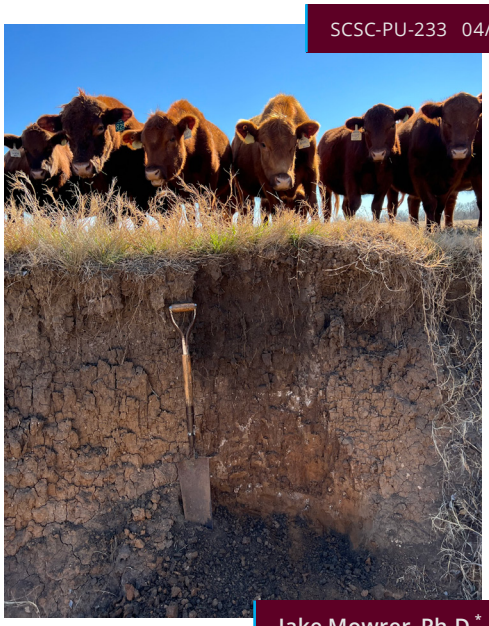
SCSC-PU-233 04/22

KNOW YOUR TEXAS SOILS



Jake Mowrer, Ph.D.*

AMAZING TEXAS SOIL FACT!

There are 12 recognized orders of soil according to the U.S. Department of Agriculture (USDA) classification system. Texas is home to more soil orders (nine) than any other U.S. state—and contains some soils that cannot be found anywhere else in the continental U.S. **Andisols** (formed by volcanoes), **Gelisols** (frozen soils), and **Oxisols** (highly weathered tropical soils) are the only three soil orders that cannot be found in Texas.

SOIL DEFINED

Soil is the layer of unconsolidated (i.e., loose) mineral and/or organic material nearest to the Earth's surface in terrestrial areas (not covered by water). Soil makes up a very small percentage of the Earth's crust. It is a dynamic body, constantly undergoing change, made up of solid particles (e.g., mineral and organic), with voids in between that are filled with gases and water. Many definitions include a requirement that it must also support plant life in order to be called "soil." There is also a size requirement for individual particles to be considered a soil. Anything less than 2 millimeters in size can be called a particle of soil, and anything greater than 2 millimeters is referred to as a rock, gravel, or stone.

Soil particles can be grouped simply into three particle size fractions. The term "soil texture" refers to the relative percentage of each of these fractions in a soil (Fig. 1).

- Sands are soil particles between 0.05 millimeters and 2 millimeters in size. Sands feel gritty to the touch.
- Silts are soil particles between 0.002 millimeters and 0.05 millimeters in size.
- Clays are the finest soil particles and include all sizes below 0.002 millimeters. Clays feel very smooth to the touch (like talc powder).

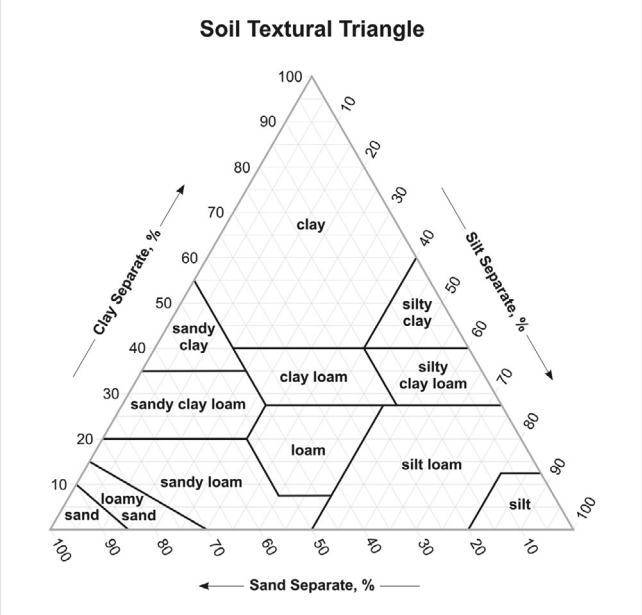


Figure 1. The USDA-NRCS Soil Textural Triangle is used to assign textural class names to soils based on their relative percentages of sand, silt, and clay particle size distribution.

HOW ARE SOILS FORMED?

Soil is always being slowly formed from the weathering or breakdown of rocks in the Earth's crust. Weathering can be caused by physical, chemical, or biological processes.

- **Physical weathering** is caused by changes in temperature, freezing water, or even when rocks impact other rocks.
- **Chemical weathering** occurs when the rocks react with water, air, or other chemicals in the environment.
- **Biological weathering** may be caused by the actions of plant roots, or by the release of enzymes from bacteria and fungi.

Soils may also be transported to new locations and deposited by the action of wind and water.

