Qualifiers (formative elements for naming soil units)

General rules

1 Soil units are defined by one or more 'qualifiers'. Each qualifier has a unique meaning.

2 Qualifiers are described in terms of established diagnostic horizons, properties and characteristics but may include additional (new) elements.

3 Qualifier definitions must not contain criteria referring to climate, parent material, vegetation, physiographic features, soil-water relationships or characteristics/properties of the substratum (below the control section).

4 Not more than two qualifiers may be used in soil unit names. If additional qualifiers are needed, these must follow the Reference Soil Group name between brackets, e.g. Acri-Geric Ferralsol (Humic and Xanthic).

5 Qualifiers used in a soil unit name may not overlap or conflict nor may qualifiers used in a soil name overlap or conflict with the definition of the Reference Soil Group to which the qualifiers are attached. For instance, a Dystri-Petric Calcisol is a contradiction ('Dystri' clashes with 'Calcisol') whereas a Eutric-Petri Calcisol is an overlap because the prefix 'Eutric' adds no information beyond the specifications of the Calcisol Reference Group.

Definitions of qualifiers

Table 1. Alphabetical list of qualifiers

Abruptic	Chernic	Geric	Lixic	Plaggic	Spolic
Aceric	Chloridic	Gibbsic	Luvic	Planic	Stagnic
Acric	Chromic	Glacic	Magnesic	Plinthic	Sulphatic
Acroxic	Cryic	Gleyic	Mazic	Posic	Takyric
Albic	Cutanic	Glossic	Melanic	Profondic	Tephric
Alcalic	Densic	Greyic	Mesotrophic	Protic	Terric
Alic	Duric	Grumic	Mollic	Reductic	Thionic
Aluandic	Dystric	Gypsic	Natric	Regic	Toxic
Alumic	Entic	Gypsiric	Nitic	Rendzic	Turbic
Andic	Eutric	Haplic	Ochric	Rheic	Umbric
Anthraquic	Eutrisilic	Histic	Ombric	Rhodic	Urbic
Anthric	Ferralic	Hortic	Oxyaquic	Rubic	Vetic
Anthropic	Ferric	Humic	Pachic	Ruptic	Vermic
Arenic	Fibric	Hydragric	Pellic	Rustic	Vertic
Aric	Folic	Hydric	Petric	Salic	Vitric
Aridic	Fluvic	Hyperochric	Petrocalcic	Sapric	Xanthic
Arzic	Fragic	Hyperskeletic	Petroduric	Silandic	Yermic
Calcaric	Fulvic	Irragric	Petrogypsic	Siltic	
Calcic	Garbic	Lamellic	Petroplinthic	Skeletic	
Carbic	Gelic	Leptic	Petrosalic	Sodic	
Carbonatic	Gelistagnic	Lithic	Placic	Spodic	

Where relevant, the names can be defined further using prefixes, for example Epigleyi-, Protothioni-. The following prefixes can be used:

Bathi	Epi	Orthi	Thapto
Cumuli	Hyper	Para	
Endo	Hypo	Proto	

Abruptic having an abrupt textural change.

Aceric having, within 100 cm from the soil surface, a pH (1:1 in water) between 3.5 and 5 and jarosite mottles (in Solonchaks only).

Acric having, in at least part of the subsurface horizon within 100 cm from the soil surface, a ferralic horizon, which meets the clay increase requirements of an argic horizon, and has less than 50 percent base saturation (in 1 *M* NH_4OAc at pH 7.0) (in Ferralsols only).

Acroxic having, within 100 cm from the soil surface, less than 2 cmol(+) kg^{-1} of (exchangeable bases plus 1 *M* KCl exchangeable Al^{3+}) in the fine earth fraction of one or more horizons with a combined thickness of 30 cm or more (in Andosols only).

Albic having, within 100 cm from the soil surface, an albic horizon.

Hyperalbic having an albic horizon within 50 cm from the soil surface and the lower boundary at a depth of 100 cm or more from the soil surface.

Glossalbic having tonguing of an albic into an argic or natric horizon.

Alcalic having, within 50 cm from the surface, soil material, which has in a 1:1 aqueous solution, a pH of 8.5 or more.

