugar beet, in addition to cattle and sheep raising.

The Eutric Cambisols occur on mountainous and hilly topography in eastern Czechoslovakia under a mean annual rainfall of 600-1 000 mm. Arable and sheep farming are important in addition to forestry. With intensive fertilization, pasture yields of 11 t DM/ha are attainable. Stony and lithic phases on hilly to mountainous topography are extensive in Italy and Spain with moisture deficits varying from 300-600 mm. In Calabria, in southern Italy, fruits and vines are intensively cultivated. Arid grazings yield 1 000 kg DM/ha. Maize yields are highly variable under rainfed conditions ranging from 1.6-3.4 t/ha. In Sardinia sheep production from rough grazing is the most common enterprise with arable and fruit cropping playing a minor role. In Apulia, fruit and vine cultivation is highly important, while in Emilia-Romagna and Tuscany, cereals and forestry are important, with some fruit and vines being also cultivated. Citrus crops are intensively cultivated on these soils in Sicily. In the central Apennines land use comprises arable cropping, forestry, rough grazing and fruits and vines. Pasture yields are equivalent to 1.3 t/ha of hay while annual forage crops yield 5.4 t/ha. Over 70 percent of pasture production is obtained in spring. In the Alpine region of southeast France sheep breeding is important on these soils, while in Anatolia in Turkey, nomadic sheep, goat and cattle production on poor pastures is the major enterprise. Cereals are also produced, especially in the Aegean, Marmara and Mediterranean zones in Turkey. Yields are low due to severe moisture stress.

These soils are extensive in the Sierra Nevada and western Sierra Morena zones in Spain. Land use consists of arable cropping, sheep production from low-yielding pastures and some fruit cultivation. Production of durum wheat is important in addition to olives, vines and nuts. Erosion susceptibility is a major hazard. In the Mount Olympus (Troodos) Massif region of Cyprus the Eutric Cambisols are lithic and are devoted mainly to forestry with some arable and livestock farming in accessible areas. Fallowing is practised and cereal yields are exceptionally low. Soil erosion is a major problem.

In the Carpathian region of Romania, land use consists of arable crops, forestry and livestock production from rough grazing. Mean annual rainfall is 800-1 000 mm. From Romania these soils extend into Yugoslavia where forestry and arable farming including cereals, fruits and vines are the major land uses. In the Rhodope mountain zone in Bulgaria, forestry is the major land use.

Bg. Gleyic Cambisols

These soils, which are on level to hilly topography, occur in Spain, the United Kingdom and Austria. Climate ranges from temperate Mediterranean in Spain to cool marine in the United Kingdom and annual rainfall ranges from 400-800 mm in Spain to 800-1 000 mm in northern United Kingdom. In Spain arable cropping is the major enterprise, with sheep and cattle production as secondary enterprises. Severe moisture stress is a major limitation. In Austria land use consists mainly of arable cropping and cattle production with some afforestation. In southeast England arable cropping and dairy farming are practised, while in Northumberland and Midlothian livestock farming assumes the major role. Artificial drainage is usually necessary for maximum yields.

Bh. Humic Cambisols

These soils, which are on hilly to mountainous topography and are stony, occur extensively in Spain, especially in Galicia and Asturias and also in the Cantabrian mountains, and the Sierra de Gata and Sierra de Guadarrama zones. Rainfall is > 1 000 mm over much of this soil and land use consists of forestry, pasture and arable cropping. In Galicia and Asturias, maize and potatoes are important. These soils are also extensive in northern Portugal where they are devoted mainly to arable cropping, including some vines, livestock farming and afforestation. Annual rainfall is over 1 000 mm. They occur to a small extent in the coastal zone of Iceland under cold marine conditions where cattle raising is the most important enterprise.

Bk. Calcic Cambisols

The Calcic Cambisols are largely confined to Spain, Portugal and Turkey, where they occur under Mediterranean climatic conditions. They are associated with hilly and mountainous topography and are mostly stony. They are extensive in the semi-arid Andalusian region in Spain on rolling to hilly terrain, where they are devoted to cereals, fruits, vines, rough grazing and forestry. Durum wheat is concentrated on this soil in the south of Spain. Average yield is 1.5 t/ha. In the grazing areas stocking rates are about 0.4 LU/ha. In Aragon, arable cropping, including winter cereals and fruits, is important while in the east forestry is extensive. A petrocalcic phase on level topography which occurs in Spain has a high fruit and vine concentration in addition to cereals. These soils also occur on hilly terrain in Estremadura and Ribatejo under marine Mediterranean conditions in Portugal. Vines and fruit, together with cereals are intensively cultivated.

In Turkey they are extensive in western Anatolia and inland from the Aegean zone under Continental Mediterranean conditions. They occur on hilly and mountainous topography and are devoted to cereals, to sheep, goat and cattle raising on poor pastures, and also fruit and forestry. A lithic phase occurs on mountainous topography in the Black Sea region of Turkey. It is devoted to forestry, rough grazing and arable cropping.

The Calcic Cambisols are subject to severe moisture stress and slope is a major limitation, together with susceptibility to erosion.

Bv. Vertic Cambisols

These soils which occur on level topography occur under cold marine conditions and are mainly confined to southern Finland and southern Sweden. They constitute important agricultural soils in these regions although a high proportion of them is afforested. They also occur in the Jaeren and Boknfjord regions of Norway where cattle, sheep and dairy production are concentrated. In Finland cereals, potatoes and sugar beet are cultivated on these soils which are fine textured. Spring cereals yield 2.5-3.5 t/ha, with irrigation raising yields by 1 t/ha under a mean annual rainfall of 600-700 mm. There is a considerable yield depression in sugar beet moving northward.

## C. Chernozems

Ch. Haplic Chernozems

These soils, which are on level to gently undulating topography and are medium textured, extend from west Ukraine northeastward through central USSR to the Ural mountains. Land use comprises arable cropping and grazing and meadows with the latter assuming a relatively higher significance approaching the Urals. The soils occur under Steppe conditions with a mean annual rainfall of 400-500 mm. In Ukraine cereals and maize are extensively cultivated. In northern Ukraine winter wheat yields of 4-5.5 t/ha are attainable. At Poltava maize grain yields of 4.2 t/ha are attainable while irrigated maize yields 8 t/ha. Irrigated sugar beet yields in excess of 90 t/ha on Haplic Chernozems in Ukraine.

In the USSR, cattle, sheep, maize and wheat are the major commodities. Irrigated dwarf wheats in the mid-Volga region yield 4-4.5 t/ha compared with 3.5 t/ha from local cultivars. In the northern Caucasus zone cereals, sunflowers and sugar beet are important crops in addition to fruit and vines. Cattle and sheep are also important. In the dry steppes of the south Urals irrigated lucerne/brome grass yields up to 110 t/ha fresh fodder. In the USSR over 80 percent of the Haplic Chernozems in agricultural use are tilled, the remainder being devoted to pastures and hay fields.

The Haplic Chernozems are very important soils near Leipzig in the German Democratic Republic under an annual rainfall of 600-800 mm. They are devoted to intensive cropping including cereals, potatoes, sugar beet, peas, lucerne and rapeseed. They also occur to a small extent in the Vienna basin in Austria and extend into Czechoslovakia. Annual rainfall is less than 600 mm. They are intensively cultivated with wheat, sugar beet, market gardening and fruit as important enterprises.

A sodic phase occurs in central USSR under a mean annual rainfall of 500 mm. This soil also occurs under Steppe conditions in the Pannonian plain in Yugoslavia. In the latter region land use consists of intensive cereals, maize, livestock and some vine production.

### Ck. Calcic Chernozems

These soils occur extensively in the Steppe zone of northern Bulgaria on level to hilly topography under a mean annual rainfall of 400-800 mm. They also occur in the Hungarian Steppe zone. In Bulgaria cereals, forage crops, sugar beet, market gardening and vines are highly important in addition to livestock production. Under rainfed conditions, maize grain yields are limited to 5 t/ha compared with 8 t/ha under irrigation. Irrigated forage maize has yielded up to 25 t DM/ha.

A petrocalcic phase occurs extensively in Romania in the semi-mountainous region of Galati, in the Baragan Steppes, in Dobrogea on the Black Sea and in the lowlands near Bucharest and in southern Olteina. Mean annual rainfall is 300-500 mm. Wheat, sugar beet, maize, cattle, sheep, dairying, vines, sunflowers, peas and beans are important crops. Irrigated maize yields of 9.7 t/ha of grain have been obtained compared with 5.5 t under rainfed conditions. Irrigated ryegrass yields in excess of 16 t DM/ha, while irrigated sugar beet yields 70 t/ha of roots. The petrocalcic phase extends into Bulgaria where arable cropping is intensive. Irrigation is required for maximum yields. A saline phase occurs in Moldavia and is intensively cultivated with cereals, forage crops and some fruits in addition to livestock farming.

### Cl. Luvic Chernozems

These soils, which occur on level to hilly topography, comprise the northern component of the Steppe zone and extend from west Ukraine to the Urals under an annual rainfall of 500-750 mm.

In the Ukraine cereals, sugar beet and livestock farming are important. In Moldavia soybean seed yields of 2.6 t/ha are attainable. In the Kharkov region winter wheat yields 2.3 t/ha and the yield range of proso-millet is 2.2-5 t/ha depending on year and locality. In Kievskaya, average winter wheat yield is 2.9 t/ha and sugar beet and potato yields of 38 and 20 t/ha respectively are reached. Hybrid maize yields are variable, ranging from 2.3 t to 6.0 t/ha depending on year. Grass/clover swards over a four-year period gave an average yield of 16.5 t/ha of fresh fodder.

A sodic phase occurs in southeast Ukraine, in Krasnodar and in Crimea under an annual rainfall of 300-500 mm. It is extensive in Krasnodar province. Maize is the main fodder grain and silage crop.

## D. Podzoluvisols

### Dd. Dystric Podzoluvisols

These soils occur extensively in the central Taiga zone of northern USSR and also occur on a small scale in the Federal Republic of Germany and in Belgium under Cool Temperate and Cool Marine conditions respectively. In north USSR, Taiga forest is the dominant land use. Some natural pasture lands and hay fields are interspersed through the forests and utilized by reindeer and cattle. Because of climatic constraints, the cultivated area on these soils is small. Hay fields and pastures constitute about 90 percent of the Dystric Podzoluvisols which are in agricultural use, the remaining 10 percent being devoted to arable cropping.

In the Lower Saxony region of the Federal Republic of Germany they are devoted mainly to pasture production with dairying and cattle raising as important enterprises. There is some cereal cultivation. Mean annual rainfall is 500-750 mm and pasture yields are limited to approximately 8 t DM/ha. In

Belgium they are devoted to intensive tillage cropping including cereals, potatoes and sugar beet. Livestock production is a secondary enterprise.

De. EUTRIC PODZOLUVISOLS

These are the major soils in Estonia, Latvia, Lithuania and Belorussia and extend in an easterly direction through north central Russia to the Urals. They are coarse and medium textured and mostly occur on level topography. They largely occur under Cold Continental conditions. They are devoted mainly to livestock farming on the grasslands and meadows which are extensive on these soils. Both dairying and cattle production are important with arable cropping including cereals, potatoes and sugar beet playing a minor role. Some buckwheat and tobacco crops are raised in Latvia. In Belorussia there is a well defined arable zone on these soils. Cereals, forage maize, flax, potatoes and sugar beet are produced. In Ukraine intensive arable cropping occurs on these soils and pasture production is also important. Small areas are afforested.

In the main land mass of north central USSR coniferous forest is the main use on these soils which occur in the southern Taiga forest zone. However, arable and pasture farming are also important, particularly in the western component of these soils. Mean annual rainfall is 500-1 000 mm. In the region south of Moscow, average potato yield over the 1965-70 period was 27 t/ha. In the same region winter wheats yield 3.0-4.5 t/ha while in Rostov province unirrigated winter wheat yields 2 t/ha compared with 5.4 t/ha under irrigation. Under rainfed conditions in Moscow province fertilized pastures, sown well, yield 20-34 t/ha of fresh herbage depending on amount of rainfall. In the Leningrad region, under intensive fertilization, herbage yields of 7.5 t DM/ha have been achieved. In Rostov irrigated grass swards have yielded 13 t DM/ha. In severe winters in the Leningrad region, winter wheat crops can be damaged with a consequent reduction or total yield loss.

In contrast to the Dystric Podzoluvisols in USSR which have an extremely low tillage concentration, in the Eutric Podzoluvisols approximately 50 percent of the soils which are in agricultural use are devoted to arable cropping. Basic soil fertility is low on these soils and acidity is a major problem. Drainage is also a limiting factor, particularly in the soils devoted to hay fields and in the wet peat soils which are interspersed throughout the southern Taiga zone.

In Poland these soils occur to a small extent under Cool Temperate conditions and are devoted to arable cropping including cereals and potatoes and also livestock farming in the grassland areas.

Dg. GLEYIC PODZOLUVISOLS

These soils are largely confined to Poland and are also found, on a small scale, in Yugoslavia. They occur on level to rolling topography. In Poland mean annual rainfall is 500-600 mm, whereas in Yugoslavia it is 800-1 000 mm. Arable cropping and livestock production from pastures are the major enterprises.

**E. Rendzinas**

These soils occur under a broad climatic range from cool marine in the United Kingdom to temperate Mediterranean in the south of France. Where topography is not restricting they are highly important arable soils. For instance, in the United Kingdom, France, Poland and the German Democratic Republic arable farming is of major importance. Near Leipzig, in the German Democratic Republic, wheat, barley, potatoes, sugar beet, peas, rapeseed and lucerne are intensively cultivated. Mean annual rainfall is >1 000 mm. In southeast Poland they are also intensively cultivated under a mean annual rainfall of 600 mm. In the Salisbury/Winchester region in the United Kingdom cereal cropping including malting barley is highly important. Barley yields of 5 t/ha are attainable. Pasture production for dairying is also important. In northeast France, in the Champagne region, cereal production and livestock production from pastures are important, whereas in Languedoc the major use is fruit and vine cultivation. Similarly in Poitou-Charentes, cereals, fruit and vine production are the principal enterprises. In Estonia cattle and sheep production from pastures is highly important with arable cropping assuming a minor role.

In the hilly and mountainous zones the Rendzinas are mostly stony or lithic. The lithic phase is extensive in the Yugoslavian mountain zone. A relatively high proportion is devoted to arable cropping in addition to rough grazing, forestry and small-scale fruit cultivation. Mean annual rainfall is >1 000 mm. On the hilly terrain north of the Bavarian Plateau, in the Federal Republic of Germany, arable cropping is important, including cereals, potatoes and sugar beet. In the Swiss Alpine and Jura zones forestry is the major land use together with livestock produced from both improved and Alpine pastures. In localized accessible zones arable farming is practised. The soils are stony in the

Austrian Alpine region and forestry is the major land use together with livestock production. In the Bratislava region of Czechoslovakia a relatively high proportion is under arable cropping including fruit cultivation. These soils also occur in the Italian Alps where they are devoted to forestry and rough grazing. At 1 900 m elevation, pasture yields in the latter region are limited to 5 t DM/ha with intensive fertilization.

## G. Gleysols

### Gd. Dystric Gleysols

They are confined to Ireland and occur under a mean annual rainfall in excess of 1 250 mm. They are devoted to dairy and cattle production from pastures. Pasture production potential is approximately 9 t DM/ha. Soil wetness is a major limitation and stocking potential is limited to 170 LU/100 ha. Present stocking rates are approximately 80-100 LU/100 ha.

### Ge. Eutric Gleysols

These soils are largely confined to the United Kingdom under cool marine climatic conditions, and also occur in the western Po Valley in Italy under Continental Mediterranean conditions. In the relatively low rainfall zones of the southern United Kingdom and in the Po Valley arable cropping is important, whereas in the northern United Kingdom livestock production from pasture is the main enterprise. In Norfolk they occur on level topography with a mean annual rainfall of 600-800 mm. Intensive arable farming is practised. Winter wheat yields of 6 t/ha and sugar yields of 8 t/ha are common. Similarly, in the coastal zone of southern United Kingdom, arable cropping is important in addition to livestock production from pastures. In Leicestershire, Nottinghamshire and east Yorkshire arable cropping and livestock production from pastures are of equal importance while in Ayrshire in Scotland, where mean annual rainfall is >1 000 mm, dairy farming is the major enterprise with pastures yielding 11-14 t DM/ha under intensive management. In Cheshire and Lancashire livestock production from pastures capable of yielding 9-10 t DM/ha is the major enterprise. Farther north in Cumberland there is a high proportion of these soils under rough grazing. In the region around Leeds, in Northern Ireland, in Caithness in Scotland and in the Orkney Islands livestock farming is the major enterprise on these soils. In Northern Ireland pastures under intensive fertilization yield 14 t DM/ha under a mean annual rainfall of 1 200 mm. These soils are generally susceptible to cattle treading damage because of excess wetness and poor soil structure.

### Gh. Humic Gleysols

The Humic Gleysols are largely confined to the United Kingdom and Ireland, where mean annual rainfall is >1 250 mm. In the Pennine region of England, sheep production from rough grazing is the major enterprise. In Glamorgan, Wales, livestock production from improved pasture is practised whereas in the west of Ireland these soils are devoted largely to sheep and cattle production from low-yielding pastures. These soils occur to a small extent under Warm Steppe conditions near Budapest in Hungary. Mean annual rainfall is 550-700 mm and intensive vegetable and fruit production is the major land use.

## H. Phaeozems

### Hc. Calcaric Phaeozems

These soils which occur on level topography are largely confined to Hungary, Czechoslovakia and Yugoslavia. They occur under steppe climatic conditions with a mean annual rainfall of 550-750 mm and are devoted to intensive arable cropping.

In the Danube plain in Czechoslovakia, maize, cereals and sugar beet are intensively cultivated. Vines and tobacco are also important with cattle production as a subsidiary enterprise. Irrigated sugar beet yields of 82 t/ha have been achieved with forage maize capable of yielding 19 t DM/ha under irrigation. Many of these soils are sodic or saline and are also devoted to intensive cultivation. In southeast Hungary, major uses include vegetable production, cereals, sugar beet and fruit. The soils are saline in the Pannonian Plain in Yugoslavia and intensive cropping of wheat, maize, sugar beet, potatoes and some vine cultivation is carried out.

### Hg. Gleyic Phaeozems

These soils occur on level topography mainly in Hungary and in Czechoslovakia under steppe conditions with a mean annual rainfall of 550-700 mm, and in some cases lower than this. In the Little Alföld region of Hungary, cereals, maize, market gardening and fruit production are important, whereas in the Elbe plain of Czechoslovakia, livestock production is practised in addition to intensive arable cropping. In the Great Alföld of Hungary, where mean annual rainfall is <550 mm the soils are sodic and are devoted to cereals, maize, market gardening, vine and fruit cultivation. Irrigation is required for maximum yields.

### Hh. Haplic Phaeozems

These soils are most extensive in Romania and Hungary and occur under steppe conditions. Mean annual rainfall is 400-800 mm. In the Transdanubian and the Great Alföld regions of Hungary, cereals and maize are intensively cultivated, together with vegetables near Budapest. The Haplic Phaeozems which occur in the lowlands and semi-mountainous zones of Romania are also under intensive cultivation. Crops include maize, cereals and sugar beet. In northeast Romania these soils are sodic and are devoted to intensive arable farming including fruit production.

### Hl. Luvic Phaeozems

The Luvic Phaeozems are confined to Romania and Bulgaria. Associated annual rainfall is 400-800 mm. They occur throughout the semi-mountainous zone of Romania and also in the lowland region southwest of Bucharest. Maize production is highly concentrated and also wheat and livestock production. A petrocalcic phase also occurs and is devoted to intensive arable farming including fruit cultivation. In northern Bulgaria, land use is similar but forestry assumes a greater role.

## I. Lithosols

The Lithosol complexes occur in the major mountain land masses of Europe. The associated soils are varied and include Luvisols, Rendzinas, Podzols, Regosols and Rankers. Climatic types range from continental Mediterranean to taiga.

In the Alpine regions of France and Italy forestry and livestock production from improved and rough grazings are the major uses whereas in the Swiss Alpine zone a large proportion of the Lithosol complexes is unsuited to plant production because of climatic severity. In the lower elevations, forestry and livestock production from Alpine and improved pastures are the major enterprises. In some of the included valley zones, under favourable climatic conditions, crops such as fruit are produced. In the Pyrenees forestry and rough grazings occur in about equal proportion. In the French Cévennes land use includes forestry, rough grazing and fruit production under temperate Mediterranean conditions. In the Trás-os-Montes and Alentejo mountain zones in Portugal, they are devoted to arable cropping including fruit production, forestry and rough grazing. Climate is relatively favourable in this zone. Mean annual rainfall is 400-800 mm.

In the Greek Lithosol complex zones climate is generally Central Mediterranean with severe moisture deficits. In Thessaly these soils are devoted to arable cropping including fruit production (cereals, tobacco, olives, citrus and vines), while in Epirus and the Peloponnese rough grazing and forestry are the major uses.

In the Taurus and eastern Anatolia Lithosol zones in Turkey, rough grazing devoted to extensive livestock raising is the major use with afforestation assuming a major role in some zones. Mean annual rainfall is 1 000-2 000 mm. In the Yugoslavian Lithosol zone along the Adriatic coast, the farming system is mainly sheep raising on low quality pastures. Some vines, olives, maize and durum wheat crops are also cultivated. At 460 m elevation introduced grass cultivars have yielded 6.5-9.5 t DM/ha compared with 8-11.5 t/ha at 1 000 m elevation. Mean annual rainfall is 800-1 000 mm. Afforestation is also important.

Because of the climatic severity of the Scandinavian Lithosol zone, plant production is precluded from large areas but extensive reindeer grazing is possible in small areas. Similarly, in Iceland the Lithosol complexes are unsuited to plant production. In the Kola peninsula of northwest USSR, forestry is the main land use with some reindeer grazing. In the west of Ireland land use on these soils is limited to extensive sheep and cattle raising from low yielding, low quality grazing.

The Lithosol complexes are extensive in the Caucasus zone in Georgia, Azerbaijan, Armenia, Crimea and in southern USSR. Land use includes forestry, rough grazing and some arable and fruit crops. The Lithosol complex with associated Chromic Cambisols in Georgia and Azerbaijan is devoted largely to pastures and meadows. The Lithosol complexes in the Urals are limited to reindeer grazing in the north and forestry and rough grazing in the central and southern components.

## J. Fluvisols

### Jc. Calcaric Fluvisols

The Calcaric Fluvisols are distributed widely throughout Europe and are most extensive in France, Yugoslavia, Romania and Turkey. They are highly important agricultural soils occurring on level topography along the major rivers such as the Danube, Oder, Rhone and Tisza. They occur under climatic conditions ranging from Cold Temperate in the German Democratic Republic to Steppe in Romania.

In Albania the Calcaric Fluvisols are intensively cultivated with crops including cereals, maize, fruit, vines and olives. Under irrigation, hybrid maize produces in excess of 9 t/ha of grain. In Greece crops such as wheat and sugar beet, fruits and vines are important. Irrigation is required for maximum yields and exceptionally high yields of sugar beet are attainable. In the Aegean region of Turkey the Calcaric Fluvisols are intensively cultivated with crops including vines, figs and olives. In Romania intensive cropping is also carried out. In the Rhone valley and estuary in France, vines, market gardening, fruits and orchards are concentrated on these soils. In the upper valley of the Oder, dividing the German Democratic Republic from Poland, intensive arable cropping is carried out on these soils while to the south forestry assumes a significant role.

In the Danube, Tisza and Sava valleys in Yugoslavia, intensive cereal, maize and pasture cropping together with fruit production is practised. Grain maize yields of 9 t/ha have been obtained under irrigation and pasture yields of 12.7 t DM/ha have also been achieved.

In northern Groningen and Friesland in the Netherlands, there is intensive arable and grassland farming. Winter wheat yields average 6-8 t/ha and sugar yields of 8.5 t/ha are attainable with good management under a mean annual rainfall of 750-800 mm. In Friesland, pasture stocking rates of 2.3 cows/ha are attainable under intensive management producing a milk output in excess of 8 000 kg/ha. Similarly in Belgium, arable and grassland farming is carried out with intensively managed pastures capable of yielding 12 t DM/ha under an annual rainfall of 800 mm.

### Je. Eutric Fluvisols

The Eutric Fluvisols also have a wide distribution and are particularly extensive in the USSR. They occur also in Germany, Poland, Switzerland and the United Kingdom. Their associated climate ranges from cool temperate to steppe.

In the lower Volga zone of the USSR, intensive arable cropping is practised. Crops include cereals, maize, oilseed, vegetables and forage crops such as alfalfa. Average hay yield in flood-plain meadows is 9 t/ha with intensive fertilization. Irrigation is required for maximum yield. Mixed arable and livestock farming is practised in Ukraine. In the valleys of the Ebro, Tagus, Guadiana and Guadalquivir in Spain these soils are mostly devoted to intensive arable cropping including fruits and vines. Crops such as sugar beet, forage maize, soybean, alfalfa and clover are successfully irrigated. In the Wash area in the United Kingdom, intensive horticultural cropping is carried out and crop yields are high. In Poland sugar beet yields of 35 t/ha are attainable and irrigation is necessary for maximum yields. In the middle section of the Vistula valley pasture production potential is 30-40 t/ha fresh matter. In the Elbe valley in Germany the Eutric Fluvisols are intensively cultivated and are also devoted to livestock production from pastures with some areas afforested. In the Vendsyssel region in north Denmark intensive arable and livestock farming is practised. Fodder root crops and barley are important. The soils are coarse textured and irrigation is necessary for maximum yields. Mixed arable and livestock farming are the land use in the Netherlands.

## K. Kastanozems

### Kh. Haplic Kastanozems

The Haplic Kastanozems occur under semi-warm steppe conditions in the Caspian and Black Sea regions of southern USSR. They are mostly sodic and their associated annual rainfall is 300-500 mm. They are devoted to arable cropping and meadows and pasture land for animal raising. They occur on level topography and are coarse and medium in texture. Irrigation is required for maximum yield.

In south Ukraine cereals, tobacco and livestock are important. Two or three crops per year are possible under irrigation. Near Odessa, winter wheat yields 7 t/ha under irrigation. In south Ukraine, under rainfed conditions, average maize yield is 15 t/ha fresh fodder. In the Volga region rainfed wheat yields 0.6-2.4 t/ha compared with 3.5 t/ha under irrigation. In Georgia and Azerbaijan land use includes rough grazing and arable cropping. In Azerbaijan winter wheat yields of 6 t/ha have been obtained under irrigation. The pastures on the Haplic Kastanozems are low yielding and of low quality in the scrub-steppeland environment. A lithic phase of the Haplic Kastanozem on level to hilly topography occurs in eastern Anatolia in Turkey and extends into Georgia and Armenia and also occurs in north Kazakhstan. In Turkey land use is confined to sheep, goat and cattle raising on rough grazing and there is limited arable cropping. In Armenia and Georgia arable cropping is practised.

Crop yields are low throughout the Haplic Kastanozems because of severe moisture stress and irrigation is required for maximum yields. Desertification hazard is moderate.

### Kk. Calcic Kastanozems

Calcic Kastanozems on hilly topography occur in the Van Lake region of eastern Anatolia in Turkey under a mean annual rainfall of 400-800 mm. They are devoted to nomadic husbandry of sheep, goats and cattle on rough grazing land. A sodic phase occurs extensively on level topography in southern USSR under a mean annual rainfall of 300-500 mm. It is devoted to livestock production from rough grazing. Some arable cropping is also carried out. Severe moisture stress is a major limitation.

### Kl. Luvic Kastanozems

These soils, which are saline or sodic, occur in southern USSR. The saline soils occur in the western Caspian Sea zone under a mean annual rainfall of 300-500 mm. They are devoted to arable cropping, forestry and also livestock production. The sodic soils are devoted to arable cropping and livestock production from grazing while in Kazakhstan, north of the Caspian Sea, these soils are devoted to rough grazing only. Severe moisture stress is a major limitation and desertification hazard is moderate.

## L. Luvisols

### Lc. Chromic Luvisols

The Chromic Luvisols occur most extensively in subtropical Mediterranean to continental Mediterranean climates in Turkey, Greece, Italy, Spain and Albania. However, they also occur under semi-warm steppe conditions in Hungary and under cool marine conditions in the United Kingdom.

They occur on level topography in the North Downs regions of the southern United Kingdom under a mean annual rainfall of 600-800 mm. They are devoted to arable cropping and dairy production from pastures. Pasture yields are limited to approximately 8.5 t DM/ha due to moisture stress limitation.

Under steppe conditions in the Balkan uplands, where mean annual rainfall is 400-800 mm, arable cropping, livestock production, forestry and fruit are the main enterprises. New wheat cultivars yield 5.3-7.0 t/ha of grain and beet sugar yields of 8.8 t/ha are attainable under irrigation. Rainfed wheat and maize grain yields are limited to 3-4 t/ha. In the Black Sea region of Turkey, these soils are devoted to arable use, forestry, grazing and fruit. Maize is highly concentrated in this region which has a mean annual rainfall of 800-1 000 mm. Chromic Luvisols also occur in the Meseta region of Spain under an annual rainfall of 400 mm and they are devoted to arable cropping including malting barley, fruit, vines and sheep raising. Irrigation is necessary for maximum yields. These soils also occur on hilly terrain in Transdanubia in west Hungary, where arable and livestock farming with fruit and market gardening are the main enterprises.

The Chromic Luvisols, associated with hilly and mountainous terrain in countries such as Greece, Albania, Italy, Portugal, Turkey, are stony in character. In Greece they are devoted mainly to rough grazing, forestry, and some arable and fruit cultivation. In the Pindus Mountains and Mount Olympus zones, sheep, goat and cattle raising are extensive. Grazings are poor in quality yielding only 1-2 t DM/ha. Some areas are afforested and arable cropping is limited.

In Albania the Chromic Luvisols are largely afforested. Accessible areas are cultivated and crops include wheat and maize. Fruits and vines are extensively cultivated on these soils in Apulia in Italy and also in Sicily. In Campania and in Latium on the Tyrrhenian coast in southwest Italy, land use comprises arable cropping, livestock raising from rough pastures and fruit, vine and olive cultivation. At Palermo, Sicily, rainfed maize yields 3.5-4.5 t/ha of grain under a mean annual rainfall of 500-750 mm compared with 6.5 t/ha with supplementary irrigation. In southern Algarve and in Estremadura in Portugal, fruits and vines are intensively cultivated on these soils, while in Alentejo cereals including durum wheat assume an important role. In Bulgaria the Chromic Luvisols are largely under forest. However, in the south, cereals, livestock, fruit and vines are important. In the Marmara region of Turkey, under a mean annual rainfall of 400-800 mm, arable cropping is important. In southeast Anatolia in Turkey under a similar rainfall, cereals, sheep, goat and cattle raising and some fruit and vine cultivation together with forestry constitute the land usage.

### Lg. Gleyic Luvisols

The Gleyic Luvisols are most extensive in the USSR, France, Romania, Poland, Yugoslavia and Czechoslovakia. They occur mainly under cold and cool temperate conditions and under Semi-warm Continental conditions. Associated mean annual rainfall ranges mostly between 400-800 mm.

In Belorussia, the soils are coarse textured and occur on level topography. They are largely devoted to livestock production on pastures with arable cropping playing a minor role. In Ukraine, arable cropping and livestock production from pastures are important. Near Bryansk in central USSR a high proportion of the Gleyic Luvisols is afforested.

In France, where they occur extensively on level topography, they are largely devoted to arable cropping and pasture livestock production. The soils are mainly medium and fine textured and rainfall is relatively high. The soils are subject to excess wetness in winter and early spring and moisture stress in the growing season. Annual maximum precipitation deficit is 200-300 mm.

In Poland they are mainly under arable use, with some areas afforested. Cereals and root crops including sugar beet are intensively cultivated. Mean annual rainfall is 500 mm and irrigation is necessary for maximum yields. In Yugoslavia the Gleyic Luvisols occur on level and hilly topography. They are devoted to arable cropping, rough grazing and forestry. Mean annual rainfall is 800 mm. In Czechoslovakia, land use comprises arable cropping, pastures, meadows and forestry. In the Baltic coastal region of the German Democratic Republic, the Gleyic Luvisols are devoted to intensive arable cropping which includes cereals, sugar beet, potatoes and forage crops. Mean annual rainfall is 400-600 mm and irrigation is required for maximum yields.

### Lo. Orthic Luvisols

The Orthic Luvisols are highly important agricultural soils occurring throughout Europe under climatic conditions ranging from cool marine in Ireland to semi-warm steppe in Hungary and Bulgaria. In Western Europe they are largely associated with cool temperate climate. However, they also occur immediately north of the Chernozems under cold continental conditions in a belt extending in a northeast direction from west Ukraine to the Urals in the USSR.

The Orthic Luvisols on level topography are largely limited to the Rhine Valley in Germany, Poland and the USSR. In the Rhine Valley they are mainly devoted to cereal cropping and vines. Mean annual rainfall is 800-1 000 mm and exceptionally high wheat yields of up to 8 t/ha are attainable. In Poland wheat and sugar beet are particularly concentrated on these soils together with livestock production on pastures. In Ukraine they are devoted to mixed arable and grassland farming under a mean annual rainfall of 500-750 mm. In central USSR farming consists of cattle and sheep raising on pastures and meadows and also cereal, maize and root crop cultivation.

The Orthic Luvisol map units on undulating and rolling terrain occur extensively in Western Europe, particularly in France where they are devoted mostly to mixed arable and livestock farming. Wheat and sugar beet are particularly concentrated and in the better endowed rainfall zones of France, pasture production potential under intensive fertilization is 10-12 t DM/ha. Forage maize yields of 16 t DM/ha have been recorded. Arable cropping is intensive in Denmark. In the Plateau zone of Switzerland, under a mean annual rainfall of 1 000-1 200 mm, high yields from cereals and pastures are possible. In Poland these soils are intensively cultivated under a mean annual rainfall of 500-700 mm. Cereal yields are approximately 4.5 t/ha of grain. In Schleswig-Holstein in the Federal Republic of Germany intensive arable and livestock farming is practised. In Bavaria maize silage and fodder beets are capable of yielding 16-18 t DM/ha. Pasture productivity is also high. Cattle livestock density is approximately 100 LU/100 ha UAA. Under a mean annual rainfall of 800 mm, beet sugar yields in excess of 8 t/ha have been achieved.

In the German Democratic Republic these soils are also intensively cultivated. Irrigation is necessary for maximum yield. In Belgium, under a mean annual rainfall of 800-1 000 mm, mixed arable and livestock farming is practised. In the United Kingdom the Orthic Luvisols are also devoted to mixed arable and grassland farming. In the Torquay-Lincoln area dairying and cattle production are major enterprises. High pasture yields are attainable. In the extreme southeast, fruit production is common.

In Ireland livestock production on pastures is the major land use, with arable cropping as a secondary enterprise. With a mean annual rainfall of 1 000 mm, pasture yields of 13 t DM/ha are possible with intensive fertilization. Current pasture stocking rate is 130 LU/100 ha. Sugar beet yields of 50 t/ha and wheat and barley yields of 7.5 t/ha are attainable. In the hills and high plains of northern Italy there is intensive arable cropping, including fruit, on these soils. Mean annual rainfall is 750 mm. Irrigation is required for maximum yields.

The Orthic Luvisols on rolling to hilly topography occur most extensively in France and also in Hungary, Turkey, Yugoslavia and Czechoslovakia. In northwest France they are devoted to intensive arable and grassland production. Cattle livestock density is approximately 120 LU/100 ha UAA. In the Dauphine region in southeast France, livestock production is the main enterprise together with forestry. In Czechoslovakia arable cropping is extensive with some areas devoted to forestry and rough grazing. These soils are intensively cultivated in Hungary.

In the transdanubian region, cereals, potatoes, fodder crops and sugar beet are produced. Between the Danube and the Tisza, potatoes and vegetables are raised. In the southeast Great Alföld, wheat, maize, alfalfa, sugar beet, oilseed and onions are important. In the Nyiregyhaza region, rye, potatoes, tobacco and sunflower are cultivated. Mean annual rainfall is 550-700 mm. In Turkey forestry is the dominant land use; in the Marmara region intensive arable cropping is practised.

The Orthic Luvisol map units on hilly and mountainous topography are stony or lithic in character. They are subject to slope limitation and susceptible to erosion. In the Balkan mountains zone of Bulgaria they are devoted largely to deciduous forest with livestock raising, arable cropping and also tree fruits to a small extent. However, in southern Portugal arable cropping together with fruit production is important, while some areas are afforested. In eastern Anatolia in Turkey, land use is confined to nomadic grazing of sheep, goats and cattle. In contrast, in the Aegean and Marmara zones arable cropping and fruit production are important enterprises in the more favourable soil areas, with forestry and rough grazing comprising the remaining uses.

#### Lv. Vertic Luvisols

The Vertic Luvisols are confined to the Meseta zone in Spain, where they occur under temperate Mediterranean conditions. They are important agricultural soils in this region and are devoted to cereal production, fruits and vines, with some areas under forestry and rough grazing.

### M. Greyzems

#### Mo. Orthic Greyzems

These soils extend from the Ukraine to the Urals in central USSR, in the Northern Steppe zone. They occur as large isolated units in the above zone and are devoted to arable and grassland production. Their texture is medium and coarse. Mean annual rainfall is 500-1 000 mm.

### O. Histosols

#### Od. Dystric Histosols

These soils are largely confined to cool and cold temperate climates. They are extensive in the Taiga zone and also under cool marine conditions. They cover vast areas in the USSR and Finland and, to a lesser extent in the Federal Republic of Germany, the United Kingdom, and some other countries. In the USSR above the Arctic Circle their use is limited to extensive deer grazing because of climatic severity. In the Taiga zone of northern Finland and in central USSR they are largely afforested or unused. In northeast Ukraine and southern Belorussia they are mostly unused. However, in west central Ukraine they are used for arable and grassland farming. Under reclaimed conditions in Ukraine, high yields have been obtained from pastures, maize and fodder beets. In northeast Scotland, under a mean annual rainfall in excess of 2 000 mm, their use is limited to extensive sheep grazing with extremely low stocking rates on low-quality swards yielding 2.5 t DM/ha. In contrast, in the Federal Republic of Germany and the Netherlands these soils are devoted to intensive pasture utilization. The Dystric Histosols constitute the English Fenlands which are intensively cultivated and productive soils. In the Caspian Sea zone in south USSR, the Dystric Histosols occur on a small scale and are sometimes saline. They are devoted to arable cropping or rough grazing, or are unsuited to agriculture.

#### Oe. Eutric Histosols

These are highly important agricultural soils in Germany, Poland and the Netherlands where they are devoted to intensive arable and pasture use. In Bavaria, under a mean annual rainfall of 800 mm, cereals and potatoes are intensively cultivated. Similarly, arable cropping is important along the Warta Valley in Poland. In the Netherlands they are devoted to intensive pasture use. In the midlands of Ireland, reclaimed Eutric Histosols are highly suited to intensive pasture production and arable cropping. Exceptionally high yields from crops such as potatoes, carrots and onions are attainable and pasture yields of 10 t DM/ha have been obtained.

#### Ox. Gelic Histosols

These occur in the permafrost zone of the USSR. Their use is limited to deer grazing.

### P. Podzols

#### Pg. Gleyic Podzols

These soils, which occur on level terrain, are confined to the Taiga zone south of the permafrost boundary in northern USSR. Forests are extensive and reindeer farming is common, with the herds moving according to herbage availability. They also occur in the Swiss Alpine regions under a mean annual rainfall of 1 200-1 600 mm. Land use consists of forestry and cattle and sheep raising on improved and rough pastures.

### Ph. Humic Podzols

The Humic Podzols occur in the Federal Republic of Germany, the Netherlands, Belgium and Denmark under Cool Temperate conditions. They are coarse textured and occur on level topography. They are devoted to intensive arable use and livestock production. Annual maximum precipitation deficit is 100-200 mm for much of these soils. Under rainfed conditions in Denmark, herbage yield potential is approximately 8 t DM/ha. In Schleswig-Holstein in Germany, average pasture yield over the 1970-75 period was 6 t DM/ha.

### Pl. Leptic Podzols

These soils occur under cool and cold temperate climates and are most extensive in Poland, Romania and the USSR. They are coarse textured and occur on level and hilly topography. Their associated annual rainfall is 600-750 mm. They are devoted to arable farming, livestock production on grassland and rough grazing and also to afforestation in the more hilly regions. In Romania they occur on hilly and mountainous topography in the Carpathian and Transylvanian Alps regions. They are stony in character and largely afforested. Some areas are devoted to livestock production from pastures.

### Po. Orthic Podzols

The Orthic Podzols occur mostly under taiga conditions in northern USSR and also in the Alpine zone. In addition, they occur under cool and cold temperate conditions and to a small extent under cool marine and cold temperate Mediterranean conditions.