*Extension Associate Professor

Photo provided by Felipe Aburto

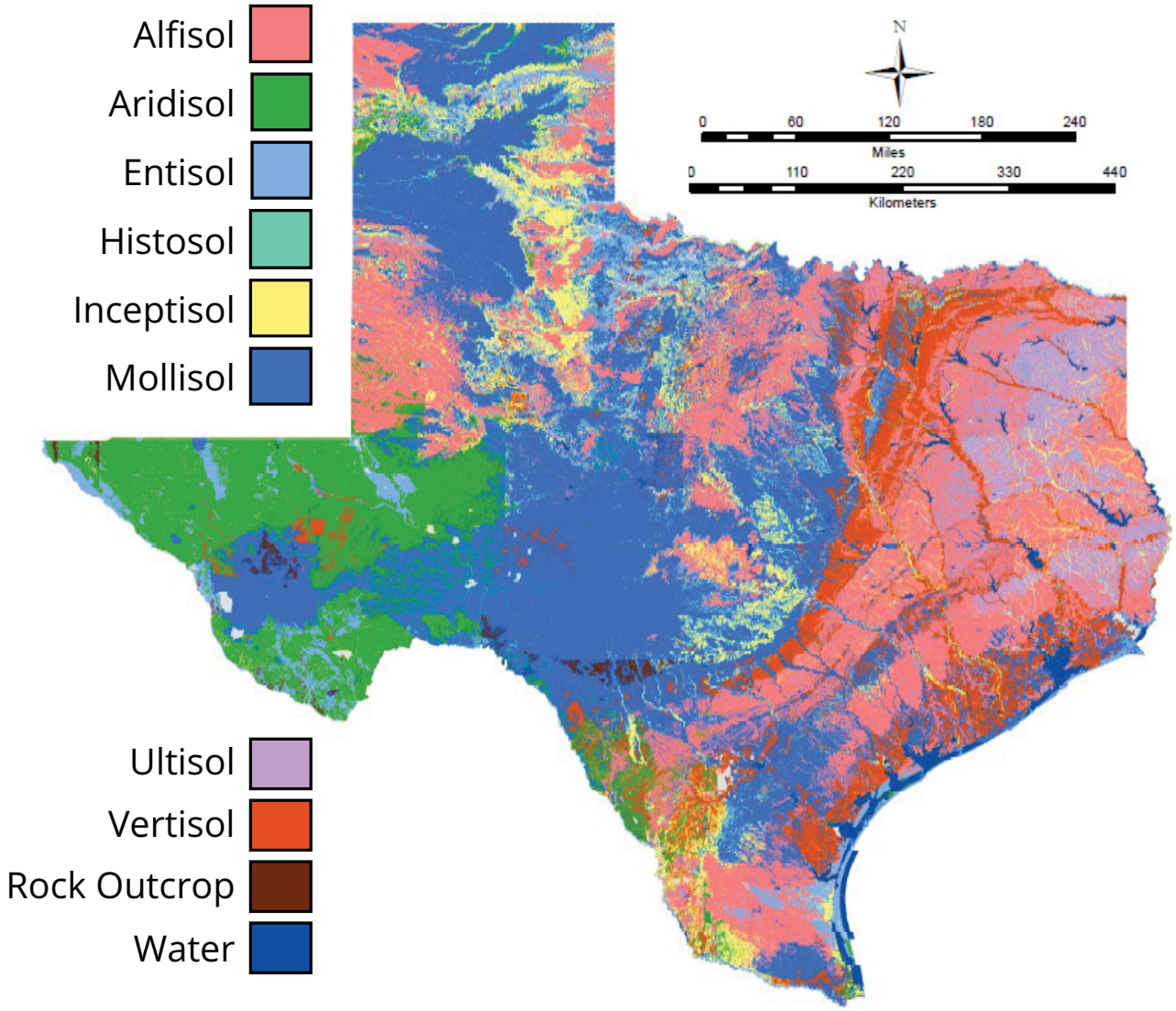


Figure 2. A map of soil orders in Texas. Note: The area covered by Spodosols is too small to be represented on the map.

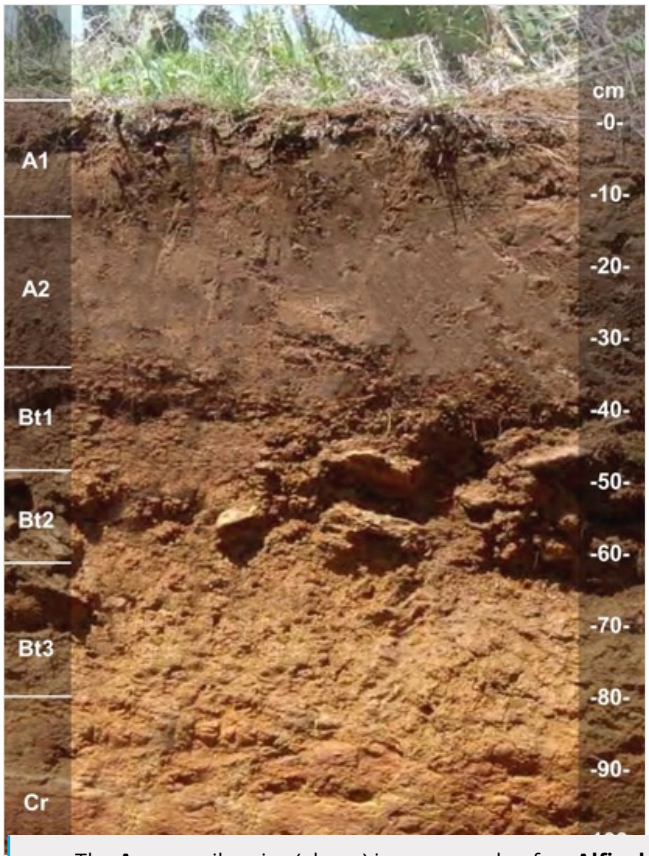
There are Five Factors that contribute to the formation of soil. Together, they are referred to by the acronym **CIORPT** (**Cl**imate, **O**rganisms, **R**elief, **P**arent material, and **T**ime). The interaction of these factors can be very complex and has resulted in a wide range of soil types across Texas.