Alic having an argic horizon, which has a cation exchange capacity (in 1 *M* NH_4OAc at pH 7.0) equal to or greater than 24 cmol(+) kg^{-1} clay throughout, a silt/clay ratio of less than 0.6, and 50 percent or more Al-saturation.

Aluandic having an andic horizon with less than 0.6 percent acid oxalate (pH 3) extractable silica, or an Al_{py} [1]/Al_{ox} [2] ratio of 0.5 or greater.

Alumic having, in at least some part of the subsurface horizon between 50 and 100 cm from the soil surface, 50 percent or more Al-saturation.

Andic having, within 100 cm from the soil surface, an andic horizon.

Anthraquic having an anthraquic horizon.

Anthric having evidence of alteration by cultivation practices.

Anthropic having evidence of profound modification of the soil by human activity other than cultivation (in Regosols only).

Aric having remnants of diagnostic horizons disturbed by repeated deep ploughing.

Arenic having, throughout the upper 50 cm soil layer, a texture of loamy fine sand or coarser.

Aridic having aridic properties and **not** having a takyric or yermic horizon.

Arzic having, within 50 cm from the soil surface, sulphate-rich groundwater at some period in most years **and** having, averaged over a depth of 100cm, 15 percent or more gypsum (in Gypsisols only).

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1. Al_{py}: pyrophosphate extractable aluminium.
2. Al_{ox}: acid oxalate (pH 3) extractable aluminium (method of Blakemore *et al, 1987*).

Calcaric calcareous at least between 20 and 50 cm from the soil surface.

Calcic having, between 50 and 100 cm from the soil surface, a calcic horizon or concentrations of secondary carbonates.

Hypercalcic having a hypercalcic horizon, which contains 50 percent or more calcium carbonate equivalent.

Hypocalcic having only concentrations of secondary carbonates within 100 cm from the soil surface.

Orthicalcic having a calcic horizon within 100 cm from the soil surface.

Carbic having a cemented spodic horizon, which does not contain enough amorphous iron to turn redder on ignition (in Podzols only).

Carbonatic having, in a 1:1 aqueous solution, a soil-pH > 8.5 **and** $HCO_3 > SO_4 >> Cl$ (in Solonchaks only).

Chernic having a chernic horizon (in Chernozems only).

Chloridic having, in a 1:1 aqueous solution, $Cl >> SO_4 > HCO_3$ (in Solonchaks only).

Chromic having a subsurface horizon, which in the major part has a Munsell hue of 7.5YR and a chroma (moist) of more than 4, or a hue (moist) redder than 7.5YR.

Cryic having, within 100 cm from the soil surface, a cryic horizon.

Cutanic having clay skins in the argic horizon.

Densic having a cemented *spodic* horizon ("Ortstein") (in Podzols only).

Duric having, within 100 cm from the soil surface, a duric horizon.

- **Hyperduric** having a duric horizon containing more than 50 percent silica.

Dystric having, in at least some part between 20 and 100 cm from the soil surface, or in a layer 5 cm thick directly above a lithic contact in Leptosols, a base saturation (in 1 *M* NH_4OAc at pH 7.0) of less than 50 percent.

- **Epidystric** having a base saturation (in 1 *M* NH_4OAc at pH 7.0) of less than 50 percent at least between 20 and 50 cm from the soil surface.
- **Hyperdystric** having a base saturation (in 1 *M* NH_4OAc at pH 7.0) of less than 50 percent in all parts between 20 and 100 cm from the soil surface, and less than 20 percent in some part within 100 cm from the soil surface.
- **Orthidystric** having a base saturation (in 1 *M* NH_4OAc at pH 7.0) of less than 50 percent in all parts between 20 and 100 cm from the soil surface.

Entic having no albic horizon and having a loose spodic horizon (in Podzols only).

Eutric having, at least between 20 and 100 cm from the soil surface, or in a layer 5 cm thick directly above a lithic contact in Leptosols, a base saturation (in 1 *M* NH_4OAc at pH 7.0) of 50 percent or more.

- **Endoeutric** having a base saturation (in 1 *M* NH_4OAc at pH 7.0) of 50 percent or more in all parts between 50 and 100 cm from the soil surface.

