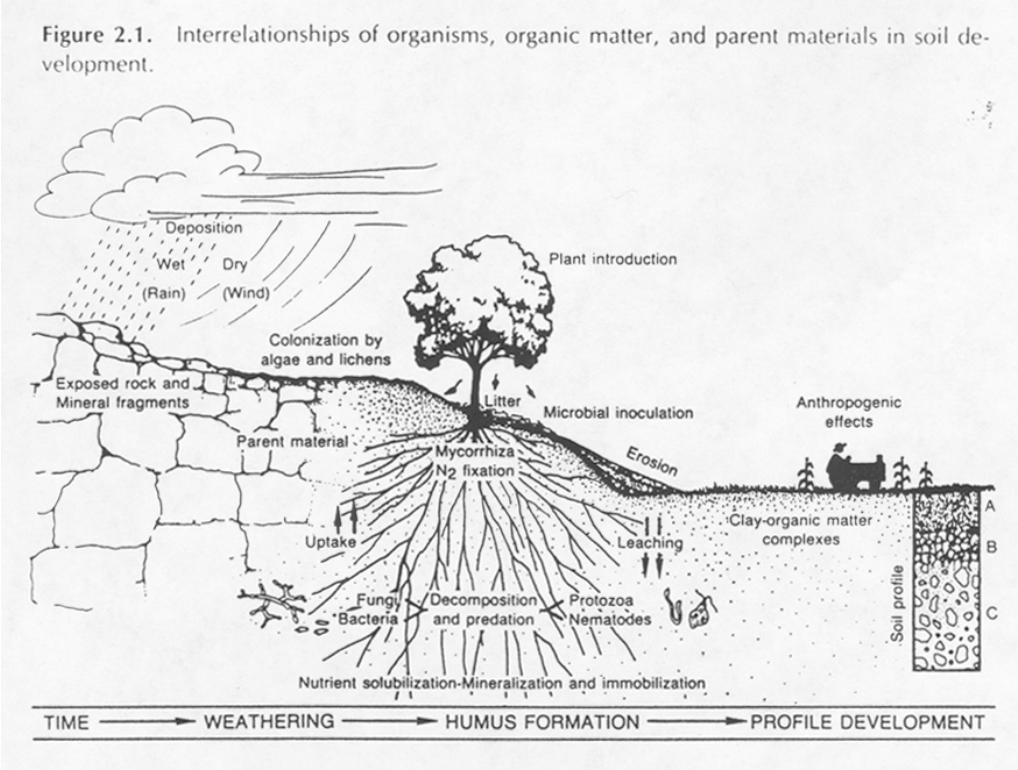
Soil chemistry

This will focus on the chemically reactive components of soil

> clays and humic materials contribute substantially to the chemical reactivity of soils

Paul and Clark fig 2.1. Soil development with time



A) The soil environment (Atlas and Bartha fig. 9.32)

water

temp

pH

redox potential

gases

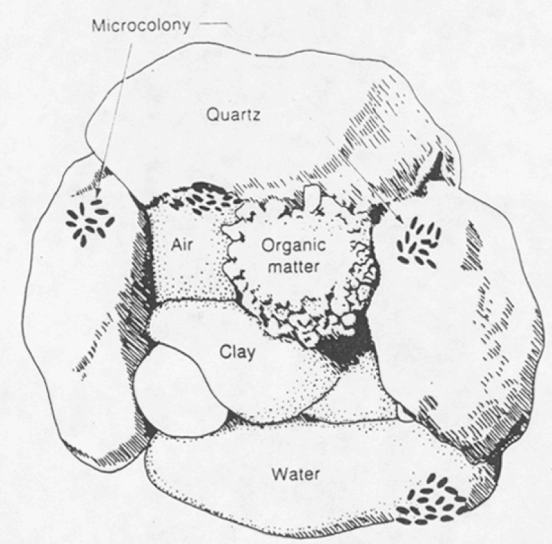
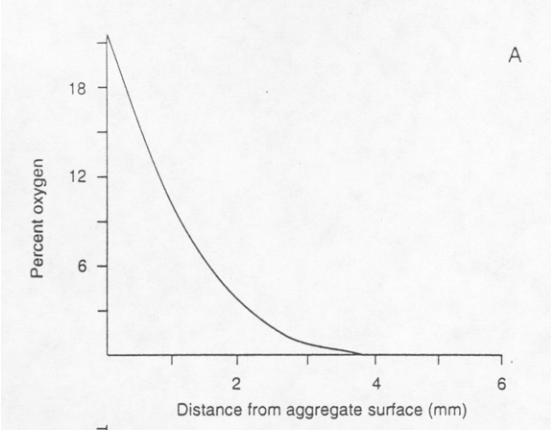