- Climate – Temperature and water are important soil forming factors that change with climate. Soils weather more rapidly in warm and wet regions than in cool and dry regions. The vegetation that grows in a region and affects weathering, also depends upon climate.
- Organisms – Living things such as micro-organisms hasten the breakdown of rocks, while larger organisms' activities (including humans) frequently redistribute, mix, and alter the soil composition.
- Relief – Topography, slope, and elevation affect soil formation through displacement of soil material, runoff, and drainage in elevated areas with steep slopes, while low lying depressional areas tend to accumulate this material.
- Parent Material – This is the mineral composition of the original rock from which the soil is formed.
- Time – Soil formation occurs over very long time scales—think hundreds to thousands of years.

TYPES OF SOILS

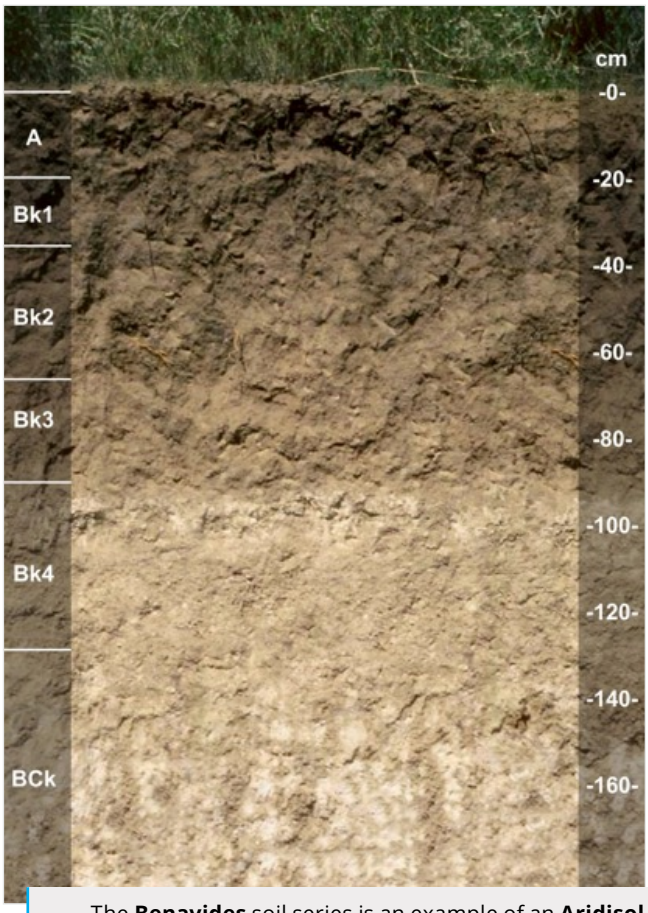
This publication covers the 12 orders of soils, highlighting the nine that can be found in Texas (Figs. 2 and 3). A soil order is the broadest level of classification in soil taxonomy. On the other hand, a soil series is the most specific level of classification under each order. Series are grouped by similarity in profile, parent material, and development under comparable climates and vegetation.

Alfisols – This soil order is formed in semi-arid to relatively wet conditions. Alfisols are well-weathered to the point where finer clay particles have been leached over time from the surface horizon to form a sub-surface clay layer. They are formed under forest or mixed vegetation. Native fertility for this soil order is high, and the associated higher percentages of basic cations (e.g., Ca^{2+}, Mg^{2+}, and K^{+}) distinguish Alfisols from Ultisols.



The **Acove** soil series (above) is an example of an **Alfisol** found in the Southwest plateaus and plains of Texas' Central Basin. It is of moderate depth and well-drained, sitting atop sandstone bedrock from which it was formed. It is therefore, the residuum of the underlying parent material. This soil is commonly used for rangeland, but may also be cultivated for peanuts, small grains, or sorghum production. Note: The sub-surface clay accumulation at ~ 40 centimeters (designated as Bt1—upper section of the B horizon).
(Soil profile photo courtesy of John Kelly)