In the taiga and tundra regions of USSR, they are largely devoted to deer grazing. In the taiga region of northern Sweden, where they are stony in character, forestry is the major use. In the Lake Ladoga region, north of Leningrad, forestry is also the major use with small areas under cropping. In Iceland, where erosion is a serious problem, cattle and sheep raising on rough grazing is the major use. In northern Finland the Orthic Podzols are mostly under forest or unusable. In the south of Finland forestry is also extensive with limited arable and pasture uses. In this region grass swards are liable to severe winter damage. In the Karelian zone in northwest USSR forestry and reindeer grazing are the main uses and where the climate is not restrictive limited cropping is carried out. Further north in the Kola Peninsula where the soils are stony, deer grazing and forestry are the major uses. In southern Sweden where the climate is cool temperate, forestry is the dominant use with some interspersed areas under arable and pasture use. Cattle are relatively highly concentrated. Annual rainfall is 400-800 mm and over the 1972-75 period rainfed barley yielded 2.4 t/ha compared with 3.6 t/ha under irrigation.

The Orthic Podzols extend throughout Norway. They are stony and largely afforested. In the Agder southern coastal region and the Trøndelag region, some livestock farming including dairying is carried out. In the coastal tip of southeast Norway, cereals, potatoes and dairying are concentrated under Cool Temperate conditions. Barley yields of 3 t/ha and oat yields of 3.6 t/ha are attainable. In the coastal strip of southwest Norway, under cool temperate conditions, dairying is important. Cattle and sheep raising are important in the Innfjord region. Mean annual rainfall is 1 000-2 000 mm. Pasture yields of 7.5-9.6 t DM/ha have been recorded under intensive management. However, a high proportion of the soils are unsuited to agriculture.

In the Alpine regions of Italy, Switzerland and Austria, forestry and Alpine grazing are the major uses. In the valley areas, such as Lugano in Switzerland, some arable cropping is practised and pasture productivity is high in these areas. In west Denmark the Orthic Podzols occur on level and rolling topography and are devoted mainly to arable cropping. They are coarse textured and subject to moisture stress. Irrigation is required for maximum yield, with barley yields increasing from 3.5 t/ha under rainfed conditions to 5 t/ha under irrigation. Fodder beets yield up to 9 t DM/ha of roots and tops. In the Steiger Wald zone of the Federal Republic of Germany mixed arable and grassland farming is practised, including cereals and potatoes with some areas under forest. In Poland land use consists of forestry, arable crops and grassland.

In the coastal region of Moray, Banffshire and Aberdeenshire in northeast Scotland, intensive arable and grassland farming is practised. In the Grampians, use is limited to extensive sheep raising on rough grazing. Herbage production ranges from 1.5-3 t DM/ha of low energy material. In the South Downs region in England, mixed arable and grassland farming is carried out in addition to forestry and rough grazing. In Beira Litoral in Portugal, cereals, vines and olives are cultivated in addition to forestry. Irrigation is required since severe moisture stress is a major limitation.

Pp. Placic Podzols

These occur in the United Kingdom and Ireland under a mean annual rainfall in excess of 1 500 mm. In the Scottish Highlands, the English Pennines, the Welsh mountains and the west Donegal mountain zone in Ireland, land use is limited to extensive sheep grazing on rough pasture. Stocking rates are approximately 25 LU/100 ha. In the Cumbrian mountain zone in northwest England, pasture quality is good and dairy farming is practised. Some areas are afforested or devoted to rough grazing.

## Q. Arenosols

Qc. Cambic Arenosols

These soils are confined to Poland, the United Kingdom, Spain and Czechoslovakia, are coarse textured and occur on level topography. They are subject to moisture stress limitation, particularly in Spain. Intensive cereal cultivation is practised, particularly malting barley in the United Kingdom. In Poland forestry and arable cropping are the main uses. In Czechoslovakia they are largely under forest. In Spain they are forested and, in addition, cereals and fruit cropping is practised.

Ql. Luvic Arenosols

The Luvic Arenosols are confined mainly to Hungary. They are devoted largely to vine, fruit, maize and livestock production and are subject to moisture stress limitation.

## R. Regosols

Rc. Calcaric Regosols

In the Netherlands and Denmark they occur as coastal dunes and are mainly devoted to recreational use. They occur under steppe conditions in northeast Hungary and are devoted to maize and fruit production. They are coarse textured and irrigation is required. In Greece, where they occur on suitable topography, they are devoted to intensive cereal and fruit production. They are also very extensive on hilly and mountainous terrain in Macedonia in Greece where they are largely devoted to extensive livestock production from rough grazing. However, in the Peloponnese they are intensively cultivated for cereals and fruit cropping. Mean annual rainfall is 800-1 200 mm in this region. In Albania they occur on hilly and mountainous terrain and forestry and rough grazing are the main uses. However, the valley areas are intensively cultivated. Associated annual rainfall is 1 000-1 400 mm.

Re. Eutric Regosols

These occur largely under Mediterranean climatic conditions. They are medium and fine and are subject to severe moisture stress; irrigation is required for maximum yield. Cereals, fruit and vines are concentrated on these soils. In Sicily durum wheat is concentrated and vine cultivation is extensive, while in Tuscany cereals and livestock production are important. Eutric Regosols occur on a small scale in central Anatolia in Turkey on hilly and mountainous terrain under semi-arid conditions and are associated with vine cultivation. They also occur to a small extent in Portugal where they are coarse textured and subject to severe moisture stress limitation. Forestry, some cereals and vines are the major uses.

Rx. Gelic Regosols

They occur extensively in the permafrost taiga zone of northern USSR. Some reindeer grazing is practised.

## S. Solonetz

Sm. Mollic Solonetz

This soil is largely confined to Hungary where it occurs on level topography in the east zone of the Hungarian Great Alföld. It occurs under Steppe conditions and is subject to moisture stress limitation. Cereals, maize and cattle production are the main features. It is found to a minor extent in Romania.

So. Orthic Solonetz

The Orthic Solonetz occurs under semi-arid conditions in northwest Kazakhstan and in Kalmytskaya. In the former region it is devoted to extensive livestock production on arid grazing. Herbage yields are 1 000 kg DM/ha in the better areas. In Kalmytskaya cereal cropping is carried out. Irrigation is required for satisfactory yields. Desertification hazard is high.

## T. Andosols

### Th. Humic Andosols

These soils occur in the Carpathian Mountains. Stony and subject to slope limitation, they are largely afforested with pasture areas devoted to livestock production. Mean annual rainfall is 1 000 mm and satisfactory levels of pasture yields are attainable.

### Tm. Mollic Andosols

The Mollic Andosols are confined to Italy. They are often lithic and occur on hilly and mountainous terrain in the Latium and Campania regions and also in northwest Sardinia. In mainland Italy they are devoted to arable crops where topography is not limiting, and also fruit and vines. They are subject to moisture stress limitation. In Sardinia they are devoted to cereals, fruit and vines and also to sheep production on rough grazing.

### Tv. Vitric Andosols

The Vitric Andosols occur mainly in Iceland and to a small extent in Sardinia. They are unsuited to plant production because of climatic severity in Iceland, except in the southern coastal zone where there is some cattle and sheep grazing on rough pastures. They are very susceptible to erosion. In Sardinia they have the same land use as the Mollic Andosols.

## U. Rankers

Rankers occur in Spain, Yugoslavia and the United Kingdom in high rainfall belts of 1 000-2 000 mm per year on hilly and mountainous terrain. In the Galician region of Spain, forestry and rough grazing are the major uses with small areas under arable and fruit cropping. Cattle production is highly concentrated on these soils. In the Dinaric Alps in Yugoslavia, forestry and rough grazing are the major uses, whereas in the Scottish Highlands their use is limited to extensive sheep grazing on low-quality heath vegetation.

## V. Vertisols

### Vc. Chromic Vertisols

The Chromic Vertisols are fine textured and occur on level topography under Subtropical Mediterranean climatic conditions. They are subject to severe moisture stress and irrigation is necessary for satisfactory yields. They are most extensive in Turkey where they are devoted to cereal cropping and also livestock production. Some areas are afforested. In the central lowland region of Cyprus they are intensively cultivated and crops include citrus, vines and olives. They are also devoted to sheep production in this region. In the Cádiz region in Spain they are largely afforested. However, cereal cropping is also important with irrigation enabling high yields to be attained.

### Vp. Pellic Vertisols

The Pellic Vertisols are also fine textured and occur on level topography. They are mainly confined to semi-warm steppe zones in Bulgaria, Romania, Yugoslavia and Hungary. They also occur under continental Mediterranean conditions in Turkey and Spain. They are subject to moisture stress limitation and irrigation is required for satisfactory yields.

In central Bulgaria cereals, fruits and vines are important crops. In the Black Sea lowlands crops include cotton, tobacco and vines. Under irrigation, maize yields of >10 t DM/ha and forage legume yields of 8-10 t DM/ha have been recorded. In Yugoslavia intensive cropping is practised. Similarly in Spain, and in the Marmara zone of Turkey, intensive arable farming is also practised.

## W. Planosols

### Wd. Dystric Planosols

These occur mainly in Spain and Yugoslavia and are subject to severe moisture stress limitation. In the Andalusian and south Meseta regions of Spain and in the Pannonian plain in Yugoslavia they are devoted to cereals, fruit cropping and also livestock production.

### We. Eutric Planosols

These are most extensive in Romania, where they have fragipan features. They are subject to moisture stress limitation and are devoted to cereals, maize, sugar beet and livestock production with some areas afforested.

## X. Xerosols

### Xh. Haplic Xerosols

The Haplic Xerosols occur in southern USSR in the Caspian Sea region under semi-arid conditions with a mean annual rainfall of 100-300 mm. They are subject to very severe moisture stress limitation and desertification hazard is high. These soils are devoted to arid grazing and some arable cropping. They are sometimes saline.

Xk. CALCIC XEROSOLS

These soils are most extensive in Turkey and Spain and also occur in the Lenkoran plain in the Azerbaijan region in the USSR where citrus crops, rice, tea and cotton are produced under irrigation. They are very extensive in central Anatolia in Turkey, where they are devoted to arable cropping and cattle, goat and sheep grazing on bush steppe vegetation. They are lithic in the mountainous zone of Turkey and are mainly used for rough grazing. Apart from severe moisture stress limitation, these soils are highly susceptible to erosion, particularly in the hill and mountain zones. A stony phase occurs in the Almeira zone of southeast Spain. Devoted mainly to sheep grazing on arid pasture, it is subject to severe moisture stress and highly susceptible to erosion.

Xl. LUVIC XEROSOLS

These soils occur extensively in Azerbaijan under semi-arid conditions. They are used for arable cropping and some forestry. Desertification hazard is high. A sodic phase occurs extensively in the Caspian Sea zone, south of the Volga. It is devoted to arable farming and rough grazing and is subject to severe moisture stress limitation.

## Z. Solonchaks

Zg. GLEYIC SOLONCHAKS

These soils occur in south USSR, Spain, Turkey, France and Portugal, largely under Mediterranean climatic conditions. They are subject to severe moisture deficits. In the southern Andalusian coastal region in Spain, they are devoted to fruit, olives, cotton and cereals under irrigation, and land use is similar in Azerbaijan. They are subject to salinization.

In the Rhone estuary in France, market gardening and fruit production are important. In Ribatejo in Portugal, land use comprises cereals, fruit, vines and forestry. In the Great Alföld of Hungary, under semi-warm steppe conditions, arable cropping, fruit and rough grazing are the main uses.

Zo. ORTHIC SOLONCHAKS

They occur in Kalmytskaya in the USSR under semi-arid conditions. They are devoted to arable and rough grazing uses and are subject to salinization and severe moisture stress limitations.

## Conclusions

Europe has a wide range of soils occurring over a broad climatic range. In Scandinavia and northern USSR where Orthic and Gelic Podzols are dominant under Taiga conditions, land use is limited by low temperatures to conifer and birch forests with some Tundra grazing. At the other extreme, in the Mediterranean climatic belt extending from Portugal to Azerbaijan on the Caspian Sea, severe moisture stress is the dominant limitation. The soils are mainly Calcic and Eutric Cambisols, Chromic Luvisols and Xerosols, which are very often stony or lithic in character and associated with hilly and mountainous topography. They are highly susceptible to erosion. Cereal and pasture yields are low, less than 1 t DM/ha, with rough grazing. However, vine, fruit, olive and citrus cultivation is carried out under optimum ecological conditions.

In the relatively high rainfall zone of northwest Europe where Orthic Luvisols, Dystric Cambisols and Gleysols are dominant, pasture yields of 12-15 t DM/ha are feasible on the free-draining soils with intensive fertilization. In the Alpine region of France, Italy, Switzerland and Austria, where Orthic Podzols, Lithosols, Rankers and Dystric Cambisols are dominant, afforestation is extensive with livestock raising in the improved low-elevation pastures and in the high-elevation Alpine pastures.

In the Central European region of Germany, Poland, Czechoslovakia, Austria and the French Massif Central, the Dystric Cambisols which are commonly stony in character are associated with the hill and mountain zones and are devoted to forestry, livestock grazing and arable farming. Moisture deficits are relatively low and grass and cereal yields are moderately good. In contrast, in the plains region of Poland and Germany, mixed arable and livestock farming is practised on the dominant Leptic and Humic Podzols, Gleyic Podzoluvisols and Dystric Cambisols. Intensive arable cropping is carried out in the Haplic Chernozems of the German Democratic Republic.

In Hungary, Romania and the Balkans, the Calcaric Phaeozems, Calcic Chernozems and Gleyic Luvisols which occur under Semi-warm Steppe conditions are intensively cultivated. Maize and wheat are the major crops. In this region irrigation is necessary for maximum yield. In the Carpathian and Transylvanian Alps where stony Cambisols are dominant, forestry is extensive; agriculture is largely limited to livestock production from pastures.

In the USSR the Eutric Podzoluvisols which occur under cold temperate conditions are the dominant soils. They are devoted to mixed arable and grassland farming and forestry. Crop yields are limited by climatic constraints and impeded drainage in the associated Gleyic Podzols is also a major limitation. The Chernozems are the dominant soils of the Ukraine and south USSR steppe zone. They are devoted to intensive arable cropping, particularly wheat and maize, and also to pastures and meadows for livestock production. Moisture stress is a limiting factor and these soils are highly productive under irrigation with forage maize capable of yielding 25 t DM/ha. Finally, in the Caspian Sea region severe moisture stress and desertification hazard are the major limitations. However, with irrigation, as in the Lenkoran Plain of Azerbaijan, intensive agriculture is possible.

# APPENDIX

## MORPHOLOGICAL, CHEMICAL AND PHYSICAL PROPERTIES OF THE SOILS OF EUROPE: DESCRIPTIONS AND RESULTS OF ANALYSIS OF TYPICAL PROFILES

In this appendix are presented descriptions and results of analysis of representative soils for the major soil units that appear as dominant or associated soils on the Soil Map of Europe.

The purpose of including these descriptions and analyses is to help define more clearly the nature of the soil units. Naturally, they do not show the range of characteristics of each soil unit, but combined with the definitions in Volume I they should help to understand the concepts on which the legend is based.

### Presentation of data

#### Classification

In most cases the soil is classified according to the system used in the country in which it was described.

#### Source

In most cases the data have been drawn from publications that are normally easy to obtain. Under the heading Source, the origin of the data is given as completely as possible.

#### Site description

Location: The sites of the profiles are located by reference to places or roads easily identifiable on atlas maps; at times it has been possible to give the latitude and longitude.

Altitude: The altitude is shown in metres above sea level. When it did not appear in the original reference, it has sometimes been added by situating the profile on a contour map.

Physiography: The terms used to describe the landscape differ from one writer to another, and it has not been possible to standardize the terminology.

Drainage: Without reference to a specific system, drainage is frequently the synthesis of runoff, permeability, infiltration and internal soil drainage.

Parent material: The nature of the bedrock is given under this heading.

Vegetation: Very often this heading reflects soil utilizations (field crops, pasture, etc.). Otherwise, the nature of the plant cover is given in very general terms.

Climate: Annual rainfall and mean annual temperature are generally given. At times it has been possible to include other details.

#### Profile description

In principle, an effort has been made to follow as closely as possible FAO's *Guidelines for soil profile description*, 1977, but without deforming the intentions and interpretations of the writer. At times modifications have been necessary for purposes of uniformity or because of the length of the text; for some profiles, the descriptive terms create uncertainty because of lack of precision by the writer or the age of the text.

#### Analyses

For a proper interpretation of analyses it is often important to know the method used. For Europe, this would have implied giving the method of analysis for almost every profile, not only because every country has its own methods, but because even in the same country methods may vary from one laboratory to the next. In order to avoid this ongrous task, it is recommended to consult the original source as necessary, although there, too, methods are not always cited, or are described incompletely.

TABLE 4. – LIST OF SOIL PROFILES

| *Symbol* | *Soil unit* | | *Country* | *Page* |
|---|---|---|---|---|
| Bd | CAMBISOL | Dystric | Germany (Dem. Rep.) | 94 |
| Be | | Eutric | France | 96 |
| Bg | | Gleyic | United Kingdom | 98 |
| Bk | | Calcic | Spain | 100 |
| Bv | | Vertic | France | 102 |
| Ch | CHERNOZEM | Haplic | USSR | 104 |
| Ck | | Calcic | Bulgaria | 106 |
| Cl | | Luvic | Romania | 108 |
| Dd | PODZOLUVISOL | Dystric | Belgium | 110 |
| De | | Eutric | USSR | 112 |
| Dg | | Gleyic | France | 116 |
| E | RENDZINA | | France | 118 |
| Gd | GLEYSOL | Dystric | Ireland | 120 |
| Ge | | Eutric | United Kingdom | 122 |
| Gh | | Humic | United Kingdom | 124 |
| Hc | PHAEOZEM | Calcaric | Romania | 126 |
| Hg | | Gleyic | Poland | 128 |
| Hh | | Haplic | Poland | 130 |
| Hl | | Luvic | Romania | 132 |
| Jc | FLUVISOL | Calcaric | Netherlands | 134 |
| Je | | Eutric | Netherlands | 136 |
| Je | | Eutric | Greece | 138 |
| Kk | KASTANOZEM | Calcic | Romania | 140 |
| Kl | | Luvic | USSR | 142 |
| Lc | LUVISOL | Chromic | Spain | 144 |
| Lc | | Chromic | Yugoslavia | 146 |
| Lg | | Gleyic | Germany (Fed. Rep.) | 148 |
| Lk | LUVISOL | Calcic | Spain | 150 |
| Lo | | Orthic | Belgium | 152 |
| Mo | GREYZEM | Orthic | USSR | 154 |
| Od | HISTOSOL | Dystric | Finland | 156 |
| Oe | | Eutric | United Kingdom | 158 |
| Oe | | Eutric | USSR | 160 |
| Pg | PODZOL | Gleyic | Germany (Fed. Rep.) | 162 |
| Pg | | Gleyic | USSR | 164 |
| Ph | | Humic | Belgium | 166 |
| Pl | | Leptic | Italy | 168 |
| Po | | Orthic | Finland | 170 |
| Po | | Orthic | Sweden | 172 |
| Pp | | Placic | Ireland | 174 |
| Qc | ARENOSOL | Cambic | Spain | 176 |
| Ql | | Luvic | Hungary | 178 |
| Sg | SOLONETZ | Gleyic | Romania | 180 |
| So | | Orthic | USSR | 182 |
| Th | ANDOSOL | Humic | France | 184 |
| To | | Ochric | France | 186 |
| Tv | | Vitric | France | 188 |
| Vc | VERTISOL | Chromic | Spain | 190 |
| Vp | | Pellic | Bulgaria | 192 |
| We | PLANOSOL | Eutric | Bulgaria | 194 |
| Xk | XEROSOL | Calcic | Turkey | 196 |
| Zo | SOLONCHAK | Orthic | Spain | 198 |

| | |
|---|---|
| **DYSTRIC CAMBISOL** | **Bd** |
| **Sauerbraunerde** | Germany (Dem. Rep.) |
| **Source** | Ehwald, E. *et al.* Beiträge zur Bodensystematik unter besonderer Berücksichtigung reliktischer und rezenter Merkmale. *Tag Ber. dt. Akad. LandwWiss. Berl.*, (102) : 272-286, 1970 |
| **Location** | Gillersdorf (50 km southwest of Weimar) |
| **Altitude** | 700 m |
| **Physiography** | Western edge of the Thüringer Schiefergebirge, long 13° slope to southeast |
| **Drainage** | Well drained |
| **Parent material** | Silt from weathering of schist, greywacke and quartzite (primary) |
| **Vegetation** | Spruce plantations (50 years old) |
| **Climate** | Annual rainfall: 1 005 mm; mean annual temperature: 5°C |

**Profile description**

| | | |
|---|---|---|
| **O** | **8-0 cm** | Raw humus. |
| **Ah** | **0-5 cm** | Reddish brown (5YR 4/4) gravelly humic loam; weak fine blocky structure; roots abundant throughout; diffuse boundary. |
| **Bw** | **5-45/55 cm** | Red (2.5YR 3-4/6) very gravelly, slightly to moderately stony loam; weak blocky structure; roots common; becoming very stony in lower part; clear, wavy boundary. |
| **2Bw** | **44/55-115+ cm** | Intensely gravelly and stony sandy loam, a little greyer than Bw (2.5YR 3/6); stones are generally oriented parallel to the slope, with fine earth coatings, many still differentiated; blocky (fragipan?); few roots throughout. |

**DYSTRIC CAMBISOL**

**Germany (Dem. Rep.)**

| Horizon | Depth cm | Particle size distribution (mm) % | | | | | | Gravel 60-2 mm % |
|---|---|---|---|---|---|---|---|---|
| | | Coarse sand 2-0.6 | Medium sand 0.6-0.2 | Fine sand 0.2-0.06 | Coarse silt 0.06-0.02 | Fine silt 0.02-0.002 | Clay < 0.002 | |
| O | 8–0 | | | | | | | |
| Ah | 0–5 | 7.8 | 7.5 | 8.1 | 19.7 | 37.1 | 19.8 | 16 |
| Bw | 5–45/55 | 7.1 | 6.8 | 6.9 | 20.9 | 36.9 | 21.4 | 15 |
| 2Bw | 45/55–115 | 18.1 | 14.0 | 11.0 | 22.7 | 26.1 | 8.1 | 36 |

| Horizon | Organic matter | | pH KCl | $CaCO_3$ % | Extractable cations me/100 g | | | | | % V (100 S/T) | Free oxides | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | % C | C/N | | | Ca | Mg | K | Na | T | | $Al_2O_3$ % | $Fe_2O_3$ % |
| O | 42 | 30.8 | | | | | | | | | | |
| Ah | 3 | 14.7 | 3.5 | 0 | 0.05 | 2.04 | 0.09 | 0.00 | 26.7 | 8 | 1.40 | 2.37 |
| Bw | 1.3 | 7.7 | 4.1 | 0 | 0.00 | 0.63 | 0.09 | 0.00 | 17.6 | 4 | 1.97 | 2.52 |
| 2Bw | 0.3 | | 4.4 | 0 | 0.94 | 1.44 | 0.07 | 0.00 | 6.5 | 38 | 0.83 | 1.76 |

| | |
|---|---|
| **EUTRIC CAMBISOL** | **Be** |
| **Eutrophic brown earth** | France |
| **Source** | Mathieu, C. Contribution à l'étude des formations argileuses à silex de Thiérache (France). *Pédologie,* 11(1) : 5-94, 1971 |
| **Location** | Marle, bois de la Grande Pièce (about 40 km northeast of Laon); Coordinates: X : 705260 Y : 226350 |
| **Altitude** | 117 m |
| **Physiography** | Gently undulating, gently sloping, northern exposure |
| **Drainage** | Well drained |
| **Parent material** | Soft chalk without flints (Lower Senonian base) |
| **Vegetation** | Hornbeam coppice |
| **Climate** | Annual rainfall: 930 mm; mean annual temperature: 9.6°C |

**Profile description**

| | | |
|---|---|---|
| **Ah1** | **0-3/5 cm** | Dark brown (10YR 4/3 moist), very humic silty clay; frequent roots; some small chalk fragments; moderately strong fine subangular blocky structure, few crumbs; plastic; clear, slightly wavy boundary. |
| **Ah2** | **3/5-8/16 cm** | Brown (10YR 4/3 moist) humic silty clay; frequent roots; strong medium to fine angular blocky structure; plastic; clear smooth boundary. |
| **Bw1** | **8/16-25/30 cm** | Dark brown (7.5YR 4/4 moist) slightly humic clay; roots common; strong medium angular blocky structure; firm; plastic; gradual, wavy boundary. |
| **Bw2** | **25/30-45/50 cm** | Brown (7.5YR 4.5/4 moist) clay; few roots; weak medium angular blocky structure; firm; plastic; gradual, wavy boundary. |
| **C1** | **45/50-65/68 cm** | Dark brown (7.5YR 4/1 moist) and some pale olive (5Y 6/3) clay; very few roots; massive, few slickensides; firm; gradual, wavy boundary. |
| **C2** | **65/68-80/83 cm** | Strong brown (7.5YR 5/6 moist) clay; few roots; massive, few slickensides; firm; gradual, wavy boundary. |
| **C3** | **80/83-115 cm** | Dark brown (7.5YR 4/1 moist) clay; few roots; massive, few slickensides; firm; gradual, wavy boundary. |
| **C4** | **115-125 cm** | Dark brown (7.5YR 3.5/2 moist) heavy clay; massive, frequent slickensides; plastic; clear, irregular boundary. |
| **R** | **125+ cm** | Very fine chalk fragments; an upper layer 30 cm thick with about 15% heavy clay, 25% clay fragments over 5 cm in diameter and 60% fragments less than 5 cm of which 80% less than 1 cm; below this layer, coarser chalk fragments, about 75% over 5 cm in diameter; in general, the large fragments are angular in both layers, while the smaller fragments are angular in the lower layer and subrounded in the upper layer. |

**EUTRIC CAMBISOL**
**France**

| Horizon | Depth cm | Particle size distribution (mm) % | | | | Organic matter | | |
|---|---|---|---|---|---|---|---|---|
| | | Sand 2-0.05 | Coarse silt 0.05-0.02 | Fine silt 0.02-0.002 | Clay < 0.002 | % C | % N | C/N |
| Ah1 | 0–3/5 | 10.2 | 25.5 | 19.2 | 45.0 | 5.4 | 0.4 | 12.8 |
| Ah2 | 3/5–8/16 | 8.7 | 27.5 | 19.7 | 43.9 | 2.7 | 0.2 | 10.7 |
| Bw1 | 8/16–25/30 | 6.8 | 23.3 | 17.0 | 52.8 | 0.6 | 0.1 | 7.6 |
| Bw2 | 25/30–45/50 | 6.6 | 20.8 | 22.9 | 52.2 | | | |
| C1 | 45/50–65/68 | 5.0 | 18.0 | 25.2 | 51.7 | | | |
| C2 | 65/68–80/83 | 5.2 | 22.5 | 24.4 | 47.7 | | | |
| C3 | 80/83–115 | 6.1 | 14.5 | 28.3 | 50.8 | | | |
| C4 | 115–125 | 8.0 | 11.7 | 35.0 | 47.2 | | | |

| Horizon | pH | | Extractable cations me/100 g | | | | | Free $Fe_2O_3$ % | Bulk density |
|---|---|---|---|---|---|---|---|---|---|
| | $H_2O$ | KCl | Ca | Mg | K | Na | T | | |
| Ah1 | 6.9 | 6.6 | 40 | 2.3 | 0.8 | 0.1 | 61.5 | 1.8 | 1.10 |
| Ah2 | 6.2 | 5.4 | 25 | 1.6 | 0.3 | 0.1 | 30.0 | 1.9 | |
| Bw1 | 5.4 | 4.1 | 25 | 1.1 | 0.2 | 0.1 | 32.0 | 2.1 | 1.23 |
| Bw2 | 5.7 | 4.5 | 32 | 0.9 | 0.2 | 0.1 | 34.2 | 2.0 | 1.27 |
| C1 | 5.9 | 4.8 | | 0.7 | 0.2 | 0.1 | 34.3 | 2.6 | |
| C2 | 6.4 | 5.3 | | 0.5 | 0.2 | 0.1 | 28.6 | 2.5 | |
| C3 | 6.9 | 5.8 | | 0.5 | 0.2 | 0.1 | 37.9 | 3.2 | 1.16 |
| C4 | 7.4 | 6.5 | | 0.5 | 0.3 | 0.1 | 42.6 | 3.2 | |

| | |
|---|---|
| **GLEYIC CAMBISOL** | **Bg** |
| **Brown forest soil with gleyed B and C horizons** | United Kingdom |
| **Source** | Ragg, J.M. & Clayden, B. *The classification of some British soils according to the Comprehensive System of the United States.* Harpenden, 1973. Soil Survey. Technical Monograph No. 3, Profile No. 22 |
| **Location** | Blackdykes, North Berwick, East Lothian (40 km northeast of Edinburgh) |
| **Altitude** | 40 m |
| **Physiography** | Flat, coastal plain |
| **Drainage** | Imperfectly drained |
| **Parent material** | Till from sandstone, shale, basalt and trachyte (Carboniferous) |
| **Vegetation** | Field crops |
| **Climate** | Annual rainfall: 600-800 mm; annual mean temperature: 8-12°C |

**Profile description**

| | | |
|---|---|---|
| **Ap** | **0-30 cm** | Dark brown to brown (10YR 4/3) sandy clay loam; occasional stones; medium blocky structure; plastic; roots abundant; abrupt boundary. |
| **Bg1** | **30-55 cm** | Brown (10YR 5/3) clay loam, common stones; abundant fine strong brown (7.5YR 5/8) mottles and dark greyish brown (10YR 4/2) ped faces; strong coarse prismatic structure; plastic; roots common; diffuse boundary. |
| **Bg2** | **55-85 cm** | Dark brown (7.5YR 4/2) clay loam with abundant fine strong brown (7.5YR 5/8) mottles, grey (10YR 5/1) streaks and ped faces; strong coarse prismatic structure; plastic; few roots; diffuse boundary. |
| **Cg** | **85+ cm** | Dark brown to brown (7.5YR 4/2) clay loam with faint brown (7.5YR 5/4) mottles and brown (7.5YR 5/2) streaks; massive; firm; stones common, including coal and black shale fragments; no roots. |

**GLEYIC CAMBISOL**

**United Kingdom**

| Horizon | Depth cm | Particle size distribution (mm) % | | % C | pH $H_2O$ | CEC(T) me/100 g | % V (100 S/T) |
|---|---|---|---|---|---|---|---|
| | | Silt 0.05-0.002 | Clay < 0.002 | | | | |
| Ap | 0–30 | 25 | 27 | 1.8 | 6.0 | 16.6 | 80 |
| Bg1 | 30–55 | 26 | 30 | 0.7 | 6.5 | 18.2 | 96 |
| Bg2 | 55–85 | 27 | 30 | | 6.8 | 20.4 | sat. |
| Cg | 85 + | 27 | 28 | | 7.0 | 18.7 | sat. |

| | |
|---|---|
| **CALCIC CAMBISOL** | **Bk** |
| **Xerorendzina** | Spain |
| **Source** | Gragera, P., Guerra, A. *et al. Conferencia sobre Suelos Mediterráneos. Guia de la excursión española.* Profil 4. Madrid, Sociedad Española de Ciencia del Suelo, 1966 |
| **Location** | Jaén, Bailén-Granada road, km 30 |
| **Altitude** | Approx. 600 m |
| **Physiography** | Slightly rolling hills |
| **Drainage** | Well drained |
| **Parent material** | Mid-Miocene clayey marl |
| **Vegetation** | Field crops |
| **Climate** | Annual rainfall: 697 mm; annual mean temperature: 16.4°C |

**Profile description**

| | | |
|---|---|---|
| **Ap** | **0-15 cm** | Light brownish grey (10YR 6/2 dry) clay loam; strong granular structure; slightly hard; very permeable; limestone nodules; considerable biological activity, with some burrows; diffuse, smooth boundary. |
| **AB** | **15-35 cm** | Brown (10YR 5/3 dry) silty clay; very strong granular structure; slightly hard; very permeable; frequent white limestone nodules; very considerable biological activity; diffuse, smooth boundary. |
| **Bk1** | **35-75 cm** | Yellowish brown (10YR 5/4 dry) clay loam; strong blocky structure; soft; very permeable; limestone nodules and pseudomycelium frequent between peds; root penetration easy; diffuse, smooth boundary. |
| **Bk2** | **75-90 cm** | Brown (7.5YR 5/4 dry) silty clay; very strong blocky structure; soft; very permeable; pseudomycelium abundant. |
| **Ck1** | **90-150 cm** | Brown (7.5YR 4/4 dry) clay loam; strong granular structure; soft; pseudomycelium abundant. |
| **Ck2** | **150+ cm** | As Ck1, but with small olive brown (2.5YR 4/4) patches of manganese oxide. |

## CALCIC CAMBISOL
### Spain

| Horizon | Depth cm | Particle size distribution (mm) % | | | | Organic matter | | | $CaCO_3$ |
|---|---|---|---|---|---|---|---|---|---|
| | | Coarse sand | Fine sand | Silt | Clay | % C | % N | C/N | % |
| Ap | 0–15 | 8.9 (1.0) | 28.3 (23.8) | 25.2 (24.0) | 38.6 (22.6) | 1.6 | 0.17 | 9 | 21.9 |
| AB | 15–35 | 6.1 (3.4) | 25.5 (21.7) | 23.1 (27.9) | 45.9 (22.6) | 0.7 | 0.09 | 8 | 20.3 |
| Bk1 | 35–75 | 7.7 (1.4) | 23.9 (21.6) | 27.5 (30.1) | 41.0 (16.2) | 0.3 | 0.04 | 7 | 29.6 |
| Bk2 | 75–90 | 5.4 (1.3) | 23.1 (20.3) | 25.4 (30.2) | 47.5 (16.6) | 0.2 | 0.04 | 5 | 28.2 |
| Ck1 | 90–150 | 5.6 (1.7) | 30.7 (29.0) | 26.7 (29.9) | 40.6 (14.9) | 0.2 | 0.03 | 4 | 21.5 |
| Ck2 | 150+ | 4.1 (1.1) | 26.8 (32.3) | 27.7 (33.6) | 41.6 (12.5) | 0.1 | 0.05 | 2 | 19.1 |

In parentheses: after decomposition of carbonates

| Horizon | pH | | Extractable cations me/100 g | | | | | | % V | Free oxides | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $H_2O$ | KCl | Ca | Mg | Na | K | S | T | (100 S/T) | $Fe_2O_3$ % | $Al_2O_3$ ppm | $SiO_2$ ppm |
| Ap | 7.9 | 6.9 | 15.5 | 1.0 | 0.2 | 0.9 | 17.6 | 18.5 | 95 | 1.0 | 20 | 379 |
| AB | 7.6 | 6.8 | 15.0 | 1.1 | 0.2 | 0.4 | 16.8 | 17.2 | 97 | 1.0 | 16 | 340 |
| Bk1 | 8.0 | 6.8 | 14.5 | 1.2 | 0.2 | 0.3 | 16.2 | 16.5 | 98 | 0.9 | 14 | 329 |
| Bk2 | 7.6 | 6.7 | 17.3 | 1.3 | 0.2 | 0.2 | 19.0 | 20.0 | 95 | 1.0 | 13 | 323 |
| Ck1 | 7.7 | 6.7 | 21.0 | 2.1 | 0.2 | 0.2 | 23.6 | 24.4 | 96 | 1.1 | 15 | 321 |
| Ck2 | 7.7 | 6.6 | 16.0 | 3.1 | 0.2 | 0.4 | 19.7 | 20.5 | 96 | 1.5 | 12 | 301 |

| Horizon | Total analyses % | | | | | | | | $\frac{SiO_2}{R_2O_3}$ | $\frac{SiO_2}{Al_2O_3}$ | $\frac{SiO_2}{Fe_2O_3}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | $SiO_2$ | $Al_2O_3$ | $Fe_2O_3$ | MgO | CaO | $Na_2O$ | $K_2O$ | $TiO_2$ | | | |
| Ap | 43.94 | 9.00 | 3.31 | 3.12 | 14.58 | — | — | 0.44 | 7.3 | 8.24 | 35.16 |
| AB | 47.18 | 9.56 | 3.59 | 2.52 | 14.16 | — | — | 0.44 | 7.1 | 8.33 | 34.82 |
| Bk1 | 39.30 | 8.92 | 3.41 | 1.96 | 20.83 | — | — | 0.42 | 6.5 | 7.43 | 30.52 |
| Bk2 | 44.31 | 9.27 | 3.48 | 2.21 | 18.64 | — | — | 0.47 | 6.6 | 8.06 | 33.73 |
| Ck1 | 49.70 | 9.94 | 3.66 | 2.92 | 15.14 | — | — | 0.47 | 7.4 | 8.45 | 35.96 |
| Ck2 | 49.35 | 11.01 | 4.14 | 2.46 | 13.68 | — | — | 0.50 | 6.8 | 7.57 | 31.58 |

| | |
|---|---|
| **VERTIC CAMBISOL** | **Bv** |
| **Vertic brown soil** | France |
| **Source** | Mathieu, C. Contribution à l'étude des formations argileuses à silex de Thiérache (France). *Pédologie*, 11(1): 5-94, 1971 |
| **Location** | Gronard (about 40 km northeast of Laon); Coordinates: X: 712100 Y: 234280 |
| **Altitude** | 140 m |
| **Physiography** | Gently undulating, moderate mid-slope, southeast exposure |
| **Drainage** | Well drained |
| **Parent material** | Soft chalk with flint (Upper Turonian) |
| **Vegetation** | Permanent pasture |
| **Climate** | Annual rainfall: 930 mm; annual mean temperature: 9.6°C |

**Profile description**

| | | |
|---|---|---|
| **Ah1** | **0-8/12 cm** | Dark greyish brown (10YR 4/2 moist) humic silty clay; strong fine to medium crumb structure; fairly frequent black flint fragments (1-2 cm) throughout the horizon, with few scattered larger fragments (5-10 cm), surface very weathered, friable with knife, whitish grey, very dark grey (N 3/0) coat; gradual smooth boundary. |
| **Ah2** | **8/12-20/24 cm** | Brown (10YR 3/4 moist) humic silty clay; strong medium granular to subangular blocky structure; flints as in Ah1; clear smooth boundary. |
| **Bw1** | **20/24-30/50 cm** | Dark brown (10YR 4/4 moist) heavy clay; strong, medium subangular blocky structure; numerous medium (5-10 cm) flint fragments, especially in the lower part, whitish grey, very weathered surface, friable with knife; clear very wavy boundary, characterized by a layer of larger flint fragments. |
| **Bw2** | **30/50-120/150 cm** | Dark brown (7.5YR 4/4 moist) heavy clay; strong, coarse to very coarse angular blocky structure; few slickensides; very firm; very frequent (50% by volume) medium (3-10 cm) flint fragments, slightly rounded; many strong brown (7.5YR 5/8) iron-manganese mottles; clear smooth boundary. |
| **Bw3** | **10-15 cm thick** | Dark brown (7.5YR 4/4 moist) to reddish brown (5YR 4/4 moist) heavy clay; very strong coarse to very coarse angular blocky structure; with frequent slickensides; very firm; very frequent flint nodules, slightly larger than in horizon Bw2 (5-15 cm), very slightly rounded, with relatively thin, slightly weathered coat; frequent strong brown (7.5YR 5/8) iron-manganese patches; locally in direct contact with the chalk; clear irregular boundary. |
| **C** | **2-4 cm thick** | Dark olive brown (5YR 3/4) and yellowish (2.5YR 7/6) mottled heavy clay; compact, with slickensides; very firm; few angular flint fragments; discontinuous weathering fringe; clear but "spotty" (*persillé*) irregular boundary. |
| **R** | | The chalk lies under the weathering fringe; very strongly weathered, in numerous fragments having a regular, almost continuous brown clayskin from infiltration and weathering; the flint beds are perfectly visible. |