Figure 9.32
Section through a soil crumb showing microhabitats and patchy distribution of bacterial microcolonies. The section also shows the occurrence of water and air within pore spaces. (Source: Brock 1979. Reprinted by permission of Prentice-Hall, Englewood Cliffs, N.J.)



B) Soil structure

Sand, silt, clay size fractions (Fig. 12-8)

McBride fig 2.2 below; mineral composition of size fractions

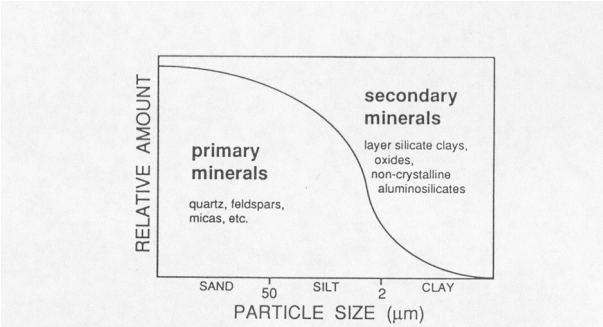


Figure 2.2. Typical abundance of primary and secondary minerals in different size fractions of the soil.

C) AEC

Important for retention of negatively charged compounds such as

Can result from

1)

2)

What influence would changing pH have on AEC?

Septic system example. MDEQ oversees the granting of permits for septic permits. In order to determine a suitable soil depth for a leach field the DEQ assumes that average soils have a maximum sorption capacity of 200 mg P / kg. The soil must have the capacity to retain 9.6 lb P / yr for 50 yrs. How much soil (bulk density = 1.3 g / cm^3) is necessary to meet this criteria?

By determining the bulk density and sorption capacity of a soil, and knowing the water table depth, the volume of soil needed to meet the DEQ criteria can be determined.

D) CEC

Important for buffering soil against pH acidification and for nutrient retention

Important for positively charged ions such as NH_4^+, K^+

Can result from

1)

2)

3)