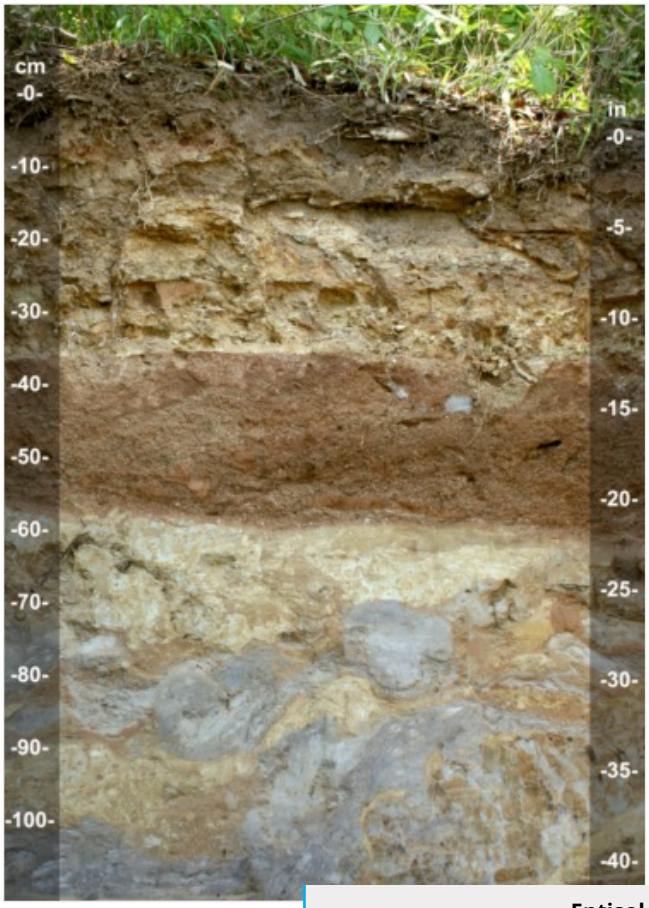
- The Duval series found in Frio County, Texas is a sand formed in semi-arid conditions. Typical A horizon texture = 86 percent sand, 6 percent silt, and 8 percent clay.
- The Falba series found in Grimes County, Texas is also a sand, but formed under a climate with more precipitation. Typical A horizon texture = 77 percent sand, 17 percent silt, and 6 percent clay.



The **Benavides** soil series is an example of an **Aridisol**, which can be found in Duval County, Texas and the greater Central Rio Grande Plain. It is a fine, sandy loam with high calcium carbonate content formed through colluviation. Benavides soils are used mainly for livestock grazing or support low disturbance wildlife habitats.
(Soil profile photo courtesy of John L. Sackett III, NRCS)

Aridisols – These are the dry soils found in desert regions. Aridisols often include horizons with carbonates (CO_3^{2-}), gypsum ($CaSO_4$), and sodium chloride (NaCl). These soils are used mainly for rangeland and recreation, but are fertile for agriculture where water for irrigation is available.

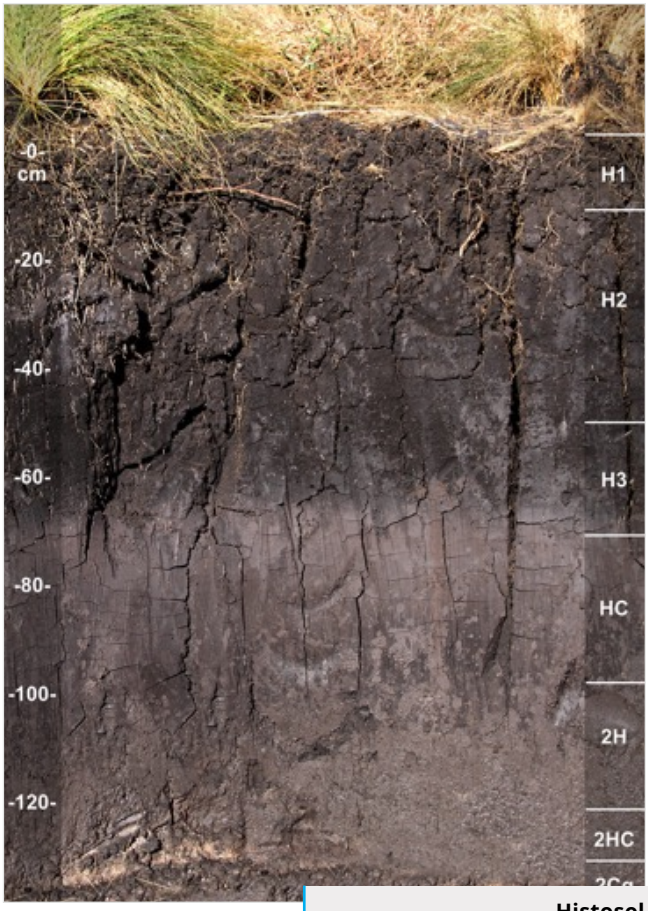
- The Hodgins series found in Pecos County, Texas is a silty loam with calcareous deposits, originating from limestone. Typical A horizon texture = 19 percent sand, 63 percent silt, and 18 percent clay.
- The Pandale series found in Crockett County, Texas is a silty loam with fine and medium limestone gravel mixed in. Typical A horizon texture = 19 percent sand, 61 percent silt, and 20 percent clay.