**VERTIC CAMBISOL**

**France**

| Horizon | Depth cm | Particle size distribution (mm) % | | | | Organic matter | | |
|---|---|---|---|---|---|---|---|---|
| | | Sand 2-0.05 | Coarse silt 0.50-0.02 | Fine silt 0.02-0.002 | Clay < 0.002 | % C | % N | C/N |
| Ah1 | 0–8/12 | 12.4 | 26.3 | 18.1 | 43.1 | 4.5 | 0.4 | 10.2 |
| Ah2 | 8/12–20/24 | 12.9 | 25.5 | 18.0 | 42.3 | 2.0 | 0.2 | 8.4 |
| Bw1 | 20/24–30/50 | 7.8 | 9.9 | 18.9 | 63.4 | 0.5 | 0.1 | 4.6 |
| Bw2 | 30/50–120–150 | 7.0 | 8.0 | 20.2 | 64.6 | | | |
| Bw3 | | 2.6 | 6.1 | 20.1 | 70.1 | | | |
| C | | 4 3 | 9.3 | 24.4 | 61.8 | | | |

| Horizon | pH | | Extractable cations me/100 g | | | | | Free $Fe_2O_3$ % |
|---|---|---|---|---|---|---|---|---|
| | $H_2O$ | KCl | Ca | Mg | K | Na | T | |
| Ah1 | 7.4 | 6.8 | sat. | 1.8 | 2.0 | 0.1 | 34.2 | 1.60 |
| Ah2 | 7.9 | 7.1 | sat. | 0.8 | 0.3 | 0.1 | 25.9 | 1.67 |
| Bw1 | 8.0 | 7.1 | sat. | 0.8 | 0.4 | 0.1 | 39.6 | 2.80 |
| Bw2 | 7.9 | 6.9 | sat. | 0.7 | 0.3 | 0.2 | 39.4 | 2.60 |
| Bw3 | 8.0 | 7.0 | sat. | 0.7 | 0.3 | 0.1 | 43.9 | 2.80 |
| C | 8.0 | 7.1 | sat. | 0.8 | 0.3 | 0.2 | 42.3 | 1.97 |

| | |
|---|---|
| **HAPLIC CHERNOZEM** | **Ch** |
| **Ordinary Chernozem** | USSR |
| **Source** | Grin, G.S., Kissel, V.D. *et al. Short guide to soil excursion Moskow-Kherson, Profil 6*, p. 52-58, Moscow, Ministry of Agriculture of the USSR, 1964 |
| **Location** | Moscow-Simferopol road, 30 km south of Novomoskovsk |
| **Physiography** | Slighly undulating plain, eroded |
| **Drainage** | Well drained |
| **Parent material** | Loess (to depth of 20-25 m) |
| **Vegetation** | Field crops |
| **Climate** | Annual rainfall: 410-490 mm; annual mean temperature: 7°C (January: —7°C; July: 22°C) |

**Profile description**

| | | |
|---|---|---|
| **Ap** | **0-30 cm** | Dark grey (moist) clay; blocky coarse crumby structure; firm; frequent roots; clear smooth boundary. |
| **Ah1** | **30-40 cm** | Dark grey (moist) clay; dusty-fine granular structure; friable; gradual boundary. |
| **Ah2** | **40-60 cm** | Dark grey, slightly brownish clay, becoming lighter in the lower part; fine granular to crumby structure; effervescence at 56 cm; frequent krotovina, coprolites and roots; transition gradual. |
| **AC** | **60-81 cm** | Dark brownish grey (moist) clay; crumby; compact; fewer roots than in Ah2; frequent krotovina and coprolites; gradual boundary. |
| **C** | **81-160 cm** | Loess; to 110 cm, pale greyish yellow; below, pale brownish yellow (moist); compact; calcareous round concretions (10-15 mm) between 80 and 115 cm; friable, powdery, with "white eyes"; few krotovina. |

**HAPLIC CHERNOZEM**
**USSR**

| Horizon | Depth cm | Particle size distribution (mm) % | | | | | |
|---|---|---|---|---|---|---|---|
| | | 1-0.25 | 0.25-0.10 | 0.10-0.01 | 0.01-0.005 | 0.005-0.001 | < 0.001 |
| Ap | 0–30 | 0.1 | 0 | 41.9 | 10.3 | 13.9 | 36.1 |
| Ah1 | 30–40 | 0 | 4.5 | 37.8 | 9.5 | 12.9 | 35.3 |
| Ah2 | 40–60 | 0 | 0 | 40.8 | 10.7 | 14.1 | 39.5 |
| AC | 60–81 | 0 | 0 | 40.1 | 10.1 | 14.8 | 35.1 |
| C | 81–160 | 0.1 | 7.8 | 39.0 | 15.3 | 1.3 | 35.5 |

| Horizon | Organic matter | | | pH $H_2O$ | Extractable cations me/100 g | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | % C | % N | C/N | | Ca | Mg | Na | K | T |
| Ap | 2.89 | 0.25 | 11.5 | 7.6 | 31.5 | 5.5 | 0.2 | 0.8 | 38.0 |
| Ah1 | 2.05 | 0.18 | 11.4 | 7.4 | 31.4 | 7.9 | 0.2 | 0.5 | 40.0 |
| Ah2 | 1.21 | 0.12 | 10.1 | 7.8 | | | | | |
| AC | 0.57 | 0.09 | 6.3 | 7.8 | | | | | |

| | |
|---|---|
| **CALCIC CHERNOZEM** | **Ck** |
| **Calcareous Chernozem** | Bulgaria |
| **Source** | Boyadgiev, T.G. *Contribution à l'étude des sols de la Bulgarie*, p. 72-74. Gand, Université de Gand, 1967 (Thesis) |
| **Location** | 2 km northeast of Krividol (Vratchansko Province), on the boundary between the Danube valley and the Pre-Balkan Chain |
| **Altitude** | 220 m |
| **Physiography** | Long western slope of the Botunja valley |
| **Drainage** | Well drained |
| **Parent material** | Sarmatian marl |
| **Vegetation** | Field crops |
| **Climate** | Annual rainfall: 630 mm; annual mean temperature: 11.2°C |

**Profile description**

| | | |
|---|---|---|
| **Ap** | **0-20 cm** | Heavy clay (10YR 4.5/2 dry; 3.5/2 moist; 4/2 crushed, moist); moderate very fine to medium granular structure; the coarse granules are very porous; hard (dry), sticky and plastic (wet); few fine shell fragments; few fine roots; calcareous; clear smooth boundary. |
| **Ah1** | **20-35 cm** | As Ap, but strong medium to coarse granular structure; gradual smooth boundary. |
| **Ah2** | **35-50 cm** | Heavy clay (10YR 5/2 dry; 3.5/2 moist; 4/2 crushed, moist); moderate medium to coarse granular structure; hard (dry), sticky and plastic (wet); worm channels and krotovina; few fine roots; few fine shell fragments; few flat fragments coated with a whitish skin of calcareous pseudomycelia; few small to medium, hard, rounded calcareous concretions; gradual smooth boundary. |
| **ACk** | **50-67 cm** | Clay (10YR 5/3 dry; 3.5/3 moist; 4/3 crushed, moist); weak coarse granular structure; hard (dry), sticky and plastic (wet); worm channels lined with blackish coating; krotovina; few shell fragments; very calcareous with fine tubular calcareous concretions and frequent calcareous pseudomycelia, striking, small and medium, clear, composite; clear smooth boundary. |
| **Ck1** | **67-88 cm** | Light clay (10YR 7/3 dry; 5.5/4 moist and crushed moist); weak medium granular structure; slightly hard (dry), sticky and plastic (wet); very porous, few worm channels lined with blackish coating; krotovina; very calcareous, diversified, with fine tubular calcareous concretions dominant; gradual smooth boundary. |
| **Ck2** | **88-108 cm** | As Ck1, except that the $CaCO_3$ content decreases. |

**CALCIC CHERNOZEM**

**Bulgaria**

| Horizon | Depth cm | Particle size distribution (mm) % | | | | C % | $Fe_2O_3$ % | |
|---|---|---|---|---|---|---|---|---|
| | | Sand 1-0.05 | Coarse silt 0.05-0.02 | Fine silt 0.02-0.002 | Clay < 0.002 | | Free | Total |
| Ap | 0–20 | 5.3 | 15.5 | 20.1 | 59.0 | 1.5 | 0.287 | 1.125 |
| Ah1 | 20–35 | 3.9 | 18.4 | 22.0 | 55.7 | 1.4 | 0.280 | 1.157 |
| Ah2 | 35–50 | 5.1 | 18.0 | 26.8 | 50.0 | 1.2 | 0.269 | 1.103 |
| ACk | 50–67 | 3.8 | 19.7 | 34.5 | 42.0 | 0.9 | 0.226 | 0.910 |
| Ck1 | 67–88 | | | | | 0.3 | 0.177 | 0.691 |
| Ck2 | 88–108 | 13.5 | 20.2 | 29.8 | 36.5 | 0.5 | 0.153 | 0.598 |

| Horizon | pH | | $CaCO_3$ % | CEC (T) me/100 g |
|---|---|---|---|---|
| | $H_2O$ | KCl | | |
| Ap | 8.2 | 7.2 | 3.7 | 50.0 |
| Ah1 | 8.1 | 7.2 | 4.7 | 49.1 |
| Ah2 | 8.1 | 7.3 | 8.0 | 42.1 |
| ACk | 8.3 | 7.5 | 27.0 | 39.2 |
| Ck1 | 8.4 | 7.7 | 40.5 | 32.1 |
| Ck2 | 8.4 | 7.7 | 32.0 | 20.6 |

**LUVIC CHERNOZEM** **Cl**

| | |
|---|---|
| **Strongly leached Chernozem** | Romania |
| **Source** | Popovatz, M. *et al. Guide book of excursions.* Volume 2. Eighth International Congress of Soil Science, Profile 5. Bucharest, 1964 |
| **Location** | Transylvanian basin, north of Unirea |
| **Altitude** | 310 m |
| **Physiography** | Terrace, flat |
| **Drainage** | Well drained |
| **Parent material** | Pleistocene silt clay |
| **Vegetation** | Field crops |
| **Climate** | Annual rainfall: 537 mm; annual mean temperature: 9.5°C |

**Profile description**

| | | |
|---|---|---|
| **Ap** | **0-20 cm** | Very dark grey (10YR 3/1 moist), dark grey (10YR 4/1 dry) silty clay; weak, medium granular structure with angular blocky peds (as result of ploughing); friable, very hard; common roots; slightly gravelly; clear boundary. |
| **Ah** | **20-40 cm** | Very dark grey (10YR 3/1 dry) silty clay; weak medium granular and fine subangular blocky structure; in lower part strong medium subangular blocks; firm, very hard; few fine roots, very fine soft iron-manganese nodules, few hard in lower part; slightly gravelly; few fine roots; gradual boundary. |
| **Bt1** | **40-72 cm** | Very dark grey (10YR 3/1 moist), dark grey (10YR 4/1 dry) clay, with coarse very dark greyish brown (10YR 3/2 moist) mottles; strong, medium prismatic structure; firm, very hard; almost continuous clayey cutans; few very fine (1 mm) iron-manganese nodules; few pebbles; gradual boundary. |
| **Bt2** | **72-100 cm** | Dark brown (10YR 4/3 moist) clay to silty clay, with very dark greyish brown (10YR 3/2 moist) vertical streaks; strong fine and medium prismatic structure; firm, very hard; frequent soft, very fine, and few hard, fine iron-manganese nodules; fine fissures; slightly gravelly; gradual boundary. |
| **Bt3** | **100-155 cm** | Dark brown (10YR 4/3 moist) clay to silty clay; fissures filled with very dark grey (10YR 3/1) material; common dark yellowish brown (10YR 3/4 moist) spots on and in peds; moderate angular and subangular structure, tending to medium prismatic; firm, very hard; few slickensides; fewer fine iron-manganese nodules than in Bt2; slightly gravelly; gradual boundary. |
| **Btk1** | **155-200 cm** | |

## LUVIC CHERNOZEM

**Romania**

| Horizon | Depth cm | Particle size distribution (mm) % | | | | | | Organic matter | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 2-0.2 | 0.2-0.1 | 0.1-0.06 | 0.06-0.02 | 0.02-0.002 | < 0.002 | % C | % N | C/N |
| Ap | 0–20 | 1.4 | 1.8 | 2.8 | 19.6 | 27.7 | 46.7 | 2.2 | 0.23 | 10 |
| Ah | 20–40 | 0.8 | 1.8 | 2.4 | 16.6 | 24.1 | 54.3 | 1.7 | 0.17 | 11 |
| Bt1 | 40–72 | 0.5 | 1.1 | 1.2 | 13.5 | 18.7 | 64.5 | 1.3 | 0.12 | 12 |
| Bt2 | 72–100 | 0.4 | 0.8 | 1.8 | 16.8 | 22.7 | 57.4 | 0.7 | 0.07 | 11 |
| Bt3 | 100–155 | 0.3 | 0.8 | 1.7 | 16.7 | 23.9 | 56.6 | 0.5 | | |
| Btk1 | 155–200 | 0.5 | 0.5 | 2.0 | 14.6 | 25.1 | 57.3 | 0.5 | | |

| Horizon | pH $H_2O$ | $CaCO_3$ % | Extractable cations me/100 g | | | | | | % V (100 S/T) |
|---|---|---|---|---|---|---|---|---|---|
| | | | Ca | Mg | K | Na | H | T | |
| Ap | 6.6 | 0 | 24.2 | 5.2 | 1.6 | 1.1 | 5.8 | 37.9 | 84 |
| Ah | 6.7 | 0 | 28.2 | 6.0 | 0.6 | 1.1 | 5.7 | 41.7 | 86 |
| Bt1 | 7.0 | 0 | 33.4 | 7.6 | 0.9 | 0.8 | 5.1 | 47.9 | 89 |
| Bt2 | 7.0 | 0 | 28.5 | 7.0 | 0.7 | 0.8 | 4.3 | 41.5 | 89 |
| Bt3 | 7.3 | 0 | 28.4 | 6.8 | 0.7 | 1.0 | 3.8 | 40.8 | 90 |
| Btk1 | 8.0 | 6.1 | 28.8 | 7.0 | 0.7 | 1.0 | | 37.6 | 100 |

**DYSTRIC PODZOLUVISOL Dd**

| | |
|---|---|
| **Glossic leached soil** | Belgium |
| **Source** | Tavernier, R. & Louis, A. La dégradation des sols limoneux sous monoculture de hêtre de la forêt de Soignes (Belgique). *Anal. Inst. St. Cerc. Pedol.*, 38: 165-191, 1971 |
| **Location** | Uccle, western part of Soignes Forest (southwest of Brussels); Coordinates: N 41790 E 1880 |
| **Altitude** | 125 m |
| **Physiography** | Gently undulating plateau |
| **Drainage** | Well drained |
| **Parent material** | Pleistocene loess (Würm III) |
| **Vegetation** | Beech monoculture (approx. 50 years, probably third generation), discontinuous undergrowth of grasses, laurel, anemones; no natural regeneration |
| **Climate** | Annual rainfall: 835 mm; annual mean temperature: 10°C |

**Profile description**

| | | |
|---|---|---|
| **O** | **2-0 cm** | Litter, decomposed plant debris. |
| **Ah1** | **0-2/7 cm** | Black (10YR 2/1) very humic (mor-type humus) loam; weak, medium platy and fine granular structure; very friable; abrupt wavy boundary. |
| **Ah2** | **2/7-7/12 cm** | Dark greyish brown (10YR 4/2) humic loam with purple glints (development of a micropodzol); moderate medium platy structure; somewhat less friable than Ah1; few brown (7.5YR 4/4) concentric (locally subhorizontal) medium distinct streaks plus faint sharp firm to very firm brown (10YR 4/4) fine specks and few pale brown (10YR 6/3) faint coarse diffuse mottles; abrupt wavy boundary. |
| **E1** | **7/12-23/57 cm** | Yellowish brown (10YR 5/4) loam; weak medium platy structure; very friable; locally old root channels filled with decomposed organic matter; clear wavy boundary. |
| **E/B** | **24/28-32/110 cm** | Locally pale brown (10YR 6/3) loam; very weak fine subangular blocky structure, locally weak medium platy; very friable; locally many light brownish grey (2.5YR 7/2 to 6/2) large diffuse prominent mottles plus few dark reddish brown (5YR 3/3) fine distinct sharp specks (small streaks), hard very fine iron-manganese nodules; locally, this horizon contains completely rotted fragments of Bt materials; abrupt broken boundary: the whitened materials penetrate the Bt horizon, primarily along the frequent deep pockets and root channels. |
| **Bt1** | **23/57-90/115 cm** | Brown (7.5YR 4/4) loam to heavy loam; fairly weak fine subangular blocky, locally platy, structure (0.5-1 cm), mainly particles whose faces show many leached grains of sand and silt; friable (and resistant); the horizon is mottled with traces, streaks and especially tongues, pale brown (10YR 6/3), distinct, clear and diffuse; the pale brown tongues are surrounded with a bright brown (7.5YR 5/8) coating; very fine iron-manganese nodules, fewer than in the rotted Bt fragments isolated in the E2 horizon; locally fairly common dark brown (10YR 3/3) coarse to very coarse diffuse distinct composite mottles; the cleavage planes are covered with fine light brownish grey (10YR 6/2-7/2) mottles and leached nodules (siliceous powder); locally, accumulation of iron and humus on the cleavage planes as a fine blackish brown to yellowish red skin (rust); frequent clay cutans; evident migration of clay; smooth diffuse boundary. |
| **Bt2** | **90/115-172 cm** | Brown (7.5YR 4/5-5/6) heavy loam; weak medium subangular blocky structure; friable (very resistant); the tongues of the preceding horizon continue but are thinner; frequent clayskins, somewhat darker than the matrix; evident migration of clay; mottles as in Bt1, but somewhat less evident; smooth diffuse boundary. |
| **BC** | **172-245 cm** | Brown (10YR 5/4) heavy loam; very weak fine to medium subangular blocky structure; friable; local migration of clay; frequent small white (2.5Y 8/2) mottles. |
| **C** | **245+ cm** | Decalcified loess. |
| | **(With bucket auger)** | Loess + staunässegley at 340 cm. |
| | | Pebbles and Tertiary substratum composed of yellowish green silt clay at 420 cm. |

**DYSTRIC PODZOLUVISOL**

**Belgium**

| Horizon | Depth cm | Particle size distribution (mm) % | | | | % C |
|---|---|---|---|---|---|---|
| | | Sand 2-0.05 | Coarse silt 0.05-0.02 | Fine silt 0.02-0.002 | Clay < 0.002 | |
| Ah1 | 0–2/7 | 3.1 | 59.1 | 27.2 | 10.5 | 3.0 |
| Ah2 | 2/7–1/12 | 3.0 | 58.3 | 29.4 | 9.1 | 1.2 |
| E1 | 7/12–23/57 | 2.8 | 55.3 | 33.0 | 8.8 | 0.4 |
| EB | 24/28–32/110 | 2.4 | 52.7 | 29.1 | 15.7 | |
| Bt1 | 23/57–90/115 | 1.7 | 56.2 | 21.0 | 20.9 | |
| Bt2 | 90/115–172 | 2.0 | 56.3 | 22.1 | 19.5 | |
| BC | 172–245 | 3.5 | 52.2 | 26.3 | 18.9 | |
| C | 245+ | 3.1 | 55.1 | 23.9 | 17.8 | |

| Horizon | pH | | CEC (T) me/100 g | % V (100 S/T) |
|---|---|---|---|---|
| | $H_2O$ | KCl | | |
| Ah1 | 3.6 | 3.3 | 24 | 10 |
| Ah2 | 4.2 | 3.4 | 13 | 14 |
| E1 | 4.7 | 3.7 | 7 | 13 |
| EB | 4.8 | 3.9 | 10 | 15 |
| Bt1 | 4.4 | 3.7 | 14 | 14 |
| Bt2 | 4.7 | 3.7 | 12 | 12 |
| BC | 4.9 | 3.9 | 13 | 38 |
| C | 5.4 | 4.1 | 14 | 58 |

## EUTRIC PODZOLUVISOL De

| | |
|---|---|
| **Derno-palevo-podzolic soil** [1] | USSR |
| **Source** | Targulian, V.O., Sokolova, T.A., Birina, A.G., Kulikov, A.V. & Tselishcheva, L.K. *Arrangement, composition and genesis of sod-pale-podzolic soils derived from mantle loams*. Document, International Congress of Soil Science, Moscow, 1974 |
| **Location** | Moscow-Yaroslav road, 107 km northeast of Moscow |
| **Altitude** | 220 m |
| **Physiography** | Undulating region dissected by deep valleys |
| **Drainage** | Imperfectly drained |
| **Parent material** | Loessic mantle loam (2-3 m) |
| **Vegetation** | Forest of *Betula pendula* and *Picea excelsa*, with *Populus tremulus, Acer platanoides, Alnus incana, Sorbus aucuparia, Quercus robur, Corylus avellana, Rubus idaens*. Undergrowth: *Asperula odorata, Galeobdolon luteum, Oxalis acetosella* |
| **Climate** | Annual rainfall: 650 mm; annual mean temperature: 5°C |

### Profile description

| | | |
|---|---|---|
| **O1** | **2-1 cm** | Moderately decomposed litter of leaves, needles, twigs, grasses; very dark brown (10YR 2/2); loose, fine stratification; few brown (10YR 4/3) coprolites, composed primarily of mineral earth; locally mycelium; no roots; abrupt or gradual wavy boundary. |
| **O2** | **1-0 cm** | Moderately decomposed forest litter of leaves, needles, slightly decomposed twigs plus decomposed organic matter cementing the organic debris; dark brown (10YR 3/2-3); structureless, friable; crumby coprolites; very dark grey and dark greyish brown (10YR 3/1-2) matter; few leached quartz and feldspar grains; matted by coarse, medium and fine roots; clear wavy boundary. |
| **Ah1** | **0-9 cm** | Very dark grey (10YR 3/1-2 moist) sandy loam, with frequent medium, distinct yellowish brown (10YR 5/4) mottles; weak crumby structure; friable; many pores; few blackish red spheroid fine soft nodules; roots frequent; worm channels with brown and black coprolites; locally frequent charcoal debris; abrupt wavy boundary. |
| **E1** | **9-25 cm** | Brown (10YR 5/3 moist) sandy loam, with fine, round, clear very dark greyish brown (10YR 3/2) mottles; weak to moderate platy structure; friable; many fine pores; few dark brown to black spheroid soft nodules; frequent fine and medium roots; frequent worm channels with dark brown coprolites; abrupt wavy boundary. |
| **E2** | **25-31 cm** | Texture, structure and porosity as E1; pale brown (10YR 5-6/2 moist) with frequent fine and medium distinct yellowish brown (10YR 5-4/4) mottles; very frequent brown, red and black irregular (1-3 cm) hard nodules; abrupt, wavy boundary, locally irregular; at times the horizon becomes very thin and almost disappears. |
| **E3** | **31-40 cm** | Discontinuous; cannot be observed on all faces of the profile; light brownish grey (10YR 6/2 moist) sandy loam to loamy sand with frequent coarse and medium, friable, diffuse, greyish brown (10YR 5/2) mottles; few fine and medium distinct brown (7.5YR 5/6, 4/4) mottles; moderate medium platy structure; moderately friable; many fine and medium pores; brown, reddish brown and black soft irregular (0.2-1.5 mm) nodules; few roots, mostly fine; few worm channels with coprolites; abrupt, wavy boundary, locally irregular. |

[1] The term *palevo* indicates, in Russian, a colour (*palevaya*) that corresponds to the following Munsell hues and values: very pale brown (10YR 7/3-4), pale brown (10YR 6/3), pale yellowish brown (10YR 6/4, 2.5Y 6/4), pale yellow (2.5Y 7/4) and yellow (2.5Y 7/6).

## EUTRIC PODZOLUVISOL
## USSR

| Horizon | Depth cm | Particle size distribution (mm) % | | | | | |
|---|---|---|---|---|---|---|---|
| | | 1-0.25 | 0.25-0.05 | 0.05-0.01 | 0.01-0.005 | 0.005-0.001 | < 0.001 |
| Ah1 | 0–9 | — | 13 | 52 | 9 | 6 | 15 |
| E1 | 9–25 | — | 12 | 57 | 8 | 11 | 9 |
| E2 | 25–31 | — | 13 | 54 | 10 | 9 | 11 |
| E3 | 31–40 | — | 12 | 62 | 9 | 7 | 7 |
| E/B | 40–49 | — | 15 | 55 | 6 | 9 | 12 |
| B/E | 49–58 | — | 13 | 52 | 7 | 8 | 16 |
| Bt1 | 58–85 | — | 10 | 47 | 7 | 8 | 24 |
| Bt2 | 85–138 | — | 7 | 49 | 7 | 7 | 26 |
| Btg1 | 138–165 | — | 10 | 35 | 11 | 9 | 33 |
| Btg2 | 165–205 | — | 8 | 32 | 14 | 7 | 34 |

**E/B** **40-49 cm** Transitional horizon with alternating pale brownish grey, pale brown and brown (10YR 6/2, 6/3, 5/3) mottles covering large areas of the lower part; the pale zones are sandy loam, moderate fine or medium platy structure; friable or firm; the brown zones are loam (heavy), strong structure, fine to medium subangular blocky, more compact; frequent pores of different sizes and shapes; small (<1 mm), hard, dark brown or black irregular nodules, becoming rapidly less frequent as compared with E2; few worm channels with coprolites; few roots, mostly fine; slightly gravelly, few small pebbles; distinct wavy boundary.

**B/E** **49-58 cm** Variegated discontinuous horizon, locally replaced by E/B and even E2; differs from E/B by the predominance of brown mottles over light mottles; base brown (7.5YR 4/4) covering 60-80%, light mottles (10YR 7/2-3 moist) in form of vertical streaks or tongues; fissures filled with light sandy silt or silty sand, structureless or platy; friable; the brown mass is silty, moderate fine and medium blocky structure; friable or compact; frequent pores of different sizes and shapes, horizontal interstitial dominant; very few small irregular black and dark red nodules; few small worm channels with brown or light grey coprolites; few fine and medium roots, few coarse roots; slightly gravelly and few small pebbles; gradual irregular boundary, locally wavy.

**Bt1** **58-85 cm** Reddish brown to dark brown (5YR 4/4, 7.5YR 4/4-3 moist) with light grey (2.5Y 7/2, 10YR 7/2-3) vertical and oblique streaks; fissures filled with sandy silt, normally structureless, with few brown peds; material between peds silty, moderate fine to medium subangular blocky structure; many interstitial and tubular pores, few black to dark brown fine, hard and soft, rounded, irregular nodules in clusters; few fine and medium roots; slightly gravelly; few small pebbles; gradual wavy boundary.

**Bt2** **85-138 cm** Brown (10YR 4/3-4, 7.5YR 5-4/4 moist), with pale grey, very pale brown (2.5Y 7/2, 10YR 8/3) and pale brown (10YR 6/3, 7.5YR 6/2) vertical fissures; infilling shows vertical stratification of light sandy cutans and of greenish blue silty and dark brown clayey cutans; material between peds silty, strong prismatic and subangular blocky structure; peds fairly firm, total mass friable; many interstitial and tubular pores; few hard and soft irregular nodules in clusters; few fine roots, more frequent in the fissures; few rock fragments and pebbles; gradual wavy boundary.

**Btg1** **138-165 cm** Brown (7.5YR 5/4-6 moist), locally redder (5YR 4/4), few small greenish grey and pale green (5GY 6-5/1, 5G 7/2) rounded and oval nodules, light grey (10YR 7/1-2), olive grey, greenish grey (5Y 6/2, 5GY 4/1) and yellowish brown edges along vertical fissures; infilling sandy silt to silt; material between peds brown, silty, moderate prismatic and medium to coarse subangular blocky, rarely coarse platy structure; slightly sticky, slightly plastic; few small black and blackish brown soft and hard, rounded irregular nodules; few roots in peds, many fine roots dominant in fissures; slightly gravelly; few small pebbles; gradual wavy boundary.

**Btg2** **165-205 cm** Heavy silt; many fine and medium mottles, yellowish brown (10YR 5/4-6-8 moist) rounded, or greenish grey (5GY 5/1), greyish brown (10YR 5/2) and brown (7.5YR 4/4, 10YR 4/4) elongated, diffuse or distinct; structure weak to moderate, medium to coarse prismatic; sticky, slightly plastic; difficult to separate into peds; few interstitial pores, frequent fine and medium tubular pores; few black and dark brown, soft and hard irregular nodules in clusters; slightly gravelly, few small pebbles; clear, wavy boundary, marked by an increase in stony fragments, gravel and pebbles.

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Note: The detailed description of the profile continues to 400 cm.

**EUTRIC PODZOLUVISOL**
**USSR**

| Horizon | Organic matter | | | pH | | Extractable cations me/100 g | | | | % V |
|---|---|---|---|---|---|---|---|---|---|---|
| | % C | % N | C/N | $H_2O$ | KCl | Ca | Mg | H | T | (100 S/T) |
| Ah1 | 3.6 | 0.3 | 12 | 4.9 | 4.0 | 8.9 | 5.5 | 4.8 | 19.2 | 75 |
| E1 | 0.6 | 0.1 | 6 | 5.6 | 4.3 | 4.5 | 3.0 | 2.9 | 10.5 | 72 |
| E2 | | | | 5.2 | 4.0 | 5.4 | 2.4 | 2.5 | 17.9 | 86 |
| E3 | 0.2 | 0.1 | 2 | 5.6 | 4.4 | 4.2 | 2.1 | 1.6 | 7.9 | 80 |
| E/B | | | | 5.2 | 4.0 | 5.8 | 2.7 | 2.2 | 10.7 | 79 |
| B/E | 0.2 | tr. | 6 | 5.1 | 3.9 | 6.1 | 6.1 | 2.9 | 15.1 | 81 |
| Bt1 | 0.2 | 0.1 | 2 | 4.8 | 3.8 | 7.6 | 7.0 | 3.2 | 17.8 | 82 |
| Bt2 | 0.2 | tr. | 5 | 5.1 | 3.8 | 12.1 | 11.9 | 1.9 | 25.9 | 93 |
| Btg1 | 0.2 | tr. | 5 | 5.6 | 4.3 | 19.5 | 13.0 | 1.3 | 28.8 | 95 |
| Btg2 | | | | 5.7 | 4.4 | 16.3 | 12.3 | 0.5 | 29.2 | 98 |

| | |
|---|---|
| **GLEYIC PODZOLUVISOL** | **Dg** |
| **Very degraded to pseudo-gley leached soil** | France |
| **Source** | De Coninck, D., Favrot, J.C., Tavernier, R. & Jamagne, M. Dégradation dans les sols lessivés hydromorphes sur matériaux argilo-sableux; exemple des sols de la nappe détritique bourbonnaise (France). *Pédologie*, 26(2): 105-151, 1976 |
| **Location** | Diou (Allier), " Les Brosses " (clay quarries) |
| **Physiography** | Edge of plateau, slight slope |
| **Drainage** | Poorly drained |
| **Parent material** | Plio-Quaternary sandy clay |
| **Vegetation** | Pasture |
| **Climate** | Annual rainfall: 800 mm; annual mean temperature: 10.5°C |

**Profile description**

| | | |
|---|---|---|
| **Ap** | **0-24 cm** | Uniform yellowish brown (10YR 5/4) sandy loam; moist, massive; friable fragments; few to common tubular pores; moderately matted fine roots, roots horizontal at base of horizon; very few hard black nodules (1 cm); abrupt smooth boundary. |
| **Eg** | **24-38 cm** | Sandy loam; moderately variegated, irregular, yellowish brown (10YR 5/4) and pale yellow (5Y 7/3) with medium irregular brown (7.5YR 5/6) mottles; frequent black nodules (0.5-2 cm long) arranged in plates located especially in upper part, and black pisolites (1 mm) in diffuse accumulations but individualized in the horizon; moist, massive, compact but with friable fragments; common very fine tubular pores; few very fine roots; clear boundary. |
| **E/Bg** | **38-55 cm** | Sandy clay loam; contrasted variegation, pale yellow (5Y 7/3) and brown (7.5YR 5/6) in irregular mottles with few yellowish brown (10YR 5/4) cores; tongues more distinct in lower part; moist to very moist; very weak medium prismatic structure; slightly sticky; pores common; channels (2-3 mm) with light brown lining; very few fine roots in channels; clear wavy boundary. |
| **Btg1** | **55-104 cm** | Clay Loam material, very clayey light brownish grey streaks; matrix brown (7.5YR 5/7) with very contrasted light brownish grey (2.5Y 6/2) streaks, vertical or oblique, with bright brown (7.5YR 5/6) coating; moist; strong, medium prismatic, moderately blocky structure, with thick clayskins; moderately firm, slightly sticky; common to frequent very fine tubular and structural pores; no roots; few black nodules (2 cm long); abrupt smooth boundary. |
| **Btg2** | **104-117 cm** | Clay Loam; yellowish brown (10YR 5/6) matrix with lighter and darker shades, crossed by light brownish grey (2.5Y 6/2) streaks 2-3 cm wide, with bright ochre coating; very frequent large black, spherical hard nodules and black dendrites on ped faces; moist; pores common; moderately hard with knife; abrupt, slightly wavy boundary. |
| **Btg3** | **117-130 cm** | Sandy clay; matrix yellowish brown (10YR 5/6) with light brownish grey (2.5Y 6/2) streaks with bright ochre coating and few black dendrites; light brown cutans; moist; moderately strong, medium prismatic structure, with moderately thick clayskins; moderately common tubular and structural pores; slightly sticky; abrupt, slightly wavy boundary. |
| **BCg** | **130-150 cm** | Sandy clay; base brown (7.5YR 5/7), locally purplish red (" *lie-de-vin* "), with sharply contrasted light brownish grey (2.5Y 6/2) vertical or oblique streaks; very moist to wet; strong, medium to coarse prismatic structure, tending to platy at top of horizon; few brown cutans; sticky; common tubular and structural pores. |

## GLEYIC PODZOLUVISOL

**France**

| Horizon | Depth cm | Particle size distribution (mm) % | | | | | % C |
|---|---|---|---|---|---|---|---|
| | | Coarse sand 2-0.21 | Fine sand 0.21-0.05 | Coarse silt 0.05-0.02 | Fine silt 0.02-0.002 | Clay < 0.002 | |
| Ap | 0–24 | 35.4 | 11.7 | 16.2 | 28.6 | 8.1 | 0.76 |
| Eg | 24–38 | 33.3 | 11.0 | 12.9 | 21.4 | 10.4 | 0.20 |
| E/Bg | 38–55 | 24.4 | 12.8 | 17.4 | 24.3 | 13.9 | 0.14 |
| Btg1 | 55–104 | [1]24.3 | 11.5 | 13.0 | 25.7 | 25.5 | 0.12 |
| | | [2]25.3 | 11.3 | 12.2 | 29.7 | 21.5 | 0.20 |
| | | [3]23.8 | 10.6 | 13.2 | 22.6 | 29.8 | 0.08 |
| Btg2 | 104–117 | 35.5 | 11.1 | 12.0 | 21.7 | 20.7 | 0.08 |
| Btg3 | 117–130 | 26.5 | 10.0 | 11.3 | 21.5 | 30.7 | 0.08 |
| BCg | 130–150 | [4]31.6 | 13.8 | 7.8 | 15.9 | 30.9 | 0.08 |
| | | [5]20.0 | 9.1 | 9.2 | 18.3 | 43.4 | 0.08 |

| Horizon | pH | | Extractable cations me/100 g | | | | | |
|---|---|---|---|---|---|---|---|---|
| | $H_2O$ | KCl | Ca | Mg | K | Na | Al | T |
| Ap | 5.9 | 4.8 | 3.91 | 0.12 | 0.07 | 0.03 | <0.06 | 4.1 |
| Eg | 6.1 | 5.0 | 2.86 | 0.40 | 0.07 | 0.02 | <0.06 | 3.4 |
| E/Bg | 6.0 | 5.0 | 4.12 | 0.18 | 0.10 | 0.03 | <0.06 | 6.5 |
| Btg1 | [1]5.0 | 3.8 | 5.14 | 0.52 | 0.18 | 0.03 | 1.13 | 11.1 |
| | [1]5.7 | 4.4 | 5.61 | 0.42 | 0.16 | 0.03 | 0.17 | 8.9 |
| | [3]5.0 | 3.7 | 5.61 | 1.02 | 0.25 | 0.04 | 2.10 | 12.6 |
| Btg2 | 5.0 | 3.9 | 3.13 | 0.95 | 0.14 | 0.03 | 1.17 | 11.6 |
| Btg3 | 5.0 | 3.7 | 4.49 | 1.70 | 0.19 | 0.04 | 1.26 | 12.9 |
| BCg | [4]4.9 | 3.6 | 5.36 | 2.10 | 0.22 | 0.04 | 1.81 | 14.1 |
| | [5]5.0 | 3.6 | 7.51 | 2.70 | 0.37 | 0.05 | 1.99 | 17.8 |

[1] Matrix. — [2] Summit of tongues. — [3] Bottom of tongues. — [4] Matrix. — [5] Tongues and grey streaks.

| | |
|---|---|
| **RENDZINA** | **E** |
| **Typical Rendzina** | France |
| **Source** | Jamagne, M. Introduction à une étude pédologique dans la partie nord du bassin de Paris. *Pédologie*, 14(2): 228-242, 1964 |
| **Location** | Goulvany par Courdemanges (Marne) |
| **Altitude** | 152 m |
| **Physiography** | Summit of a long, gentle (2%) slope, southeast exposure |
| **Drainage** | Well to excessively drained |
| **Parent material** | Senonian chalk |
| **Vegetation** | Field crops |
| **Climate** | Annual rainfall: 600-700 mm; annual mean temperature: 10.5°C |

**Profile description**

| | | |
|---|---|---|
| **Ap** | **0-18/20 cm** | Very dark greyish brown (10YR 3/2 moist) calcareous loam; moderately strongly to strongly calcareous; moderate, fairly diffuse root matting containing small coprogenic aggregates; organic matter content moderate to moderately high; many stones and small calcareous nodules; moderate, fine to medium granular structure, weak in upper part; very friable to loose; clear smooth boundary. |
| **AC** | **18/20-30/35 cm** | White weathered limestone loam; very strongly calcareous; common fine roots netted over the coarse chalk fragments; fairly large chalk fragments, mixed with smaller very rounded fragments (gravelly chalk) and coated with diffuse infiltrations of organic matter; fissures filled with very finely weathered chalk. |
| **C** | **30/35-50/55 cm** | Jointed chalk fragments infilled with very fine rounded fragments; few slight infiltrations of organic matter; very fine roots infiltrating vertically in the partially filled fissures; chalk locally slightly oxidized; diffuse smooth boundary. |
| **R** | **50/55+ cm** | Rock *in situ*, chalk layer; frequent fissures in horizontal and vertical patterns; few very fine gravelly infills; traces of very fine roots. |

Note: Old pine forest soil cleared in 1960.

