CAMBISOLS (CM)

The Reference Soil Group of the Cambisols holds soils with incipient soil formation. Beginning transformation of soil material is evident from weak, mostly brownish discolouration and/or structure formation below the surface horizon. Early soil classification systems referred to these 'brown soils' as 'Braunerde' (Germany), 'Sols bruns' (France), 'Brown soils'/'Brown Forest soils' (USA), or 'Brunizems' (Russia). FAO coined the name 'Cambisols'; USDA Soil Taxonomy classifies these soils as 'Inceptisols'.

Definition of Cambisols

Soils having:

1 a cambic horizon; **or**

2 a mollic horizon overlying subsoil with low base saturation within 100 cm depth; **or**;

3 one of the following diagnostic horizons:

- an andic, vertic or vitric horizon starting between 25 and 100, **or**
- a plinthic, petroplinthic, salic or sulfuric horizon starting between 50 and 100 cm, in the absence of loamy sand or coarser textures above these horizons.

Common soil units:

Thionic, Gelic, Leptic, Vertic, Fluvic, Endosalic, Gleyic, Vitric, Andic, Plinthic, Ferralic, Gelistagnic, Stagnic, Humic, Calcaric, Gypsiric, Takyric, Yermic, Aridic, Hyperochric, Skeletic, Sodic, Dystric, Eutric, Rhodic, Chromic, Haplic.

Summary description of Cambisols

Connotation: soils with beginning horizon differentiation evident from changes in colour, structure or carbonate content; from L. cambiare, to change.

Parent material: medium and fine-textured materials derived from a wide range of rocks, mostly in colluvial, alluvial or eolian deposits.

Profile development: ABC-profiles. Cambisols are characterized by slight or moderate weathering of parent material and by absence of appreciable quantities of illuviated clay, organic matter, aluminium and/or iron compounds.

Environment: level to mountainous terrain in all climates; wide range of vegetation types.

Use: a wide variety of agricultural uses; climate, topography, shallowness, stoniness, or low base status may pose restrictions on land use. In steep lands mainly used for grazing and/or forestry.

Regional distribution of Cambisols

Cambisols cover an estimated 1.5 billion hectares worldwide. This Reference Soil Group is particularly well represented in temperate and boreal regions that were under the influence of glaciation during the Pleistocene, partly because the soil's parent material is still young but also because soil formation is slow in cool, northern regions. Erosion and deposition cycles explain the occurrence of Cambisols in mountain regions. Cambisols are less common in the tropics and subtropics where weathering and soil formation proceed at much faster rates than in temperate and boreal regions. The (young) alluvial plains and terraces of the Ganges-Brahmaputra system are probably the largest continuous surface of Cambisols in the tropics. Cambisols are also common in areas with active geologic erosion where they may occur in association with mature tropical soils. Figure 1 shows the widespread occurrence of Cambisols.