Entisol
(Soil profile photo courtesy of John Kelly)

Entisols – These are "new" soils that show very few signs of soil formation or development. This order does not make up a large percentage of Texas' soils, and examples tend to be concentrated in the coastal region of Texas—although a small amount can be found in far West Texas.

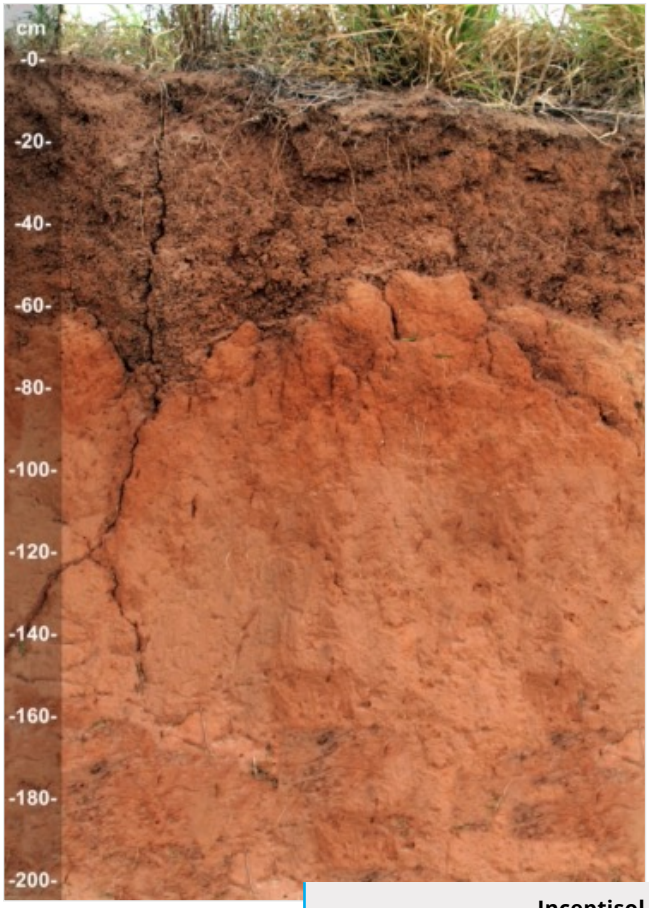
- The Mustang series found in Galveston County, Texas is a sandy loam. Typical A horizon texture = 74 percent sand, 17 percent silt, and 9 percent clay.
- The Harpersville series found in Brown County, Texas is a clay loam. Typical A horizon texture = 43 percent sand, 29 percent silt, and 28 percent clay.



Histosol
(Soil profile photo courtesy of John Kelly)

Histosols – Soils in this order are almost all decaying organic matter. Though not nearly as well represented as other orders, there are some small areas in Southeast Texas where Histosols can be found. These areas often include permanently flooded marshes.

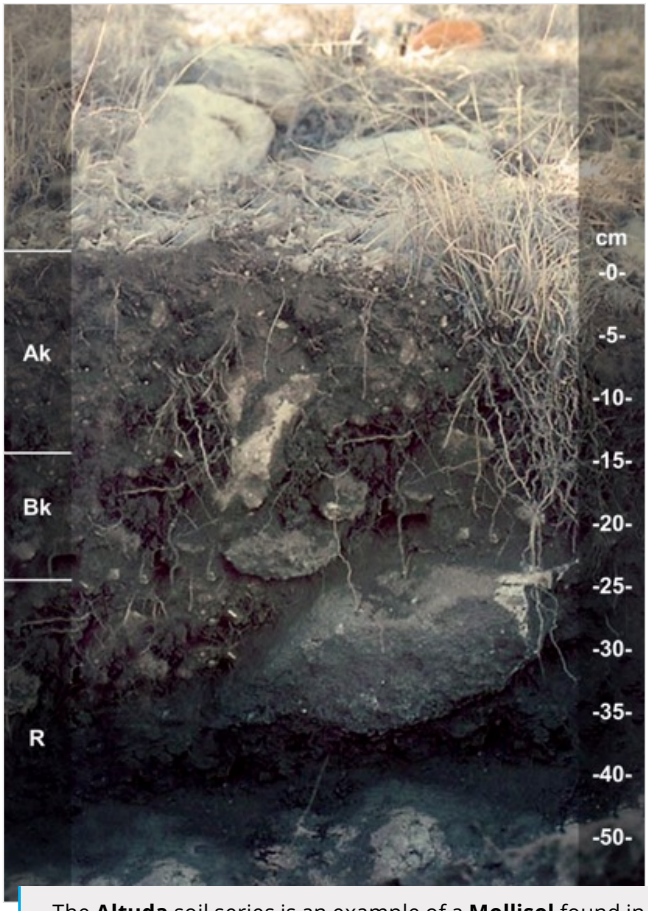
- The Allemands series found in Jefferson County, Texas is a clay. Typical A horizon texture = 10 percent sand, 40 percent silt, and 50 percent clay.



