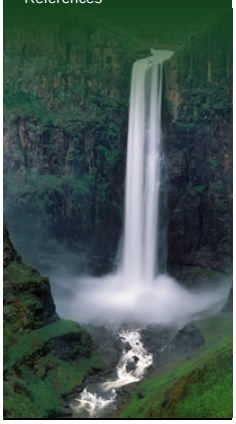


Geography: Geomorphology:

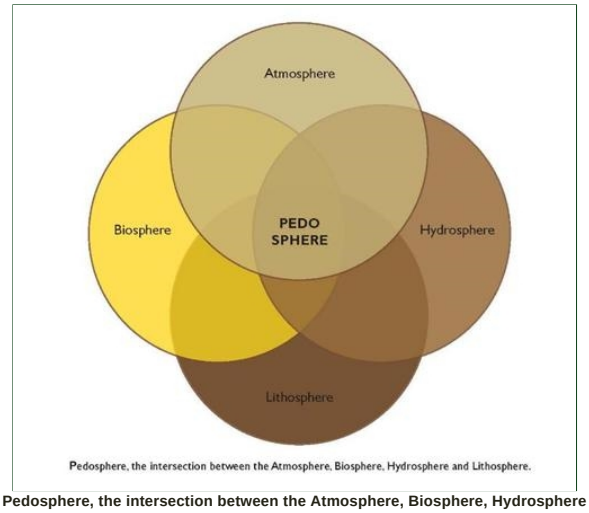
Soils

The Formation of Soils

Home to over one quarter of all living species, soil is the living skin (ISRIC 2010) that covers the Earth, supporting life and providing nutrients for plant growth, anchorage for their roots, and hold water. Soil is a highly influential factor in the biophysical environment. It provides plants with a medium for growth and therefore is a fundamental source of nutritional requirements for terrestrial food-webs. Therefore, the fertility of an ecosystem's soil is a determining factor in plant growth and can either limit or promote productivity/success of consumer organisms further down the food chain (Pidwirny 2008). A comprehensive understanding of the nature and distribution of soils is very important for sustainabledevelopment of a region, as the chemical and drainage properties of soils has a direct impact on agricultural potential.

Soil itself is created by the physical and chemical weathering of bed rock, deposition of other sediments and soils and the breakdown of organic matter. Soil formation is affected by a series of factors including the organisms that live on and in it, the climate of the region, thetopography (aspect, slope, etc), bedrock below and time (Pidwirny 2008). The study of soils is known as ***Pedology*** and the evolution of soils is often referred to as ***Pedogenesis.***

Noorallah (2009) and Mattson (1938) suggest that the development of the Pedosphere (soillayer) can be considered as the intersection of two, three and four of the four spheres - lithosphere (L), hydrosphere (H), atmosphere (A), and biosphere (B). See the diagram below for a graphical representation of this concept.



Pedosphere, the intersection between the Atmosphere, Biosphere, Hydrosphere and Lithosphere.
Source:after Noorallah 2009; Mattson 1938
(click to enlarge)

Classification of Soils

Soils are commonly classified according to the size and proportion of the mineral particles found in the soil substrate. The mineral particles that are considered in soil classification are sand, silt and loam.

Table 1: Particle sizes of sand silt and clay in soils.

Mineral Type	Size Range of Particle
Sand	2.0 - 0.06 mm
Silt	0.06 - 0.002 mm
Loam	< 0.002 mm

Pidmirny 2008

Due to gravitational effects on sediment and drainage, soils developing on slopes are often thinner.

Soil pH

Depending on the parent material, the minerals within, the amount of organic matter and the nature of the drainage of a particular soil profile, the pH can vary considerably. As a rule, the pH of soil is determined by the concentration of free hydrogen ions (Pidwirny 2008). Lower pH (acidic) soils have higher concentrations of hydrogen ions and higher pH (alkaline) soils have a lower concentration of hydrogen ions.

Soil Profiles

Soils are commonly classified using a principle called *soil profiles*, which sub-divides the cross-sectional profile of soil at a location into a series of *Horizons.*

Interactive

Basin Map

Explore the sub-basins of the Orange-Senqu River
enter

Video Tour

Tour video scenes along the Orange-Senqu River related to the River Basin
enter

Geography Maps

Investigate land cover and terrestrial ecoregions in the basin
enter

Water Cycle

Examine how the hydrologic cycle moves water through and around the earth
enter

Food Web

Explore the interactions of living organisms in aquatic environments
enter

There are 5 types of horizon, which are listed in the table below.

Table 2: Explanation of Soil Horizons

Horizon	Description
O	The upper most layer of the soil, composed primarily of litter, fallen from plants growing in the soil or close by.
A	The layer below the O Horizon, is usually the darkest layer in terms of colour, and the part of the profile from which the finer particles and soluble substances are removed - a process known as ***eluviation***. This layer is where the organic matter derived from plant litter accumulates and is mixed with mineral particles. Due to its proximity to the O Horizon, the upper portion of the A Horizon usually has a higher organic content than the lower portion.
B	While the A Horizon is the location of the eluviation, the B Horizon is the layer that receives the minerals and particles from above - ***illuviation***. The eluviated material from upper horizons may impact the colour of the soil, such as iron, which may turn the soil orange as it oxidises. This layer generally has a higher density than layers above, as it is often more compacted and less porous. This often results in poorer drainage.
C	The C Horizon is composed of weathered parent material from the bedrock below. The size and distribution of particles depends on the weathering processes, drainage of the soil and the movement of minerals in upper horizons of the soil profile.
R	Un-weathered parent material/bedrock

Adapted from Pidwirny 2008; Gilluly 1968

The depth, composition, definition and formation of these horizons are important aspects of a soils development, as they all play a significant role in the drainage and fertility of the soil

Soil Colour

Soil colour is usually determined by the mineral content, organic content (from plant and animal litter) and the drainage of the soil. Darker colours and tones are usually the result of increased organic content. Other colours or tones, such as orange or white are the result of oxidation of minerals in the soil - orange is caused by oxidation of iron minerals.

Soil Contamination

Soils are naturally occurring substrates, forming through the combination of inputs from the Lithospheric, Hydrospheric, Biospheric and Atmospheric conditions described above. They comprise different amounts of minerals and organic material; however, their general composition is entirely natural. **Soil contamination** occurs when anthropogenic (human) inputs to the soil profile occur, altering the chemical and biological composition of the soil.

Soil contamination can be caused by a number of different inputs including agricultural run-off, effluent and waste, dumped refuse from domestic and municipal sources, and chemical and hydro-carbon run-off, spillage and waste from mining and industrial sites (including Persistent Organic Pollutants or POPs), to name but a few. The primary concerns related tosoil contamination are related to the following issues:

- People and animals coming directly into contact with poisonous substances in the soil
- Releases of poisonous vapours and/or gases from the soil
- Pollution of water flowing through the soil

Depending on the nature and intensity of the contamination, soil can be remediated (restored to former state), but sometimes only with the application of complex and expensive measures such as thermal treatment, or complete removal and replacement of the contaminated soil.

Next: Soils of the Orange-Senqu River Basin