Hypereutric having a base saturation (in 1 *M* NH_4OAc at pH 7.0) of 80 percent or more in all parts between 20 and 100 cm from the soil surface.

Orthieutric having a base saturation (in 1 *M* NH_4OAc at pH 7.0) of 50 percent or more in all parts between 20 and 100 cm from the soil surface.

Eutrisilic having a silandic horizon and a sum of exchangeable bases equal to or more than 25 cmol(+) kg^{-1} fine earth within 30 cm from the soil surface.

Ferralic having, within 100 cm from the soil surface, ferralic properties.

Hyperferralic having a cation exchange capacity (in 1 *M* NH_4OAc at pH 7.0) of less than 16 cmol(+) kg^{-1} clay in at least some part within 100 cm from the soil surface.

Hypoferralic having a cation exchange capacity (in 1 *M* NH_4OAc at pH 7.0) of less than 4cmol(+) kg^{-1} fine earth in at least 30 cm of the upper 100 cm of the soil, and a Munsell colour chroma (moist) of 5 or more and/or hues redder than 10YR (in Arenosols only).

Ferric having, within 100 cm from the soil surface, a ferric horizon.

Hyperferric having, within 100 cm from the soil surface, one or more layers with a total thickness of 25 cm or more consisting of 40 percent or more iron/manganese-oxide nodules.

Fibric having more than two-thirds (by volume) of the organic soil material consisting of recognizable plant tissue (in Histosols only).

Folic having a folic horizon (in Histosols only).

Fluvic having, within 100 cm from the soil surface, fluvic soil material.

Fragic having, within 100 cm from the soil surface, a fragic horizon.

Fulvic having, within 30 cm from the soil surface, a fulvic horizon.

Garbic having soil material containing more than 35 percent (by volume) organic waste materials (in Anthropic Regosols only).

Gelic having, within 200 cm from the soil surface, permafrost.

Gelistagnic having temporary water saturation at the surface caused by frozen subsoil.

Geric having, in at least some horizon within 100 cm from the soil surface, geric properties.

Gibbsic having, within 100 cm from the soil surface, a layer more than 30 cm thick containing more than 25 percent gibbsite in the fine earth fraction.

Glacic having, within 100 cm from the soil surface, a layer more than 30 cm thick and containing 95 percent or more ice (by volume).

Gleyic having, within 100 cm from the soil surface, gleyic properties.

- **Endogleyic** having gleyic properties between 50 and 100 cm from the soil surface.
- **Epigleyic** having gleyic properties within 50 cm from the soil surface.

Glossic having tonguing of a mollic or umbric horizon into an underlying subsurface horizon or into the saprolite.

	Molliglossic	having tonguing of a mollic horizon into an underlying subsurface horizon or into the saprolite.
	Umbriglossic	having tonguing of an umbric horizon into an underlying subsurface horizon or into the saprolite.
Greyic		having uncoated silt and sand grains on structural ped faces in a mollic horizon (in Phaeozems only).
Grumic		having a surface layer with a thickness of 3 cm or more with a strong structure finer than very coarse granular (in Vertisols only).
Gypsic		having, within 100 cm from the soil surface, a gypsic horizon.
	Hypergypsic	having a gypsic horizon, which has 60 percent or more gypsum.
	Hypogypsic	having a gypsic horizon, which has 25 percent or less gypsum.
Gypsiric		having, at least between 20 and 50 cm from the soil surface, gypsiric soil material.
Haplic		having the typical expression of the Soil Reference Group in the sense that there is no further or meaningful characterization.
Histic		having, within 40 cm from the soil surface, a histic horizon.
	Fibrihistic	having, within 40 cm from the soil surface, a histic horizon, in which more than two-thirds (by volume) of the organic soil material consists of recognizable plant tissue.

Saprihistic having, within 40 cm from the soil surface, a histic horizon, in which less than one-sixth (by volume) of the organic soil material consists of recognizable plant tissue.

Thaptohistic having a buried histic horizon between 40 and 100 cm from the soil surface.

Hortic having a hortic horizon, which is 50 cm or more thick in Anthrosols or less than 50 cm thick in other soils.

