



Rocks and Minerals are the Foundation of Healthy Soils.

By Normand Helie November 2, 2025

In New England, soils are continually weathered by falling rain. This rainwater enters the ground and under the natural forces of the earth's hot molten core, gravity pulls elements, both big and small, down, to lower depths, creating very distinct layers. These layers are called the soil profile. This soil stratification process slows leaching and weathering of minerals. Trees growing in succession in our forests optimize the conditions of this soil forming process.

Rocks in Our Landscapes

Many decades ago, our ancestors planted crops in order to feed themselves and their neighbors. As they plowed the earth, they picked up rocks, removed them from soil, and placed them along the edges of their fields. These rocks became iconic stone walls in our New England landscapes. Some of these stones were also repurposed for home foundations, chimneys, and water wells.



Classic stone wall in a New England Landscape

The value of stones in the soil profile are unknown. The proportion of rocks in soil is important to the soil ecosystem. Soils containing more than twenty percent rock, those larger than sand, silt or clay, increase the movement of water through the soil profile. *With additional water moving through the soil, nutrients are replenished and the thermal properties of the soil are improved, resulting in improve tree health.*

To this day we value rock walls in beautiful landscapes more than we value rocks in a healthy soil profile.



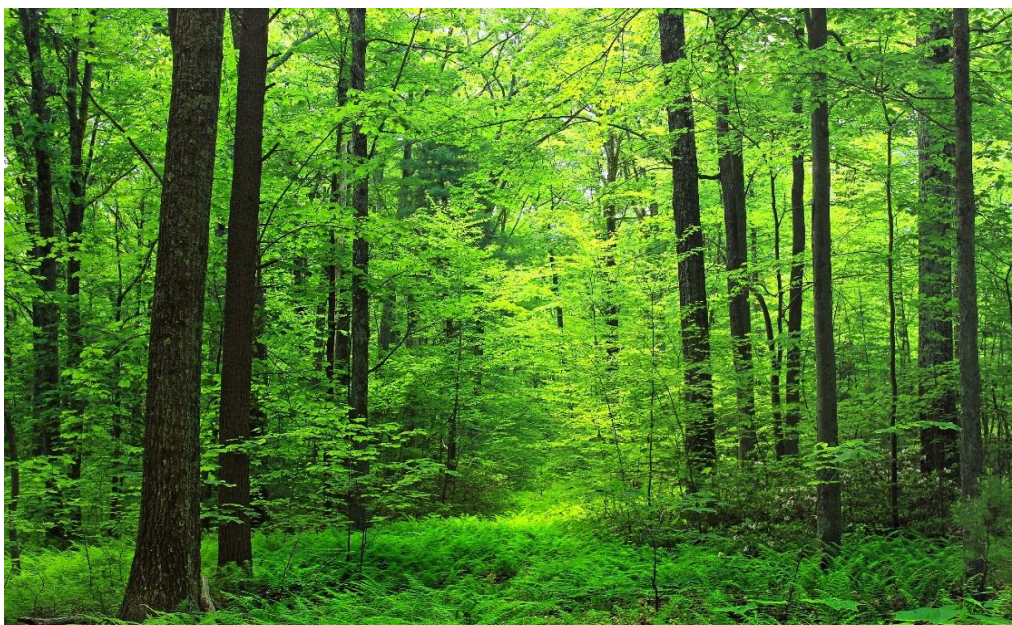
Typical soil profile

In urban environments every rock is typically raked out of the topsoil and discarded as refuse with little or no value. But rocks of all composition, shapes, and sizes play an important role in soil ecology. Soils without rocks and minerals are unhealthy and are considered weathered. Weathering removes and displaces elements necessary for plant growth.

Why Are Forest Soils Healthier Than Urban Soils?

Many say it is because of the biology of the soil. In part, this is true. However, all soil originates as rocks and minerals. Both forest soil and urban soil experience weathering, but at different rates. Forest soils are more protected because of their physical characteristics and over time have better retained their rock and mineral content. With their dense tree canopies and thick humic layer, forest soils are considerably more sustainable and undergo slower weathering than urban soils. In contrast, urban soils that lack a humic layer, and have thin or no tree canopies are subject to severe, faster weathering as rain falls unhindered, hitting open soil.

Rocks and minerals of all shapes and sizes influence soil temperature, moisture, and mineral composition, keeping our soils healthy and sustainable. Remineralization, adding fresh minerals to our soils, can support vital microorganism populations and deter pathogens from developing in our soils.



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Soil Formation and Tree Canopy Health

It is imperative that we understand how soils form and develop because it effects the canopy of all tree species. Soil formation studies help us understand tree health and tree decline.