Inceptisol
(Soil profile photo courtesy of John Kelly)

Inceptisols – These soils are defined by poorly developed sub-surface horizons. They may be shallow or deep, flat or sloped.

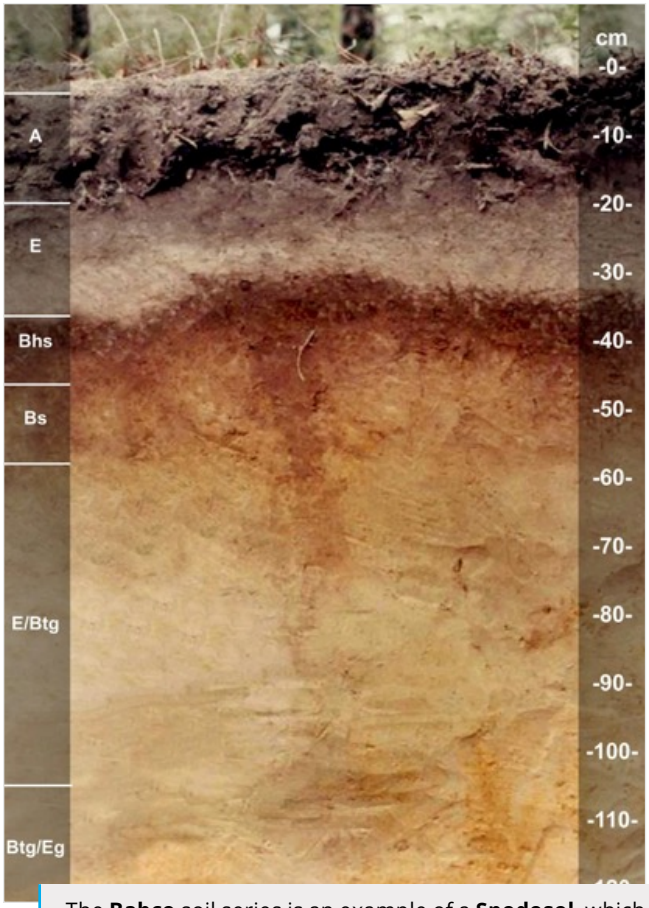
- The Weswood series is found along the flood zone in the Brazos and Colorado River Valleys, Texas. Typical A horizon texture = 26 percent sand, 54 percent silt, and 20 percent clay.
- The Cedarlake series is found in depressions on basin floors in the Southern High Plains near Brownfield, Texas. Typical A horizon texture = 51 percent sand, 26 percent silt, and 23 percent clay.



The **Altuda** soil series is an example of a **Mollisol** found in Big Bend National Park, Texas. Altuda soils are very shallow and well-drained, formed from a mixture of residuum and colluvium—originating from Permian limestone bedrock. It is used primarily for livestock grazing.
(Soil profile photo courtesy of James Gordon, James Douglass, and Lynn Loomis, NRCS)

Mollisols – These are often formed under grasslands and exhibit that legacy as a clearly visible dark surface horizon that is rich in organic matter, which makes them naturally fertile.

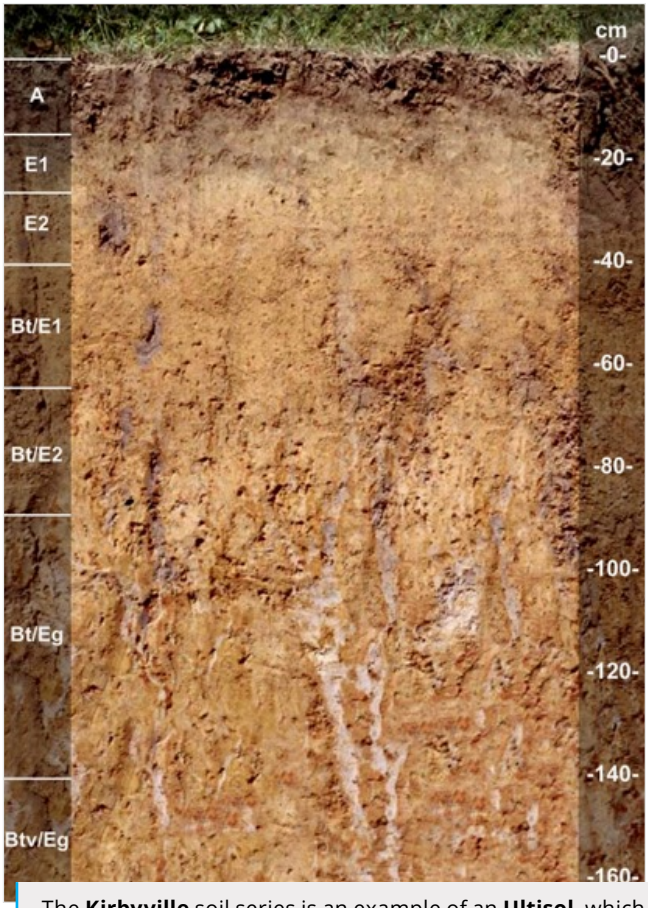
- Pullman series soils are rich in Illite minerals, which expand when wet. Typical A horizon texture = 38 percent sand, 35 percent silt, and 27 percent clay.
- Topsey series soils are rich in calcium carbonates and can be found in Coryell County, Texas and surrounding areas. Typical A horizon texture = 19 percent sand, 40 percent silt, and 41 percent clay.