Humic either having, over a depth of 100 cm from the soil surface, more than 1.4 percent organic carbon (by weight) in the fine earth fraction in Ferralsols or Nitisols, or having more than 2 percent organic carbon (by weight) to a depth of 25 cm in Leptosols, or having more than 1 percent organic carbon (by weight) to a depth of 50 cm in other soils.

Hydragric having an anthraquic horizon and an associated hydragric horizon, the latter occurring within 100 cm from the soil surface (in Anthrosols only).

Hydric having, within 100 cm from the soil surface, one or more layers with a total thickness of 35 cm or more, which have a water retention at 1500 kPa (in undried samples) of 100 percent or more (in Andosols only).

Hyperskeletic having, to a depth of 75 cm or more or to continuous hard rock, more than 90 percent (by weight) gravel or other coarse fragments (in Leptosols only).

Irragric having an irragric horizon, which is 50 cm or more thick in Anthrosols or less than 50 cm thick in other soils.

Lamellic having, within 100cm from the soil surface, clay illuviation lamellae with a combined thickness of at least 15 cm.

Leptic having, between 25 and 100 cm from the soil surface, continuous hard rock.

Endoleptic having continuous hard rock between 50 and 100 cm from the soil surface.

Epileptic having continuous hard rock between 25 and 50 cm from the soil surface.

Paraleptic having, at least between 25 and 50 cm from the soil surface, a dense heavy clayey layer that is impenetrable to roots.

Lithic having, within 10 cm from the soil surface, continuous hard rock.

Paralithic having, within 10 cm from the soil surface, a broken rock contact with fissures less than 10 cm apart, which allow roots to penetrate the underlying rock.

Hypolithic having, within 10 cm from the soil surface, continuous rock with a hardness of less than 3.

Lixic having a ferralic horizon, which meets the clay increase requirements of an argic horizon, and which has a base saturation (in 1 *M* NH_4OAc at pH 7.0) of 50 percent or more throughout the ferralic horizon to a depth of 100 cm from the soil surface (in Ferralsols only).

Luvic having an argic horizon, which has a cation exchange capacity equal to or more than 24 cmol(+) kg^{-1} clay (in 1 *M* NH_4OAc at pH 7.0) throughout, and a base saturation of 50 percent or more throughout the horizon to a depth of 100 cm from the soil surface.

Hypoluvic having (absolute) clay increase of 3 percent or more within 100 cm from the soil surface (in Arenosols only).

Magnesic having, within 100 cm from the soil surface, a ratio of exchangeable Ca/Mg of less than 1

Mazic having, in the upper 20 cm soil layer, a massive structure and hard to very hard consistence (in Vertisols only).

Melanic having a melanic horizon (in Andosols only).

Mesotrophic having, at 20 cm depth, a base saturation (in 1 *M* NH_4OAc at pH 7.0) of less than 75 percent (in Vertisols only).

Mollic having a mollic horizon.

Natric having, within 100cm from the soil surface, a natric horizon.

Nitic having, within 100cm from the soil surface, a nitic horizon.

Ochric having an ochric horizon.

Hyperochric having an ochric horizon, which is grey when dry and turns darker on moistening and which contains less than 0.4 percent organic carbon (by weight) and has little free iron oxide, coarse texture, platy structure and a thin surface crust.

Ombric having a water regime conditioned by surplus precipitation (over evaporation) during most of the year (in Histosols only).

Oxyaquic saturated with water during the thawing period and lacking oximorphic and/or reductomorphic properties within 100 cm from the soil surface (in Cryosols only).

Pachic having a mollic or umbric horizon more than 50 cm thick..

Pellic having, in the upper 30 cm of the (moist) soil matrix, a Munsell value of 3.5 or less and a chroma of 1.5 or less (in Vertisols only).

Petric strongly cemented or indurated within 100 cm from the soil surface.

Endopetric strongly cemented or indurated between 50 and 100 cm from the soil surface.

Epipetric strongly cemented or indurated within 50 cm from the soil surface.

Petrocalcic having, within 100 cm from the soil surface, a petrocalcic horizon.

Petroduric having, within 100 cm from the soil surface, a petroduric horizon.

