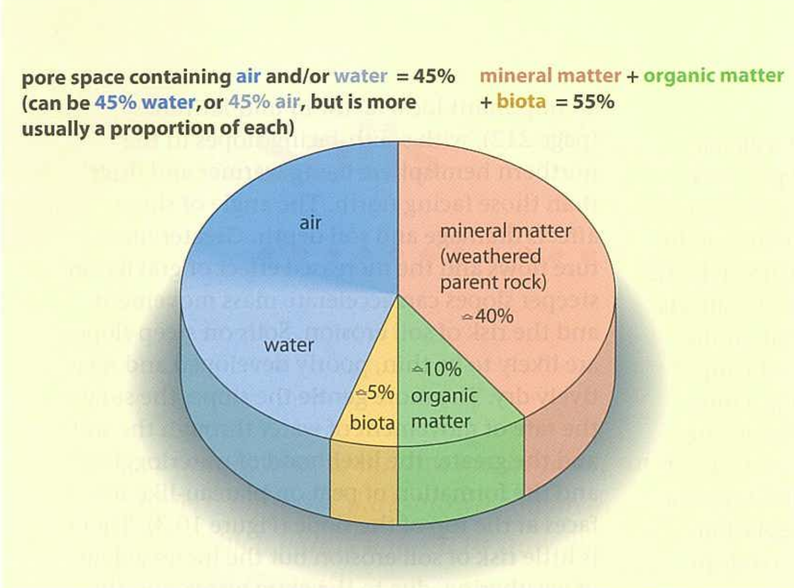


Figure 10.4

Relative proportions, by volume, of components in a 'normal' soil (*after* Courtney and Trudgill)

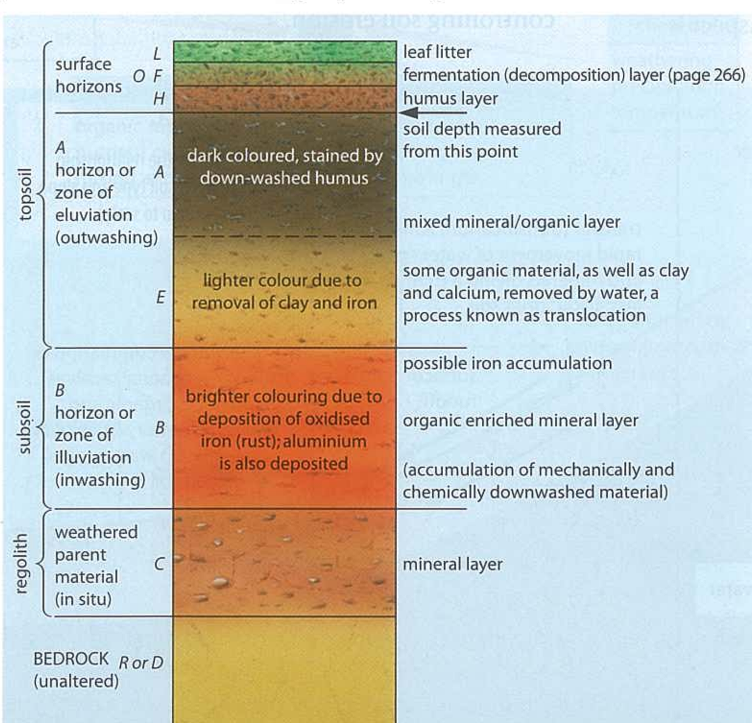
Time

Soils usually take a long time to form, perhaps up to 400 years for 10 mm and, under extreme conditions, 1000 years for 1 mm. It can take 3000 to 12 000 years to produce a sufficient depth of mature soil for farming, although agriculture can be successful on newly deposited alluvium and volcanic ash. Newly forming soils tend to retain many characteristics of the parent material from which they are derived. With time, they acquire new characteristics resulting from the addition of organic matter, the activity of organisms, and from leaching. **Horizons**, or layers (Figure 10.5), reflect the balance between soil processes and the time that has been available for their development. In northern Britain, upland soils must be less than 10 000 years old, as that was the time of the last glaciation, when any existing soil cover was removed by ice. The time taken for a mature soil to develop depends primarily on parent material and climate. Soils develop more rapidly where parent material derived from *in situ* weathering consists of sands rather than clays, and in hot, wet climates rather than in colder and/or drier environments.

A mature, fully-developed soil consists of four components: mineral matter, organic matter including biota (page 268), water and air. The relative proportions of these components in a 'normal' soil, by volume, is given in Figure 10.4.

Figure 10.5

An idealised soil profile in Britain



The soil profile

The **soil profile** is a vertical section through the soil showing its different horizons (Figure 10.5). It is a product of the balance between soil system inputs and outputs (Figure 10.6) and the redistribution of, and chemical changes in, the various soil constituents. Different soil profiles are described in Chapter 12, but an idealised profile is given here to aid familiarisation with several new terms.

The three major soil horizons, which may be subdivided, are referred to by specific letters to indicate their genetic origin.

- The upper layer, or ***A* horizon**, is where biological activity and humus content are at their maximum. It is also the zone that is most affected by the leaching of soluble materials and by the downward movement, or **eluviation**, of clay particles. Eluviation is the washing out of material, i.e. the removal of organic and mineral matter from the *A* horizon (Figure 10.5).
- Beneath this, the ***B* horizon** is the zone of accumulation, or **illuviation**, where clays and other materials removed from the *A* horizon are redeposited. Illuviation is the process of inwashing, i.e. the redeposition of organic and mineral matter in the *B* horizon. The *A* and *B* horizons together make up the true soil.
- The ***C* horizon** consists mainly of recently weathered parent material (regolith) resting on the bedrock.

