LEPTOSOLS (LP)

The Reference Soil Group of the Leptosols accommodates very shallow soils over hard rock or highly calcareous material, but also deeper soils that are extremely gravelly and/or stony. Lithosols are azonal soils with an incomplete solum and/or without clearly expressed morphological features. They are particularly common in mountain regions. Leptosols correlate with the 'Lithosols' taxa of many international classification systems (USA, FAO) and with 'Lithic' subgroups of other soils groupings. In many systems, Leptosols on calcareous rock are denoted 'Rendzinas'; those on acid rock are also called 'Rankers'.

Definition of Leptosols

Soils having

1 continuous hard rock within 25 cm from the soil surface; **or**
   * a mollic horizon with a thickness between 10 and 25 cm directly overlying material with a calcium carbonate equivalent of more than 40 percent; **or**
   * less than 10 percent (by weight) fine earth from the soil surface to a depth of 75 cm; **and**

2 having no diagnostic horizons other than a mollic, ochric, umbric or yermic horizon.

Common soil units:

Lithic, Hyperskeletic, Rendzic, Gelic, Vertic, Gleyic, Mollic, Umbric, Humic, Aridic, Gypsiric, Calcaric, Yermic, Dystric, Eutric, Haplic.

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Summary description of Leptosols

Connotation: shallow soils; from Gr. leptos, thin.

Parent material: various kinds of rock or unconsolidated materials with less than 10 percent fine earth.

Environment: mostly land at high or medium altitude and with strongly dissected topography. Leptosols are found in all climatic zones, in particular in strongly eroding areas.

Profile development: A(B)R- or A(B)C-profiles with a thin A-horizon. Many Leptosols in calcareous weathering material have a mollic A-horizon that shows signs of intensive biological activity.

Use: unattractive soils for arable cropping; limited potential for tree crop production or extensive grazing. Leptosols are best kept under forest.

Regional distribution of Leptosols

Leptosols are the most extensive Reference Soil Group on earth, extending over approximately 1655 million ha. Leptosols are found from the tropics to the cold polar tundra and from sea level to the highest mountains. Leptosols are particularly widespread in montane areas, notably in Asia and South America, in the Saharan and Arabian deserts, the Ungava peninsula of northern Canada and in the Alaskan Mountains. Elsewhere, Leptosols can be found on rocks that are resistant to weathering or where erosion has kept pace with soil formation, or removed the top of the soil profile. Lithic Leptosols (less than 10 cm deep) in montane regions are the most extensive Leptosols. See Figure 1.