The **Babco** soil series is an example of a **Spodosol**, which is found in Tyler County, Texas and the surrounding Piney Woods ecoregion. Babco soils are loamy, fine sands that are very deep but poorly drained. They are formed as sandy and loamy alluvium in or near river valleys. These soils primarily support woodland and wildlife habitats.
(Soil profile photo courtesy of Levi Steptoe, Jr., NRCS)

Spodosols – Acidic soils with deposits of organic matter and iron in the sub-soil, often formed under forests. Spodosols are not a common soil in Texas, but can be found in small areas in Southeast Texas.

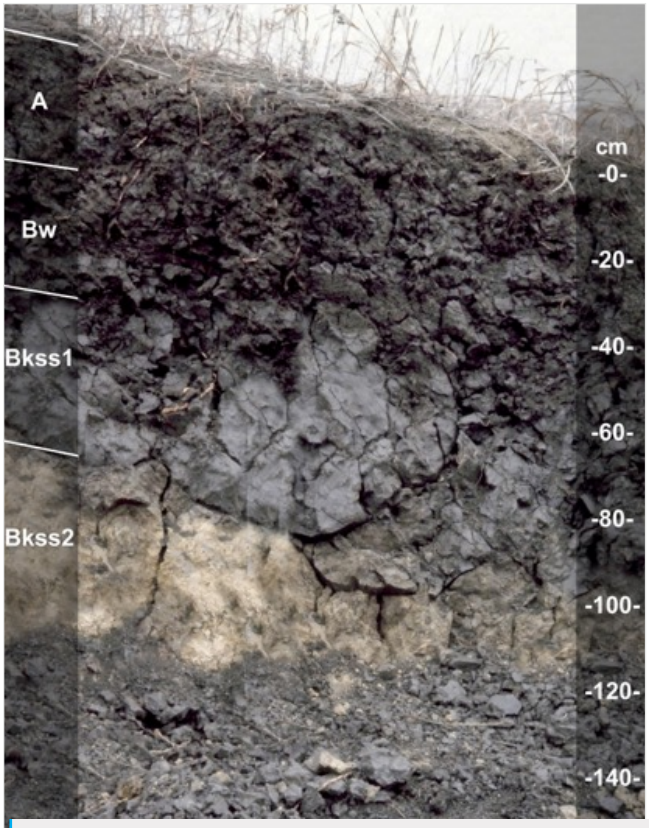
- Babco series soils are coarse (e.g., loamy, fine sands) found in Hardin County, Texas and nearby areas. Typical A horizon texture = 80 percent sand, 8 percent silt, and 12 percent clay.



The **Kirbyville** soil series is an example of an **Ultisol**, which is found in Tyler County, Texas and the surrounding Piney Woods ecoregion. Kirbyville soils are sandy loams that are very deep and moderately well drained. They are formed by marine deposition. These soils primarily support timber production and woodland and wildlife habitats. Note: The white albic formations in the Bt/Eg horizon.
(Soil profile photo courtesy of Levi Steptoe, Jr., NRCS)

Ultisols – These soils are very weathered (i.e., aged) with a clayey sub-surface horizon. They are often formed under forested lands with gentle slopes and can be acidic.

- Darco series soils are loamy, fine sands found near St. Augustine County, Texas. Typical A horizon texture = 19 percent sand, 40 percent silt, and 41 percent clay.
- Kirbyville series soils are fine, sandy loams found near Jasper County, Texas. Typical A horizon texture = 50 percent sand, 42 percent silt, and 8 percent clay.



The **Houston Black** soil series is an example of an **Vertisol**, which is found throughout much of the Blackland Prairie Ecoregion of Texas. Houston Black soils (and all vertisols) feature shrink (i.e., crack) and swell behavior when dry or wet. They were formed under prairie vegetation and feature high calcium carbonate (limestone) content. These soils are very fertile for row crops and forages. The Houston Black is the unofficial state soil of Texas.
(Soil profile photo courtesy of John Kelly)

Vertisols – These soils are defined by the presence of smectite, which is a mineral clay that swells in size when wet and shrinks when dry. This property causes the easily noticeable surface cracking during long, dry periods. These soils dominate the Central Texas Blackland Prairies, Gulf Marshes, and Prairies Ecoregions. The soils in this order in Texas are often calcareous—meaning they contain quite a bit of calcium carbonate and are high in pH, but some are not.

- Houston Black series soils found throughout the middle section of the Blacklands Ecoregion are clayey, high in pH and very dark to black in color. This soil is also the Texas (unofficial) state soil. Typical A horizon texture = 10 percent sand, 50 percent silt, and 40 percent clay.
- Burleson series soils are found in the Eastern middle Blacklands Ecoregion and can become acidic following years of nitrogen fertilizer applications. Typical A horizon texture = 35 percent sand, 26 percent silt, and 39 percent clay.