Although this threefold division is useful and convenient, it is, as will be seen later, oversimplified. Several examples show this:

- Humus may be mixed throughout the depth of the soil, or it may form a distinct layer. Where humus is incorporated within the soil to give a crumbly, black, nutrient-rich layer it is known as **mull** (page 266). Where humus is slow to decompose, as in cold, wet upland areas, it produces a fibrous, acidic and nutrient-deficient surface horizon known as **mor** (page 266) (peat moorlands).
- The junctions of horizons may not always be clear.
- All horizons need not always be present.
- The depth of soil and of each horizon vary at different sites. Local conditions produce soils with characteristic horizons differing from the basic *A*, *B*, *C* pattern: for example, a waterlogged soil, having a shortage of oxygen, develops a gleyed (*G*) horizon (page 275).

The soil system

Figure 10.6 is a model showing the soil as an open system where materials and energy are gained and lost at its boundaries. The system comprises inputs, stores, outputs and recycling or feedback loops (Framework 3, page 45). Inputs include:

- water from the atmosphere or throughflow from higher up the slope
- gases from the atmosphere and the respiration of soil animals and plants
- mineral nutrients from weathered parent material, which are needed as plant food
- organic matter and nutrients from decaying plants and animals, and
- solar energy and heat.

Outputs include:

- water lost to the atmosphere through evapotranspiration
- nutrients lost through leaching and throughflow, and
- loss of soil particles through soil creep and erosion.

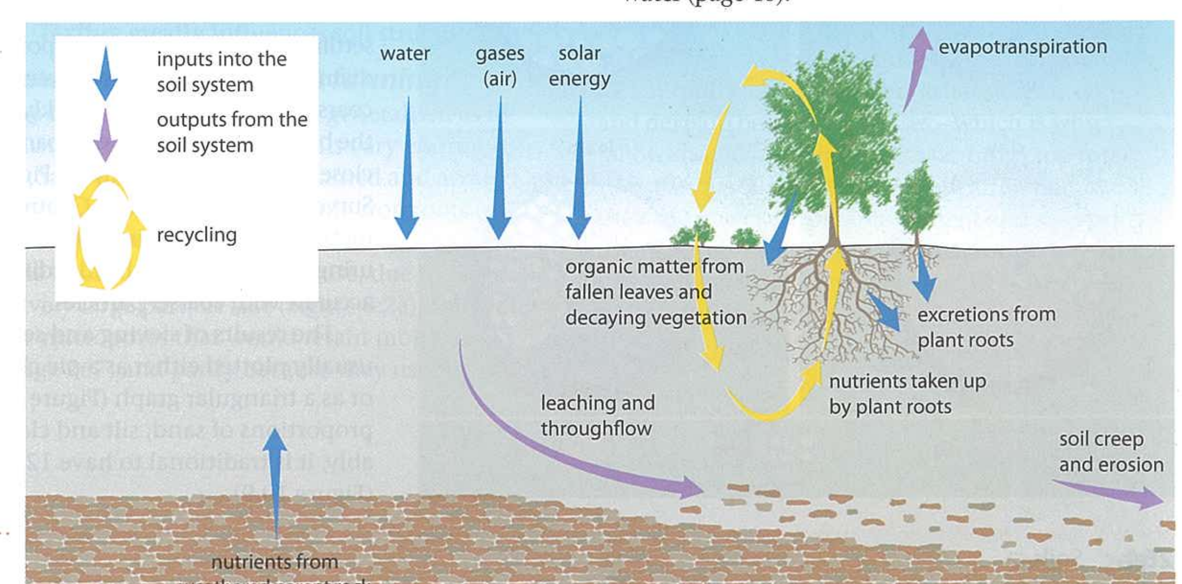
Recycling

Plants, in order to live, take up nutrients from the soil (page 268). Some of the nutrients may be stored until:

- either the vegetation sheds its leaves (during the autumn in Britain), or
- the plants die and, over time, decompose due to the activity of micro-organisms (biota, page 268).

Figure 10.6

The 'open' soil system



These two processes release the stored nutrients, allowing them to be returned to the soil ready for future use – the so-called **nutrient** (or humus) **cycle**.

Soil properties

The four major components of soil – water, air, mineral and organic matter (Figure 10.4) – are all closely interlinked. The resultant interrelationships produce a series of 'properties', ten of which are listed and described below.

1. mineral (inorganic) matter
2. texture
3. structure
4. organic matter (including humus)
5. moisture
6. air
7. organisms (biota)
8. nutrients
9. acidity (pH value)
10. temperature.

It is necessary to understand the workings of these properties to appreciate how a particular soil can best be managed.

1 Mineral (inorganic) matter

As shown in Figure 10.2, soil minerals are obtained mainly by the weathering of parent rock. Weathering is the major process by which nutrients, essential for plant growth, are released. **Primary minerals** are minerals that were present in the original parent material and which remain unaltered from their original state. They are present throughout the soil-forming process, mainly because they are insoluble, e.g. quartz. **Secondary minerals** are produced by weathering reactions and are therefore produced within the soil. They include oxides and hydroxides of primary minerals (e.g. iron) which result from the exposure to air and water (page 40).