The Soils That We Classify

2

Abstract

Soil is the natural medium for the growth of land plants, whether or not it has discernible soil horizons. People consider soil important because it supports plants that supply food, fibers, drugs, and other human needs and because it filters water and recycles wastes. Soil is a natural body comprised of solids (minerals and organic matter), liquid, and gases that occur on the land surface, occupies space, and is characterized by horizons, or layers, that are distinguishable from initial geologic material as a result of additions, losses, transfers, and transformations of energy and matter or the ability to support rooted plants in a natural environment. The upper limit of soil is the boundary between soil and air, shallow water, live plants, or plant materials that have not begun to decompose. For purposes of classification, the lower boundary of soil is arbitrarily set at 200 cm. In areas where soil has thin cemented horizons that are impermeable to roots, the soil extends as deep as the deepest cemented horizon, but not below 200 cm.

The United Arab Emirates Keys to Soil Taxonomy is designed in such a way that the reader makes the correct classification by going through the key systematically, starting at the beginning and eliminating one by one all classes that include criteria that do not fit the soil or layer in question.

Keywords

Cemented horizons • Geological material • Land plants • Natural body • Lower boundary

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2.1 Introduction

This section in general is taken from *Keys to Soil Taxonomy* (Soil Survey Staff 2010) with slight modifications that reflect the soil conditions and the soil system in the United Arab Emirates.

Soil is the natural medium for the growth of land plants, whether or not it has discernible soil horizons. This meaning is still the common understanding of the term, and the greatest interest in soil is centered on this meaning. People consider soil important because it supports plants that supply food, fibers, drugs, and other wants of humans and because it filters water and recycles wastes. Soil is a natural body comprised of solids (minerals and organic matter), liquid, and gases that occur on the land surface, occupies space, and is characterized by one or both of the following: horizons, or layers, that are distinguishable from initial geologic material as a result of additions, losses, transfers, and transformations of energy and matter *or* the ability to support rooted plants in a natural environment. This definition is expanded from the 1975 version of *Soil Taxonomy* (USDA, SCS 1975) to include soils in areas of Antarctica where pedogenesis occurs but where the climate is too harsh to support the higher plant forms.

The upper limit of soil is the boundary between soil and air, shallow water, live plants, or plant materials that have not begun to decompose. Areas are not considered to have soil if the surface is permanently covered by water too deep (typically more than about 2.5 m) for the growth of rooted plants. The lower horizontal boundaries of soil are areas where the soil grades to deep water, barren areas, rock, or ice. In some places the separation between soil and nonsoil is so gradual that clear distinctions cannot be made.

The lower boundary that separates soil from the nonsoil underneath is most difficult to define. Soil consists of the horizons near the earth's surface that, in contrast to the underlying parent material, have been altered by the interactions of climate, relief, and living organisms over time. Commonly, soil grades at its lower boundary to hard rock or to earthy materials virtually devoid of animals, roots, or other marks of biological activity. The lowest depth of biological activity, however, is difficult to discern and is often gradual. For purposes of classification, the lower boundary of soil is arbitrarily set at 200 cm. In soils where either biological activity or current pedogenic processes extend to depths greater than 200 cm, the lower limit of the soil for classification purposes is still 200 cm (Fig. 2.1). In some instances the more weakly cemented bedrocks (paralithic materials) have been described and used to differentiate soil series (series control section), even though the paralithic materials below a paralithic contact are not considered soil in the true sense. In areas where soil has thin cemented horizons that are impermeable to roots, the soil extends as

Fig. 2.1 Soil scientists examining and describing a typical soil profile. The scientists document several soil properties and features, commonly to a depth of 2 m. Note the distinct change in horizons (or layers) with depth

deep as the deepest cemented horizon, but not below 200 cm. For certain management goals, layers deeper than the lower boundary of the soil that is classified (200 cm) must also be described if they affect the content and movement of water and air or other interpretative concerns.

2.2 Buried Soils

A buried soil is covered with a surface mantle of new soil material that either is 50 cm or more thick or is 30–50 cm thick and has a thickness that equals at least half the total thickness of the named diagnostic horizons that are preserved in the buried soil. A surface mantle of new material that does not have the required thickness for buried soils can be used to establish a map unit phase of the mantled soil or even another soil series if the mantle affects the use of the soil.

A surface mantle of new material, as defined here, is largely unaltered, at least in the lower part. It may have a diagnostic surface horizon (epipedon) and/or a cambic horizon, but it has no other diagnostic subsurface horizons, all defined later. However, there remains a layer 7.5 cm or more thick that fails the requirements for all diagnostic horizons, as defined later, overlying a horizon sequence that can be clearly identified as the solum of a buried soil in at least half of each pedon. The recognition of a surface mantle should not be based only on studies of associated soils. Soil, as defined in this text, does not need to have discernible horizons, although the presence or absence of horizons and their nature are of extreme importance in soil classification. Plants can be grown under glass in pots filled with earthy materials, such as peat or sand, or even in water. Under proper conditions all these media are productive for plants, but they are nonsoil here in the sense that they cannot be classified in the same system that is used for the soils of a survey area, county, or even a nation. Plants even grow on trees, but trees are regarded as nonsoil.