**RENDZINA**

**France**

| Horizon | Depth cm | Particle size distribution (mm) % | | | | | |
|---|---|---|---|---|---|---|---|
| | | > 2 mm | Coarse sand 2-0.2 | Fine sand 0.2-0.05 | Coarse silt 0.05-0.02 | Fine silt 0.02-0.002 | Clay < 0.002 |
| Ap | 0–18/20 | 44.2 | 5.2 | 10.9 | 20.8 | 23.1 | 30.5 |
| AC | 18/20–30/35 | 82.1 | 14.1 | 7.8 | 18.6 | 25.7 | 32.2 |
| C | 30/35–50/55 | 74.2 | 18.5 | 6.4 | 12.9 | 40.9 | 28.1 |
| R | 50/55+ | 83.6 | 11.7 | 6.2 | 11.1 | 36.1 | 28.1 |

| Horizon | Organic matter | | | pH $H_2O$ | $CaCO_3$ % | | Extractable cations me/100 g | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | % C | % N | C/N | | Total | Active | Ca | Mg | K | Na | T |
| Ap | 4.7 | 0.4 | 12 | 7.9 | 95.2 | 16.0 | 42 | 1.1 | 1.1 | 0.3 | 44.5 |
| AC | 0.8 | 0.8 | 10 | 8.4 | 89.6 | 19.5 | | | | | |
| C | | | | 8.5 | 98.1 | 19.3 | | | | | |
| R | | | | 8.6 | 98.2 | | | | | | |

| | |
|---|---|
| **DYSTRIC GLEYSOL** | **Gd** |
| **Abbeyfeale Series** | Ireland |
| **Source** | *Soils of County Limerick.* Dublin, Agricultural Institute, 1966. Soil Survey Bulletin No. 16 |
| **Location** | 52°30'N; 9°2'W |
| **Altitude** | 170 *m* |
| **Physiography** | Gently undulating ground moraine; simple slope of approx. 5% |
| **Drainage** | Poorly drained |
| **Parent material** | Glacial till of Upper Carboniferous shale and sandstone |
| **Vegetation** | Rush-dominated meadow (*Junco-Molinietum*) |
| **Climate** | Cool maritime |

**Profile description**

| | | |
|---|---|---|
| **Ah1** | **0-8 cm** | Very dark greyish brown (10YR 3/2) loam; moderate, fine crumby structure; friable; abundant, diffuse roots; gradual smooth boundary. |
| **Ah2** | **8-18 cm** | As Ah1 but with less diffuse rooting; abrupt smooth boundary. |
| **AB** | **18-35 cm** | Light grey (10YR 7/2) loam to silty loam; columnar structure breaking to weak, fine subangular blocks; sticky wet; few roots; gradual smooth boundary. |
| **Bg** | **35-60 cm** | Very pale brown (10YR 8/3) loam to silty loam with common coarse, faint brown mottles; massive; sticky wet; few roots; gradual smooth boundary. |
| **Cg** | **60+ cm** | Light brownish grey (10YR 6/2) shaly, gravelly loam; many fine, distinct reddish brown mottles; massive; plastic wet; compact. |

## DYSTRIC GLEYSOL
### Ireland

| Horizon | Depth cm | pH | | Extractable cations me/100 g | | | | | | % V (100 S/T) |
|---|---|---|---|---|---|---|---|---|---|---|
| | | $H_2O$ | KCl | Ca | Mg | K | Na | S | T | |
| Ah1 | 0–8 | 5.1 | | | | | | 9.2 | 23.7 | 39 |
| Ah2 | 8–18 | 5.0 | | | | | | 6.1 | 22.4 | 27 |
| AB | 18–35 | 5.0 | | | | | | 1.2 | 9.4 | 13 |
| Bg | 35–60 | 5.1 | | | | | | 1.4 | 5.5 | 25 |
| Cg | 60– | 5.3 | | | | | | 1.2 | 4.5 | 27 |

| Horizon | Particle size distribution (mm) % | | | | | Organic matter | | | Free $Fe_2O_3$ % |
|---|---|---|---|---|---|---|---|---|---|
| | >2 mm | Sand 2-0.5 | Sand 0.5-0.05 | Silt 0.05-0.002 | Clay 0.002 | % C | % N | C/N | |
| Ah1 | | 10 | 20 | 47 | 23 | 9.5 | 0.66 | 14.4 | 1.3 |
| Ah2 | | 12 | 21 | 44 | 23 | 7.6 | 0.51 | 14.9 | 1.5 |
| AB | | 8 | 16 | 50 | 26 | 2.0 | 0.15 | 13.3 | 0.5 |
| Bg | | 8 | 19 | 50 | 23 | 0.9 | 0.13 | 6.9 | 2.0 |
| Cg | | 33 | 16 | 40 | 11 | 0.3 | 0.05 | 6.0 | 1.0 |

**EUTRIC GLEYSOL** **Ge**

**Non-calcareous surface-water gley soil** United Kingdom

**Source** Ragg, J.M. & Clayden, B. *The classification of some British soils according to the Comprehensive System of the United States.* Harpenden, 1973. Soil Survey. Technical Monograph No. 3. Profile No. 20

**Location** Belvoir, Leicestershire (near Nottingham)

**Altitude** 40 m

**Physiography** Slope 1°

**Drainage** Poorly drained

**Parent material** Lower Lias clay

**Vegetation** Field crops

**Climate** Annual rainfall: 600-800 mm; annual mean temperature: 8-12°C

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**Profile description**

| | | |
|---|---|---|
| **Ahg** | **0-28 cm** | Dark greyish brown (2.5Y 4/2) clay with abundant rusty and grey (5Y 5/1) mottling; weak medium subangular blocky structure; firm; frequent inclusions of yellowish brown subsoil; abundant fine fibrous, moderately soft roots; abrupt smooth boundary. |
| **Bg1** | **28-48 cm** | Light olive-brown (2.5Y 5/3) clay with prominent strong brown (7.5YR 5/8) mottles and grey-brown (2.5Y 5/2) mottles; moderate medium to coarse subangular blocky structure; very firm; common fine fibrous roots; gradual smooth boundary. |
| **Bg2** | **48-80 cm** | Grey (5Y 5/1) clay with prominent medium fine yellowish brown (10YR 5/6) mottles; weak coarse blocky structure; plastic (very wet); few fine fibrous roots; gradual smooth boundary. |
| **Cg** | **80+ cm** | Grey (5Y 5/1) clay with light olive-brown (2.5Y 5/6) mottles; massive; very firm; roots rare. |

## EUTRIC GLEYSOL
### United Kingdom

| Horizon | Depth cm | Particle size distribution (mm) % | | | | % C | pH | | CEC (T) me/100 g |
|---|---|---|---|---|---|---|---|---|---|
| | | Coarse sand 2-0.2 | Fine sand 0.02-0.05 | Silt 0.05-0.002 | Clay < 0.002 | | $H_2O$ | $CaCl_2$ | |
| Ahg | 0–28 | 10 | 6 | 28 | 57 | 2.8 | 7.4 | 6.8 | 34.3 |
| Bg1 | 28–48 | 12 | 4 | 27 | 57 | | 7.4 | 6.8 | 26.9 |
| Bg2 | 48–80 | 1 | 1 | 24 | 74 | | 6.8 | 6.3 | 32.9 |
| Cg | 80÷ | 1 | 1 | 26 | 72 | | 6.5 | 6.1 | 31.7 |

| | |
|---|---|
| **HUMIC GLEYSOL** | **Gh** |
| **Non-calcareous gley intergrading to peaty gley soil** | United Kingdom |
| **Source** | Ragg, J.M. & Clayden, B. *The classification of some British soils according to the Comprehensive System of the United States.* Harpenden, 1973. Soil Survey. Technical Monograph No. 3, Profile No. 24 |
| **Location** | Westfield Wood, West Calder, Midlothian (30 km southwest of Edinburgh) |
| **Altitude** | 160 m |
| **Physiography** | Flat |
| **Drainage** | Poorly drained |
| **Parent material** | Till from sandstone, argillite, carbonaceous argillite and coal (Carboniferous) |
| **Vegetation** | Scrub woodland with *Betula pubescens* and *Calluna vulgaris* |
| **Climate** | Annual rainfall: 800-1 000 mm; annual mean temperature: 8-12°C |

**Profile description**

| | | |
|---|---|---|
| **Ha** | **8-0 cm** | Black (10YR 2/1.5) humic sandy loam; structure obscured by abundant roots; plastic; abrupt boundary. |
| **Eg** | **0-25 cm** | Grey-brown (2.5Y 5/2) clay loam with frequent diffuse grey (10YR 5/1), few yellowish red (5YR 4/6) and common medium strong brown (7.5YR 5/8) mottles; few small stones; medium subangular blocky, tending to prismatic structure; plastic; roots common; clear boundary. |
| **Bg** | **25-55 cm** | Grey (N5/0) clay loam with abundant reddish yellow (7.5YR 6/8) and few dark red (2.5Y 3/6) mottles; frequent subrounded white, yellow and brown sandstones, coal and carbonaceous shale stones; coarse prismatic structure; plastic; few roots, some dead; diffuse boundary. |
| **BCg** | **55-90 cm** | Grey (2.5Y 5/1) and dark grey (N4/0) clay with frequent coarse strong yellowish brown (10YR 5/6) mottles; stones as in Bg; strong coarse prismatic structure, becoming massive at base; plastic; few dead roots, abundant tree roots; diffuse boundary. |
| **Cg** | **90+ cm** | As BCg, but massive, and mottling and roots less frequent. |

**HUMIC GLEYSOL**

**United Kingdom**

| Horizon | Depth cm | Particle size distribution (mm) % | | | | % C | pH $H_2O$ | CEC(T) me/100 g | % V (100 S/T) |
|---|---|---|---|---|---|---|---|---|---|
| | | Coarse sand 2-0.2 | Fine sand 0.2-0.05 | Silt 0.05-0.02 | Clay < 0.002 | | | | |
| Ha | 8–0 | | | | | 20.7 | 3.9 | 48.1 | 6 |
| Eg | 0–25 | 17 | 36 | 30 | 17 | 1.6 | 4.3 | 11.1 | 7 |
| Bg | 25–55 | 14 | 32 | 31 | 23 | | 5.3 | 10.0 | 43 |
| Bcg | 55–90 | 15 | 35 | 34 | 16 | | 6.2 | 12.2 | 94 |

| | |
|---|---|
| **CALCARIC PHAEOZEM** | **Hc** |
| **Cernoziom tipic carbonatic** | Romania |
| **Source** | I. Risnoveanu, Soil Research Institute, Bucharest, Romania |
| **Location** | E-NE of Sf. Gheorghe, Brasov Depression; coord. 45°55′ N, 25°47′ E, Romania |
| **Altitude** | 560 m |
| **Physiography** | Flat, less than 2% slope |
| **Drainage** | Well drained |
| **Parent material** | Alluvial-proluvial deposits |
| **Vegetation** | Cultivated |
| **Climate** | Dfbk (Köppen) |

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**Profile description**

| | | |
|---|---|---|
| **Ap** | **0-25 cm** | Grayish brown-dark grayish brown (10YR 4,5/2 dry) to very dark grayish brown (10YR 3/2 moist) loam; slightly hard when dry, friable when moist; structure disturbed by cultivation; slightly plastic; slightly sticky; porous; many fine and very fine roots; lower gradual boundary. |
| **Ah1** | **25-42 cm** | Very dark grayish brown-dark grayish brown (10YR 3,5/2 dry) to very dark brown (10YR 2/2 moist) loam; slightly hard when dry, friable when moist; strong, fine-medium subangular blocky structure; slightly plastic; slightly sticky; porous; many fine roots; very intensive biological activity; slightly effervescent; lower gradual boundary. |
| **Ah2** | **42-58 cm** | Grayish brown-dark grayish brown (10YR 4,5/2 dry) to very dark grayish brown (10YR 3/2 moist) loam; slightly hard when dry, friable when moist; moderate, fine-medium subangular blocky structure; slightly plastic, slightly sticky; porous; intensive biological activity rare, fine roots; slightly effervescent; lower gradual boundary. |
| **C1** | **58-80 cm** | Brown-pale brown (10YR 5,5/3 dry) to brown (10YR 4/3 moist) loam; slightly hard when dry, friable when moist; massive; slightly plastic, slightly sticky; porous; fine veins of calcium carbonate; strongly effervescent; lower gradual boundary. |
| **C2** | **80-120 cm** | Pale brown (10YR 6/3 dry) to yellowish brown (10YR 5/4 moist) sandy loam; friable; massive rare crotovinas; veins of calcium carbonate; strongly effervescent. |

## CALCARIC PHAEOZEM

**Romania**

| Horizon | Depth cm | Particle size distribution (mm) % | | | | Organic matter | | |
|---|---|---|---|---|---|---|---|---|
| | | Sand | | Silt | Clay | | | |
| | | 2-0.2 | 0.2-0.02 | 0.02-0.002 | < 0.002 | % C | % N | C/N |
| Ap | 0-25 | 11.1 | 39.9 | 21.7 | 27.3 | 1.6 | 0.16 | 10 |
| $Ah_1$ | 25-42 | 9.1 | 40.5 | 19.7 | 30.7 | 1.3 | 0.13 | 10 |
| $Ah_2$ | 42-58 | 8.3 | 42.5 | 20.3 | 28.9 | 1.1 | | |
| $C_1$ | 58-80 | 12.4 | 49.9 | 13.6 | 24.1 | 0.6 | | |
| $C_2$ | 80-120 | 34.9 | 40.8 | 17.2 | 17.1 | 0.3 | | |

| Horizon | pH $H_2O$ | Exchangeable cations me/100 g | | | | | | % V (100 S/T) | $CaCO_3$ % | $P_2O_5$ % Total |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Ca | Mg | K | Na | S | T | | | |
| Ap | 7.84 | 17.6 | 2.7 | 0.3 | 0.4 | 21.0 | 21.0 | 100 | 2.5 | 0.118 |
| $Ah_1$ | 8.08 | 18.1 | 2.1 | 0.4 | 0.4 | 21.0 | 21.0 | 100 | 3.7 | 0.121 |
| $Ah_2$ | 8.20 | 16.8 | 1.9 | 0.4 | 0.4 | 19.5 | 19.5 | 100 | 7.3 | 0.125 |
| $C_1$ | 8.30 | 12.3 | 1.0 | 0 2 | 0.2 | 13.7 | 13.7 | 100 | 10.0 | 0.080 |
| $C_2$ | 8.38 | 9.1 | 1.4 | 0.3 | 0.4 | 11.2 | 11.2 | 100 | 9.6 | 0.066 |

| | |
|---|---|
| **GLEYIC PHAEOZEM** | **Hg** |
| **Chernozem** | Poland |
| **Source** | Third International Working Meeting on Soil Micromorphology. *Guidebook of excursion. Soils of southwestern Poland,* p. 59. Wroclaw, 1969 |
| **Location** | Dobrogostów, Strzelin District |
| **Altitude** | 170 m |
| **Physiography** | Great Wroclaw Plain |
| **Drainage** | Poorly drained |
| **Parent material** | Clay |
| **Vegetation** | Field crops |
| **Climate** | Annual rainfall: 591 mm; annual mean temperature: 8.2°C |

**Profile description**

| | | |
|---|---|---|
| **Ap** | **0-27 cm** | Very dark grey (N3/0) clay; prismatic structure; frequent roots; gradual boundary. |
| **Ah1** | **27-42 cm** | Very dark grey (N3/0) clay; prismatic structure; gradual boundary. |
| **A/C** | **42-60 cm** | Dark grey (N4/0) clay with humic tongues; prismatic structure; tonguing boundary. |
| **Cg1** | **60-95 cm** | Yellowish brown (10YR 5/6) clay, light grey (N7/0) mottles; columnar; few limestone nodules; gradual boundary. |
| **Cg2** | **95-165 cm** | As Cg1, but limestone and iron-manganese nodules more frequent. |
| **Cg3** | **165+ cm** | Grey (N6/0) gleyed clay; columnar; very frequent iron-manganese nodules. |

## GLEYIC PHAEOZEM
**Poland**

| Horizon | Depth cm | Particle size distribution (mm) % | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Sand | | | | Silt | | Clay |
| | | 1-0.5 | 0.5-0.25 | 0.25-0.1 | 0.1-0.05 | 0.05-0.02 | 0.02-0.002 | < 0.002 |
| Ap | 0–27 | 1.5 | 1.5 | 6.0 | 7 | 10 | 26 | 48 |
| Ah1 | 27–42 | 0.7 | 1.0 | 4.3 | 5 | 11 | 25 | 53 |
| A/C | 42–60 | 0.7 | 0.7 | 3.6 | 6 | 9 | 27 | 53 |
| Cg1 | 60–95 | 5.2 | 2.6 | 2.2 | 3 | 2 | 11 | 74 |
| Cg2 | 95–165 | 0.5 | 0.5 | 3.0 | 3 | 2 | 16 | 75 |
| Cg3 | 165+ | 2.7 | 2.0 | 2.3 | 5 | 15 | 8 | 65 |

| Horizon | Organic matter | | | pH | | $CaCO_3$ % | Extractable cations me/100 g | | | | | | % V (100 S/T) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | % C | % N | C/N | $H_2O$ | KCl | | Ca | Mg | K | Na | S | T | |
| Ap | 2.2 | 0.2 | 10 1 | 7.7 | 7.0 | 0.6 | 29.8 | 4.7 | 0.3 | 0.2 | 35.1 | 35.5 | 99 |
| Ah1 | 2.1 | 0.1 | 13.0 | 7.7 | 6.9 | 0.5 | 27.0 | 9.5 | 0.3 | 0.3 | 37.1 | 37.8 | 98 |
| A/C | 0.9 | tr. | 13.4 | 7.9 | 6.8 | 0.4 | 26.2 | 9.1 | 0.4 | 0.3 | 36.0 | 36.6 | 98 |
| Cg1 | 0.2 | tr. | 6.0 | 7.9 | 7.0 | 2.3 | 24.3 | 8.3 | 0.4 | 0.4 | 33.5 | 34.2 | 98 |
| Cg2 | 0.1 | tr. | 3.7 | 7.9 | 6.8 | 8.0 | 21.5 | 8.0 | 0.4 | 0.3 | 30.3 | 30.7 | 98 |
| Cg3 | 0.1 | tr. | 3.3 | 7.7 | 6.9 | 4.3 | 22.9 | 7.2 | 0.3 | 0.3 | 30.8 | 31.1 | 99 |

| | |
|---|---|
| **HAPLIC PHAEOZEM** | **Hh** |
| **Chernozem** | Poland |
| **Source** | Third International Working Meeting on Soil Micromorphology. *Guidebook of excursion. Soils of southwestern Poland*, p. 53. Wroclaw, 1969 |
| **Location** | Suchy Dwór, Wroclaw District |
| **Altitude** | 130 m |
| **Physiography** | Great Wroclaw Plain |
| **Drainage** | Moderately well drained |
| **Parent material** | Loess on glacial till |
| **Vegetation** | Field crops |
| **Climate** | Annual rainfall: 592 mm; annual mean temperature: 8.7°C |

**Profile description**

| | | |
|---|---|---|
| **Ap** | **0-43 cm** | Very dark grey (5Y 3/1) moderately heavy clay; crumby structure; gradual boundary. |
| **AC** | **43-55 cm** | Dark olive grey (5Y 3/2) moderately heavy clay; crumby structure. |
| **2C1** | **55-78 cm** | Yellowish brown (10YR 5/4) moderately heavy clay, with humic mottles; frequent stones; prismatic; gradual boundary. |
| **2C2** | **78-140 cm** | Yellowish brown (10YR 5/6) moderately heavy clay with light grey mottles; stony; prismatic; limestone nodules; iron-manganese precipitations, gleying patches and mottling; diffuse boundary. |
| **2C3** | **140-250 cm** | Pale brown (10YR 6/3) moderately heavy clay; stony; prismatic; mottled, gleyed. |

**HAPLIC PHAEOZEM**

**Poland**

| Horizon | Depth cm | Gravel > 1 | Particle size distribution (mm) % Sand | | | | Silt | | Clay |
|---|---|---|---|---|---|---|---|---|---|
| | | | 1-0.5 | 0.5-0.25 | 0.25-0.1 | 0.1-0.05 | 0.05-0.02 | 0.02-0.002 | < 0.002 |
| Ap | 0–43 | 0.2 | 6.5 | 2.7 | 9.8 | 7 | 28 | 30 | 16 |
| AC | 43–55 | 0.3 | 3.0 | 5.2 | 8.8 | 9 | 27 | 29 | 18 |
| 2C1 | 55–78 | 1.8 | 10.3 | 16.1 | 14.6 | 14 | 9 | 17 | 19 |
| 2C2 | 78–140 | 5.2 | 10.6 | 14.8 | 16.6 | 11 | 8 | 19 | 20 |
| 2C3 | 140–250 | 3.5 | 10.5 | 14.7 | 15.8 | 12 | 9 | 19 | 19 |

| Horizon | Organic matter | | | pH | | $CaCO_3$ | Extractable cations me/100 g | | | | | | % V |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | % C | % N | C/N | $H_2O$ | KCl | % | Ca | Mg | K | Na | S | T | (100 S/T) |
| Ap | 2.1 | 0.2 | 10.8 | 6.5 | 5.9 | — | 19.3 | 4.2 | 0.7 | 0.2 | 24.5 | 27.6 | 88 |
| AC | 1.2 | 0.1 | 11.1 | 7.1 | 6.1 | — | 22.2 | 1.9 | 0.3 | 0.1 | 24.7 | 26.2 | 94 |
| 2C1 | 0.2 | tr. | 8.6 | 7.3 | 6.1 | — | 34.4 | 5.7 | 0.4 | 0.2 | 40.8 | 41.4 | 98 |
| 2C2 | 0.1 | tr. | 13.0 | 8.1 | 6.4 | 3.0 | 31.8 | 3.8 | 0.3 | 0.2 | 36.2 | 36.5 | 99 |
| 2C3 | 0.1 | tr. | 9.0 | 8.1 | 6.7 | 3.0 | 30.0 | 3.5 | 0.3 | 0.2 | 34.0 | 34.4 | 99 |

## LUVIC PHAEOZEM Hl

**Reddish brown forest soil** Romania

**Source** Ghitulescu, N. Etude micromorphologique de quelques sols de la plaine de Cilnistea (Roumanie). *Pédologie*, 21(2): 131-151, 1971

**Location** 2 km north of Naipu, Cilnistea Plain, western Romania

**Altitude** 95 m

**Physiography** Broad plain

**Drainage** Well drained

**Parent material** Upper Pleistocene loess, 5-12 m thick

**Vegetation** Field crops

**Climate** Annual rainfall: 480-545 mm; annual mean temperature: 10.4-10.7°C

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**Profile description**

**Ap** **0-27 cm** Very dark greyish brown to dark brown (10YR 3/2.5 moist, 10YR 5/2 dry) clay loam; structureless, locally moderate, medium and coarse granular; slightly sticky, slightly plastic; friable moist, hard dry; fairly frequent fine and very fine pores; few worm channels and aggregates of crumby excreta; few fine and medium roots; rare fissures.

**Ah1** **27-42 cm** Dark brown (10YR 3/3 moist) clay loam to clay, with frequent reddish mottles, fine and medium, distinct, greyish brown to brown (10YR 5/2-7.5YR 5/4 dry); moderate, granular and fine subangular blocky structure; slightly sticky; slightly plastic; firm moist, hard dry; fairly frequent fine and very fine pores; few fine roots; rare fissures; clear wavy boundary.

**Bt1** **42-62 cm** Brown to dark brown (7.5YR 3.5/2 moist, 7.5YR 5/4 dry) clay; moderate, medium and coarse subangular blocky structure; sticky; plastic; very firm moist, very hard dry; patchy thin to moderately thick clayey cutans on horizontal and few vertical ped faces; few very fine pores; few small dusky red iron and iron-manganese nodules, soft and hard; few fine and very fine roots; gradual smooth boundary.

**Bt2** **62-95 cm** Brown to dark brown (7.5YR 3.5/2 moist, 7.5YR 5/4 dry) clay, with fairly many small and medium darker mottles; strong, medium prismatic structure; slightly sticky; plastic; very firm moist, very hard dry; patchy thin clayey cutans on horizontal and vertical ped faces; few fine and very fine pores; few small dusky red iron and iron-manganese nodules, soft and hard; few fine mica leaves; few fine and very fine roots; gradual smooth boundary.

**Bt3** **95-120 cm** Brown to dark brown (7.5YR 3.5/4 moist) clay with frequent small distinct brown and dark brown (7.5YR 3.5/4 moist, 7.5YR 5/4 dry) mottles; strong medium prismatic structure; slightly sticky; plastic; very firm moist, very hard dry; patchy thin clayey cutans on horizontal and vertical ped faces; few fine and very fine pores; few small dusky red iron and iron-manganese nodules, soft and hard; few fine mica leaves; gradual smooth boundary.

**Bt4** **120-165 cm** Brown to dark brown (7.5YR 4/4 moist, 7.5YR 5/4 dry) clay; humus infiltration in root channels; strong medium prismatic and medium and coarse angular blocky structure; slightly sticky; plastic; very firm moist, very hard dry; patchy thin clayey cutans on few ped faces; few very fine pores; few small dusky red iron and iron-manganese nodules, soft and hard; few fine mica leaves; abrupt irregular boundary.

**Cck** **165-205 cm** Brown to dark brown to dark yellowish brown (7.5YR 4/4-10YR 4/4 moist, 7.5YR 5/4-10YR 5/3 dry) clay loam to clay; structureless, locally weak medium subangular blocky; slightly sticky; plastic; firm moist, very hard dry; few patchy thin clayey cutans on few ped faces; fine pores more frequent; few small dusky red iron and iron-manganese nodules, soft and hard; very frequent small, medium and large white and greyish limestone nodules, spherical and irregular, soft and hard; rare vermiform calcareous accretions; strongly calcareous.

## LUVIC PHAEOZEM
**Romania**

| Horizon | Depth cm | Particle size distribution (mm) % | | | | Organic matter | |
|---|---|---|---|---|---|---|---|
| | | Sand 2-0.05 | Coarse silt 0.05-0.02 | Fine silt 0.02-0.002 | Clay < 0.002 | % C | C/N |
| Ap | 0–27 | 4.4 | 29.1 | 33.4 | 33.1 | 0.9 | 13 |
| Ah1 | 27–42 | 4.9 | 24.3 | 30.9 | 39.9 | 0.8 | 13 |
| Bt1 | 42–62 | 4.4 | 20.7 | 26.0 | 48.9 | 0.6 | 13 |
| Bt2 | 62–95 | 4.2 | 22.2 | 45.5 | 28.1 | 0.7 | 12 |
| Bt3 | 95–120 | | | | | | |
| Bt4 | 120–165 | 4.6 | 23.3 | 43.1 | 29.0 | 0.4 | |
| Cck | 165–205 | 3.4 | 24.3 | 41.0 | 31.3 | 0.4 | |

| Horizon | pH $H_2O$ | $CaCO_3$ % | Extractable cations me/100 g | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Ca | Mg | K | Na | H | T |
| Ap | 6.2 | 0 | 15.7 | 3.8 | 0.3 | 0.3 | 5.8 | 25.9 |
| Ah1 | 6.0 | 0 | 16.8 | 3.8 | 0.4 | 0.4 | 7.1 | 28.5 |
| Bt1 | 5.8 | 0 | 20.1 | 5.4 | 0.6 | 0.5 | 8.4 | 35.0 |
| Bt2 | 6.0 | 0 | 23.6 | 5.1 | 0.5 | 0.6 | 8.0 | 37.8 |
| Bt3 | | | | | | | | |
| Bt4 | 6.8 | 0 | 21.7 | 5.6 | 0.5 | 0.5 | 4.5 | 32.8 |
| Cck | 8.6 | 15 | 22.4 | 6.6 | 0.5 | 0.7 | — | 30.2 |

| | |
|---|---|
| **CALCARIC FLUVISOL** | **Jc** |
| **Polder " vague " soil** | Netherlands |
| **Source** | Stiboka. *Bodemkaart van Nederland 1/50 000.* Blad 53 Sluis, 54 West Terneuzen, p. 72. Wageningen, 1967 |
| **Location** | Biervliet, Ameliapolder (5 km north of the Belgian border) |
| **Altitude** | 2 m |
| **Physiography** | Marine alluvial plain |
| **Drainage** | Poorly drained |
| **Parent material** | Recent marine sediment |
| **Vegetation** | Field crops |
| **Climate** | Annual rainfall: 800 mm; annual mean temperature: 9⁰C |

**Profile description**

| | | |
|---|---|---|
| **Ap** | **0-25 cm** | Dark greyish brown (2.5Y 4/2) silty clay sand, slightly humic; calcareous; abrupt boundary. |
| **Cg1** | **25-60 cm** | Greyish brown (2.5Y 5/2) silty clay sand; calcareous; frequent strong rust mottles; diffuse boundary. |
| **Cg2** | **60-95 cm** | Light olive grey (5Y 6/2) clayey fine sand; calcareous; very frequent strong rust mottles; gradual boundary. |
| **Cg3** | **95-120 cm** | Grey (5Y 6/1.5) fine sand; calcareous; frequent strong rust mottles. |

**CALCARIC FLUVISOL**

**Netherlands**

| Horizon | Depth cm | Particle size distribution (mm) % | | | | $CaCO_3$ % | pH KCl | % C |
|---|---|---|---|---|---|---|---|---|
| | | 2-0.15 | 0.15-0.05 | 0.05-0.002 | < 0.002 | | | |
| Ap | 0–25 | 9 | 47 | 33 | 12 | 7.1 | 7.6 | 1.1 |
| Cg1 | 25–60 | 13 | 53 | 25 | 9 | 9.5 | 8.0 | 0.4 |
| Cg2 | 60–95 | 16 | 67 | 12 | 5 | 7.0 | 7.6 | 0.2 |
| Cg3 | 95–120 | 43 | 51 | 4 | 2 | 4.5 | 8.2 | 0.1 |

| | |
|---|---|
| **EUTRIC FLUVISOL** | **Je** |
| **Polder " vague " soil** | Netherlands |
| **Source** | Stiboka. *Bodemkaart van Nederland 1/50 000.* Blad 39 West Rhenen, 39 Oost Rhenen, p. 119. Wageningen, 1973 |
| **Location** | Rumpt, Gelderland Province (between Rhine and Maas) |
| **Altitude** | 2-3 m |
| **Physiography** | Fluvio-marine alluvial plain |
| **Drainage** | Poorly drained |
| **Parent material** | Recent fluvio-marine sediment |
| **Vegetation** | Grass |
| **Climate** | Annual rainfall: 900 mm; annual mean temperature: 8°C |

**Profile description**

| | | |
|---|---|---|
| **Ahg** | **0-8 cm** | Dark greyish brown (10YR 3.5/2) very heavy clay, strongly humic; rust mottles; non-calcareous; moderate, coarse prismatic structure, breaking to strong, very small subangular blocks; pores fairly frequent. |
| **ACg** | **8-25 cm** | Dark grey (10YR 4/1.5) very heavy clay, moderately humic; few rust mottles; non-calcareous; structure as Ahg, but coarser and less porous. |
| **Cg1** | **25-50 cm** | Dark grey (10YR 4/1) very heavy clay; rust mottles; non-calcareous; strong coarse prismatic structure, breaking to very strong medium blocks; few pores. |
| **Ahb1** | **50-64 cm** | Dark grey (N4/0) very heavy clay; non-calcareous; few calcite needles in fossil root channels. (This layer is called *laklaag* in Dutch.) |
| **Cgb1** | **64-94 cm** | Grey to dark grey (5Y 4.5/1) very heavy clay; non-calcareous, but with few hard limestone nodules; fairly frequent rust mottles. |
| **Ahb2** | **94-106 cm** | Dark grey (N4/0) very heavy clay; non-calcareous (second *laklaag*). |
| **Cgb2** | **106-120 cm** | Grey (5Y 5/1) very heavy clay; non-calcareous; few rust mottles; moderately firm; structure from 50 cm: strong very coarse prismatic. |

**EUTRIC FLUVISOL**
**Netherlands**

| Horizon | Depth cm | Particle size distribution (mm) % | | | | $CaCO_3$ % | pH KCl | % C | % V (100 S/T) |
|---|---|---|---|---|---|---|---|---|---|
| | | Coarse sand 2-0.15 | Fine sand 0.15-0.05 | Silt 0.05-0.002 | Clay < 0.002 | | | | |
| Ahg | 0–8 | 2 | 5 | 41 | 52 | 0 | 4.8 | 9.8 | |
| ACg | 8–25 | 1 | 4 | 36 | 59 | 0 | 4.6 | 3.8 | |
| Cg1 | 25–50 | 0 | 1 | 31 | 68 | 0.2 | 5.9 | 1.4 | 82 |
| Ahb2 | 94–106 | 1 | 5 | 40 | 54 | 0.3 | 6.1 | 1.1 | |

| | |
|---|---|
| **EUTRIC FLUVISOL** | **Je** |
| **Regosol** | Greece |
| **Source** | Koutalos, A. & Louis, A. Les sols du bassin versant de Terpillos (Grèce). *Pédologie*, 15(1): 48-83, 1965 |
| **Location** | Plagiokhori, on the Baxi River (55 km north of Salonika) |
| **Altitude** | 260 m |
| **Physiography** | Baxi River valley |
| **Drainage** | Well drained |
| **Parent material** | Silty sand alluvium |
| **Vegetation** | Field crops |
| **Climate** | Annual rainfall: 537 mm; annual mean temperature: 15.9°C |

**Profile description**

| | | |
|---|---|---|
| **Ap** | **0-14 cm** | Dark brown (10YR 3/3) humic sandy loam; very fine subangular blocky structure, mostly fine crumb plus loose material; very friable; clear smooth boundary. |
| **Ah1** | **14-42 cm** | Dark brown (10YR 3/3) slightly humic sandy loam; very fine subangular blocks, plus loose material; very friable; abrupt smooth boundary. |
| **Ah2** | **42-60 cm** | Dark brown (7.5YR 3.5/2) slightly humic sandy loam; stronger than Ah1, subangular blocky; friable; abrupt smooth boundary. |
| **C1** | **60-70 cm** | Brown (7.5YR 4/4) sandy loam; structureless; loose; abrupt smooth boundary. |
| **C2** | **70-108 cm** | Brownish (7.5YR 4.5/4) alternate layers of sandy loam and loamy sand; abrupt smooth boundary. |
| **Cg** | **108-146 cm** | Greyish brown (2.5Y 5/2) layers of sandy loam and loamy sand; frequent yellowish red (5YR 5/8) rust mottles, distinct, clear, as streaks, and iron-manganese mottles at top; abrupt smooth boundary. |
| **2C** | **146+ cm** | Pale brown (10YR 6/3) sand; very frequent fine mica leaves; structureless; very loose. |

**EUTRIC FLUVISOL**
**Greece**

| Horizon | Depth cm | Particle size distribution (mm) % | | | % C | pH | |
|---|---|---|---|---|---|---|---|
| | | Sand 2-0.05 | Silt 0.05-0.002 | Clay < 0.002 | | $H_2O$ | KCl |
| Ap | 0–14 | 37.0 | 50.9 | 12.0 | 1.3 | 6.3 | 5.5 |
| Ah1 | 14–42 | 43.2 | 45.6 | 11.1 | 1.1 | 6.2 | 5.3 |
| Ah2 | 42–60 | 31.1 | 52.3 | 16.5 | 1.0 | 6.3 | 5.4 |
| C1 | 60–70 | 52.3 | 39.4 | 8.2 | 0.2 | 6.5 | 5.3 |
| C2 | 70–108 | 21.9 | 64.2 | 14.8 | 0.7 | 6.6 | 5.6 |
| Cg | 108–146 | 37.4 | 53.9 | 8.6 | 0.3 | 7.7 | 6.5 |
| 2C | 146+ | 85.2 | 12.4 | 2.3 | 0.0 | 7.5 | 6.2 |

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|---|---|
| **CALCIC KASTANOZEM** | **Kk** |
| **Chestnut soil of the steppe** | Romania |
| **Source** | Ghitulescu, N. & Stoops, G. Etude micromorphologique de l'activité biologique dans quelques sols de la Dobroudja (Roumanie). *Pédologie*, 20(3): 339-356, 1970 |
| **Location** | 7 km north of Babadag, in the Dobruja |
| **Altitude** | 12 m |
| **Physiography** | Black Sea coastal plain |
| **Drainage** | Somewhat excessively drained (water-table at 8-10 m) |
| **Parent material** | Pleistocene loess |
| **Vegetation** | Field crops |
| **Climate** | Annual rainfall: 400 mm; annual mean temperature: 11-12°C |

**Profile description**

| | | |
|---|---|---|
| **Ap** | **0-31 cm** | Very dark greyish brown to brown (10YR 3.5/2 moist, 10YR 4.5/3 dry) fine loam, becoming somewhat lighter below 15 cm; weak medium to coarse crumb, consisting almost entirely of coprogenic material; friable moist, slightly hard dry; roots frequent; frequent worm channels infilled with coprogenic granular material; strongly calcareous; gradual boundary. |
| **Ah1** | **31-50 cm** | Brown to pale brown (10YR 4/3 moist, 10YR 5.5/3 dry) fine loam; weak fine to coarse crumb, consisting mostly of coprogenic material; friable moist, slightly hard dry; roots frequent; frequent worm channels infilled with coprogenic granular material; few krotovinas; calcareous pseudomycelium; strongly calcareous; gradual boundary. |
| **ACk** | **50-75 cm** | Yellowish brown to pale brown (10YR 5/4 moist, 10YR 6.5/3 dry) fine loam; massive; friable moist, slightly hard dry; very few roots; very considerable biological activity, as indicated by frequency of worm channels infilled with coprogenic granular material and krotovinas; calcareous pseudomycelium; strongly calcareous; gradual boundary. |
| **Ck1** | **75-115 cm** | As ACk, but somewhat lighter and with more limestone nodules. |
| **Ck2** | **115-180 cm** | Light olive brown to light yellowish brown (2.5Y 5.5/4 moist, 10YR 7/4 dry) fine loam; massive; very friable wet, slightly hard dry; worm channels and krotovinas frequent to 150 cm, rare below; fine mica leaves; fairly frequent calcareous pseudomycelium, very few soft nodules; strongly calcareous. |

## CALCIC KASTANOZEM

**Romania**

| Horizon | Depth cm | Particle size distribution (mm) % | | | | Organic matter | |
|---|---|---|---|---|---|---|---|
| | | Sand 2-0.06 | Coarse silt 0.06-0.02 | Fine silt 0.02-0.002 | Clay < 0.002 | % C | C/N |
| Ap | 0–31 | 2.9 | 48.5 | 24.0 | 24.6 | 1.2 | 10.8 |
| Ah1 | 31–50 | 3.8 | 47.7 | 24.5 | 24.0 | 1.0 | 8.7 |
| ACk | 50–75 | 3.9 | 48.3 | 23.4 | 24.4 | 0.8 | 8.8 |
| Ck1 | 75–115 | | | | | | |
| Ck2 | 115–180 | 4.1 | 47.5 | 25.1 | 23.3 | 0.6 | 10.2 |

| Horizon | pH $H_2O$ | $CaCO_3$ % | Extractable cations me/100 g | | | |
|---|---|---|---|---|---|---|
| | | | Ca + Mg | K | Na | T |
| Ap | 8.2 | 6.9 | 18.1 | 0.7 | 0.3 | 19.1 |
| Ah1 | 8.3 | 8.6 | 16.3 | 0.6 | 0.5 | 17.4 |
| ACk | 8.3 | 10.1 | 17.2 | 0.4 | 0.4 | 18.0 |
| Ck1 | | | | | | |
| Ck2 | 8.4 | 16.1 | 18.6 | 0.3 | 0.3 | 19.4 |

## LUVIC KASTANOZEM Kl

| | |
|---|---|
| **Dark chestnut soil** | USSR |
| **Source** | Grin, G.S., Kissel, V.D. *et al. Short guide to soil excursion Moskow-Kherson, Profile* 8, p. 68-75. Moscow, Ministry of Agriculture of the USSR, 1964 |
| **Location** | Askania-Nova Reserve, on the Sea of Azov |
| **Altitude** | 15-20 m |
| **Physiography** | Coastal plain, gently sloping to the sea |
| **Drainage** | Well drained |
| **Parent material** | Loess |
| **Vegetation** | Steppe (*Festuca*, *Stipa*) |
| **Climate** | Annual rainfall: 340-360 mm; annual mean temperature: 10°C (January: —4°C; July: 24°C) |

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**Profile description**

| | | |
|---|---|---|
| **Ah1** | **0-8 cm** | Dark grey (moist) medium loam; compact mat of fine roots; granular platy, dusty fine structure; quartz powder on ped faces; clear boundary. |
| **Ah2** | **8-25 cm** | Dark grey, with reddish brown tinge (moist), clay; medium granular structure; slightly compact peds; gradual boundary. |
| **Bt1** | **25-38 cm** | Dark grey to reddish brown (moist) clay; fine nutty structure; compact; visible colloidal varnish on ped faces; gradual boundary. |
| **Bt2** | **38-50 cm** | Chestnut dark brown (moist) clay; fine nutty structure; compact; clear boundary with tongues. |
| **Btk1** | **50-65 cm** | Greyish pale yellow brown (moist) clay; fine crumby structure; compact; few krotovinas; effervescence with HC1 from 53 cm; gradual boundary. |
| **Btk2** | **65-102 cm** | Pale yellow brown clay; crumby structure; up to 90 cm fine pores abundant; compact; limestone "white eyes"; ped faces varnished. |
| **C** | **102-170 cm** | Brownish pale yellow clayey loess. |

## LUVIC KASTANOZEM
## USSR

| Horizon | Depth cm | Particle size distribution (mm) % | | | | | | $CaCO_3$ % |
|---|---|---|---|---|---|---|---|---|
| | | 1-0.25 | 0.25-0.05 | 0.05-0.01 | 0.01-0.005 | 0.005-0.001 | < 0.001 | |
| Ah1 | 0–8 | 0.2 | 1.7 | 42.3 | 11.8 | 13.3 | 30.6 | 0 |
| Ah2 | 8–25 | 0 | 7.7 | 34.7 | 6.7 | 15.1 | 35.8 | |
| Bt1 | 25–38 | 0 | 0 | 35.4 | 10.1 | 15.4 | 39.1 | 0 |
| Bt2 | 38–50 | | | | | | | |
| Btk1 | 50–65 | 0.3 | 6.6 | 33.9 | 11.1 | 10.5 | 37.8 | 12.7 |
| Btk2 | 65–102 | | | | | | | 19.2 |
| C | 102–170 | 0.1 | 16.2 | 33.7 | 7.8 | 10.2 | 32.2 | 9.9 |

| Horizon | Organic matter | | | pH $H_2O$ | Extractable cations me/100 g | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | % C | % N | C/N | | Ca | Mg | Na | K | T |
| Ah1 | 2.79 | 0.25 | 11.1 | 7.1 | 21.1 | 5.0 | 1.5 | 1.7 | 29.3 |
| Ah2 | 1.44 | 0.14 | 10.3 | 7.4 | 25.5 | 5.9 | 1.5 | 1.4 | 34.3 |
| Bt1 | 1.01 | 0.10 | 10.1 | 7.4 | 25.5 | 6.9 | 1.4 | 1.1 | 34.5 |

| | |
|---|---|
| **CHROMIC LUVISOL** | **Lc** |
| **Red mediterranean soil** | Spain |
| **Source** | Gragera, P., Guerra, A. *et al. Conferencia sobre Suelos Mediterráneos. Guía de la excursión española.* Profile I. Madrid, Sociedad Española de Ciencia del Suelo, 1966 |
| **Location** | Fuente del Fresno, km 143 on the Madrid-Ciudad Real road |
| **Altitude** | Approx. 700 m |
| **Physiography** | Region of *serratas* (small sierras); plateaux with quartzite summits, dissected by shaly valleys |
| **Drainage** | Well drained |
| **Parent material** | Silurian shale |
| **Vegetation** | Field crops |
| **Climate** | Annual rainfall: 450 mm; annual mean temperature: 14°C |

