Soil Formation: Soil forming rocks

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Soil formation involves two steps to become capable to support plant growth are:

I. Weathering: of rocks (disintegration of big rock materials into smaller fine particles

II. Pedogenesis (formation of mature soil, which involves processes like addition of organic residues, losses of some components, translocation of newly synthesized materials and transformation of organic compounds by the involvement of microbes).

Weathering

Soil formation starts with breakdown of big rocks into finer particles is termed 'weathering'. Rocks started to disintegration when equilibrium condition is disturbs, for example by earth quaqe, land slides, deposition of sand in flood plains etc., thus disequilibrium conditions exists then process of weathering starts.

The parent rocks involve in weathering process are of three types:

I. **Igneous rocks:** They form when molten lava solidified, and contains primary minerals only. Primary minerals can not altered chemically. These are:

Granite: It is usually light in colour, containing coarse to medium grain and is composed of the principal minerals quarts, feldspar, mica, amphibole and iron oxides.

Diorite: It is grey to dark in colour, containing coarse to medium grain and is consisted of feldspar, amphibole, iron oxide and biotite as principal minerals.

Basalt: It is dark to black in colour, containing dense to fine grain and is formed of feldspar, pyroxene, iron oxide and biotite mineral constituents.

I. **Sedimentary rocks:** These are formed by the deposition of weathered minerals, which are derived from igneous rocks. They contain primary as well as secondary minerals. secondary minerals are formed by weathering of the primary minerals. They are:

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- **Shales:** These are light to dark in colour and are thinly laminated. They contain quartz and clay as principal minerals.
- **Sand Stone:** It is light to red in colour and is granular and porous. Quartz, clay minerals, iron oxides and calcium carbonate are present as the principal minerals.
- **Lime Stone:** It is light grey, red, brown or black in colour and contains compact and fine grains.

III. **Metamorphic Rocks:** These are formed by changes in pre-existing rocks, *viz.* igneous or sedimentary rocks, through the exposure of pressure and heat. It is composed of the following five types of rocks (contain both primary and secondary minerals):

- **Slate:** It is grey to black in colour and compact and uniform in texture. Its composition is similar to shale from which it is supposed to be formed.
- **Quartzite:** It is light to brown in colour, compact and uniform in texture. It is similar in composition with that of sandstone from which it is formed.

  Marble: It is light, red, green or black in colour and compact and fine to coarse in texture. It is consisted of the minerals, calcite and
- **Gneiss:** It is a rock with light and dark bands. It‘s constituents are much as in granite, such as quarts, feldspar, mica, amphibole and iron oxides.
- **Schist:** It is rock with foliated structure and its chemical constituents are much similar to basalt or shale from which it is formed.

Chemical Composition of Soil Forming Rocks

The soil forming rocks are the chemical mixtures of numerous minerals. The chemical composition of some of the most common minerals of soil forming rocks may be summarized as below:

(i) Sand and silt minerals:

It is composed of eight mineral constituents, *viz.* Quartz or silica (SiO_2), Feldspars [consisted of three minerals; Orthoclase ($K_2Al_2Si_6O_{16}$), Plagioclase ($NaAlSi_2O_8$) and Calcium feldspar (CaAl2Si2O)], Micas [consisted of two minerals; Muscovite ($K(OH)_2Al_2(AlSi_3)O_{10}$) and Biotite (K,Mg,Fe,Al silicate)],Pyroxene {$(Mg,Fe)SiO_3$}, Amphibole {$(MgFe)_7(Si_4O_{11})_2(OH)_2$}, Olivine and serpentine {$(MgFe)_2SiO_4$}, Calcite($CaCO_3$), magnesite ($MgCO_3$) and dolomite ($CaCO_3.MgCO_3$), and Iron oxides (consisted of three minerals; Haematite (Fe_2O_3), Magnetite (Fe_3O_4)and Limonite {$FeO(OH),xH_2O$}.

(ii) Clay Minerals:

It is consisted of two minerals, *viz.* Kaolin (Al_2O_3, $2SiO_2$, $2H_2O$) and Montmorillonite{$(Ca,MgO)Al_2O_3,5SiO_3,5H_2O$}.

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Besides the above, certain others common minerals in soil forming rocks, these minerals occur in trace amounts, such as Toarmalive (boron, silica or aluminium with alkali metals and iron and magnesium), Rutile (Titanium oxides), Zircon (Zirconium oxide), and Gauconite (Hydrated silicon of iron and potassium). Minerals divided into their constituent elements e.g. mineral quartz is composed of two elements, silicon and oxygen. Such other minerals may contain many elements. For example, the mineral amphibole is made up of a laundry list of elements including sodium, calcium, magnesium, iron, aluminum, silicon, and oxygen.

SOME IMPORTANT SOIL FORMING MINERALS

Primary minerals		Secondary minerals	
		Goethite	FeOOH
Most resistant			
		Hematite	Fe_2O_3
		Gibbsite	$Al_2O_3.3H_2O$
Quartz	SiO_2		
Muscovite	$KAl_3Si_3O_{10}(OH)_2$		
Microcline	$KAl_3Si_3O_8$		
Orthoclase	$KAl_3Si_3O_8$		
Biotite	$KAl(Mg\ Fe)Si_3O_{10}(OH)_2$		
Albite	$NaAlSi_3O_8$		
Hornblende	$Ca_2Al_2Mg_2Fe_3Si_6O_{22}(OH)_2$		
Augite	$Ca_2(Al\ Fe)_4(Mg\ Fe)Si_6O_{24}$		
Anorthite	$CaAl_2Si_2O_8$		
Olivine	$(MgFe)SiO_4$		
		Dolomite	$CaCO_3.MgCO_3$
		Calcite	$CaCO_3$
		Gypsum	$CaSO_4.2H_2O$
Least resistant			

References

Brady, N.C. and Weil, R.R. (2017).The Nature and Properties of Soils. 15th editionPearson Education, ISBN: 978-0133254488