Petrogypsic having, within 100 cm from the soil surface, a petrogypsic horizon.

Petroplinthic having, within 100 cm from the soil surface, a petroplinthic horizon.

Petrosalic having, within 100 cm from the soil surface, a horizon 10 cm or more thick, which is cemented by salts more soluble than gypsum.

Placic having, within 100 cm from the soil surface, a sub-horizon of the spodic horizon, which is 1 cm or more thick and which is continuously cemented by a combination of organic matter and aluminium, with or without iron ("thin iron pan"; in Podzols only).

Plaggic having a plaggic horizon, which is 50 cm or more thick in Anthrosols or less than 50 cm thick in other soils.

Planic having, within 100 cm from the soil surface, an eluvial horizon abruptly overlying a slowly permeable horizon.

Plinthic having, within 100 cm from the soil surface, a plinthic horizon.

- **Epiplinthic** having a plinthic horizon within 50 cm from the soil surface.
- **Hyperplinthic** having a plinthic horizon in which irreversible hardening results in a continuous sheet of ironstone.
- **Orthiplinthic** having a plinthic horizon in which irreversible hardening results in a layer of gravel-sized ironstone.
- **Paraplinthic** having a mottled horizon with at least 10 percent (by volume) iron nodules resembling a plinthic horizon but which does not irreversibly harden on repeated drying and wetting.

Posic having, within 100 cm from the soil surface, a zero or positive charge (pH_{KCl} - pH_{water}) in a layer more than 30 cm thick (in Ferralsols only).

Profondic having an argic horizon in which the clay content does not decrease by more than 20 per-cent (relative) from its maximum within 150 cm from the soil surface.

Protic having no appreciable soil horizon development (in Arenosols only).

Reductic having accumulation of anthropogeomorphic materials with anaerobic conditions caused by gaseous emissions (e.g. methane, carbon dioxide) (in Anthropic Regosols only).

Regic lacking recognizable buried horizons (in Anthrosols only).

Rendzic having a mollic horizon, which is between 10 and 25 cm thick and contains or immediately overlies calcaric soil material having more than 40 percent calcium carbonate equivalent (in Leptosols only).

Rheic having a water regime conditioned by surface water (in Histosols only).

Rhodic having a subsurface horizon with a Munsell hue of 3.5YR or redder in all parts (apart from transitional horizons to A- and C-horizons), a moist colour value of less than 3.5 and a dry colour value no more than one unit higher than the moist value.

Rubic having a subsurface horizon with a Munsell hue redder than 10YR and/or a moist chroma of 5 or more (in Arenosols only).

Ruptic having, within 100 cm from the soil surface, a lithological discontinuity.

Rustic having a cemented spodic horizon, which turns redder on ignition, underlies an albic horizon and lacks a sub-horizon, which is 2.5 cm or more thick and which is continuously cemented by a combination of organic matter and aluminium, with or without iron ("thin iron pan") (in Podzols only).

Salic having, within 100 cm from the soil surface, a salic horizon.

Endosalic having a salic horizon between 50 and 100 cm from the soil surface.

Episalic having a salic horizon between 25 and 50 cm from the soil surface.

Hyposalic having, in at least some sub-horizon within 100 cm from the soil surface, an electric conductivity of the saturation extract of more than 4 dS m^{-1} at 25 ^{o}C.

Hypersalic having, in at least some sub-horizon within 100 cm from the soil surface, an electric conductivity of the saturation extract of more than 30 dS m^{-1} at 25 ^{o}C.

Sapric having, after rubbing, less recognizable plant tissue than one-sixth (by volume) of the organic soil material (in Histosols only).

Silandic having an andic horizon with 0.6 percent or more acid oxalate (pH 3) extractable silica, or an Al_{py}/Al_{ox} ratio of less than 0.5.

Siltic having, within 100 cm from the soil surface, a horizon more than 30 cm thick and containing 40 percent or more silt.

Skeletic having, to a depth of 100 cm from the soil surface, between 40 and 90 percent (by weight) gravel or other coarse fragments.

- **Endoskeletic** having, between 50 and 100 cm from the soil surface, between 40 and 90 percent (by weight) gravel or other coarse fragments.
- **Episkeletic** having, between 20 and 50 cm from the soil surface, between 40 and 90 percent (by weight) gravel or other coarse fragments.