**Profile description**

| | | |
|---|---|---|
| **Ap** | **0-15 cm** | Dark brown (10YR 4/3 dry) sandy loam, slightly humic, abundant subrounded quartzite fragments; weak crumby structure; slightly hard; very permeable; few roots, very slight biological activity; abrupt smooth boundary. |
| **E** | **15-30 cm** | Pale brown (10YR 6/3 dry) sandy loam, slightly humic, subrounded quartzite fragments of varying sizes; medium blocky structure; hard; very permeable; few iron nodules; gradual smooth boundary. |
| **Bt1** | **30-50 cm** | Brown (7.5YR 5/4 dry) loam; few subrounded quartzite fragments; medium coarse blocky structure; moderately permeable; few iron nodules; moderately diffuse, moderately irregular boundary. |
| **Bt2** | **50-100 cm** | Yellowish red (2.5YR 4/6 dry) clay; few quartzite fragments; strong coarse prismatic structure with clayskins; very hard; slightly permeable; gradual irregular boundary. |
| **CB** | **100-130 cm** | Very weathered and reddened shale; platy structure; slightly hard; moderately permeable; gradual irregular boundary. |
| **CR** | **130-150 cm** | Weathered shale. |

## CHROMIC LUVISOL
**Spain**

| Horizon | Depth cm | Particle size distribution % | | | | Organic matter | | | $CaCO_3$ % |
|---|---|---|---|---|---|---|---|---|---|
| | | Coarse sand | Fine sand | Silt | Clay | % C | % N | C/N | |
| Ap | 0–15 | 12.3 | 47.7 | 28.0 | 12.0 | 0.9 | 0.08 | 11 | 0 |
| E | 15–30 | 12.9 | 50.1 | 26.1 | 11.0 | 0.6 | 0.07 | 8 | 0 |
| Bt1 | 30–50 | 9.0 | 39.1 | 30.0 | 22.9 | 0.3 | 0.05 | 6 | 0 |
| Bt2 | 50–100 | 3.6 | 21.1 | 30.8 | 44.8 | 0.2 | 0.04 | 5 | 0 |
| CB | 100–130 | 0.8 | 28.7 | 42.1 | 27.0 | 0.1 | 0.03 | 3 | 0 |
| CR | 130–150 | 1.5 | 33.0 | 39.3 | 24.9 | 0.1 | 0.02 | 5 | 0 |

| Horizon | pH | | Extractable cations me/100 g | | | | | | % V (100 S/T) | Free oxides | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $H_2O$ | KCl | Ca | Mg | Na | K | S | T | | $Fe_2O_3$ % | $Al_2O_3$ ppm | $SiO_2$ ppm |
| Ap | 6.3 | 5.4 | 2.8 | 1.2 | 0.2 | 0.1 | 4.3 | 7.2 | 60 | 4.2 | 56 | 117 |
| E | 6.3 | 5.0 | 2.5 | — | 0.2 | 0.1 | 2.8 | 6.0 | 46 | 4.3 | 73 | 76 |
| Bt1 | 6.0 | 4.9 | 3.0 | 0.8 | 0.2 | — | 4.0 | 6.5 | 61 | 4.2 | 84 | 123 |
| Bt2 | 6.6 | 5.3 | 5.3 | 5.2 | 0.2 | — | 10.7 | 17.0 | 63 | 5.3 | 196 | 252 |
| CB | 6.7 | 4.5 | 9.3 | 7.6 | 0.2 | — | 17.1 | 24.5 | 69 | 4.7 | 96 | 183 |
| CR | 6.6 | 4.6 | 8.0 | 5.5 | 0.2 | — | 13.7 | 20.0 | 69 | 3.5 | 71 | 145 |

| Horizon | Total analyses % | | | | | | | | $\frac{SiO_2}{R_2O_3}$ | $\frac{SiO_2}{Al_2O_3}$ | $\frac{SiO_2}{Fe_2O_3}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | $SiO_2$ | $Al_2O_3$ | $Fe_2O_3$ | MgO | CaO | $Na_2O$ | $K_2O$ | $TiO_2$ | | | |
| Ap | 75.70 | 10.45 | 5.55 | 0.83 | 0.98 | — | — | 0.68 | 9.69 | 12.23 | 36.11 |
| E | 76.25 | 10.04 | 5.84 | 0.85 | 1.26 | — | — | 0.67 | 9.76 | 12.82 | 34.58 |
| Bt1 | 68.34 | 13.25 | 6.26 | 1.07 | 1.25 | — | — | 0.68 | 7.06 | 8.70 | 28.91 |
| Bt2 | 58.78 | 12.13 | 8.20 | 1.55 | 1.40 | — | — | 0.76 | 6.06 | 8.17 | 18.97 |
| CB | 58.18 | 12.13 | 7.75 | 2.06 | 1.26 | — | — | 0.75 | 6.40 | 8.09 | 19.87 |
| CR | 60.55 | 17.74 | 5.60 | 2.24 | 1.12 | 0.72 | 3.05 | 0.51 | 5.00 | 5.76 | 28.64 |

| | |
|---|---|
| **CHROMIC LUVISOL** | **Lc** |
| **Terra rossa** | Yugoslavia |
| **Source** | Soil Survey Staff. *Soil taxonomy, a basic system of soil classification for making and interpreting soil surveys*, p. 510-511. Washington, D.C., US Soil Conservation Service, 1974 |
| **Location** | 24 km north of Pula, Istria (extreme northwest Yugoslavia) |
| **Altitude** | 100-200 m |
| **Physiography** | Plateau, gently sloping; gradient about 2%; northwest exposure |
| **Drainage** | Well drained |
| **Parent material** | Cretaceous limestone |
| **Vegetation** | Field crops |
| **Climate** | Annual rainfall: 900-1 000 mm; annual mean temperature: 14°C; summer hot and dry |

**Profile description**

| | | |
|---|---|---|
| **Ap1** | **0-15 cm** | Dark reddish brown (5YR 3/3 moist) silty clay; strong fine granular structure; friable, sticky, plastic; abrupt smooth boundary. |
| **Ap2** | **15-23 cm** | Dark reddish brown (5YR 3/3 moist, 5YR 4/3 dry) silty clay; few 1- to 3-cm limestone fragments; coarse prisms breaking easily to fine blocks; very hard dry, very firm moist; sticky and plastic wet; patchy clayskins; diffuse smooth boundary. |
| **BA** | **23-41 cm** | Dark reddish brown (5YR 3/3 moist, 5YR 4/3 dry) silty clay; strong coarse prisms breaking to fine blocks; very hard dry, very firm moist; sticky and plastic wet; dusky red (2.5YR 3/2 moist) to dark reddish brown (2.5YR 2/4 dry) clayskins moderately thick on 40-60% of ped faces and thin on the remainder; diffuse smooth boundary. |
| **Bt1** | **41-56 cm** | Dark reddish brown (4YR 3/3 moist, 5YR 4/3 dry) silty clay; moderate coarse subangular blocks breaking to fine blocks; very firm moist, sticky and plastic wet; many fine roots; many fine pores; continuous dusky red (2.5YR 3/2 moist) to dark reddish brown (2.5YR 2/4 dry) clayskins on ped faces; diffuse smooth boundary. |
| **Bt2** | **56-91 cm** | Dark reddish brown (4YR 3/4 moist) heavy clay; weak coarse prisms breaking to medium and fine subangular blocks; dark reddish brown (2.5YR 2/4 moist, 2.5YR 3/4 dry) thick continuous clayskins; abrupt wavy boundary. |
| **R** | **91-110 cm** | Fractured limestone in 5- to 13-cm diameter fragments; edges rounded by solution; penetration of clay and calcite between fragments. |

**CHROMIC LUVISOL**

**Yugoslavia**

| Horizon | Depth cm | Particle size distribution (mm) % | | | | Organic matter | | |
|---|---|---|---|---|---|---|---|---|
| | | Sand 2-0.05 | Coarse silt 0.05-0.02 | Fine silt 0.02-0.002 | Clay < 0.002 | % C | % N | C/N |
| Ap1 | 0–15 | 2.9 | 23.5 | 27.8 | 45.8 | 1.68 | 0.17 | 10 |
| Ap2 | 15–23 | 2.7 | 25.1 | 26.4 | 45.8 | 1.57 | 0.16 | 10 |
| BA | 23–41 | 2.3 | 21.1 | 29.8 | 46.8 | 1.34 | 0.15 | 9 |
| Bt1 | 41–56 | 1.9 | 18.9 | 29.2 | 50.0 | 1.20 | 0.12 | 10 |
| Bt2 | 56–91 | 1.1 | 9.0 | 14.1 | 75.8 | 0.84 | 0.10 | 8 |

| Horizon | pH $H_2O$ | $CaCO_3$ % | Exchangeable cations me/100 g | | | | | | | % V (100 S/T) |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Ca | Mg | Na | K | H | S | T | |
| Ap1 | 6.9 | 3.5 | 15.8 | 1.5 | 0.1 | 0.4 | 6.6 | 17.8 | 24.4 | 73 |
| Ap2 | 6.7 | 3.6 | 13.8 | 1.4 | 0.1 | 0.3 | 7.0 | 15.6 | 22.6 | 69 |
| BA | 6.6 | 3.5 | 12.2 | 1.2 | 0.2 | 0.2 | 9.0 | 13.8 | 22.8 | 60 |
| Bt1 | 6.4 | 3.6 | 11.7 | 1.2 | 0.2 | 0.2 | 9.5 | 13.3 | 22.8 | 58 |
| Bt2 | 6.2 | 5.3 | 18.8 | 2.0 | 0.2 | 0.3 | 13.0 | 21.3 | 34.3 | 62 |

| Horizon | Total analyses % | | | | | $\frac{SiO_2}{R_2O_3}$ |
|---|---|---|---|---|---|---|
| | $K_2O$ | CaO | $SiO_2$ | $Fe_2O_3$ | $Al_2O_3$ | |
| Ap1 | 1.7 | 1.1 | 59.3 | 8.0 | 18.8 | 4.2 |
| Ap2 | 1.7 | 1.0 | 59.9 | 7.4 | 18.9 | 4.3 |
| BA | 1.8 | 0.9 | 59.3 | 7.8 | 19.7 | 4.1 |
| Bt1 | 1.8 | 0.8 | 58.7 | 7.6 | 19.6 | 4.1 |
| Bt2 | 1.7 | 0.9 | 49.9 | 9.9 | 24.4 | 2.8 |

| | |
|---|---|
| **GLEYIC LUVISOL** | **Lg** |
| **Sekundärer Pseudogley mit Tonverlagerung** | Germany (Fed. Rep.) |
| **Source** | Mückenhausen, E. *et al. Exkursionsführer zur Tagung der Kommissionen V und VI der Internationalen Bodenkundlichen Gesellschaft in Stuttgart-Hohenheim. Landschaften und Böden in der Bundesrepublik Deutschland, Excursion C*, p. 369-373. Mitteilungen der Deutschen Bodenkundlichen Gesellschaft 13, 1971 |
| **Location** | Kottenforst (7 km southwest of Bonn) |
| **Altitude** | 165 m |
| **Physiography** | Principal terrace of the Rhine; flat |
| **Drainage** | Poorly drained (high watertable, pronounced alternation of dry and humid phases) |
| **Parent material** | Pleistocene loess (Würm) on terrace gravel |
| **Vegetation** | Forest (*Querco-Carpinetum tilietosum*) |
| **Climate** | Annual rainfall: 600-650 mm; annual mean temperature: 9-10°C |

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**Profile description**

| | | |
|---|---|---|
| **O1** | | Thin beech and oak litter. |
| **O2** | **3-0 cm** | Very dark brown (10YR 2/2) friable moder. |
| **Ah** | **0-15 cm** | Dark reddish brown (5YR 3/2) loam, strongly humic, lighter in lower part; crumby structure, blocky in lower part; porous, friable; very frequent roots; gradual wavy boundary. |
| **Eg1** | **15-27 cm** | Light brownish grey (2.5Y 6/2) loam with yellowish red (5YR 6/8) mottles; blocky and platy structure; porous, friable; very frequent roots. |
| **Eg2** | **27-47 cm** | Light grey (2.5Y 7/2) loam with yellowish red (5YR 5/6) mottles; blocky structure; moderately to very porous, friable; roots common. |
| **Btg1** | **47-67 cm** | Light grey (2.5Y 7/2) clay loam with yellowish red (5YR 4-5/6) mottles and dark reddish brown (5YR 2/2) nodules; blocky and platy structure; moderately porous, moderately friable; roots common. |
| **Btg2** | **67-92 cm** | Greyish brown (2.5Y 5/2) clay loam with distinct yellowish red (5YR 4-5/6) mottles and nodules; coherent; blocky and platy structure; moderately firm; few roots. |
| **Btg3** | **92-107 cm** | Greyish brown (2.5Y 5/2) clay loam with large reddish brown (5YR 4/3-4) mottles; few pebbles; firm; blocky and platy structure; few roots. |
| **2Btg** | **107-122 cm** | Grey (5Y 6/1) pebbly loam with yellowish red (5YR 5/6) mottles; very firm; no roots. |

## GLEYIC LUVISOL
### Germany (Fed. Rep.)

| Horizon | Depth cm | Gravel > 2 mm | Particle size distribution (mm) % | | | | | Organic matter | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Coarse sand 2-0.2 | Fine sand 0.2-0.06 | Coarse silt 0.06-0.02 | Fine silt 0.02-0.002 | Clay < 0.002 | % C | % N | C/N |
| O2 | 3–0 | | 2.2 | 4.3 | 53.5 | 29.1 | 10.9 | 10.8 | 0.51 | 21 |
| Ah | 0–15 | | 1.5 | 4.0 | 50.7 | 32.5 | 11.3 | 5.7 | 0.26 | 22 |
| Eg1 | 15–27 | | 1.6 | 3.6 | 49.8 | 32.6 | 12.4 | 1.1 | 0.04 | 29 |
| Eg2 | 27–47 | | 5.1 | 3.5 | 43.1 | 32.4 | 15.9 | 0.4 | 0.03 | 12 |
| Btg1 | 47–67 | | 2.8 | 2.8 | 37.2 | 26.5 | 30.7 | 0.3 | 0.03 | — |
| Btg2 | 67–92 | | 2.1 | 3.3 | 41.4 | 23.8 | 29.4 | 0.2 | 0.04 | — |
| Btg3 | 92–107 | | 4.4 | 6.1 | 41.5 | 21.4 | 26.6 | 0.2 | 0.03 | — |
| 2Btg | 107–122 | 72 | 23.7 | 6.3 | 27.1 | 19.0 | 23.9 | 0.2 | 0.02 | — |

| Horizon | pH | | | Extractable cations me/100 g | | | | | | % V (100 S/T) |
|---|---|---|---|---|---|---|---|---|---|---|
| | $H_2O$ | KCl | $CaCl_2$ | Ca | Mg | K | Na | S | T | |
| O2 | 4.4 | 3.9 | 4.0 | 5.4 | 0.6 | 0.5 | 0.2 | 6.7 | 25.5 | 26.3 |
| Ah | 4.2 | 3.6 | 3.8 | 2.1 | 1.3 | 0.3 | 0.2 | 3.9 | 18.4 | 21.2 |
| Eg1 | 4.2 | 3.7 | 3.8 | 0.3 | 0.1 | 0.1 | 0.2 | 0.7 | 6.9 | 10.1 |
| Eg2 | 4.1 | 3.6 | 3.8 | 0.6 | 0.1 | 0.1 | 0.2 | 1.0 | 7.4 | 13.5 |
| Btg1 | 4.4 | 3.6 | 4.0 | 4.6 | 1.0 | 0.2 | 0.3 | 6.1 | 15.7 | 38.9 |
| Btg2 | 4.6 | 3.8 | 4.3 | 5.9 | 1.1 | 0.2 | 0.3 | 7.5 | 15.1 | 49.7 |
| Btg3 | 4.8 | 3.9 | 4.4 | 7.0 | 1.1 | 0.2 | 0.4 | 8.7 | 14.7 | 59.2 |
| 2Btg | 5.0 | 4.1 | 4.6 | 5.7 | 1.1 | 0.2 | 0.3 | 7.3 | 11.9 | 61.3 |

## CALCIC LUVISOL Lk

| | |
|---|---|
| **Calcareous red mediterranean soil** | Spain |
| **Source** | Gragera, P., Guerra, A. *et al. Conferencia sobre Suelos Mediterráneos. Guía de la excursión española.* Profile II. Madrid, Sociedad Española de Ciencia del Suelo, 1966 |
| **Location** | Almagro, km 26 on the Ciudad Real-Valdepeñas road |
| **Altitude** | Approx. 600 m |
| **Physiography** | Flat shoulder of hill |
| **Drainage** | Well drained |
| **Parent material** | Limburgites and basalts |
| **Vegetation** | Olive grove |
| **Climate** | Annual rainfall: 450 mm; annual mean temperature: 14°C |

**Profile description**

| | | |
|---|---|---|
| **Ap** | **0-30 cm** | Reddish yellow (5YR 4/6 dry) sandy clay loam; quartzite fragments common; weak structure; soft; very permeable; abrupt smooth boundary. |
| **Bt** | **30-65 cm** | Dark red (10R 3/4 dry) clay; very strong blocky structure; slightly hard; very permeable; few large pores; the material has a shiny waxed appearance; very abrupt smooth boundary. |
| **Bmk** | **65-90 cm** | Very hard calcareous pan (petrocalcic horizon). |
| **2C** | **90+ cm** | Yellowish red (7.5YR 7/4 dry) rubble, silty clay sand; strongly calcareous; moderate subangular blocky structure; very hard; very permeable. |

## CALCIC LUVISOL
**Spain**

| Horizon | Depth cm | Particle size distribution (mm) % | | | | Organic matter | | | $CaCO_3$ % |
|---|---|---|---|---|---|---|---|---|---|
| | | Coarse sand | Fine sand | Silt | Clay | % C | % N | C/N | |
| Ap | 0–30 | 10.9 | 49.3 | 11.8 | 27.0 | 0.7 | 0.08 | 8 | tr. |
| Bt | 30–65 | 8.5 | 27.5 | 11.3 | 52.3 | 0.5 | 0.08 | 6 | tr. |
| Bmk | 65–90 | — | — | — | — | — | — | — | — |
| 2C | 90 + | 24.6 (12.7) | 29.4 (15.1) | 23.1 (10.7) | 23.8 (19.7) | 0.2 | 0.03 | 8 | 38.6 |

In brackets: After decomposition of carbonates (38.6% $CaCO_3$)

| Horizon | pH | | Extractable cations me/100 g | | | | | | % V (100 S/T) | Free oxides | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $H_2O$ | KCl | Ca | Mg | Na | K | S | T | | $Fe_2O_3$ % | $Al_2O_3$ ppm | $SiO_2$ ppm |
| Ap | 7.8 | 7.0 | 8.4 | 1.4 | 0.2 | 0.4 | 10.4 | 11.5 | 91 | 2.7 | 214 | 667 |
| Bt | 7.7 | 6.8 | 13.2 | 3.6 | tr. | — | 16.8 | 17.5 | 96 | 4.4 | 431 | 684 |
| Bmk | — | — | — | — | — | — | — | — | — | — | — | — |
| 2C | 8.0 | 6.9 | 9.9 | 1.1 | tr. | — | 11.0 | 11.1 | 99 | 2.2 | 76 | 511 |

| Horizon | Total analyses % | | | | | | | | $\frac{SiO_2}{R_2O_3}$ | $\frac{SiO_2}{Al_2O_3}$ | $\frac{SiO_2}{Fe_2O_3}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | $SiO_2$ | $Al_2O_3$ | $Fe_2O_3$ | MgO | CaO | $Na_2O$ | $K_2O$ | $TiO_2$ | | | |
| Ap | 75.00 | 7.39 | 4.20 | 1.55 | 1.96 | — | — | 0.67 | 13.70 | 17.13 | 47.30 |
| Bt | 61.90 | 15.57 | 6.50 | 1.45 | 1.48 | — | — | 0.75 | 5.02 | 6.70 | 25.22 |
| Bmk | 11.90 | 2.67 | 1.40 | 2.27 | 42.64 | 0.26 | 0.50 | 0.27 | 9.50 | 7.52 | 22.52 |
| 2C | 36.40 | 7.18 | 4.20 | 1.95 | 24.25 | — | — | 0.75 | 6.60 | 8.55 | 22.94 |

| | |
|---|---|
| **ORTHIC LUVISOL** | **Lo** |
| **Leached brown soil** | Belgium |
| **Source** | Louis, A. Centre de cartographie des sols, Gand, 1965 |
| **Location** | Zottegem (39 km west of Brussels) 50°52′57″N; 3°48′38″E |
| **Altitude** | 60 m |
| **Physiography** | Gently undulating area; profile on flat shoulder of long 1-2% gradient |
| **Drainage** | Well drained |
| **Parent material** | Upper Pleistocene loess (Würm III) |
| **Vegetation** | Field crops |
| **Climate** | Annual rainfall: 800 mm; annual mean temperature: 9.5°C |

**Profile description**

| | | |
|---|---|---|
| **Ap** | **0-30 cm** | Dark brown (10YR 4/3 moist) loam, slightly humic; weak fine crumby and very fine subangular blocky structure; locally, in lower part, more compact platy structure (plough sole); abundant fine roots; abrupt smooth boundary. |
| **Bt1** | **30-95 cm** | Dark yellowish brown (10YR 4/4 moist) clay loam, yellowish brown (10YR 5/4) crushed; moderately strong medium subangular blocky structure; firm; frequent dark brown (7.5YR 4/4) clayey cutans; frequent fine pores; few worm channels, lines with dark brown (10YR 4/3) humic clayey cutans; gradual smooth boundary. |
| **Bt2** | **95-250 cm** | Dark yellowish brown (10YR 5/4 moist) loam, same colour crushed; moderately stratified in 40-cm lamellae, slightly undulating, separated by thin (1-cm) bands of pale yellowish brown (10YR 6/4) light loam; weak very coarse subangular blocky structure; moderately firm, becoming friable in lower part; frequent very fine pores; few worm channels; diffuse smooth boundary. |
| **C1** | **250-295 cm** | Yellowish brown (10YR 5/4 moist) loam; structureless, massive, but stratified; friable; clayey streaks on few walls of small worm channels; less porous than Bt2; abrupt, very wavy boundary. |
| **C2** | **295+ cm** | Pale yellowish brown (10YR 6/4 moist) loam; structureless, massive; calcareous (with pseudomycelium). |

## ORTHIC LUVISOL
**Belgium**

| Horizon | Depth cm | Particle size distribution (mm) % | | | | % C | $CaCO_3$ % |
|---|---|---|---|---|---|---|---|
| | | 2-0.05 | 0.05-0.02 | 0.02-0.002 | < 0.002 | | |
| Ap | 0–30 | 6.0 | 66.3 | 16.6 | 11.0 | 0.73 | 0 |
| Bt1 | 30–95 | 2.8 | 54.5 | 19.8 | 22.9 | 0.24 | 0 |
| Bt2 | 95–250 | 2.9 | 64.8 | 15.2 | 17.0 | 0.05 | 0 |
| C1 | 250–295 | 4.9 | 59.7 | 20.0 | 15.8 | 0.07 | 0 |
| C2 | 295+ | 2.2 | 58.4 | 27.4 | 11.9 | 0.08 | 9.7 |

| Horizon | pH | | CEC(T) me/100 g | % V (100 S/T) |
|---|---|---|---|---|
| | $H_2O$ | KCl | | |
| Ap | 6.6 | 5.6 | 9.3 | 64 |
| Bt1 | 6.2 | 4.9 | 13.5 | 70 |
| Bt2 | 6.6 | 5.3 | 11.7 | 82 |
| C1 | 6.7 | 5.5 | 11.0 | 83 |
| C2 | 8.3 | 7.6 | 7.0 | 100 |

| | |
|---|---|
| **ORTHIC GREYZEM** | **Mo** |
| **Dark grey forest soil** | USSR |
| **Source** | Fridland, V.M. *et al. Short guide to soil excursion Moskow -Kherson. Profile 2,* p. 16-27. Moscow, Ministry of Agriculture of the USSR, 1964 |
| **Location** | Moscow-Simferopol road, 22 km north of Tula |
| **Physiography** | Gently undulating plain |
| **Drainage** | Well drained |
| **Parent material** | Loess silt |
| **Vegetation** | Deciduous forest (*Tilia, Quercus, Acer platanoides*) |
| **Climate** | Annual rainfall: 558 mm; annual mean temperature: 4.4°C (January: —9.8°C; July: 18.8°C) |

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**Profile description**

| | | |
|---|---|---|
| **Ah1** | **0-15 cm** | Dark grey (moist) clay; friable; fine nutty structure; compact root mat; abrupt smooth boundary. |
| **Ah2** | **15-40 cm** | Dark grey (moist) clay, becoming lighter on drying, with fine pale powdering; firm; nutty structure; becoming prismatic nutty in the lower part; fewer roots than in Ah1; black cutans on ped faces and along cracks; tonguing boundary. |
| **Bt1** | **40-60 cm** | Brownish grey (moist) clay; pale powder clearly visible on drying; reddish brown-grey cutans on peds; prismatic nutty structure; more compact than Ah2; gradual, wavy boundary. |
| **Bt2** | **60-110 cm** | Greyish brown (moist) clay; pale powder visible on drying; prismatic structure; more compact and firm than Bt1; strong reddish brown cutans and mottles on ped faces; gradual irregular boundary. |
| **BC** | **110-190 cm** | Brown, locally strong brown (moist) clay; blocky prismatic structure; dark and light reddish brown cutans and mottles on ped faces; irregular boundary. |
| **2C** | **190-230 cm** | Reddish brown (moist) sandy silt; compact. |

**ORTHIC GREYZEM**
**USSR**

| Horizon | Depth cm | Particle size distribution (mm) % | | | | | |
|---|---|---|---|---|---|---|---|
| | | 1-0.25 | 0.25-0.05 | 0.05-0.01 | 0.01-0.005 | 0.005-0.001 | < 0.001 |
| Ah1 | 0–15 | 0.9 | 2.7 | 46.0 | 13.1 | 19.3 | 18.0 |
| Ah2 | 15–40 | 1.5 | 2.2 | 49.5 | 12.4 | 16.9 | 17.5 |
| Bt1 | 40–60 | 0.6 | — | 49.9 | 12.4 | 11.8 | 25.3 |
| Bt2 | 60–110 | 0.8 | 0.6 | 45.5 | 10.4 | 13.9 | 30.4 |
| BC | 110–190 | 1.5 | 2.1 | 42.1 | 9.8 | 13.5 | 31.0 |

| Horizon | Organic matter | | | pH | | Extractable cations me/100 g | | | | % V (100 S/T) |
|---|---|---|---|---|---|---|---|---|---|---|
| | % C | % N | C/N | $H_2O$ | KCl | Ca | Mg | H | T | |
| Ah1 | 5.90 | 0.50 | 11.9 | 6.3 | 5.8 | 35.4 | 3.5 | — | 38.9 | 100 |
| Ah2 | 2.83 | 0.24 | 12.8 | 5.9 | 5.3 | 19.1 | 1.5 | — | 20.6 | 100 |
| Bt1 | 0.88 | 0.08 | 11.0 | 5.4 | 4.3 | 14.3 | 2.5 | 0.5 | 17.3 | 97 |
| Bt2 | | | | 5.3 | 5.9 | 11.9 | 3.0 | 1.0 | 14.9 | 93 |
| BC | | | | 5.4 | 4.0 | 14.9 | 3.0 | — | 17.9 | 100 |

**DYSTRIC HISTOSOL** **Od**

| | |
|---|---|
| **Organic soil** | Finland |
| **Source** | Tikkurila Agronomic Research Station |
| **Location** | Myras, southern Finland |
| **Altitude** | 40 m |
| **Physiography** | Gently undulating plain |
| **Drainage** | Very poorly drained; marshy |
| **Parent material** | Post-glacial sphagnous peat |
| **Vegetation** | Forest of dwarf *Pinus silvestris* with *Ledum palustre, Calluna vulgaris, Vaccinium uliginosum, Empetrum nigrum, Rubus chamaemorus, Vaccinium vitis-idaca, Sphagnum fuscum* |
| **Climate** | Rainfall during growth period: 300 mm; length of growth period (>5°C): 170 days |

**Profile description**

| | | |
|---|---|---|
| **H1** | **0-20 cm** | Brownish yellow sphagnous peat; humification scale: 2. |
| **H2** | **20-40 cm** | Sphagnous peat; humification scale: 6 (decomposition resulting from installation of drainage ditches). |
| **H3** | **40-70 cm** | Brownish yellow sphagnous peat; humification scale: 2. |
| **H4** | **70-120 cm** | Brownish yellow sphagnous peat; humification scale: 1. |

The peat layer is 4 m thick; it is followed by a layer of moderately decomposed reed peat on a clay subsoil.

## DYSTRIC HISTOSOL

### Finland

| Horizon | Depth cm | pH | | | Extractable cations me/100 g | | | | | | % V (100 S/T) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | $H_2O$ | KCL | $CaCl_2$ | Ca | Mg | K | Na | H | T | |
| H1 | 0–20 | 3.9 | 2.7 | 2.9 | 7.2 | 3.7 | 1.4 | 0.6 | 121 | 134 | 9.6 |
| H2 | 20–40 | 3.7 | 2.5 | 2.9 | | | | | | | |
| H3 | 40–70 | 3.7 | 2.4 | 2.7 | | | | | | | |
| H4 | 70–120 | 3.8 | 2.4 | 2.7 | 2.5 | 3.3 | 0.3 | 0.4 | 122 | 129 | 5.1 |

| Horizon | Organic matter | | | Bulk density |
|---|---|---|---|---|
| | % C | % N | C/N | |
| H1 | 40.8 | 0.5 | 80 | 0.08 |
| H2 | 40.8 | 0.6 | 66 | |
| H3 | 42.2 | 0.7 | 55 | |
| H4 | 42.2 | 0.5 | 74 | |

| | |
|---|---|
| **EUTRIC HISTOSOL** | **Oe** |
| **Organic soil** | United Kingdom |
| **Source** | Ragg, J.M. & Clayden, B. *The classification of some British soils according to the Comprehensive System of the United States.* Harpenden, 1973. Soil Survey Technical Monograph No. 3, Profile No. 76 |
| **Location** | Rand Hall, Swaffham Prior Glen, Cambridgeshire (100 km north of London) |
| **Altitude** | 2 m |
| **Physiography** | Flat |
| **Drainage** | Very poorly drained (water-table at 65 cm, 1 February 1966) |
| **Parent material** | Peat |
| **Vegetation** | Grass |
| **Climate** | Annual rainfall: 600-800 mm; annual mean temperature: 8-12°C |

**Profile description**

| | | |
|---|---|---|
| **Ha1** | **0-23 cm** | Brownish black (10YR 2/1.5) very friable peat; weak crumby structure; fine fibrous roots common in upper 8 cm, less common below; earthworms present; few wood fragments, but otherwise no recognizable plant remains; clear slightly wavy boundary. |
| **Ha2** | **23-33/40 cm** | Black very friable peat; crumby to granular structure; few roots; earthworms present; no recognizable plant remains; clear slightly wavy boundary. |
| **He1** | **33/40-50 cm** | Dark reddish brown (2.5YR 2/4) and black (10YR 2/1) friable peat; massive and matted; breaking into angular lumps up to 15 cm across; fine matted roots, live and dead; some wood fragments; earthworms present; brown (7.5YR 5/4) and white gypseous streaks and patches 5 mm across; diffuse boundary. |
| **He2** | **50-80 cm** | Black matted rather spongy peat; slightly variegated with dark reddish brown (5YR 3/2) where less decomposed; fibrous roots common but mostly dead; few earthworms; *Phragmites* remains present; clear boundary. |
| **He3** | **80+ cm** | Dark reddish brown (5YR 3/2) matted peat, changing to dark olive (5Y 2/3) after 3 minutes of exposure to air; brown *Phragmites* remains present; odourless. |

**EUTRIC HISTOSOL**

**United Kingdom**

| Horizon | Depth cm | % C | pH |  | CEC(T) me/100 g | % V (100 S/T) |
|---|---|---|---|---|---|---|
|  |  |  | $H_2O$ | $CaCl_2$ |  |  |
| Ha1 | 0–23 | 31 | 6.9 | 6.7 | 131 | 69 |
| Ha2 | 23–33/40 | 32 | 6.5 | 6.3 | 182 | 80 |
| He1 | 33/40–50 | 38 | 4.8 | 4.6 | 138 | (*) |
| He2 | 50–80 | 44 | 4.6 | 4.4 | 129 | (*) |
| He3 | 80+ | 43 | 5.0 | 4.8 | 108 | (*) |

(*) Leachate contained much $SO_4^{--}$, probably from gypsum.

**EUTRIC HISTOSOL** **Oe**

| | |
|---|---|
| **Ferruginated cultivated peaty soil** | USSR |
| **Source** | Bukhman, V.A. *et al. Guide to soil excursion, Forest zone, Karelia. Profile 5.* Document, International Congress of Soil Science, Moscow, 1974 |
| **Location** | Biological Institute of the Karelian Section, Academy of Sciences of the USSR, Essoila, south of Lake Stamozero (80 km west of Lake Onega) |
| **Altitude** | Approx. 70 m |
| **Physiography** | Large depression in undulating landscape of fluvio-glacial basin |
| **Drainage** | Poorly drained (watertable at 90-120 cm)[1] |
| **Parent material** | Peat (1-3 m) on varied clays |
| **Vegetation** | Temporary pasture; field crops |
| **Climate** | Annual rainfall: 550-600 mm (400 mm in summer); annual mean temperature: 2°C (February: —10°C; July: 16°C); length of growth period (> 5°C): 150 days |

**Profile description**

| | | |
|---|---|---|
| **H1** | **0-25/28 cm** | Dark reddish brown (5YR 2/2) wood and grass peat, 35% decomposed; friable; grass roots; clear boundary. |
| **H2** | **25/28-46 cm** | Dark reddish brown (5YR 2/2) wood and grass peat, 30% decomposed, with reddish yellow tinge of iron origin; many live roots and tree stumps. |
| **H3** | **46-73 cm** | Greyish yellow (2.5YR 3/4) clayey peat, turning black immediately on exposure to air; < 50% decomposed. |
| **H4** | **73-140 cm** | Very dark grey (5YR 3/1) moss and reed peat, turning darker on exposure to air; flaky, compact. |
| **H5** | **140-190 cm** | Black (5YR 2/1) wood and reed peat; flaky, compact; strong $H_2S$ odour. |
| **H6** | **190-275 cm** | Dark reddish brown (5YR 2/2) wood peat, less decomposed and less compact. |
| **2Cg** | **275-315 cm** | Greyish blue (10Y 7/1) heavy loam, indistinctly stratified. |

[1] In 1962 this soil was drained by an underground system of wooden drains, 20 m apart, at a depth of 1 m; open drainage ditches 1.8 m deep and 6 m across are installed every 120 m.

## EUTRIC HISTOSOL
## USSR

| Horizon | Depth cm | pH | | Extractable cations me/100 g | | | | % V (100 S/T) | Organic matter | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | $H_2O$ | KCl | Ca | Mg | H | T | | % C | % N | C/N |
| H1 | 0–25/28 | 5.7 | 4.9 | 51.0 | 27.7 | 34.4 | 113.1 | 70 | 41.3 | 1.9 | 20 |
| H2 | 25/28–46 | 5.9 | 4.6 | 32.3 | 18.8 | 45.0 | 96.1 | 54 | 43.6 | 2.0 | 21 |
| H3 | 46–73 | 5.5 | 4.3 | 28 1 | 7.9 | 45.1 | 81.1 | 40 | | | |
| H4 | 73–140 | 5.5 | 4.6 | 32.6 | 16.2 | 31.4 | 80.2 | 61 | 48.7 | 2.2 | 21 |
| H5 | 140–190 | 5.7 | 4.4 | 27.9 | 19.6 | 38.4 | 85.9 | 53 | | | |
| H6 | 190–219 | 5.4 | 4.6 | 26.6 | 26.6 | 43.5 | 96.7 | 55 | | | |
| | 225–275 | 6.0 | 4.9 | 32.6 | 9.2 | 44.9 | 86.7 | 48 | | | |
| 2Cg | 275–315 | 5.4 | 4.6 | 35.1 | 1.5 | 5.6 | 10.2 | 52 | | | |

| Horizon | Depth cm | Bulk density g/cm³ | Total porosity % vol. | Max. hygroscopy % wt | Max. water capacity % wt | Min. water capacity % vol. | Water permeability mm/hr |
|---|---|---|---|---|---|---|---|
| H1 | 0–10 | 0.18 | 99 | 28 | 67 | 80 | 252 |
| | 10–20 | 0.21 | 88 | 27 | 76 | 68 | 109 |
| H2 | 20–30 | 0 18 | 89 | 27 | 72 | 69 | 63 |
| | 30–40 | 0.13 | 89 | 27 | 69 | 88 | 63 |
| | 40–50 | 0.12 | 93 | 27 | 79 | 51 | |
| H3 | 50–60 | 0.14 | 91 | 24 | 66 | 68 | 4.6 |
| | 60–70 | 0.13 | 92 | 28 | 70 | 64 | 4.6 |
| H4 | 70–80 | 0.11 | 94 | 30 | 59 | 91 | 4.6 |
| | 80–90 | 0.11 | 93 | 26 | 66 | 75 | 4.6 |
| | 90–100 | 0.12 | 93 | 27 | 75 | 79 | |

## GLEYIC PODZOL Pg

| | |
|---|---|
| **Podsol-Gley** | Germany (Fed. Rep.) |
| **Source** | Mückenhausen, E. *Die wichtigsten Böden der Bundesrepublik Deutschland, Profil 52.* Bonn, Wissenschaftliche Schriftenreihe des AID, Heft 14 |
| **Location** | 1 km northwest of Kalle (Emsland, 8 km from the Netherlands border) |
| **Altitude** | 14 m |
| **Physiography** | Low-lying plain |
| **Drainage** | Poorly drained (the water-table originally lay at 40 cm, but has been lowered by artificial drainage) |
| **Parent material** | Aeolian sand on fissured fluvio-glacial sand |
| **Vegetation** | Thin pine forest with *Erica tetralix, Molinia caerulea, Cladonia rangiferina* |
| **Climate** | Annual rainfall: 600-720 mm; annual mean temperature: 8-8.5°C |

**Profile description**

| | | |
|---|---|---|
| **O** | **2-0 cm** | Blackish brown raw humus, fibrous. |
| **AE** | **0-10 cm** | Very dark grey silty fine sand; strongly humic; abundant roots; structureless. |
| **Bhg** | **10-33 cm** | Slightly reddish dark brown silty fine sand, becoming lighter in lower part; long vertical black mottles from old roots; structureless. |
| **BCg** | **33-98 cm** | Strong reddish brown to greyish red-brown fine sand; long vertical blackish brown mottles from old roots; few thin subhorizontal streaks. |
| **Cg1** | **98+ cm** | Light yellowish grey sand; structureless. |

**GLEYIC PODZOL**

**Germany (Rep. Fed.)**

| Horizon | Depth cm | Particle size distribution (mm) % | | | | Organic matter | |
|---|---|---|---|---|---|---|---|
| | | Coarse sand 2-0.2 | Fine sand 0.2-0.06 | Silt 0.06-0.002 | Clay < 0.002 | % C | C/N |
| O | 2-0 | | | | | 12.3 | 21 |
| AE | 0-10 | 28.6 | 56.1 | 10.1 | 5.3 | 2.5 | 24 |
| Bhg | 10-33 | 23.0 | 59.3 | 12.6 | 5.1 | | |
| BCg | 33-98 | 31.0 | 61.7 | 3.2 | 4.0 | | |
| Cgl | 98 + | 57.2 | 40.9 | 0.6 | 1.2 | | |

| Horizon | pH | | Extractable cations me/100 g | | % V (100 S/T) |
|---|---|---|---|---|---|
| | $H_2O$ | KCl | S | T | |
| O | 3.6 | 3.0 | 3.6 | 17.2 | 21 |
| AE | 3.8 | 3.1 | 0.4 | 21.1 | 2 |
| Bhg | 4.2 | 3.8 | 0.3 | 23.8 | 1 |
| BCg | 4.5 | 4.3 | 1.5 | 14.4 | 10 |
| Cgl | 4.8 | 4.4 | 4.5 | 8.5 | 53 |

| | |
|---|---|
| **GLEYIC PODZOL** | **Pg** |
| **Humus-illuvial peaty podzol** | USSR |
| **Source** | Morozova, R.M. *et al.* *Guide to soil excursion, Forest zone, Karelia. Profile 3.* Document, International Congress of Soil Science, Moscow, 1974 |
| **Location** | Kivach natural reserve, northwest of Lake Onega |
| **Altitude** | Approx. 70 m |
| **Physiography** | Undulating lacustro-glacial plain |
| **Drainage** | Poorly drained |
| **Parent material** | Sandy fluvio-glacial deposits |
| **Vegetation** | Taiga, pine forest, with *Vaccinium*, *Polytrichum*, etc. |
| **Climate** | Annual rainfall: 600 mm (400 mm in summer); annual mean temperature: 2°C (January: —10.9°C; July: 17.2°C) |

**Profile description**

| | | |
|---|---|---|
| **H1** | **15-5 cm** | Brown (10YR 3/3) moss and pine needle peat, half decomposed. |
| **H2** | **5-0 cm** | Dark brown to black (10YR 2/1) peat, strongly decomposed; abundant shrub and tree roots; few charcoal fragments at lower boundary. |
| **Eg** | **0-5/15 cm** | Grey (10YR 6/1) sand, with brownish mottles and tongues in upper part; few roots; clear tonguing boundary. |
| **Bhg1** | **5/15-10/22 cm** | Dark yellowish brown (10YR 3/4) sand; more compact; few roots; few nodules; gradual boundary. |
| **Bhg2** | **10/22-25/28 cm** | Brown to dark yellowish brown (10YR 4/2) sand; lighter than in Bhg1, becoming lighter in lower part. |
| **Bg** | **25/28-45 cm** | Mottled bluish grey (10YR 5/4 and 5Y 6/1) sand, water-saturated. |
| **BCg** | **45-55 cm** | Bluish (10YR 6/3) sand, with grey and rusty mottles and tongues; water-saturated. |

## GLEYIC PODZOL
## USSR

| Horizon | Depth cm | Particle size distribution (mm) % | | | | | |
|---|---|---|---|---|---|---|---|
| | | 1-0.25 | 0.25-0.05 | 0.05-0.01 | 0.01-0.005 | 0.005-0.001 | < 0.001 |
| H1 | 15–5 | | | | | | |
| H2 | 5–0 | | | | | | |
| Eg | 0–5/15 | 77.7 | 9.9 | 9.8 | 0.8 | 1.3 | 1.3 |
| Bhg1 | 5/15–10/22 | 71.2 | 13.8 | 7.8 | 2.0 | 2.9 | 2.3 |
| Bhg2 | 10/22–25/28 | 80.8 | 10.3 | 3.4 | 1.5 | 2.0 | 2.0 |
| Bg | 25/28–45 | 92.0 | 4.2 | 1.8 | 0.0 | 1.2 | 0.8 |
| BCg | 45–55 | 94.1 | 3.0 | 1.3 | 0.5 | 0.5 | 0.6 |

| Horizon | pH | | Organic matter | | | Extractable cations me/100 g | | | | | | % V (100 S/T) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $H_2O$ | KCl | % C | % N | C/N | Ca | Mg | K | Na | H | T | |
| H1 | 3.5 | 2.8 | 44.5 | 1.02 | 43 | — | — | — | — | — | — | |
| H2 | 3.7 | 3.0 | 37.3 | 0.92 | 40 | 9.9 | 4.6 | 4.5 | 1.0 | 50.4 | 70.4 | 28.4 |
| Eg | 4.0 | 3.2 | 0.4 | 0.03 | 15 | 2.0 | 1.1 | 1.7 | 0.4 | 2.9 | 8.1 | 64.2 |
| Bhg1 | 4.4 | 3.9 | 4.0 | 0.16 | 25 | 2.2 | 0.9 | 1.4 | 0.6 | 24.5 | 29.6 | 17.9 |
| Bhg2 | 4.6 | 4.1 | 2.3 | 0.08 | 28 | 2.1 | 1.2 | 1.5 | 0.4 | 12.4 | 17.6 | 29.5 |
| Bg | 4.8 | 4.5 | 0.3 | 0.02 | 18 | 1.7 | 1.3 | 1.7 | 0.4 | 0.7 | 5.8 | 87.9 |
| BCg | 5.1 | 4.6 | | | | 1.8 | 1.7 | 1.5 | 0.5 | 0.3 | 5.8 | 95.0 |

## HUMIC PODZOL Ph

**Humic Podzol** Belgium

**Source** De Coninck, F. & Tavernier, R. *La pédogenèse dans les sols sableux de la Campine. Guide de l'excursion en Campine anversoise.* Gand, Société belge de pédologie, 1975

**Location** Gierle, in the northern Antwerp Campine (northwest of Antwerp)

**Altitude** 20 m

**Physiography** Region of old interior dunes

**Drainage** Moderately well drained (water-table at 120 cm in May)

**Parent material** Pleistocene sand cover, reworked by aeolian action during the Holocene

**Vegetation** *Pinus sylvestris* plantation (undergrowth with *Molinia caerulea* dominant)

**Climate** Annual rainfall: 750 mm; annual mean temperature: 10°C

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**Profile description**

**Ah1** **0-3/4 cm** Dark grey (N 4/0 dry), black (10YR 2/1 moist) sand; humic, the organic matter forming isolated particles between the leached quartz grains; structureless; loose; clear smooth boundary.