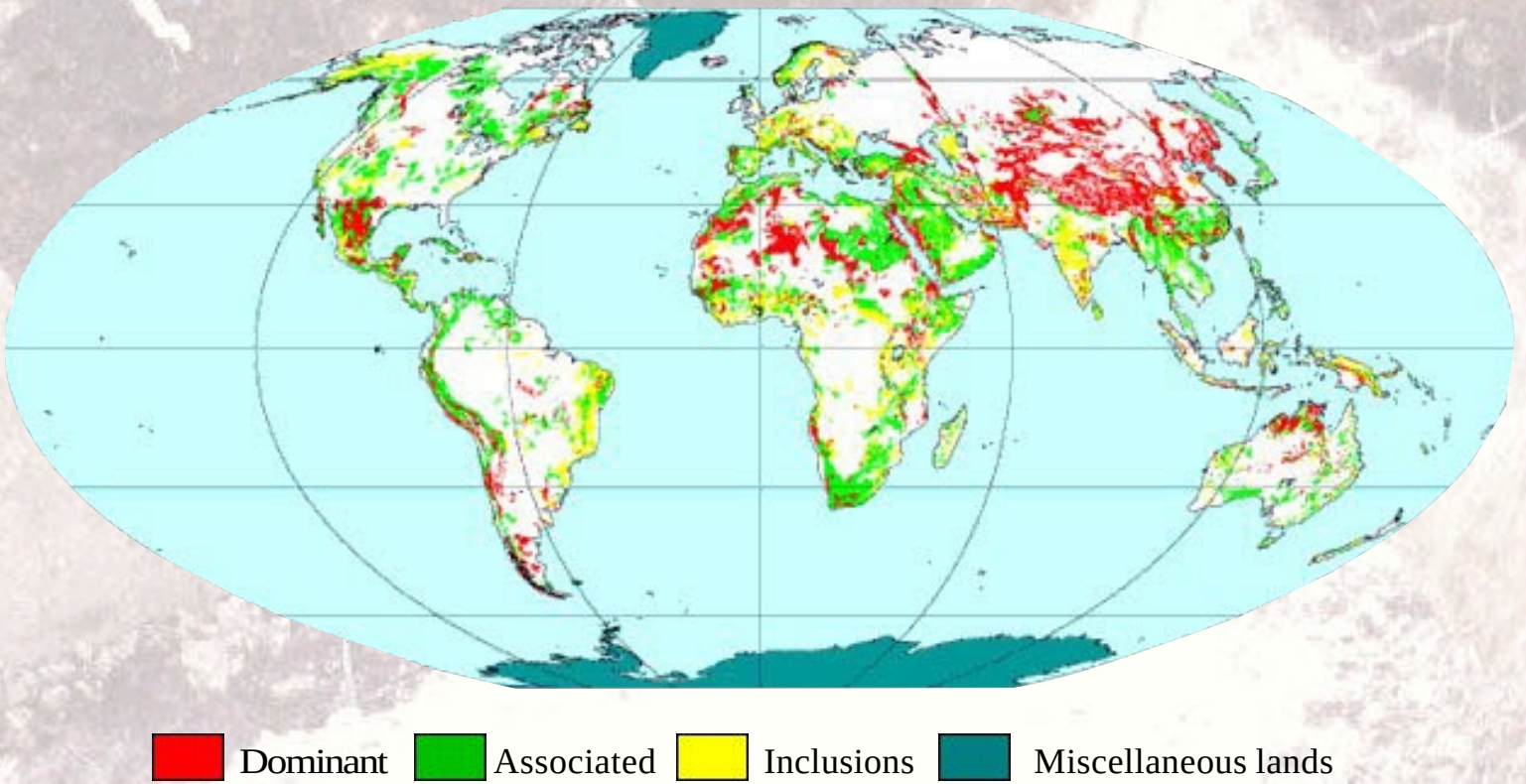

Figure 1. Leptosols worldwide.

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Associations with other Reference Soil Groups

The WRB definition of Leptosols refers specifically to shallow soils with continuous hard rock within 25 cm from the soil surface, excluding cemented layers such as a petrocalcic or petroplinthic horizon. However, the definition includes also deeper soils, provided that these have less than 10 percent fine earth over a depth of at least 75 cm. When discussing linkages between (diverse!) Leptosols and other Reference Soil Groups, one might make a distinction between Leptic units of other reference groups and soil units of Leptosols.

Leptic units of other Reference Soil Groups

The qualifier "Leptic" indicates continuous hard rock between 25 and 100 cm from the soil surface and is listed for many reference groups but not for Histosols, Anthrosols, Vertisols, Fluvisols, Solonchaks, Gleysols, Podzols, Plinthosols, Ferralsols, Solonetz, Planosols, Chernozems, Kastanozems, Albeluvisols, Alisols, Nitisols and Arenosols.

Leptic units of Histosols, Vertisols and Podzols are known to exist and are likely to be included in the listing in the near future. Leptic units of Fluvisols, Solonchaks, Gleysols, Plinthosols, Ferralsols, Solonetz, Planosols, Chernozems, Kastanozems, Albeluvisols, Alisols and Nitisols are probably rare (or have not been sufficiently documented) or unlikely to occur; some of these may yet have to be included. Leptic Arenosols are excluded because continuous hard rock between 50 to 100 cm is not allowed in Arenosols; soils with a texture of sand or loamy sand above continuous hard rock between 25 and 100 cm would be Areni-Leptic Regosols.

Leptosol soil units

Qualifiers distinguished for the Leptosol reference group link Leptosols to Cryosols (Gelic Leptosols), Gleysols (Gleyic Leptosols), Umbrisols (Umbric Leptosols), Phaeozems (Mollic Leptosols), Regosols (Hyperskeletic Leptosols) and Gypsisols (Gypsiric Leptosols). Because the central concept of Leptosols is one of weakly developed and/or very shallow soils, Leptosols are not supposed to have a histic, andic, spodic, argic or cambic horizon. For the same reason, soils with a petrocalcic, petrogypsic, petroduric or petroplinthic horizon within 25 cm of the surface are not classified as Leptosols but as Calcisols, Gypsisols, Durisols and Plinthosols respectively. Pedogenetic horizons may however develop in very shallow soils. Thin histic surface layers occur over hard rock, especially in the boreal regions of the world and in areas with high precipitation (e.g. the "blanket peats" of the British Isles). If less than 10 cm thick, the shallow peat layer is ignored and the soils are classified as Lithic Leptosols; if more than 10 cm of peat are present, they key out as (Leptic) Histosols.