Sodic having, within 50 cm from the soil surface, more than 15 percent exchangeable sodium or more than 50 percent exchangeable sodium plus magnesium.

- **Endosodic** having, between 50 and 100 cm from the soil surface, more than 15 percent exchangeable sodium or more than 50 percent exchangeable sodium plus magnesium.
- **Hyposodic** having, within 100 cm from the soil surface, more than 6 percent exchangeable sodium in at least some sub-horizon more than 20 cm thick..

Spodic having a spodic horizon.

Spolic having soil material containing more than 35 percent (by volume) industrial waste, e.g. mine spoil, dredge spoil, etc. (in Anthropic Regosols only).

Stagnic having stagnic properties within 50 cm from the soil surface.

Endostagnic having stagnic properties between 50 and 100 cm from the soil surface.

Sulphatic having, in a 1:1 aqueous solution, SO_4 >> HCO_3 > Cl (in Solonchaks only).

Takyric having a takyric horizon.

Tephric having, to a depth of 30 cm or more from the soil surface, tephric soil material.

Terric having a terric horizon, which is 50 cm or more thick in Anthrosols or less than 50 cm thick in other soils.

Thionic having, within 100 cm from the soil surface, a sulfuric horizon or sulfidic soil material.

Orthithionic having a sulfuric horizon within 100 cm from the soil surface.

Protothionic having sulfidic soil material within 100 cm from the soil surface.

Toxic having, within 50 cm from the soil surface, ions other than aluminium, iron, sodium, calcium or magnesium, in concentrations that are toxic to plants.

Turbic having, either at the surface or within 100 cm from the soil surface, features resulting from cryoturbation. These include mixed soil material, disrupted soil horizons, involutions (swirl-like patterns in soil horizons), organic intrusions, frost heave, separation of coarse from fine soil materials, cracks and patterned surface features such as earth hummocks, frost mounds, stone circles, nets and polygons (in Cryosols only).

Umbric having an umbric horizon.

Urbic having soil material containing more than 35 percent (by volume) earthy materials mixed with building rubble and artefacts (in Anthropic Regosols only).

Vermic having, in the upper 100 cm of the soil or down to rock or to a petrocalcic, petroduric, petrogypsic or petroplinthic horizon, whichever is shallower, 50 percent or more (by volume) wormholes, worm casts, and/or filled animal burrows.

Vertic having, within 100 cm from the soil surface, a vertic horizon or vertic properties.

Vetic having, in at least some part of the subsurface horizon within 100 from the soil surface, less than 6 cmol(+) kg^{-1} clay of (exchangeable bases plus exchangeable acidity).

Vitric having, within 100 cm from the soil surface, a vitric horizon and having no andic horizon overlying the vitric horizon.

Xanthic having a ferralic horizon with a yellow to pale yellow colour (rubbed soil has Munsell hues of 7.5YR or yellower with a value, moist, of 4 or more and a chroma, moist, of 5 or more).

Yermic having a yermic horizon including a desert pavement.

Nudiyermic having a yermic horizon without a desert pavement.

Prefixes

The following prefixes may be used to indicate depth of occurrence or degree of expression of soil characteristics or properties. Prefixes are combined with other elements to one word, e.g. Orthicalcic. A double combination, e.g. Epihypercalcic, is allowed.

Bathi horizon, property or material starting between 100 and 200 cm from the soil surface.

Cumuli having repetitive accumulation of soil material of 50 cm or more in the surface or A-horizon.

Endo horizon, property or material starting at some depth, generally between 50 and 100 cm from the soil surface.

Epi horizon, property or material starting within 50 cm from the soil surface.

Hyper having excessive or strong expression.

Hypo having slight or weak expression.

Orthi having an expression that is typical for the feature (typical in the sense that there is no further or meaningful characterization).

Para having resemblance to a particular feature (e.g. Paralithic).

Proto indicating a precondition or an early stage of development (e.g. Protothionic).

Thapto having, within 200 cm from the soil surface, a buried horizon or a buried soil (given in combination with the buried diagnostic horizon, e.g. Thaptomollic).