**E** **3/4-14/25 cm** Grey to light grey (10YR 6/1 dry), dark grey (10YR 4/1 moist) sand; slightly humic; structureless; loose; clear smooth boundary, but forming a few tongues that reach the centre and even near the lower boundary of Bh1.

**Bh1** **14/25-24/30 cm** Dark reddish brown (5YR 3/2 moist), black (5YR 2/1 moist) sand, locally only 5 to 7 cm thick; strongly humic, with many leached grains; structureless, massive; frequent roots, distributed regularly but not matted; friable to firm; horizontal or parallel with the upper boundary of the horizon; very fine, darker, more humic peds appearing locally to become the fibres of Bh2; clear wavy boundary; there is in fact a gradual transition throughout the entire horizon, the greyish shade fading into the brownish shade.

**Bh2** **24/30-45/50 cm** Sand, passing with increasing depth from dark reddish brown (5YR 3/3 moist, 5YR 3/2 moist) to strong brown (7.5YR 4/6 moist, 7.5YR 3/4 moist); humic in the form of cutans covering the quartz grains; structureless, massive; locally more firm, locally as firm as Bh1, with:

*a*) abundant very irregular fibres, vague, clear, 2-5 mm thick, darker and firmer than the matrix;

*b*) common mottles, distinct, clear, irregular, from brown to dark brown (10YR 4/3 dry) or very dark greyish brown (10YR 3/2 moist) to brown to dark brown (7.5YR 4/4 dry, 7.5YR 4/2 moist), 1-2 cm in diameter, looser than the matrix, appearing to be extensions of the light mottles of Bh1; the fibres referred to in *a*) pass through the mottles;

gradual wavy boundary.

**Bh3** **45/50-60/65 cm** Sand, passing with increasing depth from strong brown (7.5YR 4/6 moist) or dark brown (7.5YR 3/4 moist) to strong brown (7.5YR 5/6 moist) or brown to dark brown (7.5YR 4/4 moist); humic as in Bh2; structureless, massive; friable to firm with:

*a*) frequent looser mottles, as in Bh2, light yellowish brown (10YR 6/4 moist) or yellowish brown (10YR 5/4 moist);

*b*) few dark irregular fibres as in Bh2;

*c*) few dark reddish brown (5YR 3/4 moist or 3/2 moist); rounded mottles 5-10 mm in diameter, or vertical channels, less than 1 cm broad, striking, clear to diffuse, humic, firmer than the matrix, developed around dead roots;

much fewer roots than in Bh2; some roots (matted) in horizontal or oblique planes which coincide with a stronger concentration of the bleached mottles; gradual smooth boundary.

## HUMIC PODZOL

**Belgium**

| Horizon | Depth cm | Particle size distribution (mm) % | | | % C | Fre $Fe_2O_3$ % |
|---|---|---|---|---|---|---|
| | | Sand 2-0.05 | Silt 0.05-0.002 | Clay < 0.002 | | |
| Ah1 | 0–3/4 | | | | | |
| E | 3/4–14/25 | 94.1 | 5.3 | 0.6 | 0.7 | 0.02 |
| Bh1 | 14/25–24/30 | 94.7 | 3.2 | 2.1 | 2.8 | 0.08 |
| Bh2 | 24/30–45/50 | 92.7 | 6.0 | 1.2 | 1.3 | 0.10 |
| Bh3 | 45/50–60/65 | 81.6 | 17.4 | 0.9 | 0.4 | |
| Cg | 60/65–120 | 81.5 | 16.5 | 1.9 | | |
| Cg | blanchi | 92.7 | 6.8 | 0.4 | | |

| Horizon | pH | | Extractable cations me/100 g | | | |
|---|---|---|---|---|---|---|
| | $H_2O$ | KCl | Ca | Mg | K | Na |
| Ah1 | | | | | | |
| E | 4.2 | 3.3 | 0.11 | 0.03 | 0.03 | 0.03 |
| Bh1 | 4.0 | 3.6 | 0.15 | 0.03 | 0.05 | 0.04 |
| Bh2 | 4.4 | 4.2 | 0.08 | 0.03 | 0.03 | 0.02 |
| Bh3 | 4.5 | 4.2 | 0.13 | 0.04 | 0.04 | 0.01 |
| Cg | 4.5 | 4.4 | 0.07 | 0.04 | 0.03 | 0.01 |

**Cg** **60/65-120 cm** Three different types of sand:

*a*) strong brown (7.5YR 5/6 moist); stratified; structureless, massive; firm;

*b*) light yellowish brown (10YR 6/4 moist) or yellowish brown (10YR 5/4 moist); stratified; looser than *a*);

*c*) light grey (10YR 7/2 moist); unstratified; looser than *b*), less clayey than *a*) and *b*);

*a*) forms large rust mottles, very irregular, striking, diffuse, in the midst of *b*); *c*) forms large mottles or tongues in which the podzol is developed; all the roots are present in *c*); in the upper part *b*) displays a clear stratification of more clayey layers, surrounded by a thin gangue of rust, but interrupted by *c*); abrupt smooth boundary.

**2Cg** **120+ cm** Light brownish grey (2.5Y 6/2 moist) light sandy silt; gleyed; structureless, massive; firm; not plastic; with frequent large yellowish brown (10YR 5/6 moist) mottles, striking, diffuse to clear.

## LEPTIC PODZOL Pl

**Podzolic brown soil tending to podzol** Italy

**Source** Valenti, A. & Sanesi, G. Quelques aspects des sols bruns acides et des sols bruns podzoliques des formations gréseuses de la Toscane (Italie). *Pédologie*, 17(1): 33-59, 1967

**Location** Abetone

**Altitude** 1 350 m

**Physiography** Moderately high mountains (Tuscan Apennines)

**Drainage** Well drained

**Parent material** Macigno sandstone

**Vegetation** Forest of *Abies alba* and *Pseudotsuga*, with *Vaccinium myrtillus*, *Festuca*, *Epilobium angustifolium*, *Rubus fruticosus*

**Climate** Annual rainfall: 2 600 mm; annual mean temperature: 6°C

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**Profile description**

**O** **1-0 cm** Slightly decomposed leaf litter.

**Ah1** **0-3 cm** Dark brown (7.5YR 3/2) sandy loam; structureless; friable dry; very slight biological activity; frequent roots; frequent leached grains; mat of mould and slightly decomposed roots; abrupt smooth boundary.

**E** **3-5 cm** Discontinuous; light brown (7.5YR 6/3) sandy loam; structureless; very friable dry; slight biological activity, roots common; abrupt wavy boundary.

**Bs** **5-54 cm** Brown (7.5YR 5.5/6) sandy loam to light sandy loam; very fine crumby structure; very friable, powdery, dry; abundant pores; slight biological activity, fine roots common; gradual smooth boundary.

**BC** **54-65 cm** Brown (7.5YR 5/6) sandy loam to light sandy loam; frequent coarse stones; very fine crumby structure; very friable dry; abundant pores; slight biological activity; few roots.

## LEPTIC PODZOL

**Italy**

| Horizon | Depth cm | Particle size distribution (mm) % | | | | Organic matter | | |
|---|---|---|---|---|---|---|---|---|
| | | Sand 2-0.05 | Coarse silt 0.05-0.02 | Fine silt 0.02-0.002 | Clay < 0.002 | % C | % N | C/N |
| E | 3–5 | 53.9 | 7.9 | 23.7 | 14.6 | 5.0 | 0.3 | 17 |
| Bs | 5–54 | 46.8 | 16.1 | 23.6 | 13.5 | 1.9 | 0.1 | 19 |
| BC | 54–65 | 49.0 | 21.6 | 19.2 | 10.2 | 1.8 | 0.1 | 18 |

| Horizon | pH | | Free $Fe_2O_3$ % |
|---|---|---|---|
| | $H_2O$ | KCl | |
| E | 3.5 | 2.9 | 0.235 |
| Bs | 4.2 | 3.7 | 0.692 |
| BC | 4.3 | 3.9 | 0.526 |

| | |
|---|---|
| **ORTHIC PODZOL** | **Po** |
| **Iron Podzol** | Finland |
| **Source** | International Soil Museum collection (SF4), Wageningen |
| **Location** | Khniö, 20 km north of Parkano; Coord. 62°10′ N, 23°00′ E |
| **Altitude** | 125 m |
| **Physiography** | Flat site in almost flat country |
| **Drainage** | Moderately well drained |
| **Parent material** | Glacial till |
| **Vegetation** | Coniferous forest with *Picea abies*, *Pinus sylvestris* and *Betula verrucosa;* understorey of *Vaccinium* spp., *Pleurozium schreberi*, *Dicranum scoparium* and *undulatum* |
| **Climate** | Rainfall during growth period: 300 mm; length of growth period (> 5°C): 170 days |

**Profile description**

| | | |
|---|---|---|
| **O** | **5-0 cm** | Rootmat with poorly decomposed plant remains. |
| **E** | **0-10 cm** | Pinkish grey (7.5YR 6/2) dry, stony sand; single grain; non-sticky, non-plastic, loose moist and dry; frequent (sub)rounded gravel and stones of mostly granitic rocks; abrupt smooth boundary. |
| **Bsh1** | **10-14 cm** | Very dark greyish brown (10YR 3/2) dry, stony sand; single grain; non-sticky, non-plastic, loose moist, soft dry; frequent (sub)rounded gravel and stones of mostly granitic rocks; abrupt smooth boundary. |
| **Bsh2** | **14-32/35 cm** | Yellowish red (5YR 3/6) dry, gradually becoming strong brown (7.5YR 5/8) dry at 24 cm depth, stony sand; single grain; non-sticky, non-plastic, friable moist, soft dry; frequent (sub)rounded gravel and stones of mostly granitic rocks; clear wavy boundary. |
| **C** | **32/35-75 cm** | Light brownish grey (10YR 6/2) dry, stony sand; single grain; non-sticky, non plastic, friable moist, soft dry; frequent (sub)rounded gravel and stones of mostly granitic rocks; clear wavy boundary. |
| **Cg** | **75-95+ cm** | Light brownish grey (10YR 6/2) dry, common coarse, faint diffuse yellowish red (5YR 4/6) mottles; stony sand; porous massive; frequent (sub)rounded gravel and stones of mostly granitic rocks. |

**ORTHIC PODZOL**
**Finland**

| Horizon | Depth cm | Particle size distribution (mm) % | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Sand | | | | | Silt | | Clay |
| | | > 2 | 2-1 | 1-0.5 | 0.5-0.2 | 0.2-0.05 | 0.05-0.02 | 0.02-0.002 | < 0.002 |
| O | 5–0 | | | | | | | | |
| E | 0–10 | 10 | | 68 | | 19 | 6 | 7 | tr. |
| Bsh1 | 10–14 | 34 | | 69 | | 16 | 5 | 10 | tr. |
| Bsh2 | 14–32/35 | 42 | | 67 | | 22 | 6 | 4 | 1 |
| C | 32/35–75 | 46 | | 63 | | 20 | 9 | 5 | 3 |

| Horizon | Organic matter | | | Free $Fe_2O_3$ | pH | | Exchangeable cations me/100 g | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | % C | % N | C/N | | $H_2O$ | KCl | Ca | Mg | K | Na | S | T |
| O | 27.2 | 1.13 | 24 | 0.30 | 3.6 | 2.9 | 7.2 | 4.9 | 2.4 | 0.2 | 14.8 | 10.9 |
| E | 0.52 | 0.02 | 26 | 0.08 | 4.3 | 3.5 | 0.5 | 0.2 | tr. | tr. | 0.7 | 4.4 |
| Bsh1 | 2.28 | 0.10 | 23 | 1.86 | 4.8 | 4.4 | 0.3 | 0.1 | tr. | tr. | 0.4 | 23.9 |
| Bsh2 | 0.51 | 0.04 | 13 | 0.39 | 5.5 | 5.2 | | | | | | 7.9 |
| C | 0.16 | 0.01 | 16 | 0.18 | 5.7 | 5.1 | | | | | | 2.9 |

| | |
|---|---|
| **ORTHIC PODZOL** | **Po** |
| **Iron Podzol** | Sweden |
| **Source** | International Soil Museum collection (S 16), Wageningen |
| **Location** | Kulbäcksliden, Västerbottens Län; Coord. 64°15′ N, 19°40′ E |
| **Altitude** | 300 m above sea level |
| **Physiography** | High part of convex slope in undulating terrain. Gently sloping |
| **Drainage** | Well drained |
| **Parent material** | Late Plaistocene glacial till, derived from granitic bedrock |
| **Vegetation** | Northern coniferous forest with *Pinus*, *Albies*, *Betula*, *Vaccinium* and *Lycopodium* |
| **Climate** | Dfb (Köppen) cold with warm summer |

**Profile description**

| | | |
|---|---|---|
| **O** | **7-0 cm** | Partly decomposed organic matter, mainly decaying leaves, twigs and roots; abrupt smooth boundary. |
| **E** | **0-6 cm** | Light grey (10YR 6.5/1) moist, gravelly sandy loam; single grain; porous; non-sticky, non-plastic, loose moist, very porous; abrupt wavy boundary. |
| **EB** | **6-7 cm** | Brown (7.5YR 4/6) moist, sandy loam; massive; non-sticky, non-plastic, very friable moist, soft dry; wavy boundary. |
| **Bs1** | **7-15 cm** | Strong brown (7.5YR 4/8) moist, bouldery gravelly sandy loam; porous massive, weakly cemented; non-sticky, non-plastic, very friable moist, slightly hard dry; gradual boundary. |
| **Bs2** | **15-30 cm** | Yellowish brown (10YR 5/8) moist, gravelly sandy loam; porous massive; non-sticky, non-plastic, very friable moist, soft dry; gradual boundary. |
| **C** | **30+ cm** | Light olive brown (2.5Y 5/4) with streaks of brownish grey (2.5Y 6/2) and yellowish brown (10YR 5/8) moist, bouldery gravelly sandy loam; porous massive. |

## ORTHIC PODZOL
### Sweden

| Horizon | Depth cm | Particle size distribution (mm) % | | | | | |
|---|---|---|---|---|---|---|---|
| | | Sand | | | Silt | | Clay |
| | | > 2 | 2-0.2 | 0.2-0.05 | 0.05-0.02 | 0.02-0.002 | < 0.002 |
| **O** | 7–0 | | | | | | |
| **E** | 0–6 | 20 | 16 | 45 | 20 | 17 | 2 |
| **Bs1** | 7–15 | 24 | 12 | 42 | 23 | 20 | 3 |
| **Bs2** | 15–30 | 31 | 17 | 43 | 21 | 17 | 2 |
| **C** | 30+ | 25 | 36 | 28 | 18 | 16 | 2 |

| Horizon | Organic matter | | | Free $Fe_2O_3$ | pH | | Exchangeable cations me/100 g | | | | | | % V (100 S/T) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | % C | % N | C/N | | $H_2O$ | KCl | Ca | Mg | K | Na | S | T | |
| **O** | 26.7 | 1.09 | 25 | 0.15 | 3.7 | 3.3 | 4.3 | 3.1 | 1.9 | 0.1 | 9.4 | 88.9 | 11 |
| **E** | 0.4 | 0.03 | 12 | 0.05 | 4.3 | 3.3 | 0.3 | 0.1 | tr. | tr. | 0.4 | 4.6 | 9 |
| **Bs1** | 1.3 | 0.07 | 18 | 2.45 | 5.9 | 5.0 | 0.3 | 0.1 | 0.1 | tr. | 0.5 | 21.8 | 2 |
| **Bs2** | 0.2 | 0.02 | 10 | 0.76 | 6.0 | 5.1 | tr. | tr. | tr. | tr. | 0.1 | 3.9 | 2 |
| **C** | 0.1 | 0.01 | 10 | 0.46 | 5.9 | 4.8 | tr. | tr. | tr. | tr. | tr. | 2.2 | |

| | |
|---|---|
| **PLACIC PODZOL** | **Pp** |
| **Peaty ironpan podzol** | Ireland |
| **Source** | Conry, M.J. & Ryan, Pierce. *Soils of Co. Carlow*, p. 130-131. Dublin, National Soil Survey of Ireland. Soil Survey Bulletin No. 17 |
| **Location** | Knockendrane, Borris (20 km south of Carlow) |
| **Altitude** | Approx. 380 m |
| **Physiography** | Steeply rolling hills |
| **Drainage** | Impeded |
| **Parent material** | Shale bedrock |
| **Vegetation** | Sheep-grazed heath dominated by *Calluna vulgaris* and *Erica cinerea*; few grasses (*Festuca ovina, Sieglingia decumbens, Nardus stricta*) |
| **Climate** | Annual rainfall: 941 mm; annual mean temperature: 10°C |

**Profile description**

| | | |
|---|---|---|
| **H1** | **0-5 cm** | Very dark brown (10YR 2/2) peat; partly decomposed organic material; clear smooth boundary. |
| **H2** | **5-17 cm** | Black (10YR 2/1) peat; cloddy tending toward moderate, fine granular structure; firm; abundant roots; abrupt smooth boundary. |
| **Eg** | **17-22/36 cm** | Dark grey (10YR 4/1) sandy loam; weak, fine granular structure; friable; plentiful roots, root-mat above ironpan; abrupt tonguing boundary. |
| **Bmhs** | | Dark reddish brown (5YR 2/2) continuous ironpan 3-6 mm thick; very hard; abrupt tonguing boundary. |
| **Bs1** | **22-52/62 cm** | Strong brown (7.5YR 5/8) sandy loam to loam; weak, fine granular structure; very friable; few roots; gradual boundary. |
| **C** | **52+ cm** | Light olive brown (2.5Y 5/4) very shaly sandy loam; structureless; friable; no roots. |

## PLACIC PODZOL

**Ireland**

| Horizon | Depth cm | Particle size distribution (mm) % | | | | pH | Organic matter | | | Free $Fe_2O_3$ % |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Coarse sand | Fine sand | Silt | Clay | | % C | % N | C/N | |
| H1 | 5–5 | — | — | — | — | 4.4 | 36.8 | 1.8 | 20 | 0.7 |
| H2 | 5–17 | — | — | — | — | 4.6 | 24.0 | 0.95 | 25 | 1.7 |
| Eg | 17–22/36 | 36 | 22 | 32 | 10 | 4.7 | 4.6 | 0.23 | 20 | 1.0 |
| Bmhs | | — | — | — | — | — | 4.7 | 0.24 | 19 | 7.4 |
| Bs1 | 22–52/62 | 25 | 28 | 34 | 13 | 4.9 | 2.2 | 0.23 | 9 | 3.6 |
| C | 52+ | 38 | 29 | 30 | 3 | 5.3 | 0.7 | — | — | 1.6 |

| Horizon | Extractable cations me/100 g | | % V (100 S/T) |
|---|---|---|---|
| | S | T | |
| H1 | 6.1 | 98.4 | 6 |
| H2 | 1.3 | 88.8 | 15 |
| Eg | 0.9 | 22.0 | 4 |
| Bmhs | 0.4 | 46.0 | 1 |
| Bs1 | 1.0 | 19.6 | 5 |
| C | 0.7 | 14.4 | 5 |

| | |
|---|---|
| **CAMBIC ARENOSOL** | **Qc** |
| **Arenales** | Spain |
| **Source** | Gragera, G., Guerra, A. *et al. Conferencia sobre Suelos Mediterráneos. Guía de la excursión española.* Profile XV. Madrid, Sociedad Española de Ciencia del Suelo, 1966 |
| **Location** | Between Hinojos and Almonte, about 50 km west of Seville |
| **Altitude** | Approx. 75 m |
| **Physiography** | Flat to slightly undulating area |
| **Drainage** | Subsoil slightly permeable |
| **Parent material** | Pliocene sand |
| **Vegetation** | Pine and eucalyptus plantation |
| **Climate** | Annual rainfall: 650 mm; annual mean temperature: 16.3°C |

**Profile description**

| | | |
|---|---|---|
| **OAh** | **0-3 cm** | Dark greyish brown (10YR dry) sand; slightly humic; weak, medium crumby and elementary structure; very loose; porous, very permeable; fine roots; slight biological activity; abrupt broken boundary. |
| **Ah1** | **3-30 cm** | Dark brown (10YR 4/3 dry) silty sand; structureless, elementary; very loose; porous, very permeable; abundant coarse roots running horizontally; moderate biological activity; gradual smooth boundary. |
| **AC** | **30-50 cm** | Yellowish brown (10YR 5/4 dry) sand, with few lighter streaks; structureless, elementary; loose; porous, very permeable; few coarse roots; slight biological activity; gradual smooth boundary. |
| **C** | **50-60 cm** | Light yellowish brown (10YR 6/4 dry) sand; structureless, elementary; loose; porous, very permeable; few horizontal coarse roots; slight biological activity; iron nodules; clear smooth boundary. |
| **2Cg1** | **60-80 cm** | Yellowish brown (10YR 5/6) sandy clay loam, slight fine gravel; moderate coarse subangular blocky structure; firm; slightly porous, slightly permeable; few medium roots, slight biological activity; few small iron nodules; diffuse smooth boundary. |
| **2Cg2** | **80+ cm** | Sandy clay loam with fine and medium gravel; reddish brown (2.5YR 4/4) and light grey (10YR 7/1) mottles; strong coarse blocky structure; firm; slightly porous, very slightly permeable; few traces of roots. |

**CAMBIC ARENOSOL**
**Spain**

| Horizon | Depth cm | Particle size distribution (mm) % | | | | Organic matter | | | $CaCO_3$ % |
|---|---|---|---|---|---|---|---|---|---|
| | | Coarse sand | Fine sand | Silt | Clay | % C | % N | C/N | |
| OAh | 0–3 | 46.2 | 44.8 | 2.5 | 4.8 | 0.5 | 0.08 | 6 | 0.3 |
| Ah1 | 3–30 | 50.3 | 36.2 | 6.8 | 5.5 | 0.1 | 0.01 | 10 | 0 |
| AC | 30–50 | 54.7 | 36.9 | 2.6 | 5.1 | 0.1 | 0.01 | 10 | 0 |
| C | 50–60 | 40.5 | 49.9 | 2.7 | 5.2 | tr. | — | — | 0 |
| 2Cg1 | 60–80 | 34.6 | 37.4 | 2.2 | 24.3 | 0.2 | 0.02 | 10 | 0.5 |
| 2Cg2 | 80 + | 12.6 | 48.8 | 3.7 | 34.1 | 0.1 | 0.01 | 10 | 0 |

| Horizon | pH | | Extractable cations me/100 g | | | | | | % V (100 S/T) | Free $Fe_2O_3$ |
|---|---|---|---|---|---|---|---|---|---|---|
| | $H_2O$ | KCl | Ca | Mg | Na | K | S | T | | |
| OAh | 6.3 | 5.7 | 6.5 | 1.8 | — | 0.3 | 8.6 | 10 | 86 | 0.26 |
| Ah1 | 6.5 | 5.7 | 1.7 | 0.9 | — | 0.2 | 2.8 | 2.8 | 100 | 0.27 |
| AC | 7.1 | 6.4 | 2.0 | 0.9 | — | 0.1 | 3.0 | 3.1 | 96 | 0.24 |
| C | 7.3 | 6.4 | 0.4 | 0.4 | — | 0.1 | 0.9 | 0.9 | 100 | 0.21 |
| 2Cg1 | 5.3 | 4.4 | 2.1 | 2.4 | — | 0.3 | 4.8 | 5.1 | 94 | 1.01 |
| 2Cg2 | 5.2 | 4.5 | 5.4 | 6.1 | 0.3 | 0.3 | 12.1 | 14.5 | 83 | 0.91 |

| Horizon | Total analysis % | | | | | | | | $\frac{SiO_2}{R_2O_3}$ | $\frac{SiO_2}{Al_2O_3}$ | $\frac{SiO_2}{Fe_2O_3}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | $SiO_2$ | $Al_2O_3$ | $Fe_2O_3$ | MgO | CaO | $Na_2O$ | $K_2O$ | $TiO_2$ | | | |
| OAh | 92.91 | 1.39 | 0.44 | 0.11 | 0.17 | 0.06 | 1.02 | 0.35 | 74.69 | 113.69 | 572.67 |
| Ah1 | 95.75 | 1.26 | 0.41 | 0.24 | 0.05 | — | 1.04 | 0.19 | 91.57 | 128.50 | 612.85 |
| AC | 96.35 | 1.24 | 0.37 | — | 0.63 | 0.12 | 1.08 | 0.24 | 91.62 | 131.43 | 697.13 |
| C | 95.86 | 1.77 | 0.36 | 0.38 | 0.43 | 0.12 | 1.25 | 0.22 | 71.54 | 91.68 | 725.14 |
| 2Cg1 | 85.35 | 7.70 | 1.80 | 0.11 | 0.08 | 0.06 | 1.63 | 0.47 | 15.32 | 18.81 | 125.66 |
| 2Cg2 | 79.72 | 12.04 | 1.96 | 0.55 | 0.19 | 0.13 | 1.76 | 0.58 | 9.64 | 11.23 | 107.86 |

## LUVIC CAMBISOL Ql

| | |
|---|---|
| **Kovárvány brown forest soil** [1] | Hungary |
| **Source** | Stefanovits, P. *Brown forest soils of Hungary*, p. 138. Budapest, Akadémiai Kiadó, 1971 |
| **Location** | Dejtár (north central Hungary near Czechoslovakian border) |
| **Physiography** | Danube Plain |
| **Drainage** | Somewhat excessively drained |
| **Parent material** | Quaternary sand |
| **Vegetation** | Field crops |
| **Climate** | Moderately warm, moderately humid |

**Profile description**

| | | |
|---|---|---|
| **Ap** | **0-25 cm** | Brown (10YR 4/3) weakly humic sand; grain diameters 0.1 to 0.5 mm; many black grains. |
| **Bt1** | **25-65 cm** | Strong brown (7.5YR 5/6) sand with yellowish red (5YR 4/6) clay lamellae 5-20 mm thick, at 10-cm intervals; structureless; lamellae very compact; clay formation in indistinct patches between lamellae; sand grain sizes more uniform; many black and coloured grains. |
| **Bt2** | **65-85 cm** | Yellowish brown (10YR 5/6) sand with yellowish red (5YR 4/6) clay lamellae 1 cm thick at 5- to 6-cm intervals; much fewer reddish elements than in Bt1; colour and cementation increase with depth. |
| **BC** | **85-115 cm** | Very pale brown (10YR 7/4) sand with uniform (0.2-0.3 mm) grains, many black and green; few lamellae, weak, very far apart. |
| **C** | **115-150 cm** | Yellowish brown (10YR 5/4) coarse stratified sand, many black and green grains; fine sand in lower part. |

[1] Kovárvány (Hung.): thin clay lamellae.

**LUVIC ARENOSOL**

**Hungary**

| Horizon | Depth cm | Particle size distribution (mm) % | | | | % C |
|---|---|---|---|---|---|---|
| | | 0.25-0.05 | 0.05-0.02 | 0.02-0.002 | < 0.002 | |
| Ap | 0–25 | 77.9 | 8.2 | 6.9 | 7.0 | 1.0 |
| Bt1 | 25–65 | 76.7 | 6.9 | 4.4 | 12.0 | 0.5 |
| Bt2 | 65–85 | 83.7 | 4.9 | 4.0 | 7.4 | 0.4 |
| BC | 85–115 | 86.1 | 5.7 | 4.0 | 4.2 | 0.3 |
| C | 115–150 | 89.0 | 5.3 | 2.5 | 3.3 | 0.2 |

| Horizon | pH $H_2O$ | Extractable cations me/100 g | | | | | | % V (100 S/T) |
|---|---|---|---|---|---|---|---|---|
| | | Ca | Mg | K | Na | S | T | |
| Ap | 6.2 | 70.4 | 22.0 | 7.0 | 0.7 | 6.0 | 10.6 | 57 |
| Bt1 | 6.2 | 77.0 | 20.5 | 1.6 | 0.9 | 9.4 | 14.5 | 65 |
| Bt2 | 6.6 | 70.5 | 26.3 | 1.9 | 1.3 | 6.7 | 9.6 | 70 |
| BC | 6.6 | 66.1 | 31.0 | 1.9 | 0.9 | 6.2 | 6.6 | 94 |
| C | 6.6 | 74.4 | 23.0 | 1.9 | 0.8 | 7.0 | 7.1 | 99 |

| | |
|---|---|
| **GLEYIC SOLONETZ** | **Sg** |
| **Solodized solonetz** | Romania |
| **Source** | Popovatz, M. *et al. Guidebook of excursions.* Volume 2. International Congress of Soil Science, Profile 17. Bucharest, 1964 |
| **Location** | Tisza River Plain, Crisul Alb |
| **Altitude** | 92 m |
| **Physiography** | Subsidence plain, very slightly undulating |
| **Drainage** | Poorly drained (water-table at 2.36 m) |
| **Parent material** | Slightly calcareous alluvia |
| **Vegetation** | Prairie |
| **Climate** | Annual rainfall: 577 mm; annual mean temperature: 10.8°C |

**Profile description**

| | | |
|---|---|---|
| **Ah** | **0-2 cm** | Very dark greyish brown (10YR 3/2 moist), grey (10YR 5/1 dry) loam; friable; many fine roots; abrupt wavy boundary. |
| **E** | **2-5 cm** | Dark greyish brown (2.5Y 4-5/2 moist), light grey (2.5Y 7/2 dry) loam; frequent fine strong brown (7.5YR 5/8 dry) mottles; weak coarse platy and medium granular structure; friable; firm in lower part; frequent roots; clear wavy boundary. |
| **Bt1** | **5-22 cm** | Dark greyish brown (2.5Y 4-5/2 moist), light grey (2.5Y 7/2 dry) clay loam; fine strong brown (7.5YR 5/8 dry) mottles, darker within peds; frequent fine diffuse very dark grey to black (5Y 3-2/1) and reddish brown (2.5YR 4/4) mottles; strong coarse columnar structure; very hard; 5- to 10-mm fissures containing silica; fine iron-manganese nodules; clear boundary. |
| **Bt2** | **22-47 cm** | Very dark grey (5Y 3/1 moist), dark grey (5Y 4/1 dry) silty clay; strong coarse subangular blocky structure; very hard; very compact; abundant fissures; silica from upper horizons; abundant iron-manganese nodules; clear boundary. |
| **Btg** | **47-67 cm** | Dark greyish brown (2.5Y 4/2 moist), greyish brown (2.5Y 5/2 dry) silty clay; strong coarse angular blocky structure; firm; compact; sticky; few fine iron-manganese nodules; few fine silico-calcareous nodules; clear boundary. |
| **Ckg1** | **67-89 cm** | Olive grey (5Y 4/2) silty clay loam; abundant fine diffuse reddish yellow (5YR 6/8) mottles; structureless; plastic; compact; soft calcareous and few silico-calcareous nodules; effervescent except locally; soft fine iron-manganese nodules; gradual diffuse boundary. |
| **Ckg2** | **89-127 cm** | Olive (5Y 4/3) silty clay loam with mica flakes and shell fragments; few dark grey (5Y 3/1) to yellowish red (5YR 5/8 moist) mottles; tongues of dark material penetrating from above; abundant fine iron-manganese nodules; gradual boundary. |

## GLEYIC SOLONETZ
### Romania

| Horizon | Depth cm | Particle size distribution (mm) % | | | | | | % $CaCO_3$ |
|---|---|---|---|---|---|---|---|---|
| | | 2-0.2 | 0.2-0.1 | 0.1-0.06 | 0.06-0.02 | 0.02-0.002 | < 0.002 | |
| Ah | 0–2 | 5.2 | 5.2 | 7.0 | 30.6 | 32.2 | 19.8 | |
| E | 2–5 | 1.6 | 8.5 | 9.5 | 31.2 | 28.2 | 21.0 | |
| Bt1 | 5–22 | 3.4 | 8.5 | 9.2 | 26.2 | 25.3 | 27.4 | |
| Bt2 | 22–47 | 1.2 | 6.0 | 7.3 | 19.4 | 23.0 | 43.1 | |
| Btg | 47–67 | 0.8 | 5.5 | 5.7 | 20.8 | 25.4 | 41.8 | |
| Ckg1 | 67–89 | 0.8 | 6.2 | 6.5 | 24.8 | 26.3 | 35.4 | 13.2 |
| Ckg2 | 89–127 | 0.8 | 5.8 | 6.6 | 25.7 | 28.0 | 33.1 | |

| Horizon | Organic matter | | | ph | Extractable cations me/100 g | | | | | | % V (100 S/T) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | % C | % N | C/N | $H_2O$ | Ca | Mg | K | Na | H | T | |
| Ah | 10.8 | 1.04 | 12 | 5.4 | 12.0 | 5.8 | 0.6 | 0.5 | 19.9 | 38.8 | 49 |
| E | 2.7 | 0.26 | 12 | 6.0 | 4.2 | 2.6 | 0.2 | 0.6 | 10.3 | 18.1 | 42 |
| Bt1 | 1.3 | 0.11 | 14 | 7.4 | 5.1 | 5.0 | 0.3 | 5.8 | 3.5 | 19.7 | 82 |
| Bt2 | 0.9 | 0.1 | 10 | 8.7 | 6.2 | 8.8 | 0.4 | 17.2 | 0.5 | 33.2 | 98 |
| Btg | 0.8 | — | — | 9.1 | 5.0 | 10.0 | 0.3 | 17.2 | 0.2 | 32.7 | 99 |
| Ckg1 | 0.4 | — | — | 9.2 | 9.5 | | 0.4 | 14.4 | — | 24.4 | 99 |
| Ckg2 | — | — | — | 9.7 | 8.3 | | 0.3 | 13.4 | — | 22.0 | 100 |

| Horizon | Soluble salts me/100 g | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Anions | | | | Cations | | | |
| | $HCO_3$ | Cl | So, | $CO_3$ | Ca | Mg | K | Na |
| Ah | 0.35 | 0.26 | 0.22 | | 0.22 | 0.05 | 0.07 | 0.49 |
| E | 0.21 | 0.09 | 0.13 | | 0.12 | — | 0.03 | 0.27 |
| Bt1 | 1.06 | 0.83 | 0.19 | | 0.18 | — | 0.03 | 1.87 |
| Bt2 | 0.57 | 1.36 | 7.89 | | 0.16 | 0.05 | 0.06 | 9.52 |
| Btg | 0.87 | 1.24 | 7.20 | 0.02 | 0.37 | 0.04 | 0.06 | 8.88 |
| Ckg1 | 2.27 | 1.44 | 4.95 | 0.59 | 0.15 | 0.03 | 0.03 | 9.04 |
| Ckg1 | 1.75 | 1.00 | 1.63 | 0.67 | 0.24 | 0.04 | 0.03 | 4.78 |
| [1] | 29.5 | 18.0 | 43.4 | 7.9 | 0.5 | 4.5 | 0.02 | 88.0 |

[1] Salts dissolved in the groundwater (me/l).

| | |
|---|---|
| **ORTHIC SOLONETZ** | **So** |
| **Steppe solonetz** | USSR |
| **Source** | Grin, G.S., Kissel, V.D. *et al. Short guide to soil excursion Moskow-Kherson, Profile 9*, p. 75-82. Moscow, Ministry of Agriculture of the USSR, 1964 |
| **Location** | Askania-Nova Reserve, on the Sea of Azov |
| **Altitude** | 15-20 m |
| **Physiography** | Coastal plain, gently sloping to the sea; on a gentle slope of the Great Chapel " pod " [1] |
| **Drainage** | Well drained |
| **Parent material** | Loess |
| **Vegetation** | Summer cyprus-*Festuca* association |
| **Climate** | Annual rainfall: 340-360 mm; annual mean temperature: 10°C (January: —4°C; July: 24°C) |

**Profile description**

| | | |
|---|---|---|
| **Ah** | **0-15 cm** | Dark grey and light grey medium loam; platy structure; friable; abrupt boundary. |
| **Bt1** | **15-30 cm** | Dark reddish brown silty clay; columnar prismatic structure; compact; gradual boundary. |
| **Bt2** | **30-45 cm** | Dark brown silty clay with reddish brown tinge; compact; fine pores; gradual boundary. |
| **Btk** | **45-95 cm** | Pale brown clay; crumby between 55 and 85 cm; abundant limestone " white eyes "; humus along the roots. |
| **C** | **95-170 cm** | Pale brown clayey loess; large gypsum crystals in upper part; below 160 cm abundant fine crystalline gypsum, forming large crystals. |

[1] Pod: Saucer-like depressions varying in area from a few square metres to some tens of square kilometres. They contain hydromorphic soils (here, for example, Gleyic Solonetz).