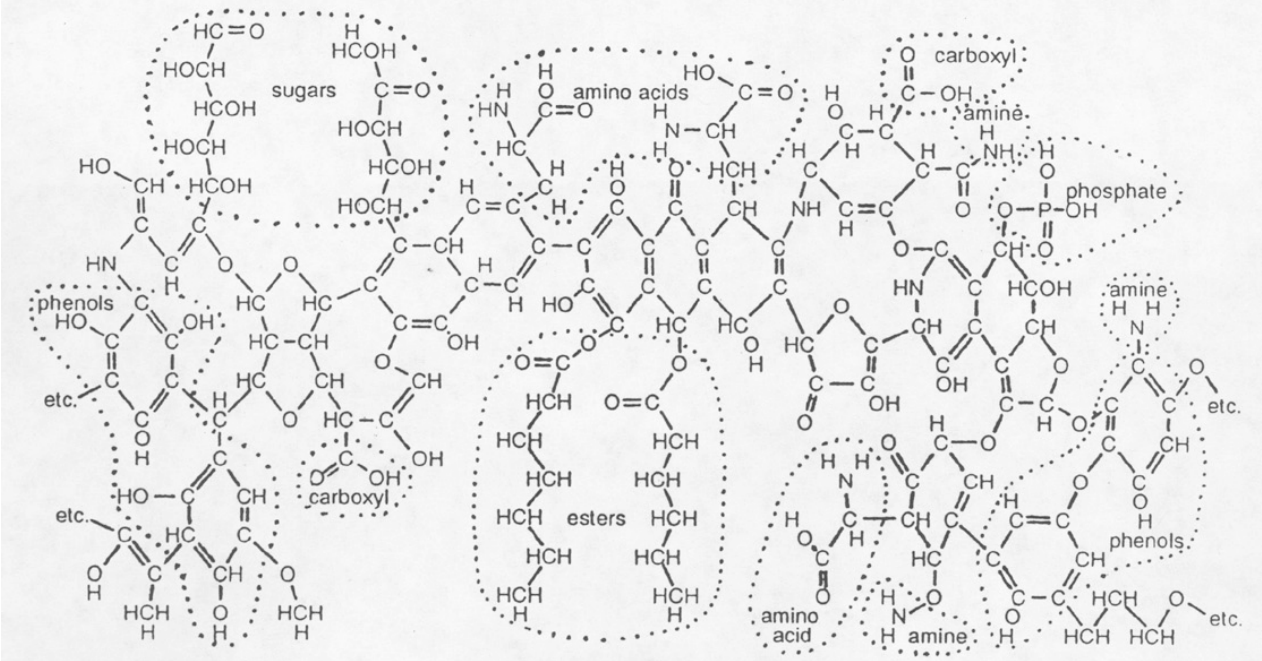
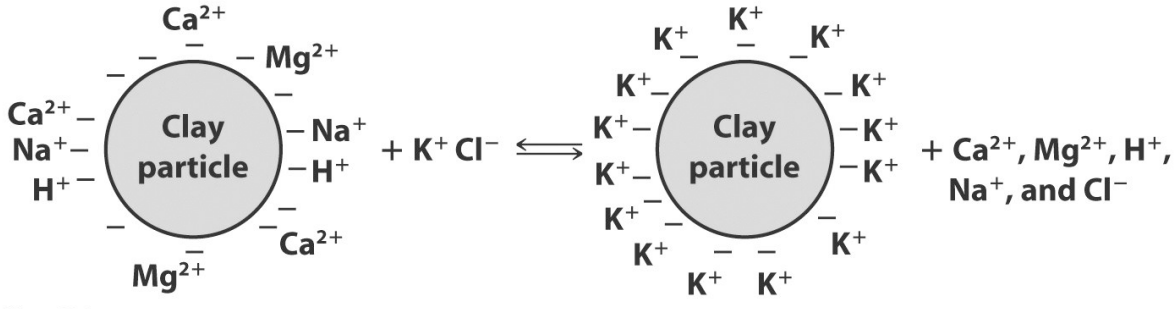


Figure 5.6. Hypothetical structure of a segment of humic acid. An actual humic acid molecule should have a formula weight of more than 10,000. The formula for this segment is $C_{130}H_{140}O_{64}N_9P$, giving it a formula weight of 2,881, so it represents less than one-quarter of a typical molecule. (*Based on information from several sources, with special credit to Jeff Novak, University of Georgia*)

What influence would changing pH have on CEC?

How is CEC determined? Percent base saturation (Fig 12-9 from Baird)



CEC of soil clays and humus

	CEC (meq / 100 g)	(meq = mmol charge)
	Representative CEC	Usual range of CEC
humus	200	100 - 300
vermiculite	150	100 - 200
allophane	100	50 - 200
montmorillonite	80	60 - 100
illite	30	20 - 40
chlorite	30	20 - 40
peat	20	10 - 30
kaolinite	8	3 - 15

In what soil type is AEC high relative to CEC? Fig 7.7 (T&T)

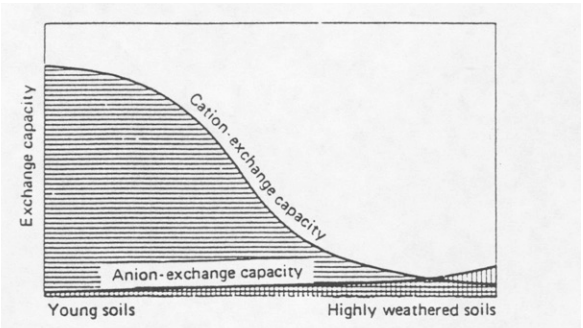


Figure 7.7. Cation- and anion-exchange capacities as related to age (degree of weathering) of clays.