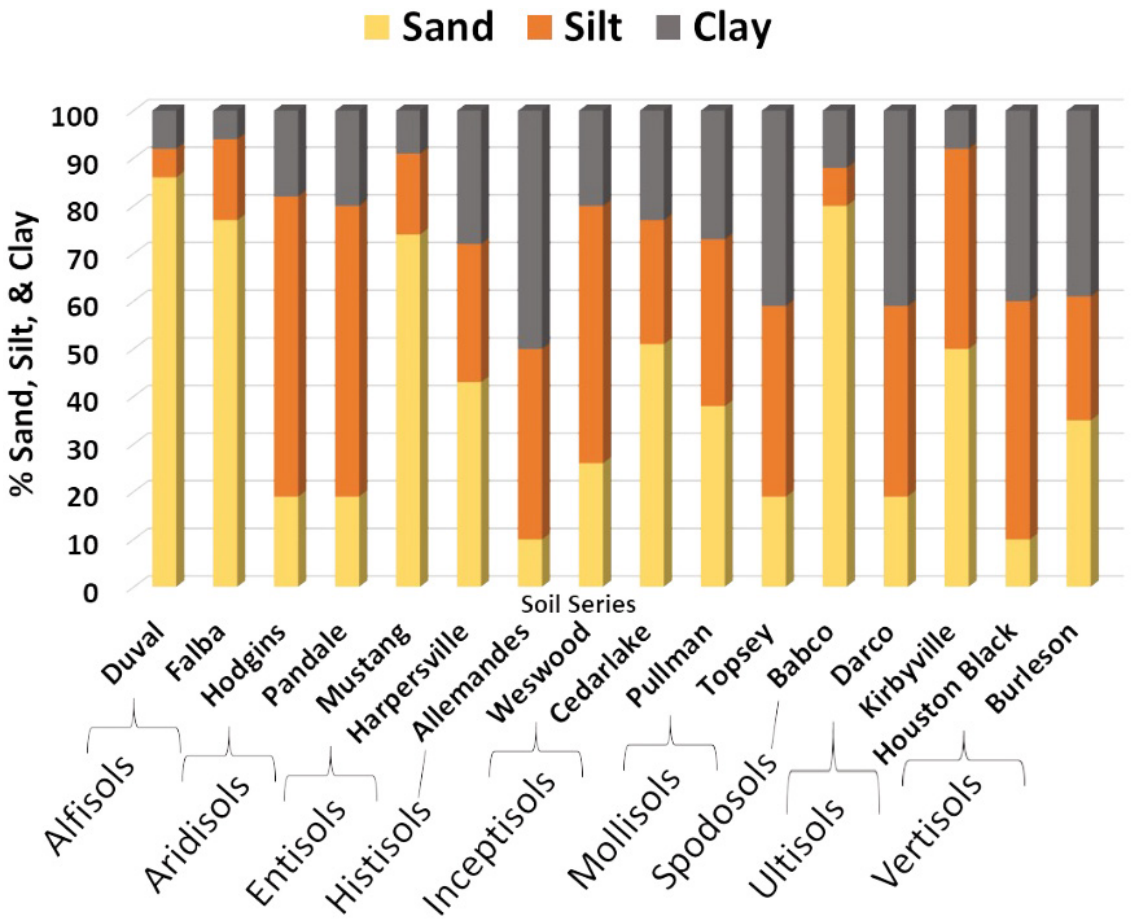


Figure 3. Orders of soil found in Texas: Examples of the series under each order, including textures reported for each.

GLOSSARY OF SOIL FORMATION TERMS

Alluvium – Soil and/or rock deposited by moving water (i.e., flooding). Alluvial soils are formed this way.

Colluvium – Soil and/or rock deposited by gravitation disturbance, such as falling downhill slopes. It may also include movement by downhill rain wash.

Eluviation – The process of redistributing soluble soil minerals and/or very fine clay particles downward through the soil profile. This often results in distinct and visible formations such as E (eluvial) horizons or albic materials (white formations where fine clays and iron minerals have been leached away).

Horizon – A distinct formation in the soil profile parallel to the surface, which features different chemical, physical, or biological characteristics to those above or below it.

Loam – A soil featuring a mixture of sand, silt, and clay particle sizes without an extreme amount of any of the three.

Loess – Soils transported and deposited by winds (i.e., Aeolian deposition).

Marine – Deposition as seafloor sediment. When ocean coastlines recede, marine depositions remain as soil.

Parent Material – Geologic material from which soil horizons are formed.

Pedon (*rhymes with "head-on"*) – The smallest unit of soil that can be differentiated and classified on its own. The size of a Pedon may range from 1 to 10 meters in surface area and generally only as deep as the deepest plant root (or 6 feet), whichever comes first.

Profile – The vertical arrangement of soil horizons.

Residuum – Weathered geologic material disintegrated and accumulated in place. No significant transportation has occurred.