## ORTHIC SOLONETZ
## USSR

| Horizon | Depth cm | Particle size distribution (mm) % | | | | | |
|---|---|---|---|---|---|---|---|
| | | 1-0.25 | 0.25-0.05 | 0.05-0.01 | 0.01-0.005 | 0.005-0.001 | < 0.001 |
| Ah1 | 0–15 | 0.8 | 3.6 | 50.5 | 4.5 | 18.1 | 22.2 |
| Bt1 | 15–30 | 0 | 5.5 | 29.5 | 15.2 | 10.1 | 42.8 |
| Bt2 | 30–45 | 0 | 8.3 | 32.9 | 8.7 | 3.3 | 36.9 |
| Btk | 45–95 | 0.1 | 2.3 | 38.2 | 10.6 | 6.1 | 42.8 |
| C | 95–170 | 0.1 | 6.9 | 31.8 | 11.8 | 8.9 | 40.1 |

| Horizon | Organic matter | | | pH $H_2O$ | Extractable cations me/100 g | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | % C | % N | C/N | | Ca | Mg | Na | K | T |
| Ah1 | 1.97 | 0.17 | 11.6 | 7.6 | 10.3 | 5.1 | 0.5 | 1.5 | 17.4 |
| Bt1 | 1.05 | 0.11 | 9.5 | 7.6 | 16.1 | 9.3 | 2.4 | 1.3 | 29.2 |
| Bt2 | 0.77 | 0.08 | 9.6 | 7.6 | 12.0 | 11.1 | 2.9 | 0.8 | 26.8 |
| Btk | | | | 8.2 | | | | | |
| C | | | | 8.4 | | | | | |

| | |
|---|---|
| **HUMIC ANDOSOL** | **Th** |
| **Differentiated melanic Andosol** | France |
| **Source** | Moinereau, J. *Altération des roches, formation et évolution des sols sur basalte, sous climat tempéré humide* (*Velay, Vivarais, Coiron*). Profile 126. Montpellier, Université des sciences et techniques du Languedoc, 1977 (Thesis) |
| **Location** | Cime de Rouyon. Burzet sheet coordinates: X = 756; Y = 274 (approx. 130 km south of Lyons) |
| **Altitude** | 1 400 m |
| **Physiography** | Cone of recent basaltic scoriae and pumice |
| **Drainage** | Well drained |
| **Parent material** | Scoriae, lapilli, Quaternary pumice |
| **Vegetation** | Beech forest and meadow with ferns, myrtle and raspberry |
| **Climate** | Annual rainfall: 1 525 mm; annual mean temperature: 5.3°C |

**Profile description**

| | | |
|---|---|---|
| **O** | **5-0 cm** | Litter of fern leaves, grass roots and straw, and beech leaves and nuts. |
| **Ah1** | **0-25 cm** | Very dark brown (10YR 2/2 moist), dark greyish brown (10YR 3/2 dry) loam clay; humic; very fine crumby fluffy structure; powdery dry; loose; low density; strong overall porosity; abundant fine and medium roots; gradual boundary. |
| **AB** | **25-50 cm** | Dark brown (10YR 3/3 moist and dry) loam; very fine crumby fluffy structure; loose; strongly porous; roots, channels and cavities of biological origin; gradual boundary. |
| **B** | **50-70 cm** | Dark brown (10YR 3/3 moist), brown (10YR 4/3 dry) loam, slightly stony and gravelly from basaltic pumice; crumby fluffy structure; less loose, more cohesive; slightly less porous; abundant roots with fern rhizomes; frequent worm channels; clear irregular boundary with humus pockets. |
| **BC** | **70-85 cm** | Deep yellowish brown (10YR 5/6 moist), light yellowish brown (10YR 6/4 dry) sandy loam, gravelly and stony from basaltic pumice; fine crumby fluffy structure; porous; loose; clear irregular boundary with pockets. |
| **C** | **85-110 cm** | Deep yellow brown (10YR 4/4 moist), light yellowish brown (10YR 6/4 dry) gravelly and sandy lapilli and pumice, coated with a yellow ochre (10YR 4/4) sandy silt. |

## HUMIC ANDOSOL

**France**

| Horizon | Depth cm | Particle size distribution (mm) % | | | | |
|---|---|---|---|---|---|---|
| | | Coarse sand 2-0.2 | Fine sand 0.2-0.05 | Coarse silt 0.05-0.02 | Fine silt 0.02-0.002 | Clay < 0.002 |
| Ah1 | 0–25 | 20.0 | 13.7 | 8.4 | 26.6 | 31.3 |
| AB | 25–50 | 28.2 | 14.1 | 7.7 | 27.2 | 22.8 |
| B | 50–70 | 28.5 | 18.1 | 8.8 | 28.0 | 16.6 |
| BC | 70–85 | 33.7 | 13.3 | 16.5 | 25.9 | 10.6 |
| C | 85–110 | 25.7 | 19.0 | 18.0 | 27.6 | 9.7 |

| Horizon | Organic matter | | | pH $H_2O$ | pH NaF | | Extractable cations me/100 g | | | | | | % V (100 S/T) pH 7 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | % C | % N | C/N | | 30″ | 1′ | Ca | Mg | K | Na | T pH 7 | T pH 4 | |
| Ah1 | 11.1 | 0.85 | 13.0 | 4.6 | 10.2 | — | 2.05 | 0.29 | 0.23 | 0.07 | 27.0 | 3.4 | 9.8 |
| AB | 9.8 | 0.71 | 13.8 | 4.9 | 10.4 | 10.5 | 1.05 | 0.19 | 0.11 | 0.10 | 25.5 | 2.8 | 5.8 |
| B | 6.9 | 0.56 | 12.3 | 5.1 | 10.6 | 10.8 | 0.75 | 0.12 | 0.08 | 0.08 | 19.0 | 1.3 | 5.4 |
| BC | 2.5 | 0.19 | — | 5.4 | 10.7 | 10.8 | 0.73 | 0.08 | 0.04 | 0.05 | 13.0 | 0.3 | 6.9 |
| C | 1.5 | 0.11 | — | 5.8 | 10.4 | 10.6 | 0.60 | 0.11 | 0.05 | 0.04 | 12.0 | 0.2 | 6.9 |

| Horizon | Humidity % | | | Bulk density |
|---|---|---|---|---|
| | 105° | Field cap. | Wilting point | |
| Ah1 | 27.4 | 59.9 | 44.9 | 0.82 |
| AB | 22.0 | 52.5 | 40.3 | |
| B | 17.6 | 48.9 | 33.1 | 0.88 |
| BC | 16.3 | 41.4 | 26.1 | |
| C | 11.9 | 35.0 | 20.0 | |

| | |
|---|---|
| **OCHRIC ANDOSOL** | **To** |
| **Differentiated chromic Andosol** | France |
| **Source** | Moinereau, J. *Altération des roches, formation et évolution des sols sur basalte, sous climat tempéré humide* (*Velay, Vivarais, Coiron*). Profile 109. Montpellier, Université des sciences et techniques du Languedoc, 1977 (Thesis) |
| **Location** | Lachamp Raphaël, col du Pranlet. Burzet sheet coordinates: X = 752.6; Y = 281.3 (approx. 130 km south of Lyons) |
| **Altitude** | 1 370 m |
| **Physiography** | Old basaltic plateau |
| **Drainage** | Well drained |
| **Parent material** | Grey scoriae and yellow tuffs |
| **Vegetation** | Subalpine meadow with gentian, nard, *Calluna, Festuca, Cytisus purgans* |
| **Climate** | Annual rainfall: 1 525 mm; annual mean temperature: 5.3°C |

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**Profile description**

| | | |
|---|---|---|
| **Ah1** | **0-12 cm** | Deep reddish brown (5YR 2/2 moist), dark brown (10YR 4/3 dry) clay loam silt, humic; very fine crumby structure tending to structureless; strongly porous; non-plastic wet, soft dry; abundant vertical fine roots; few channels of biological origin; clear smooth boundary. |
| **Ah2** | **12-35 cm** | Dark brown (7.5YR 4/4 moist), dark yellowish brown (10YR 4/4 dry) silt loam, gravelly; fine crumby structure tending to structureless; strongly porous; non-plastic wet, soft dry; abundant vertical fine roots; considerable biological activity; clear smooth boundary. |
| **B** | **35-65 cm** | Dark brown (7.5YR 4/2 moist), dark yellowish brown (10YR 4/4 dry) silty clay loam; subangular blocky structure with crumby substructure; non-plastic; strongly porous; few roots; abundant traces of worms; gradual irregular boundary. |
| **BC** | **65-90 cm** | Deep brown (7.5YR 3/2 moist), brown (10YR 5/4 dry) clay loam, with fine stones and rubble of greenish yellow tuff; continuous structure breaking to slightly platy subangular blocks; highly porous; non-plastic, sticky; clear smooth boundary. |
| **C1** | **90-115 cm** | As BC, but with streaks of iron oxide rust and beds of basalt bombs of augite phenocrysts (semi-porphyroid basalt) and purplish clayey scoriae; clear smooth boundary. |
| **C2** | **115-130 cm** | Greyish (5Y 7/2 moist), greenish yellow (10YR 7/8 dry) tuff, with purplish scoriae. |

## OCHRIC ANDOSOL

**France**

| Horizon | Depth cm | Particle size distribution (mm) % | | | | |
|---|---|---|---|---|---|---|
| | | Coarse sand 2-0.2 | Fine sand 0.2-0.05 | Coarse silt 0.05-0.02 | Fine silt 0.02-0.002 | Clay < 0.002 |
| Ah1 | 0–12 | 13.5 | 13.7 | 11.2 | 31.8 | 29.8 |
| Ah2 | 12–35 | 8.9 | 9.7 | 12.4 | 50.0 | 19.0 |
| B | 35–65 | 12.0 | 7.1 | 8.6 | 34.3 | 38.0 |
| BC | 65–90 | 14.0 | 8.8 | 10.3 | 35.8 | 31.1 |
| C1 | 90–115 | 13.7 | 11.7 | 14.9 | 34.4 | 25.3 |
| C2 | 115–130 | 4.3 | 8.3 | 15.8 | 42.9 | 28.7 |

| Horizon | Organic matter | | | pH | pH NaF | | Extractable cations me/100 g | | | | | | % V (100 S T) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | % C | % N | C/N | $H_2O$ | 30″ | 1′ | Ca | Mg | K | Na | T pH 7 | T pH 4 | pH 7 |
| Ah1 | 11.1 | 0.89 | 12.6 | 5.0 | 9.4 | 9.5 | 11.38 | 3.70 | 0.55 | 0.08 | 49.5 | 24.3 | 31.7 |
| Ah2 | 6.1 | 0.46 | 13.2 | 5.1 | 10.1 | 10.4 | 7.0 | 0.76 | 0.08 | 0.08 | 37.0 | 13.6 | 21.4 |
| B | 3.3 | 0.41 | 8.2 | 5.6 | 10.1 | 10.3 | 9.0 | 1.16 | 0.04 | 0.06 | 30.5 | 10.1 | 33.6 |
| BC | 1.7 | 0.19 | — | 5.7 | 10.2 | 10.5 | 8.13 | 2.20 | 0.03 | 0.15 | 38.5 | 14.9 | 27.2 |
| C1 | 1.6 | 0.13 | — | 5.4 | 9.9 | 10.2 | 12.75 | 6.20 | 0.05 | 0.19 | 44.5 | 30.0 | 44.7 |
| C2 | 0.4 | 0.05 | — | 5.6 | 9.4 | 9.7 | 19.50 | 11.7 | 0.04 | 0.34 | 59.0 | 51.5 | 53.5 |

| Horizon | Humidity % | | | Bulk density |
|---|---|---|---|---|
| | 105° | Field cap. | Wilting point | |
| Ah1 | 18.8 | 56.9 | 46.8 | |
| Ah2 | 23.0 | 55.4 | 32.6 | 0.70 |
| B | 30.7 | 55.9 | 39.1 | 0.61 |
| BC | 23.4 | 43.6 | 31.4 | |
| C1 | 18.9 | 41.5 | 30.5 | |
| C2 | 26.3 | 50.2 | 38.5 | |

## VITRIC ANDOSOL Tv

| | |
|---|---|
| **Slightly differentiated Vitric Andosol** | France |
| **Source** | Moinereau, J. *Altération des roches, formation et évolution des sols sur basalte, sous climat tempéré humide (Velay, Vivarais, Coiron).* Profile 113. Montpellier, Université des sciences et techniques du Languedoc, 1977 (Thesis) |
| **Location** | Coupe d'Alzac. Privas sheet coordinates: X = 758.7; Y = 269.8 (approx. 130 km south of Lyons) |
| **Altitude** | 740 m |
| **Physiography** | Breached crater of recent volcano |
| **Drainage** | Excessively drained |
| **Parent material** | Basaltic pumice and scoriae |
| **Vegetation** | Chestnut forest, ferns, broom |
| **Climate** | Annual rainfall: 900-1 200 mm; annual mean temperature: 10°C |

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**Profile description**

| | | |
|---|---|---|
| **O** | **3-0 cm** | Litter of leaves, chestnut burrs, fern branches; fermentation layer at base. |
| **Ah1** | **0-5 cm** | Deep brown (10YR 3/3 dry) sandy loam, humic, with basaltic coarse and fine gravel and sand; very fine crumby structure tending to structureless, fluffy; slightly cohesive, low density; abundant roots; clear irregular boundary. |
| **Ah2** | **5-25 cm** | Deep yellowish brown (10YR 3/4 moist), brown (10YR 4/3 dry) sandy loam, humic, with reddish glints from basaltic pumice; crumby fluffy structure; loose; powdery dry; very strong porosity, due partly to pumice; very heterogeneous, with blocks, stones and gravel; abundant roots, considerable biological activity; gradual boundary. |
| **Ah3** | **25-40 cm** | As Ah2, but pumice more abundant and boundary marked by bed of vesicular bombs. |
| **C** | **40-150 cm** | Brown (7.5YR 4/2 moist), light brown (7.5YR 6/4 dry) pumice sand and gravel, alternating with beds of volcanic bombs; surfaces weathered to silt and sand; very slightly cohesive; no structure visible in rare fine earth. |

**VITRIC ANDOSOL**

**France**

| Horizon | Depth cm | Particle size distribution (mm) % | | | | |
|---|---|---|---|---|---|---|
| | | Coarse sand 2-0.2 | Fine sand 0.2-0.05 | Coarse silt 0.05-0.02 | Fine silt 0.02-0.002 | Clay < 0.002 |
| Ah1 | 0–5 | 15.6 | 26.3 | 17.9 | 33.7 | 6.5 |
| Ah2 | 5–25 | 15.4 | 22.2 | 19.1 | 35.3 | 8.0 |
| Ah3 | 25–40 | 23.3 | 16.7 | 19.4 | 34.2 | 6.4 |
| C | 40–150 | 27.5 | 17.2 | 16.3 | 31.5 | 7.5 |

| Horizon | Organic matter | | | pH | pH NaF | | Extractable cations me/100 g | | | | | | % V (100 S/T) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | % C | % N | C/N | $H_2O$ | 30″ | 1′ | Ca | Mg | K | Na | T pH 7 | T pH 4 | pH 7 |
| Ah1 | 11.5 | 0.78 | 14.6 | 6.0 | 9.3 | 9.6 | 13.50 | 7.2 | 0.40 | 0.19 | 43.0 | 23.6 | 49.5 |
| Ah2 | 4.5 | 0.31 | 14.3 | 5.8 | 10.4 | 10.6 | 2.33 | 1.0 | 0.15 | 0.11 | 21.0 | 1.5 | 17.1 |
| Ah3 | 3.3 | 0.27 | | 5.5 | 10.3 | 10.5 | 1.63 | 0.5 | 0.07 | 0.01 | 18.5 | 0.9 | 11.9 |
| C | 2.4 | 0.18 | | 5.8 | 10.2 | 10.4 | 1.38 | 0.5 | 0.03 | 0 | 14.5 | 0.4 | 13.2 |

| Horizon | Humidity % | | | Bulk density |
|---|---|---|---|---|
| | 105° | Field cap. | Wilting point | |
| Ah1 | 18.3 | 55.8 | 49.3 | |
| Ah2 | 9.6 | 37.1 | 23.1 | 0.8 |
| Ah3 | 9.1 | 35.9 | 20.3 | |
| C | 8.1 | 34.3 | 15.0 | |

| | |
|---|---|
| **CHROMIC VERTISOL** | **Vc** |
| **Lithomorphic vertisol** | Spain |
| **Source** | Gragera, P., Guerra, A. *et al. Conferencia sobre Suelos Mediterráneos. Guía de la excursión española.* Profile IX. Madrid, Sociedad Española de Ciencia del Suelo, 1966 |
| **Location** | Km 60 on the Cordova-Seville road |
| **Altitude** | Approx. 100 m |
| **Physiography** | Plain, Guadalquivir depression |
| **Drainage** | Slightly permeable |
| **Parent material** | Tortonian grey marl |
| **Vegetation** | Field crops |
| **Climate** | Annual rainfall: 679 mm; annual mean temperature: 13.1°C |

**Profile description**

| | | |
|---|---|---|
| **Ap1** | **0-5 cm** | Pale olive (5Y 6/3 dry) clay; slightly humic; strong medium and coarse crumby structure; friable; slightly porous, permeable; fine roots; moderate biological activity; abrupt irregular boundary. |
| **AC1** | **5-35 cm** | Pale olive (5Y 6/3 dry) clay; slightly humic; mixed structure: moderate to weak, breaking to subangular blocks, and crumby; hard; slightly porous, slightly permeable; calcareous; very fine roots; moderate biological activity; diffuse irregular boundary. |
| **AC2** | **35-70 cm** | Pale olive (5Y 6/3 dry) clay, with very diffuse yellowish brown and grey streaks; strong coarse prismatic structure; slickensides; hard, compact; slightly permeable; calcareous; fine roots; diffuse irregular boundary. |
| **C** | **70-150 cm** | Light olive brown (2.5Y 5/2) and brownish yellow (10YR 6/6) clay; moderate structure, prismatic and medium blocky; hard, compact; slightly permeable; calcareous; few fine roots. |

## CHROMIC VERTISOL

**Spain**

| Horizon | Depth cm | Particle size distribution (mm) % | | | | Organic matter | | | $CaCO_3$ % |
|---|---|---|---|---|---|---|---|---|---|
| | | Coarse sand | Fine sand | Silt | Clay | % C | % N | C/N | |
| Ap | 0–5 | 2.9 | 26.3 | 16.7 | 53.2 | 0.5 | 0.06 | 9 | 31.0 |
| AC1 | 5–35 | 0.6 | 27.9 | 24.4 | 45.6 | 0.5 | 0.06 | 9 | 31.4 |
| AC2 | 35–70 | 0.9 | 30.6 | 24.5 | 43.3 | 0.3 | 0.04 | 7 | 34.2 |
| C | 70–150 | 2.2 | 32.5 | 23.5 | 39.6 | 0.1 | 0.02 | 5 | 32.8 |

| Horizon | pH | | Extractable cations me/100 g | | | | | | % V (100 S/T) | Free $Fe_2O_3$ % |
|---|---|---|---|---|---|---|---|---|---|---|
| | $H_2O$ | KCl | Ca | Mg | Na | K | S | T | | |
| Ap | 7.5 | 6.9 | 15.6 | 2.1 | — | 1.3 | 19.0 | 19.0 | 100 | 0.74 |
| AC1 | 7.6 | 6.8 | 15.4 | 1.9 | — | 0.9 | 18.3 | 18.3 | 100 | 0.82 |
| AC2 | 7.8 | 6.9 | 14.1 | 2.4 | 0.7 | 0.5 | 17.7 | 17.7 | 100 | 0.75 |
| C | 7.6 | 7.0 | 11.2 | 3.1 | 2.5 | 0.5 | 17.3 | 17.3 | 100 | 0.77 |

| Horizon | Total analysis % | | | | | | | | $\frac{SiO_2}{R_2O_3}$ | $\frac{SiO_2}{Al_2O_3}$ | $\frac{SiO_2}{Fe_2O_3}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | $SiO_2$ | $Al_2O_3$ | $Fe_2O_3$ | MgO | CaO | $Na_2O$ | $K_2O$ | $TiO_2$ | | | |
| Ap | 39.60 | 9.10 | 4.37 | 3.81 | 19.99 | — | 1.77 | 0.44 | 5.40 | 7.39 | 24.05 |
| AC1 | 39.52 | 9.11 | 4.95 | 3.75 | 19.98 | — | 1.74 | 0.49 | 5.21 | 7.36 | 21.28 |
| AC2 | 38.45 | 8.71 | 3.91 | 3.91 | 20.71 | — | 1.58 | 0.48 | 5.49 | 7.49 | 23.79 |
| C | 38.74 | 8.61 | 3.89 | 4.02 | 21.75 | — | 1.61 | 0.50 | 5.61 | 7.64 | 26.53 |

**PELLIC VERTISOL** Vp

**Leached smolnitza** Bulgaria

**Source** Boyadgiev, T.G. *Contribution à l'étude des sols de la Bulgarie*, p. 41-44. Gand, Université de Gand, 1967 (Thesis)

**Location** 1 km north of Sredez, 100 m west of the Dimitrovgrad-Stara Zagora road

**Altitude** 182 m

**Physiography** Thrace valley, Great Stara Zagora Plain

**Drainage** Moderately well drained

**Parent material** Pliocene clay

**Vegetation** Field crops

**Climate** Annual rainfall: 613 mm; annual mean temperature: 12.5°C

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**Profile description**

**Ap** **0-25 cm** Very heavy clay (10YR 2.5/1 dry; 2/1 moist; 2.5/1 crushed moist); in upper part: strong very fine and fine crumby structure, indicating the self-mulching nature of the soil; in lower part: medium to coarse subangular blocky or massive structure; hard dry, very sticky and very plastic wet; slightly porous; few fine roots; clear smooth boundary.

**Ah1** **25-50 cm** Very heavy clay (10YR 2/1 moist and crushed moist); strong medium to very coarse granular structure; hard dry, very sticky and very plastic wet; few small slickensides; few fine roots; few small worm channels with coprogenic material; few small black rounded iron-manganese nodules and mottles; non-calcareous; gradual smooth boundary.

**Ah2** **50-86 cm** Very heavy clay (10YR 3/1 dry, 2/1 moist and crushed moist); strong coarse and very coarse angular blocky structure; very hard dry, very sticky and very plastic wet; very frequent slickensides at 45° angle; few fine roots; small worm channels; few small black rounded iron-manganese nodules; non-calcareous; diffuse irregular boundary.

**ACk** **86-115 cm** Very heavy clay (10YR 5/2 dry, 4/2 moist, 3.5/2 crushed moist); coarse and very coarse prismatic structure, breaking to strong very coarse angular blocks; very hard dry, very sticky and very plastic wet; slickensides common; blackish coatings originating in above horizon; few small rounded iron-manganese nodules, mottles and irregular mottles; strongly calcareous, with " white eyes ", moderately distinct, medium to large, clear, irregular; diffuse wavy boundary.

**Ck1** **115-160 cm** Very heavy clay (10YR 5.5/3 dry, 5/4 moist and crushed moist); strong very coarse angular blocky structure; very hard dry, very sticky and very plastic wet; slickensides; blackish coatings originating in above horizon in gaps and cracks; moderately distinct, small, moderately clear, rounded, composite iron-manganese nodules and mottles; strongly calcareous, with " white eyes ", mottled, striking, medium to large, clear, irregular; diffuse wavy boundary.

**Ck2** **160-180 cm** As above, with fewer " white eyes "; few hollow calcareous nodules; gradual smooth boundary.

**Ck3** **180-210 cm** Very heavy clay (10YR 4.5/3 dry, 4/3 moist, 4.5/2 crushed moist); moderate coarse to very coarse subangular blocky structure; very hard dry, sticky and very plastic wet; slickensides; blackish coatings in cracks; moderately distinct, small, clear, rounded, irregular iron-manganese mottles and nodules; strongly calcareous, with " white eyes " and frequent, slightly distinct, medium, moderately clear, irregular nodules.

**PELLIC VERTISOL**
**Bulgaria**

| Horizon | Depth cm | Particle size distribution (mm) % | | | | % C |
|---|---|---|---|---|---|---|
| | | Sand 1-0.05 | Coarse silt 0.05-0.02 | Fine silt 0.02-0.002 | Clay < 0.002 | |
| Ap | 0–25 | 4.8 | 9.9 | 32.5 | 52.7 | 1.4 |
| Ah1 | 25–50 | 5.1 | 7.5 | 34.2 | 53.0 | 1.3 |
| Ah2 | 50–86 | 4.8 | 12.9 | 38.0 | 54.9 | 1.0 |
| ACk | 86–115 | 4.2 | 17.0 | 19.5 | 59.3 | 0.8 |
| Ck1 | 115–160 | 4.3 | 17.4 | 20.6 | 57.6 | |
| Ck2 | 160–180 | 5.2 | 17.0 | 19.7 | 58.1 | |
| Ck3 | 180–210 | 5.2 | 16.2 | 19.9 | 58.5 | 0.4 |

| Horizon | pH | | $CaCO_3$ % | CEC (T) me/100 g | % V (100 S/T) |
|---|---|---|---|---|---|
| | $H_2O$ | KCl | | | |
| Ap | 7.9 | 7.1 | | 58.0 | 92.8 |
| Ah1 | 7.7 | 6.8 | | 54.0 | |
| Ah2 | 7.9 | 6.8 | | 57.0 | 95.8 |
| ACk | 8.1 | 7.3 | 9.7 | 57.0 | |
| Ck1 | 8.4 | 7.4 | 11.0 | 47.5 | |
| Ck2 | 8.3 | 7.5 | 8.5 | 53.0 | |
| Ck3 | 8.2 | 7.4 | 5.2 | 56.0 | |

| | |
|---|---|
| **EUTRIC PLANOSOL** | **We** |
| **Pseudopodzolic to pseudogley cinnamon soil** | Bulgaria |
| **Source** | Boyadgiev, T.G. *Contribution à l'étude des sols de la Bulgarie*, p. 45-48. Gand, Université de Gand, 1967 (Thesis) |
| **Location** | Badaschte, 9 km south of Stara Zagora, 200 m west of the Dimitrovgrad-Stara Zagora road |
| **Altitude** | 150 m |
| **Physiography** | Thrace valley, Great Stara Zagora Plain |
| **Drainage** | Poorly drained |
| **Parent material** | Pliocene fluvio-lacustrine or limnic clay |
| **Vegetation** | Oak forest |
| **Climate** | Annual rainfall: 613 mm; annual mean temperature: 12.5°C |

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**Profile description**

| | | |
|---|---|---|
| **Ah1** | **0-8 cm** | Loam (10YR 6.5/2 dry, 4/2 moist); in upper part, coarse to very coarse platy structure; in lower part, moderate medium and coarse granular; slightly hard dry, sticky and very slightly plastic wet; abundant roots; few small and very small rust mottles; slightly distinct but clear nodules; clear smooth boundary. |
| **E** | **8-26 cm** | Loam (10YR 4/2 moist and crushed moist, mottled 10YR 7.5-7/2), darker mottles (10YR 6/2 dry, 5/2 moist); contrast between mottles disappears in lower part; very weak medium granular structure, almost massive *in situ*; moderately hard dry; abundant leached sand and silt grains; abundant small rust mottles, some distinct and clear; medium and fine pores common; abrupt smooth boundary, but with small tongues (2 cm long, 0.5 cm wide), with leached sand and silt grains dominant. |
| **Bt1** | **26-52 cm** | Very heavy clay (matrix: 10YR 4/3 moist and crushed moist; common mottles, moderately large, irregular: 10YR 4/4, few 7.5YR 4/4 to 5/6); very weak medium and coarse prismatic structure, breaking to moderate medium and coarse angular blocks; hard dry, very sticky and plastic wet; thin discontinuous clayey cutans; few fissures, up to 5 cm broad and 1 m deep, from drying; cutans appear to be concentrated in fissures; small and medium rust mottles, more sharply contrasted in lower part (up to 5YR 5/6); diffuse smooth boundary. |
| **Bt2** | **52-100 cm** | Very heavy clay (10YR 4.5/3 dry, 4/3 moist and crushed moist); moderate coarse prismatic structure, breaking to very coarse angular blocks; very hard dry, sticky and very plastic wet; few roots; very slightly porous; slickensides and few shrinkage fissures; moderately distinct, small, rounded or irregular iron-manganese mottles and nodules; the rust mottles gradually disappear in lower part; slightly clear, discontinuous cutans; gradual smooth boundary. |
| **BC** | **100-130 cm** | Heavy clay (10YR 5/3 dry, 4/3 moist); almost massive *in situ*; hard dry, sticky and plastic wet; few roots; very few distinct, small, moderately clear, rounded iron-manganese nodules and mottles; strongly calcareous, with calcareous nodules, most friable, few small moderately hard; few slickensides at 10° angle; diffuse smooth boundary. |
| **C1** | **130-160 cm** | Silty clay (10YR 5.5/2.5 dry, 4.5/3 moist, 4.5/2.5 crushed moist); massive *in situ*; slightly hard to hard dry, sticky and plastic wet; strongly calcareous, with nodules and "white eyes" (variegated), striking, large, moderately clear and irregular; diffuse smooth boundary. |
| **C2** | **160-200 cm** | Silty clay (10YR 6.5/2 dry, 4.5/2 moist); massive *in situ*; slightly hard dry, sticky and very plastic wet; few roots; worm channels and krotovinas infilled with coproliths, with masses from the above horizon, moderately porous; strongly calcareous, with frequent calcareous nodules. |

**EUTRIC PLANOSOL**

**Bulgaria**

| Horizon | Depth cm | Particle size distribution (mm) % | | | | $Fe_2O_3$ % | | % C |
|---|---|---|---|---|---|---|---|---|
| | | Sand 1-0.05 | Coarse silt 0.05-0.02 | Fine silt 0.02-0.002 | Clay < 0.002 | Free | Total | |
| Ah1 | 0–8 | 21.0 | 21.2 | 37.9 | 19.9 | 0.134 | 0.621 | 2.2 |
| E | 8–26 | 24.8 | 15.9 | 34.4 | 24.9 | 0.177 | 0.889 | 0.7 |
| Bt1 | 26–52 | 9.0 | 10.2 | 17.4 | 63.3 | 0.250 | 1.296 | 0.4 |
| Bt2 | 52–100 | 10.5 | 9.9 | 29.1 | 50.4 | | | 0.5 |
| BC | 100–130 | 11.0 | 16.9 | 22.9 | 49.1 | | | 0.3 |
| C1 | 130–160 | 12.2 | 17.9 | 27.4 | 42.4 | | | 0.3 |
| C2 | 160–200 | 16.6 | 18.6 | 34.7 | 30.0 | | | 0.3 |

| Horizon | pH | | $CaCO_3$ % | CEC (T) me/100 g | % V (100 S/T) |
|---|---|---|---|---|---|
| | $H_2O$ | KCl | | | |
| Ah1 | 6.9 | 6 2 | | 15.6 | 73 |
| E | 4.6 | 3.9 | | 16.6 | 35 |
| Bt1 | 4.8 | 3.9 | | 47.0 | 51 |
| Bt2 | 6.2 | 5.2 | | 41.0 | 90 |
| BC | 8.3 | 7.6 | 13.2 | 38.2 | 100 |
| C1 | 8.3 | 7.7 | 26.5 | 32.5 | 100 |
| C2 | 8.2 | 7.8 | 21.7 | 28.7 | 100 |

| | |
|---|---|
| **CALCIC XEROSOL** | **Xk** |
| **Steppe marl soil (Calciorthid)** | Turkey |
| **Source** | de Meester, T. *Highly calcareous lacustrine soils in the Great Konya Basin, Turkey. Profile C 3.1*, p. 28. Wageningen, Pudoc, 1971 |
| **Location** | Hotamis, approx. 50 km east of Konya |
| **Altitude** | Approx. 1 000 m |
| **Physiography** | Secondary plain of the Great Konya Basin |
| **Drainage** | Poorly drained |
| **Parent material** | Strongly calcareous lacustrine deposit |
| **Vegetation** | Semi-arid steppe |
| **Climate** | Annual rainfall: 335 mm; annual mean temperature: 11°C (January: —1°C; July: 23°C) |

**Profile description**

| | | |
|---|---|---|
| **Ah1** | **0-8 cm** | Olive brown (2.5Y 4/4) loam; coarse platy structure, breaking to very strong fine crumby; sticky, plastic; soft; clear smooth boundary |
| **Ah2** | **8-45 cm** | Dark brown (10YR 4/3) loam; very strong fine and medium crumby structure; sticky, plastic; soft; clear smooth boundary. |
| **Bwk1** | **45-67 cm** | Light brownish grey (2.5Y 6/2) clay; moderate coarse subangular blocky structure; no pores; sticky, plastic; soft; clear smooth boundary. |
| **Bwk2** | **67-100 cm** | Pale olive (5Y 6/3) clay; medium and coarse angular and subangular blocky structure; no pores; sticky, plastic; soft; few krotovinas; abundant clear olive yellow (5Y 6/8) mottles; many shell fragments. |

## CALCIC XEROSOL

**Turkey**

| Horizon | Depth cm | Particle size distribution (mm) % | | | $CaCO_3$ % | % C |
|---|---|---|---|---|---|---|
| | | Sand 2-0.05 | Silt 0.05-0.002 | Clay < 0.002 | | |
| Ah1 | 0–8 | 24.5 | 45.8 | 31.7 | 36.6 | 1.6 |
| Ah2 | 8–45 | 19.8 | 41.1 | 38.2 | 35.5 | 1.1 |
| Bwk1 | 45–67 | 7.5 | 50.5 | 41.9 | 57.5 | |
| Bwk2 | 67–100 | 6.9 | 44.3 | 48.5 | 51.7 | |

| Horizon | pH | | Extractable cations me/100 g |
|---|---|---|---|
| | $H_2O$ | $CaCl_2$ | |
| Ah1 | 7.8 | 7.5 | 20 |
| Ah2 | 7.7 | 7.0 | 19 |
| Bwk1 | 7.1 | 7.5 | 16 |
| Bwk2 | 7.5 | 7.6 | 15 |

| | |
|---|---|
| **ORTHIC SOLONCHAK** | **Zo** |
| **Saline alluvial soil** | Spain |
| **Source** | Gragera, P., Guerra, A. *et al. Conferencia sobre Suelos Mediterráneos. Guía de la excursión española*, p. 133-138. Profile II. Madrid, Sociedad Española de Ciencia del Suelo, 1966 |
| **Location** | Guadalquivir marsh |
| **Altitude** | 3 m |
| **Physiography** | Alluvial plain |
| **Drainage** | Poorly drained [1] |
| **Parent material** | Recent alluvia |
| **Vegetation** | Field crops |
| **Climate** | Annual rainfall: 500 mm; annual mean temperature: 19.5°C |

**Profile description**

| | | |
|---|---|---|
| **Ap** | **0-10 cm** | Grey (10YR 5/1) loam, slightly humic; crumby structure; dense roots. |
| **Ah1** | **10-30 cm** | Light grey (10YR 6/1) silty clay; massive to structureless, incipient formation of blocks by irregular fissuring; cohesive; gradual boundary. |
| **B** | **30-60 cm** | Brownish grey (10YR 6/2) clay; prisms with vertical fissures; cutans absent; gradual boundary. |
| **BC** | **60+ cm** | Reddish-brown grey (7.5YR 5/2) clay; structure tending to cubical; gradual transition to fine, massive alluvia. |

[1] Artificially drained; the water-table has been lowered by 60-70 cm.