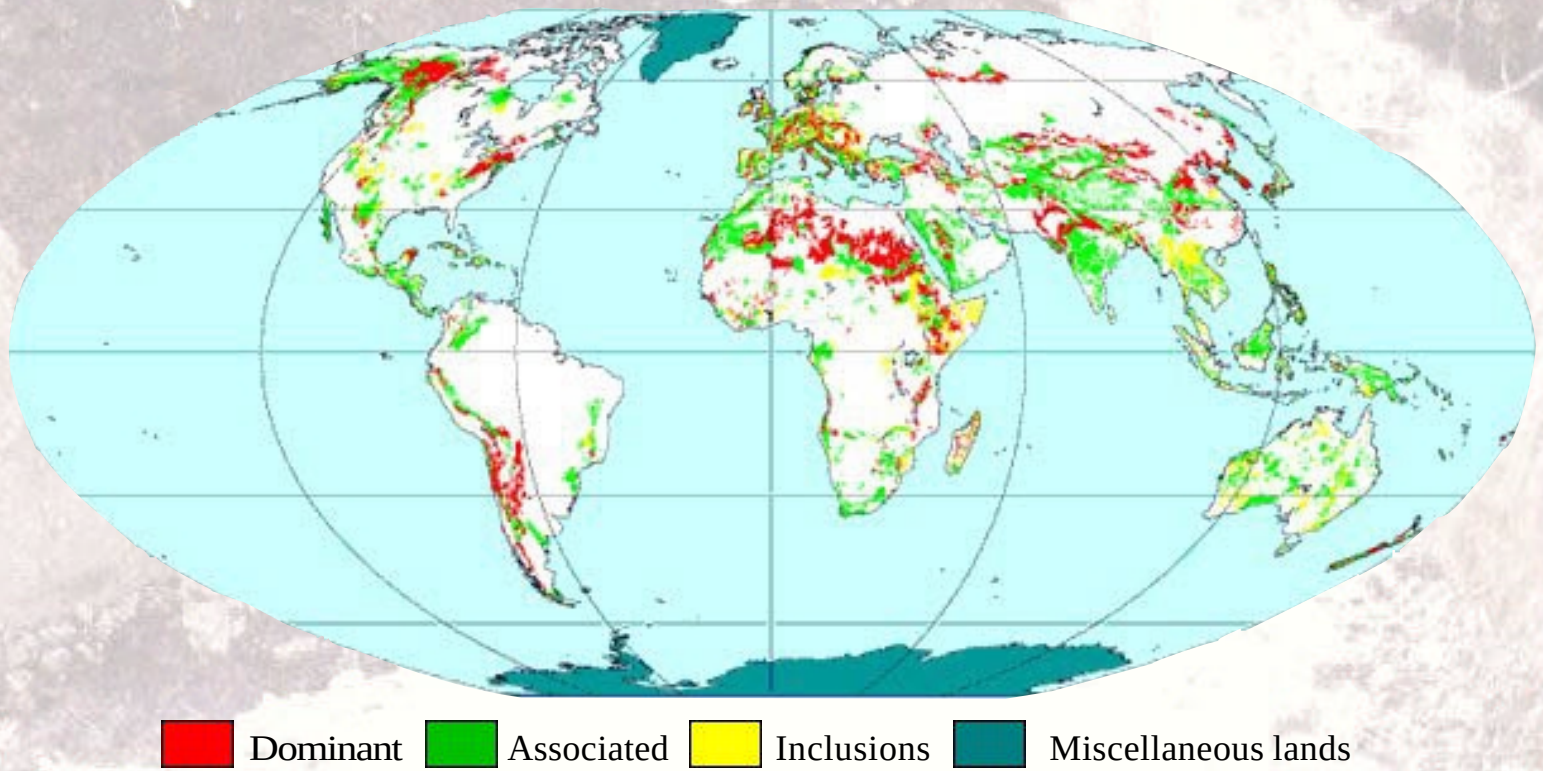

Figure 1. Cambisols worldwide.

Associations with other Reference Soil Groups

Cambisols in cool regions are particularly common in alluvial, colluvial and eolian deposits where they occur together with a wide range of soil groups. In wetlands, Cambisols are associated with Gleysols and Fluvisols.

Cambisols in the arid (sub)tropics are particularly widespread; they are found in young deposition areas but also in erosion areas where they form after genetically mature soils such as Luvisols have eroded away.

Cambisols in the humid tropics occur predominantly at medium altitudes in hilly and mountainous regions but also in deposition areas and in eroding lands at lower altitude where they occur alongside genetically mature residual soils (e.g. Acrisols or Ferralsols).

Genesis of Cambisols

Most (not all) Cambisols are soils with beginning horizon differentiation; they are in a transitional stage of development, from a young soil to a mature soil with an argic, natric, spodic, or ferralic B-horizon. The first step in this development is formation of a cambic subsurface horizon that is to be regarded as a 'minimum B-horizon'. Nonetheless, a cambic horizon can be quite stable, viz. where pedogenetic development is slow because of low temperatures, low precipitation, impeded drainage, highly calcareous or weathering-resistant parent materials, or where slow but continuous erosion is in equilibrium with weathering processes. In practice, a cambic horizon is any section of a soil profile situated between an A-horizon and a relatively unaltered C-horizon, that has soil structure rather than rock structure and a colour that differs from that of the C-horizon.

