

The Mineral Fraction of Soil

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The elements needed in your soil for plant growth

Minerals can be either primary or secondary. Primary means they were formed as igneous rocks in the form of molten extrusive lava which cools very fast or as intrusive subsurface bodies that cool very slow. When molten rock cools very slowly, crystals of minerals can form depending on their melting temperature. This results in rocks such as granite which consists of quartz, feldspars, mica, and others as visible separate crystals. The larger the crystals, the slower it has cooled. Rapidly cooled lava is very fine grained and individual minerals are not visible.

Primary minerals occur in soil as sand and silt. Sand is visible to the naked eye, but silt particles are so small they cannot be seen without a microscope. Quartz is a very resistant mineral and is the most common kind of sand, but it does not have elements important for plant growth. It does provide substrate for plants to root in. Sand is important for soil drainage, but too much sand will dry too fast. There are many minerals that contain elements important for plant growth. As they weather, they are available for uptake by plants. Primary minerals in the sand and silt fraction determine the long-term fertility level of soil.

Secondary minerals form as primary minerals become weathered and their chemical components re-crystallize into different minerals. The most common secondary mineral in soil is clay. There are many types of clay depending on their composition and structure. One of the most observable behaviors in clay is the shrink-swell capacities resulting in cracks when it is dry. There are some soils with large amounts of clay that have high levels of shrink-swell which can be a real problem for foundations and roads which can be damaged as the result. Heavy clay soils take a long time to dry out and are difficult to cultivate. This is usually not a problem in Skagit County, but it pays to be aware of the potential. Clays are important for soil fertility, however, because they hold the nutrients in the soil as the result of the physical and chemical properties.

Sand, silt, and clay are the three main size fractions of minerals in soil. Each one has important properties that make soil suitable for various purposes. However, if a soil consists of only one size fraction there will be problems. Too much sand, it is too dry. Too much clay is too wet. Too much silt has its own problems as related to engineering and agriculture. The best soil for agriculture, generally speaking, is a combination of all three size fractions. These combinations are called soil textures and have specific percentages as displayed in the Soil Texture Triangle.

The distribution of soil textures are the result of geologic processes such as glaciation and alluvial sorting. The textures of upland soils are highly variable but usually consist of rocks and gravel as the result of the deposits of glacial drift. Soil textures in the flood plain are based on the

proximity to the river. Closer to the river soils will be sandy and be finer textured farther away. This is complicated by the fact the river has meandered all over the valley resulting in extreme variability.



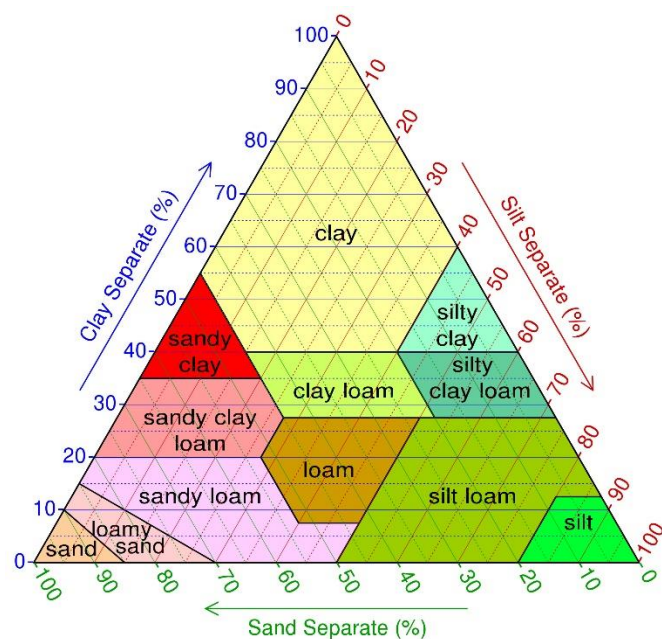
Quartz is, generally, the most common mineral in soil and it takes much physical weathering to break it down into a sand or silt size fraction. *Photo by B.A. Lindsay / WSU Skagit County Extension Master Gardeners.*

In most soils the texture also varies with depth as the result of chemical and physical leaching. Silt and clay in the soil surface can be moved down by water and deposited in the subsurface. This process takes a lot of time and the alluvial soils in Skagit County are too young for this to be significant. Even the uplands and mountains are too young as glaciation has removed whatever soil development may have occurred and dumped glacial drift in its place. In some mountain soils there is an accumulation of secondary minerals in the subsurface called spodic horizons which consists of aluminum and iron oxides.

The alluvial soils in the Skagit Valley are some of the best in the world as the result of soil textures that are not too wet and not too dry. Most of the textures consist of silt and sand so it is possible to cultivate fairly quickly once the rains slow down. There are many minerals in the sand and silt fractions that contain elements important for plant growth. Still, quartz is the most common mineral in sand and silt.



Above: Weathering of primary minerals in the upper part of the soil profile results in red colors of iron oxides." USDA Soil Survey.



Above: The soil texture triangle is based on the percentages by weight of sand silt, and clay. With much practice it is possible to estimate soil texture by feel. Picture courtesy of USDA-NRCS.

RESOURCES:

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- Dixon J.B, Weed S.B. Mineral in the Soil Environments Volume 1.; Second Edition.