Soil formation is largely ignored by many soil scientists because of the element of time; many believe it takes thousands of years for soil formation to occur. However, in as little as one hundred years, soils will stratify and create a soil profile that is capable of supporting a healthy and diverse forest of trees. Conversely, it takes less than one hundred years for soils to become highly weathered and depleted of minerals.

Soil formation studies are used only to classify and name the soil. This is called soil taxonomy. Yet these studies give us understanding about how to maintain soil health. From the outset, all soil formation begins on the top. Parent material, also known as sand silt and clay, is largely placed there by wind, water, gravity, and ice. Minerals placed on the top of the soil will help the soil maintain its health.

Both urban and forest soils are constantly changing as soil particles break down and move downward into lower levels in the soil profile, but this process happens much faster in urban soils. *Trees, however, recycle nutrients internally and store them, miraculously surviving changes in both the urban and forest soil.*

Let's take a deeper look at science of soil development.

The five factors of soil development are:

1. parent material (rocks and minerals)
2. climate (temperature and rainfall)
3. living organisms (trees, plants, animals, and microbes)
4. topography (mountains, hills, and valleys)
5. time (relative to disturbance)

For sake of convenience let us consider the first three factors.

Parent material: All soils begin as mineral called parent material. When rocks and minerals are broken down by mechanical and chemical process, they become what we commonly call the soil texture. Sand, silt, and clay are minerals called parent material. Clay is considered a very valuable secondary mineral in many cases. This material is the building blocks of a firm foundation for the lives of trees, plants, animals, and all microbes. Soils with larger fragments called rocks and gravel are also very important to the health of forest soil.

Climate and living organisms: As the soils develop, gravity sifts and sorts every small and every large particle into a perfect arrangement for supporting plant life growing in it. But even a soil without plants will become a unique arrangement of fine and coarse fragments. The climate brings rain and with increasing rain, soils weather faster. This is a noteworthy statement to consider in an ever-changing climate. Mineral health must be addressed because minerals support all life and especially soil microbes. A healthy soil will continue to be healthy when minerals such as stone dust and limestone are added to the top of the soil. Adding organics alone will not improve the mineral health of the soil but adding minerals will improve both mineral and microbe health in the soil. Adding organic matter is an excellent practice but, it can actually increase the removal of minerals from the topsoil.

Thus, adding and maintaining soil mineral density in our top soil should be our highest priority in soil health. The study of how soils form can be very helpful in our understanding of soil health. This flies in the face of current soil health conversations. *Most speak exclusively about adding organic material and this can be very helpful but it does not address the foundational problem of mineral depletion in our soils.*

Increasing the Amount of Minerals in Our Soils

What can we do to improve soil mineral density? The solution can be as simple as adding minerals along with organics. From my experience, soils should receive a minimum of two tons per acre of freshly mined minerals every seven years to maintain soil health of minerals for plants and microbes.

Soil testing can be helpful but somewhat limiting when it comes to mineral health. Current chemical analysis measures availability of nutrients based on soil volume. This is useful for the current growing seasons and up to three years later. However, these tests do not measure total mineral composition. In fact, most labs test for elements, not minerals. A **soil density test** will measure all minerals.

The Benefits of Adding Minerals to Soil

Adding minerals to agricultural soil will increase the nutrients present in the crops we grow. By improving the level of nutrition in our food we can live healthier, longer lives.

Plants that are supplied with mineral nutrition, in both agricultural and landscape settings, will be healthier and better able to resist diseases and pests, reducing the need to apply pesticides.

The addition of minerals would also improve the microbial community in our soils. Many of these microorganisms assist plants by making nutrients more available for absorption. As a result, plants grown in soils with a healthy microbial population are stronger, disease and pest resistant, and more nutritious.



By improving the level of nutrition in our food, we can live healthier, longer lives.

Final Thoughts

We need diverse rocks and minerals in soil of all shapes and sizes. For centuries we have been removing the life of the soil for ease in working it. In urban environments, rocks are eliminated from every planting and replanting project because they are seen as refuse. In contrast, forest soil scientists know rocks and minerals are central to the productivity and health of the trees (Lutz and Chandler, 1946). As soils weather or develop, minerals in the soil are changed and become depleted in a relatively short amount of time. Adding minerals to your soil will improve the foundations of healthy soil.

Rocks are the foundation of soils and understanding their influence in soil is necessary if we want to improve overall tree health and cultivate resilient urban tree canopies.

Soil formation studies help us understand how climate (temperature and water) and living organisms (plant and microbes) interact with parent material. Through these studies we can develop sustainable, healthy soil in the urban forest.

Better soil health through soil science literature.

Jenny, Hans. 1941. *Factors of Soil Formation: A System of Quantitative Pedology*. McGraw-Hill Co., New York.

Lutz H.J., Chandler R. F., 1946. *Forest Soils* pp. 234-235 John Wiley & Sons, Inc.