Soils are three dimensional (3-D) bodies, and many scientists have different opinions about the classification. From a soil classification point of view, however, the entity that is classified is the *soil profile*, which is a vertical section of soil through different horizon to the parent material. Soil has many properties that fluctuate with the seasons. It may be alternately cold and warm or dry and moist. Biological activity is slowed or stopped if the soil becomes too cold or too dry. The soil receives flushes of organic matter when leaves fall or grasses die. Soil is not static. The pH, soluble salts, amount of organic matter and carbon-nitrogen ratio, numbers of micro-organisms, soil fauna, temperature, and moisture all change with the seasons as well as with more extended periods of time. Soil must be viewed from both the short-term and long-term perspective.

Soils are (Shahid 2007):

- The essence of life
- A product of the environment
- Developed, and not merely an accumulation of debris from rocks and organic matter
- Different from the material from which they are derive
- Continuously changing due to natural and human influences
- Different in inherent capability
- The sites for chemical reactions and organisms
- A medium for the support of plants
- A medium for filtering water and recycling wastes
- Very fragile
- Very slowly renewable

The hierarchy of Dubai (DM 2005), Abu Dhabi (EAD 2009a, b; Shahid et al. 2004) and Northern Emirates soil classification (EAD 2012) has been used in the preparation of this book to help the new user assign soil taxonomic classifications in areas of his/her interest for the maintenance of soil surveys in the UAE. It is most likely that in the process of future soil surveys, new classifications will be identified. In the light of new findings, this edition will be updated periodically as needed.

2.3 Approach to Soil Classification

When classifying soils the user must first consider: (1) the depth in which the soil feature (property or characteristic) occurs; (2) the thickness of the layer where it occurs; and (3) the extent or degree of expression that the feature exhibits. Those soil properties that have a major influence for use and management of the soil are defined as diagnostic horizons. For the diagnostic subsurface horizons identified in the UAE to be recognized at the highest levels of classification (order, suborder, great group, or subgroup) they must occur within a depth of 100 cm from the soil surface. This is the predominant rooting depth of most plants commonly grown. If these features are present but occur at a lower depth (but within 200 cm) they still play an important role in land use planning and have been identified as phases.

Often the soil feature critical to classification is confirmed by simple observation (Fig. 2.2) and volume estimation (qualitative analysis). However, once the feature has been identified, laboratory support is commonly needed to quantify the amount or degree of expression to confirm classification. For example, the presence of calcium carbonate may be observed in the soil profile in the form of coatings, masses, or nodules and a subjective estimate (by volume) is made. However, to confirm the presence of a calcic horizon samples must be collected and analyzed and the presence of calcium carbonate determined quantitatively (by weight). The amount of the material, depth in which the material was observed, and the thickness of the horizon in which it occurs all go together to document the presence of the diagnostic horizon and subsequent taxonomic placement.

The *United Arab Emirates Keys to Soil Taxonomy* is designed in such a way that the reader makes the correct classification by going through the key systematically, starting at the beginning and eliminating one by one all classes that include criteria that do not fit the soil or layer in question. The key has been designed to provide separation of major soil features. In many sections the sequence of the key is based on the severity of limitation the particular property may pose.

Fig. 2.2 Any information collected at a soil description site is carefully documented and geo-referenced

2.4 Naming Subgroups

Subgroups are keyed in a specific and consistent order based on their limitation to use and management of the soils. Subgroups are arrayed in order of most limiting to least limiting. For example, within any great group the Lithic subgroup always keys first. The significant limitation posed by shallow depth to hard bedrock is considered the most limiting of all subgroups to land use and management.

Subgroup names are applied in the following order:

Lithic
Petrogypsic
Petrocalcic
Anhydritic
Gypsic
Leptic

Calcic
Salidic
Sodic

If none of the listed subgroups apply, the subgroup is considered *typic* or typical for the central concept of the great group.

Many soil taxa have properties that encompass more than one subgroup. If more than one subgroup is needed, additional names are added. To date, only two subgroups modifiers have been recognized for individual great groups identified in the United Arab Emirates. The most limiting subgroup is used to initially modify the great group and additional names are added in order of significance. For example, a pedon classified in a Torripsamment great group has properties of a lithic and salidic subgroup. The pedon would be classified at the subgroup level as a "Salidic Lithic Torripsamment". Currently, it is recommended to identify more than two subgroups as differentiae at the series level and the classification remain unchanged.

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Multicolored soil profile indicates phases of soil development

Uniform looking desert landscapes present indepth picturesque features