Note that a cambic horizon can also occur in other Reference Soil Groups for which it is not a differentiating characteristic because other properties have higher priority. The fact that Cambisols key out late in the taxonomic hierarchy of Reference Soil Groups implies that this group includes many soils that just missed out on one or more requirements for other Reference Soil Groups.

Appreciable quantities of weatherable minerals and absence of any signs of advanced pedogenesis evidence the fact that Cambisols are in an early stage of soil formation. There are, however, signs of incipient weathering/transformation of primary minerals in a situation of free internal and external drainage. Hydrolysis of iron-containing minerals (biotite, olivine, pyroxenes, amphiboles, etc) in a weakly acid environment produces ferrous iron that is oxidized to ferric oxides and hydroxides (e.g. goethite, haematite). This 'free iron' coats sand and silt particles, and cements clay, silt and sand to aggregates. The soil becomes structured and yellowish brown to reddish in colour. Aluminium oxides and hydroxides, and silicate clays are formed in addition to ferric oxides. There may be some leaching of bases but no clear migration of Fe, Al, organic matter or clay. This oxidative weathering process is not limited to the cambic horizon; it occurs just as well in the A-horizon and may even be stronger there, but the dark colours of accumulated soil organic matter obscure its signs.

The processes that lead to formation of a cambic subsurface horizon are fundamentally the same in all climate zones but the intensities of chemical and biological transformations are considerably greater in the (humid) tropics than elsewhere. Cambisols in the humid tropics can form in a few years time. Those in cool and/or dry regions require more time, because soil formation is halted for shorter or longer periods.

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GENESIS
CHARACTERISTICS
MANAGEMENT / USE
SAMPLE PROFILE
SLIDESHOW

Characteristics of Cambisols

Morphometric characteristics

The 'typical' Cambisol profile has an ABC-horizon sequence with an ochric, mollic or umbric A-horizon over a cambic B-horizon that has normally a yellowish-brown colour but that may also be an intense red. Cambisols in poorly drained terrain positions may show '*redoximorphic*' features. The soil texture is loamy to clayey. Signs of beginning clay illuviation may be detectable in the cambic horizon but the clay content is normally (still) highest in the A-horizon.

Mineralogical, physical and chemical characteristics

It is not well possible to sum up all mineralogical, physical and chemical characteristics of Cambisols in one generalized account because Cambisols occur in such widely differing environments.
However most Cambisols:

- contain at least some weatherable minerals in the silt and sand fractions.
- occur in regions with a precipitation surplus but in terrain positions that permit surficial discharge of excess water.
- are medium-textured and have a good structural stability, a high porosity, a good water holding capacity and good internal drainage.
- have a neutral to weakly acid soil reaction, a satisfactory chemical fertility and an active soil fauna.

Note that there are numerous exceptions to the above generalizations !

Management and use of Cambisols

By and large, Cambisols make good agricultural land and are intensively used. The Eutric Cambisols of the Temperate Zone are among the most productive soils on earth. Dystric Cambisols, though less fertile, are used for (mixed) arable farming and as grazing and forest land. Cambisols on steep slopes are best kept under forest; this is particularly true for Cambisols in highlands.

Vertic and Calcaric Cambisols in (irrigated) alluvial plains in the dry zone are intensively used for production of food and oil crops. Eutric, Calcaric and Chromic Cambisols in undulating or hilly (mainly colluvial) terrain are planted to a variety of annual and perennial crops or are used as grazing land. Dystric and Ferralic Cambisols in the humid tropics are poor in nutrients but still richer than associated Acrisols or Ferralsols and they have greater cation exchange capacity. The Gleyic Cambisols of alluvial plains are highly productive ‘paddy soils’.