

Soil Formation

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CHAPTER

1

Soil Formation

- Describe the factors that affect soil formation: weathering, climate, parent rock, slope, time and biological activity.

**How are these two soils different?**

What color is the soil on the left? What color is the soil on the right? Why do you think they differ so much in color? Which soil do you think is better for growing things? See below to find out!

Soil Formation

How well soil forms and what type of soil forms depends on several different factors, which are described below.

- An animation of how weathering makes soil is found here: http://courses.soil.ncsu.edu/resources/soil_classification_genesis/mineral_weathering/mineral_weathering.swf .

Soil development takes a very long time. It may take hundreds or even thousands of years to form the fertile upper layer of soil. Soil scientists estimate that in the very best soil forming conditions, soil forms at a rate of about 1mm/year. In poor conditions, it may take thousands of years!

Weathering

Soil formation requires weathering. Where there is less weathering, soils are thinner. However, soluble minerals may be present. Where there is intense weathering, soils may be thick. Minerals and nutrients would have been washed out.

Climate

Climate is the most important factor determining soil type. Given enough time, a climate will produce a particular type of soil. The original rock type does not matter. Two rocks of the same type will form a different soil type in each different climate. This is true because most rocks on Earth are made of the same eight elements. When the rock breaks down to become soil, the soil is the same.

The same climate factors that lead to high weathering also produce more soil.

- More rain weathers minerals and rocks more. Rain allows chemical reactions especially in the top layers of the soil.
- More rain can dissolve more rock. More rain can carry away more material. As material is carried away, new surfaces are exposed. This also increases the rate of weathering.
- Higher temperatures increase the rate of chemical reactions. This also increases soil formation.
- In warmer regions, plants and bacteria grow faster. Plants and animals weather material and produce soils. In tropical regions, where temperature and precipitation are consistently high, thick soils form. Arid regions have thin soils.

Soil type also influences the type of vegetation that can grow in the region. We can identify climate types by the types of plants that grow there.

Parent Rock

The original rock is the source of the inorganic portion of the soil. Mechanical weathering breaks rock into smaller pieces. Chemical reactions change the rock's minerals.

Soil may form in place or from material that has been moved.

- **Residual soil** forms in place. The underlying rock breaks down to form the layers of soil above it. Only about one-third of the soils in the United States are residual.
- **Transported soil** has come in from somewhere else. Sediments can be transported into an area by glaciers, wind, water, or gravity. Soils form from the loose particles that have been transported and deposited.

Slope

Weathered material washes off steep slopes and so does not stay in place to form soil. Soil forms where land areas are flat or gently undulating.

Time

Soils thicken as the amount of time available for weathering increases. The longer the amount of time that soil remains in a particular area, the thicker it will be.

Biological Activity

Biological activity produces the organic material in soil. **Humus** forms from the remains of plants and animals. It is an extremely important part of the soil. Humus coats the mineral grains. It binds them together into clumps that hold the soil together. This gives the soil its structure. Soils with high humus are better able to hold water. Soils rich with organic materials hold nutrients better and are more fertile. These soils are more easily farmed.

The color of soil indicates its fertility. Black or dark brown soils are rich in nitrogen and contain a high percentage of organic materials. Soils that are nitrogen poor and low in organic material might be gray, yellow, or red (**Figure 1.1**). Soil with low organic material is not good for growing plants.

- An animation of how different types of weathering affect different minerals in soil: http://courses.soil.ncsu.edu/resources/soil_classification_genesis/mineral_weathering/elemental_change.swf .

**FIGURE 1.1**

This sandy soil shows evidence of very little organic activity. Plants grow, but are far apart and short-lived. This means that little soil can form. The soil that's there has little organic content.

Vocabulary

- **humus:** Partially decayed remains of plants and animals; forms the organic portion of soil.
- **residual soil:** Soil that forms from the bedrock upon which it lies.
- **transported soil:** Soil that forms from weathered components transported to a different area.

Summary

- Many factors affect soil formation. Some are climate, rock type, slope, time, and biological activity. Differences in these factors may produce different types of soil.
- Soil type determines what can grow in a region.
- Humus is the decayed remains of living organisms. Humus makes soil fertile.

Practice

Use the resource below to answer the questions that follow.

- **The Five Factors of Soil Formation** at <http://www.youtube.com/watch?v=bTzslvAD1Es> (9:28)



MEDIA

Click image to the left for more content.

1. Which chemical property most contributes to soil formation and what effects does it have?
2. Which physical properties most contribute to soil formation and what effect does it have?
3. How does relief affect soil formation?
4. What do the scientists say is the succession that occurs in soil development?

5. How does the slope that has been deglaciated for 50 years differ from the nearby slope that has been glacier free for thousands of years?
6. How does agricultural development affect the timing of soil formation?
7. Why do scientists who study soils need a new set of terms to describe soils?

Review

1. Why is climate more important than rock type for determining the type of soil that forms?
2. How would you create a very thick, organic-rich soil?
3. How would you create a very thin, sandy soil?
4. Why is time important for soil formation?

References

1. Mike Baird. An area with sandy soil and low fertility. CC BY 2.0