## ORTHIC SOLONCHAK

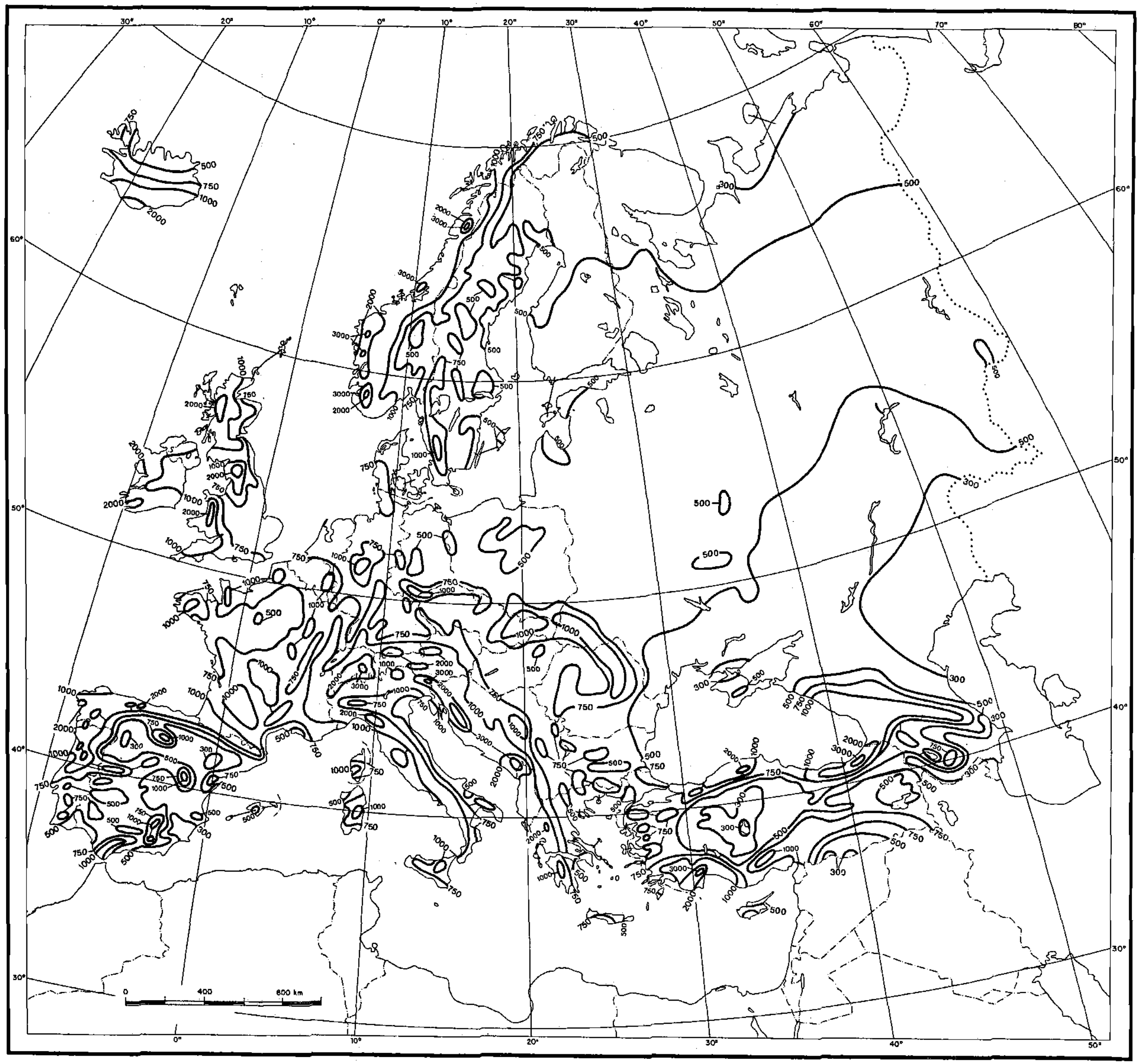
**Spain**

| Horizon | Depth cm | Particle size distribution (mm) % | | | | % C | $CaCO_3$ % | Bulk density |
|---|---|---|---|---|---|---|---|---|
| | | Coarse sand | Fine sand | Silt | Clay | | | |
| Ap | 0–10 | 0.3 | 36.9 | 38.0 | 24.7 | 0.8 | 16.4 | 1.42 |
| Ah1 | 10–30 | 0.1 | 23.1 | 37.0 | 39.7 | 0.5 | 12.3 | 1.46 |
| B | 30–60 | 0.1 | 13.4 | 34.7 | 51.7 | 0.3 | 14.7 | 1.17 |
| BC | 60 + | 0.1 | 17.4 | 35.7 | 46.7 | 0.3 | 21.3 | 1.25 |

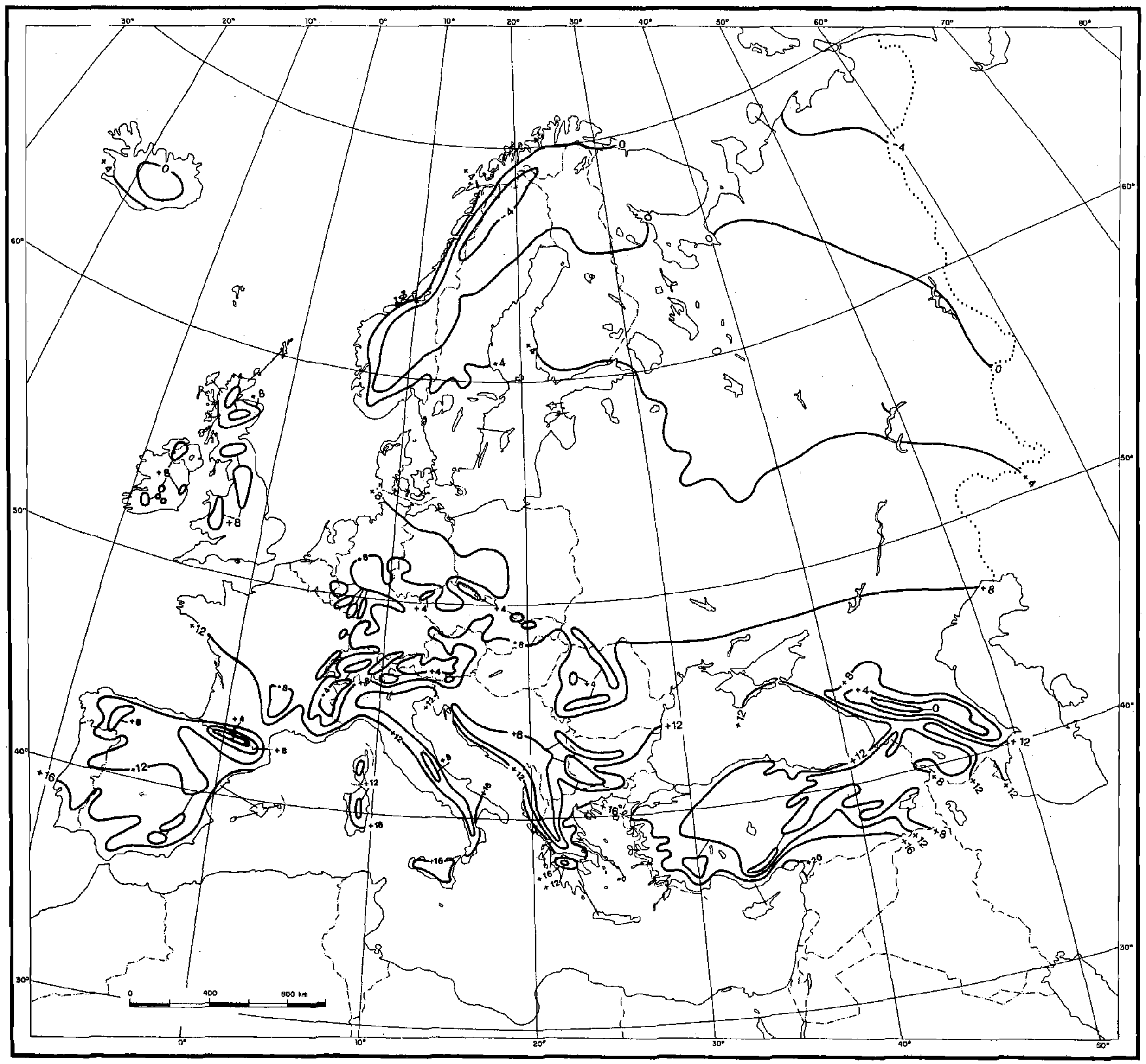
| Horizon | pH | | Soluble chlorides % | Extractable cations me/100 g | | Salinity | | Conductivity mmhos/cm |
|---|---|---|---|---|---|---|---|---|
| | $H_2O$ | KCl | | Ca + Mg | Na | ESP | SAR | |
| Ap | 8.3 | 7.0 | 0.008 | 5.0 | 6.4 | 4.0 | 4.0 | 0.9 |
| Ah1 | 8.6 | 7.2 | 0.055 | 3.5 | 21.2 | 18.0 | 16.0 | 2.4 |
| B | 8.4 | 7.3 | 0.275 | 19.5 | 67.5 | 22.6 | 21.6 | 8.6 |
| BC | 7.9 | 7.0 | 0.675 | 75.0 | 124.1 | 22.0 | 20.2 | 19.7 |

## Figures

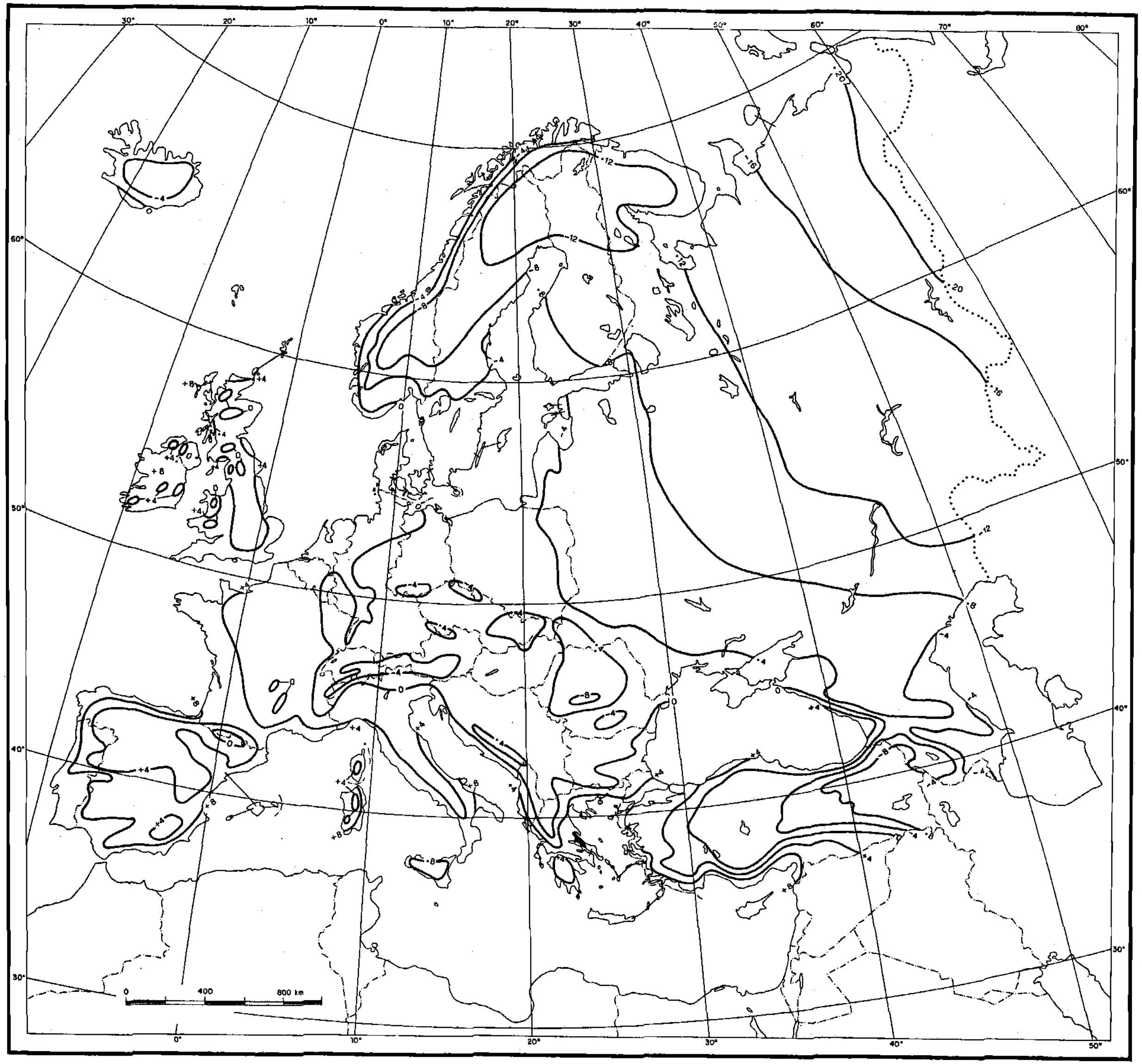
# 1. CLIMATES


0
400
800 km

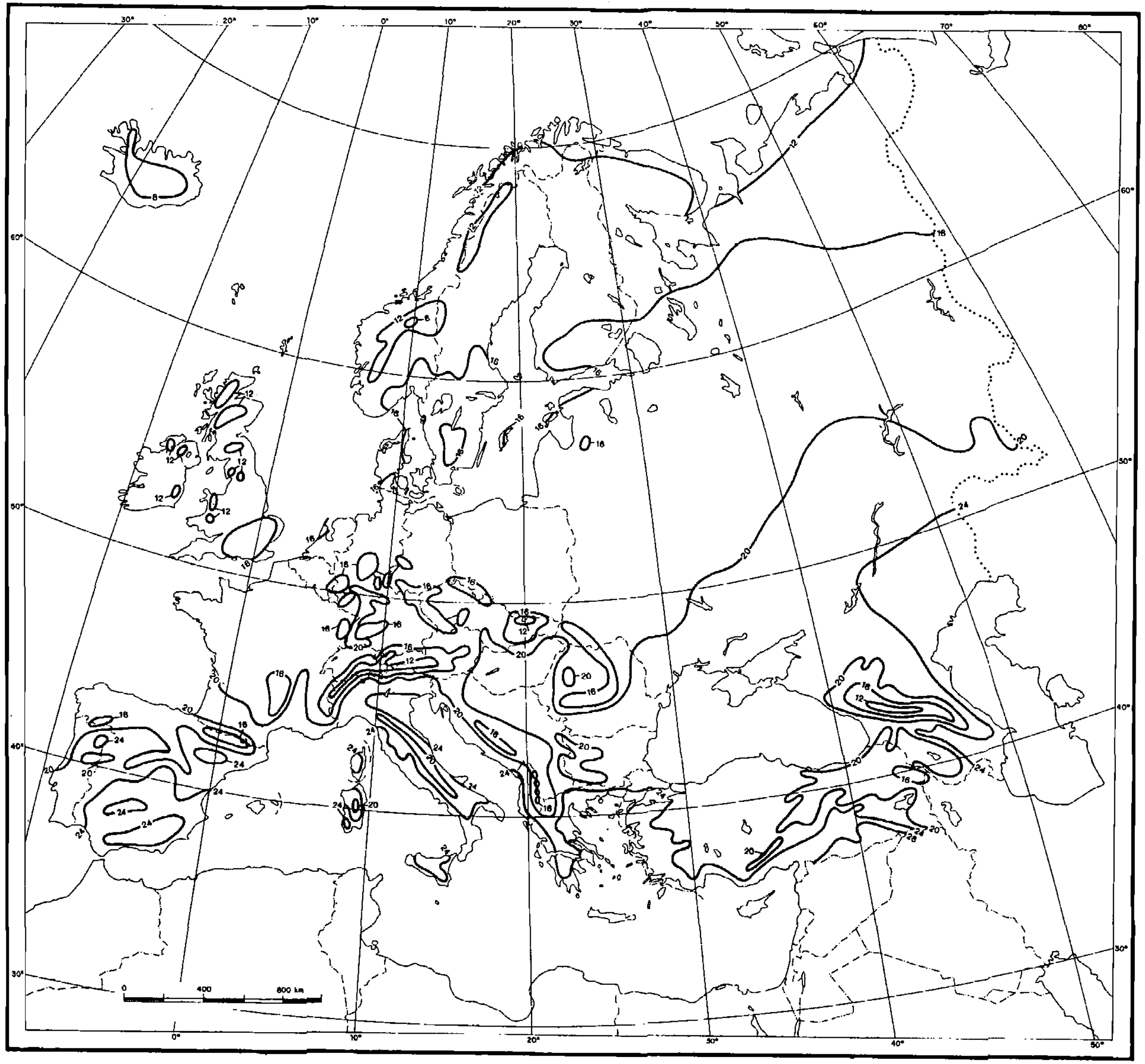
# 2. CLIMATES



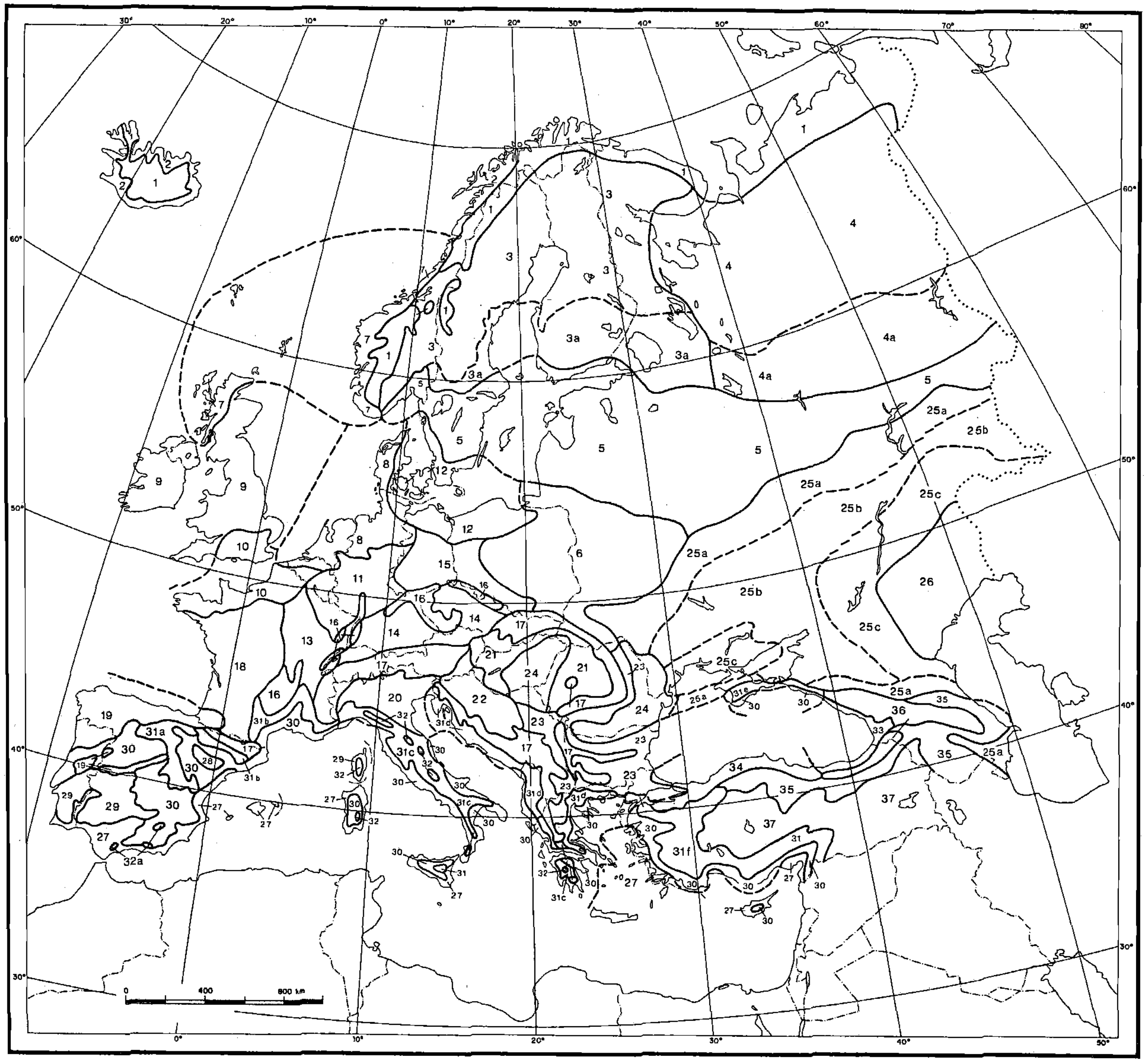
# 3. CLIMATES


0
400
800 km

# 4. CLIMATES



# 5. VEGETATION



ARCTIC AND SUBARCTIC BELT
1. Arctic tundra
2. Subarctic birch formation

BOREAL AND SUB-BOREAL CONIFEROUS BELT
3. Fennoscandian boreal forest
   a. Southern sector
4. Russian boreal forest
   a. Southern sector
5. Mixed coniferous/deciduous boreal forest
6. Sub-boreal oak and pine forests
7. Boreo-atlantic oak/Norway pine forest

MESOTHERMIC TEMPERATE FOREST BELT
8. Boreo-atlantic oak/birch forest
9. Boreo-atlantic oak/holly forest
10. Atlantic beech forests
11. Sub-atlantic beech forests
12. Baltic beech forests
13. Sub-atlantic oak/hornbeam forest
14. Central European oak/hornbeam forest
15. Baltic oak/hornbeam forest
16. Montane beech/fir forest
17. Alpine forest complex

THERMOPHILOUS TEMPERATE FOREST BELT
18. Franco-atlantic oak forests
19. Ibero-atlantic oak forests
20. Insubrian oak forests
21. Pannonian oak forest
22. Illyrian oak forest
23. Balkan oak forest

TEMPERATE STEPPE BELT
24. Danubian steppes
25. Russian steppes
   a. Silvo-steppe
   b. Grassy steppe
   c. Sodic steppe
26. Caspian steppes

MEDITERRANEAN BELT
27. Thermomediterranean level
28. Xeromediterranean level
29. Mesomeditterranean cork-oak level
30. Mesomediterranean holm-oak level
31. Supramediterranean level
   a.-f. See text
32. Oromediterranean level

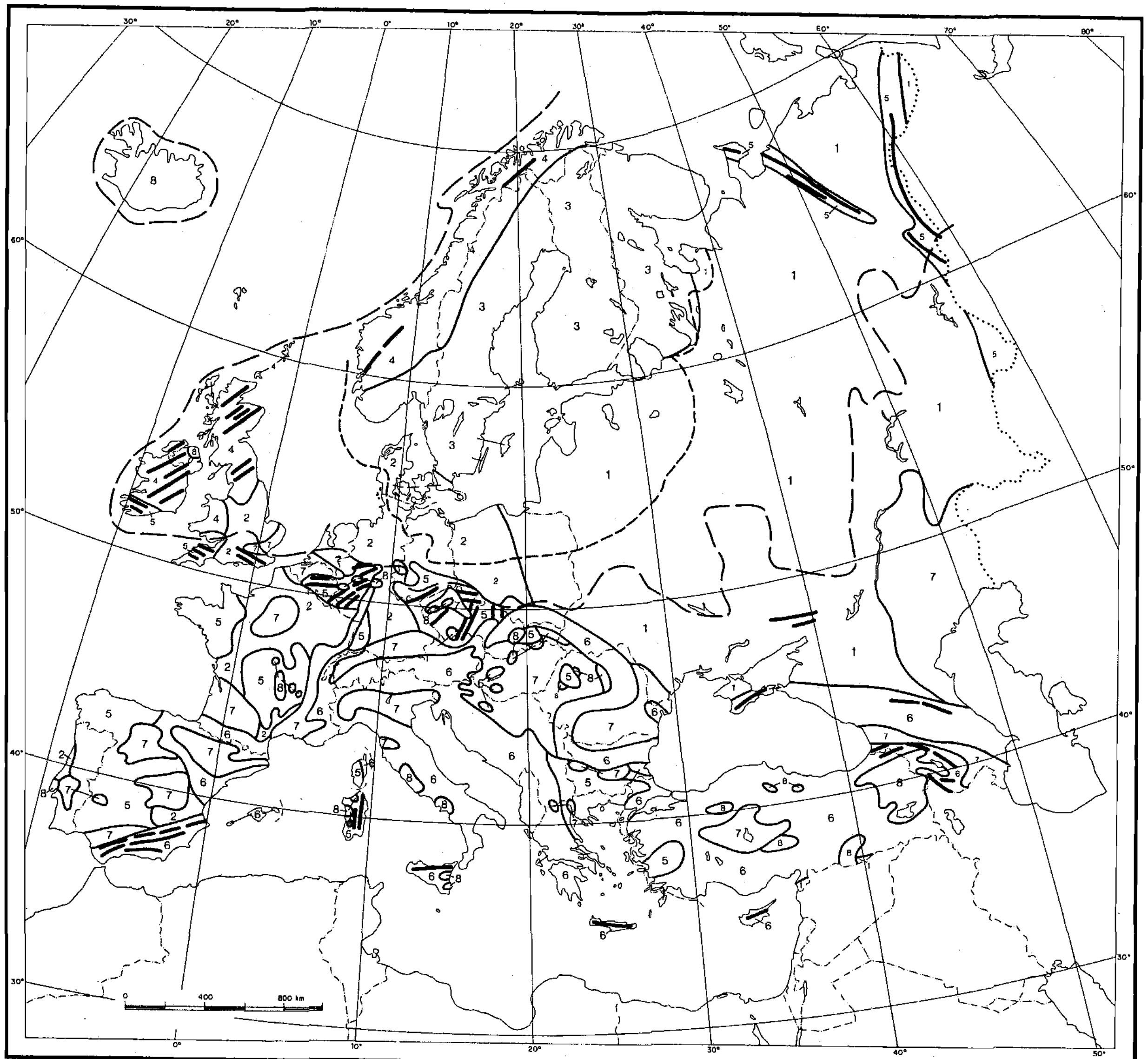
PONTIC BELT
33. Colchian forest
34. Pontic forest
35. Substeppe oak forests
36. Orocaucasian forests
37. Anatolian steppe

# 6. PHYSIOGRAPHY

1. Huronian peneplain (Baltic or Fennoscandian Shield)
2. Russo-Siberian shelf
3. Caledonide mountain system
4. Hercynian mountain system
5. Secondary shelves and tabular regions
6. Alpine mountain system
7. Basins partially filled with Quaternary deposits
8. Volcanic massifs, active volcanoes

— — — Boundaries of the last and maximum glaciations

▬▬▬ Fold axes



# 7. GEOLOGY

Rock types indicated are those most representative of the map unit; other types occur within the areas delineated, but they are relatively inextensive.

1. Precambrian

   Metamorphic rocks (gneiss, micaschist, amphibolite, phyllite, quartzite); plutonic rocks (granite); sedimentary rocks (conglomerate, sandstone, limestone, schist).

2. Paleozoic (not specified)

   2.1. *Cambrian*

   Neritic and littoral rocks (conglomerate, arkose, coarse sandstone, dolomitic limestone); sedimentary and metamorphic rocks (fine sandstone, schist, phyllite, slate, limestone, limestone schist, arkose, conglomerate, quartzite, gneiss); plutonic rock (granite).

   2.2 *Silurian and Ordovician*

   Neritic rocks (limestone, coarse sandstone); sedimentary and metamorphic rocks (schist, sandstone, limestone, slate); plutonic rocks (granite, gabbro); volcanic rocks (basalt, tuff).

   2.3 *Devonian*

   Sedimentary and metamorphic rocks (conglomerate, sandstone, schist, arkose, greywacke, psammite, limestone, slate, quartzite, marble); volcanic rocks.

   2.4 *Carboniferous*

   Sedimentary and metamorphic rocks (limestone, sandstone, arkose, schist, conglomerate, coal); flysch; plutonic rocks (granite); volcanic rocks.

   2.5 *Permian*

   Marine sedimentary rocks (limestone, dolomite); continental and neritic sedimentary rocks (sandstone, shaley schist, clay, marl, conglomerate, dolomitic limestone); flysch.

3. Mesozoic (not specified)

   3.1 *Triassic*

   Continental sedimentary rocks (clay, schist, sandstone); marine sedimentary rocks (limestone, marl, sandstone, dolomite, schist); metamorphic rocks (quartzite, marble, slate, phyllite, gneiss).

   3.2 *Jurassic*

   Sedimentary rocks (limestone, marl, clay, sand, dolomite, sandstone); metamorphic rocks (marble, mica schist).

   3.3 *Cretaceous*

   Sedimentary rocks (chalk, marl, limestone, sand, clay, limestone schist); flysch; volcanic rocks.

4. Tertiary (not specified)

   4.1 *Paleocene*

   Marine sedimentary rocks, saline and lacustrine (sand, sandstone, clay, travertine, limestone, marl); continental sedimentary rocks (sandstone, limestone, marl, conglomerate); flysch; volcanic rocks.

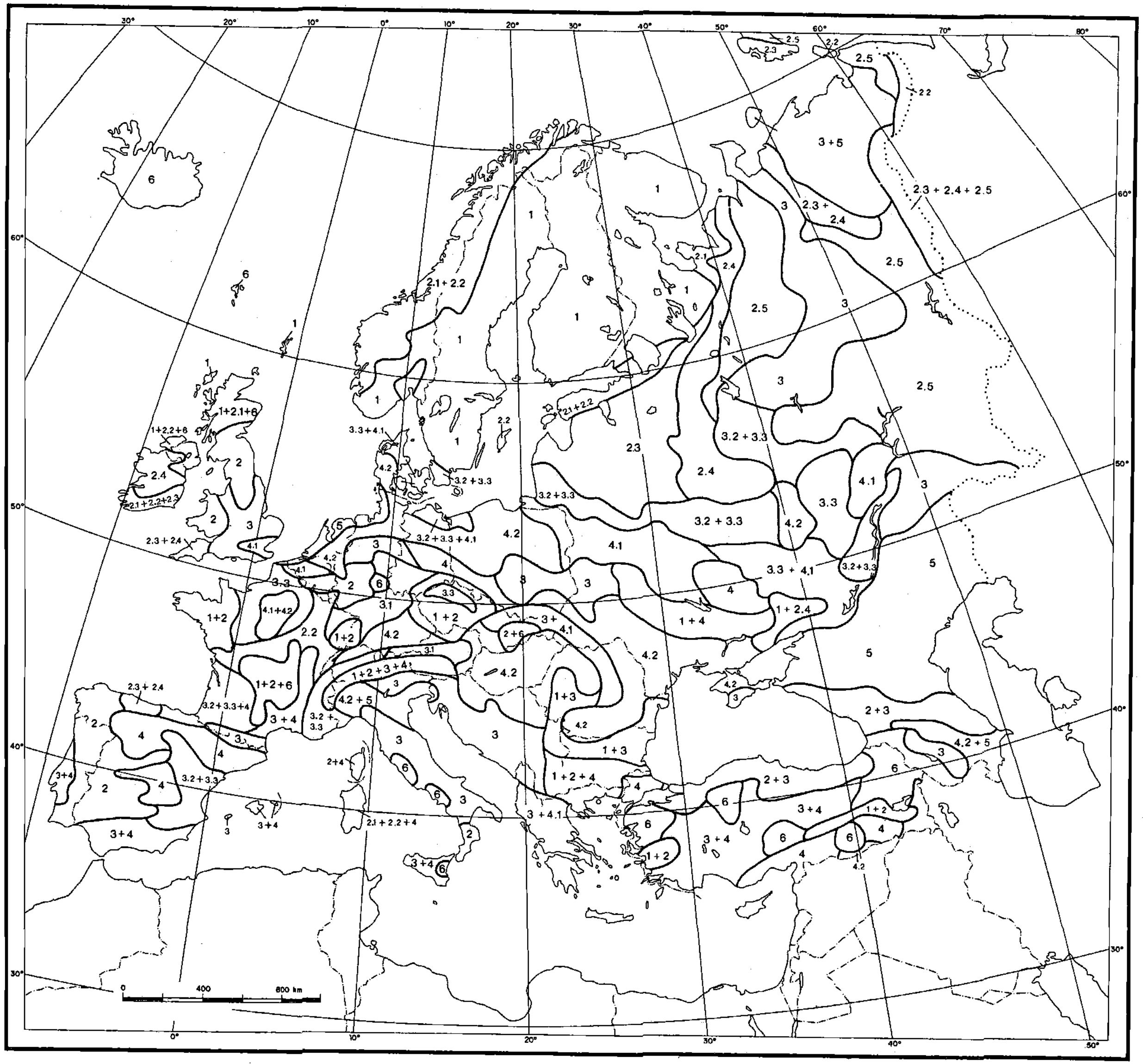
   4.2 *Neocene*

   Marine sedimentary rocks (conglomerate, sandstone, limestone, marl); continental and lacustrine sedimentary rocks (sand, clay, gravel, conglomerate); flysch; volcanic rocks.

5. Quaternary (not specified)

   Marine sedimentary rocks (clay); continental sedimentary rocks; volcanic rocks.

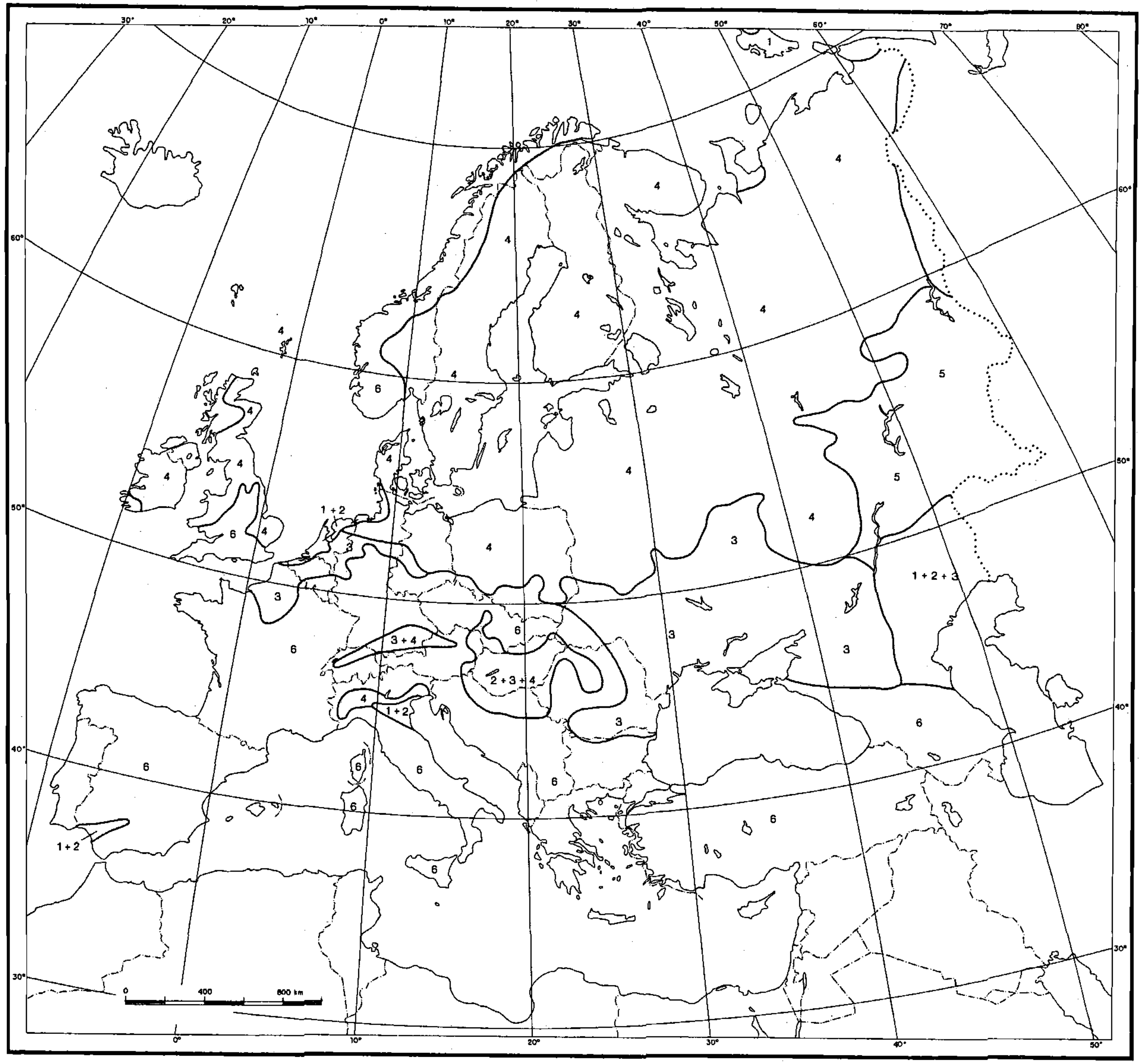
6. Volcanic rocks (not specified)



# 8. LITHOLOGY

## 8. QUATERNARY SEDIMENTS

1. Marine alluvia
2. Fluvial alluvia
3. Aeolian sediments (loess, sand)
4. Glacial sediments and outwashes
5. Quaternary sediments (not specified)
6. Locally, thin quaternary sediments of various origins



# 9. CLIMATES

**Mediterranean**

6.1 Subtropical mediterranean
6.2 Marine mediterranean
6.5 Temperate mediterranean
6.6 Cold mediterranean
6.7 Continental mediterranean
6.8 Semi-arid subtropical mediterranean
6.9 Continental semi-arid mediterranean

**Marine**

7.1 Warm marine
7.2 Cool marine
7.3 Cold marine
7.5 Warm temperate
7.6 Cool temperate
7.7 Cold temperate

**Continental**

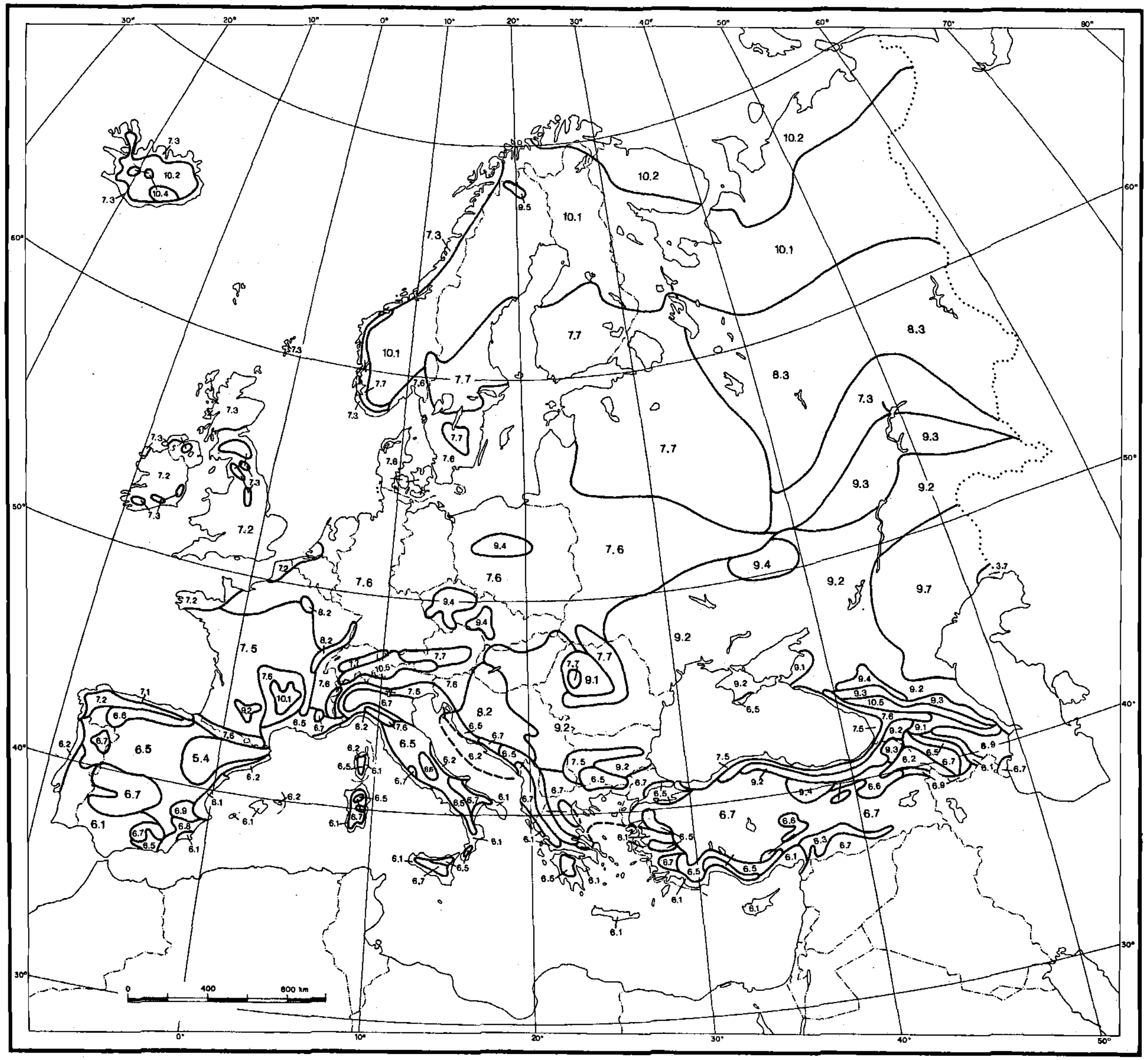
8.2 Semi-warm continental
8.3 Cold continental

**Steppe**

9.1 Warm steppe
9.2 Semi-warm steppe
9.3 Cold steppe
9.4 Temperate steppe
9.7 Semi-arid continental

**Polar**

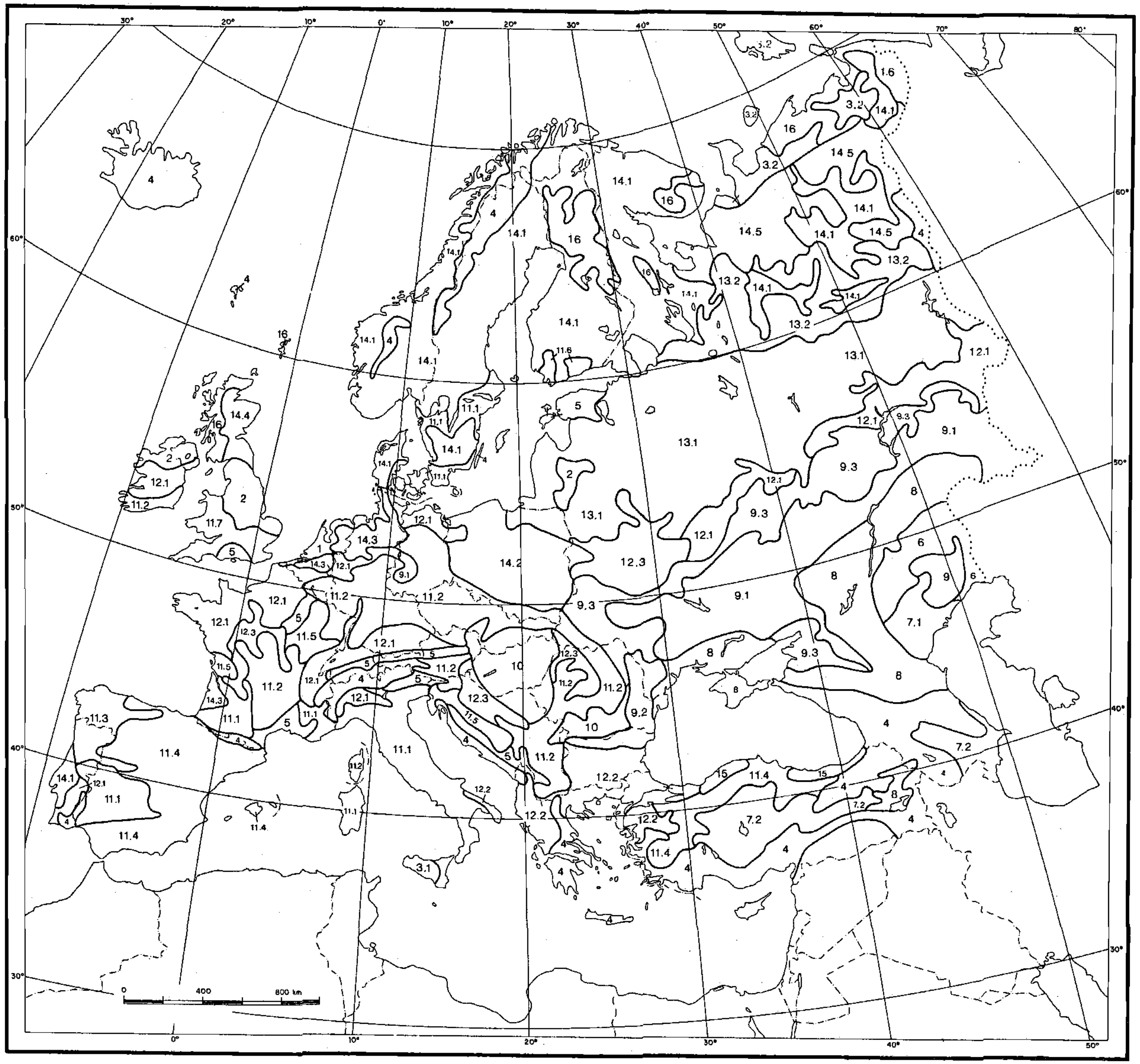
10.1 Taiga
10.2 Tundra
10.4 Ice-cap
10.5 Alpine



# 10. SOILS

# 10. MAJOR SOIL REGIONS

1. Fluvisols
2. Gleysols
3. Regosols
   3.1 Eutric and Calcaric Regosols
   3.2 Gelic Regosols
4. Lithosols
5. Rendzinas
6. Solonetz
7. Xerosols
   7.1 Haplic and Luvic Xerosols
   7.2 Calcic Xerosols
8. Kastanozems
9. Chernozems
   9.1 Haplic Chernozems
   9.2 Calcic Chernozems
   9.3 Luvic Chernozems
10. Phaeozems
11. Cambisols
    11.1 Eutric Cambisols
    11.2 Dystric Cambisols
    11.3 Humic Cambisols
    11.4 Calcic Cambisols
    11.5 Chromic Cambisols
    11.6 Vertic Cambisols
    11.7 Cambisols Complex
12. Luvisols
    12.1 Orthic Luvisols
    12.2 Chromic Luvisols
    12.3 Gleyic Luvisols
13. Podzoluvisols
    13.1 Eutric Podzoluvisols
    13.2 Dystric Podzoluvisols
14. Podzols
    14.1 Orthic Podzols
    14.2 Leptic Podzols
    14.3 Humic Podzols
    14.4 Placic Podzols
    14.5 Gleyic Podzols
15. Acrisols
16. Histosols
17. Dune or shifting sands complex



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