The first evidence of pedological development in a Leptosol normally hints at formation of a cambic subsurface horizon. However, the soil ceases to be a Leptosol to become (classified as) a Cambisol as soon as the developing horizon becomes a real cambic horizon (at least 15 cm thick and its base deeper than 25 cm below the surface).

An andic horizon is not permitted in Leptosols but soils consisting of tephric soil material, with less than 10 percent of fine earth, represent intergrades of Leptosols to the Andosols.

The definition of the spodic horizon leaves the possibility open that a full-fledged Podzol exists within the depth limits of Leptosols. Such (mature!) soils are not Leptosols, despite the presence of hard rock within 25 cm from the surface, but are classified as (Leptic) Podzols.

The definition of the argic horizon precludes that an argic horizon can be present within the depth limits of Leptosols, unless there is an abrupt textural transition from the overlying horizon to the (more than 7.5 cm thick) argic horizon. In that case the soil is classified as a (Leptic) Luvisol (or Acrisol or Lixisol, depending on the CEC_{clay} and the base saturation).

"Gleyic properties" in Leptosols are exclusive to (deeper) soils that qualify as Leptosols because they have less than 10 percent (by weight) fine earth to a depth of at least 75 cm. "Stagnic properties" may have to be considered both in Leptosols with continuous hard rock within 25 cm of the surface and in Leptosols with less than 10 percent of fine earth to a depth of 75 cm, but Leptosols with stagnic properties have not been sufficiently documented so far.

Genesis of Leptosols

Leptosols are genetically young soils and evidence of soil formation is normally limited to a thin A-horizon over an incipient B-horizon or directly over the unaltered parent material. The principal soil forming process in Rendzic and Mollic Leptosols is the dissolution and subsequent removal of carbonates. A relatively small residue remains behind and is thoroughly mixed with stable humifying organic matter and, in Rendzic Leptosols, fragments of limestone rock. Swelling and shrinking smectite clays in the mineral residue are accountable for the dominance of blocky structures. Umbric Leptosols occur mostly on siliceous parent rock in (montane) regions with a cool climate and a high precipitation sum.

Characteristics of Leptosols

Morphological characteristics

Most Leptosols have an A(B)R- or A(B)C-configuration of only weakly expressed horizons. Rendzic and Mollic Leptosols have more pronounced morphological features. Their dark brown or black calcareous organo-mineral surface soil, in Rendzic Leptosols speckled with white limestone fragments, has a well-developed crumb or granular structure, or a vermicular structure with abundant earth worm casts. At the base of the soil profile, there is an abrupt change to the underlying rock or there may be a narrow transition horizon.

Hydrological, chemical and physical characteristics

The Reference Soil Group of the Leptosols contains a wide variety of soils with greatly different chemical and physical properties. By and large, Leptosols are free draining soils with the exception of certain Hyperskeletic Leptosols that may have groundwater at shallow depth. Stagnic properties can occur in Leptosols on gentle slopes or in pockets but they are rather exceptional.

The physical, chemical and biological properties of non-calcareous Leptosols are largely conditioned by the characteristics of the parent material and the climate. Calcareous Leptosols have generally better physical and chemical properties than non-calcareous ones and are also less diverse. Leptosols are normally free from noxious levels of soluble salts. However, their shallowness and/or stoniness, and implicit low water holding capacity, are serious limitations. The natural vegetation on Leptosols varies with the climate but is generally richer on calcareous Leptosols than on acid ones. Earthworms, enchytraeid worms and arthropods are the chief soil organisms. The soil fauna may be temporarily inactive in dry spells.

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Management and use of Leptosols

Leptosols have a resource potential for wet-season grazing and as forest land. Rendzic Leptosols in southeast Asia are planted to teak and mahogany; those in the temperate zone are under (mainly) deciduous mixed forest whereas acid Lithic, Umbric and Dystric Leptosols are commonly under pine forest. Erosion is the greatest threat to Leptosol areas, particularly in montane regions in the temperate zones where high population pressure (tourism), overexploitation and increasing environmental pollution lead to increasing deterioration of forests and threaten large areas of vulnerable Leptosols.

Leptosols on hill slopes are generally more fertile than their counterparts on more level land. One or a few ‘good’ crops could perhaps be grown on such slopes but at the price of severe erosion. Steep slopes with shallow and stony soils can be transformed into cultivable land through terracing, the removal of stones by hand and their use as terrace fronts. Agro-forestry (a combination of rotation of arable crops and forest under strict control) holds promise but is largely still in an experimental stage. The excessive internal drainage of many Leptosols can cause drought even in a humid environment.