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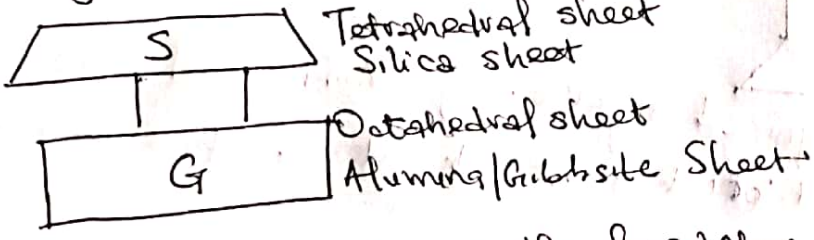
CIVIL ENGINEERING
CVE 313 (ENGINEERING GEOLOGY)

1, clay minerals are the characteristic minerals of the earths near surface environments, the form in soils and sediments, and by diagnetic and hydrothermal alteration of rocks. Clay mineral, any group of important hydrous aluminum silicates with a layer (sheetlike) structure and very small particle size. They may contain significant amounts of iron, alkali metals, or alkaline earths.

Clay minerals are composed essentially of silica, alumina or magnesia or both and water, but iron substitutes for aluminum and magnesium in varying degrees, and few quantities of potassium, sodium and calcium are frequently present as well. Structurally, the clay minerals are composed of planes of cations, arranged in sheets, which may be tetrahedrally or octahedrally coordinated (with oxygen) which in turn are arranged into layers often described as 2:1 if they involve units composed of two tetrahedral and one octahedral sheet, or 1:1 if they involve units of alternating tetrahedral and octahedral sheets. Additionally some 2:1 clay minerals have interlayers sites between successive 2:1 units which may be occupied by interlayer cations, which are often hydrated. The planar structure of clay minerals give rise to characteristic platy habit of many and to perfect cleavage, as seen for example in larger hand specimens of micas

Clay mineralogy: is the scientific discipline of all aspect of clay minerals, including their composition, properties, classification, crystal structures and occurence in nature

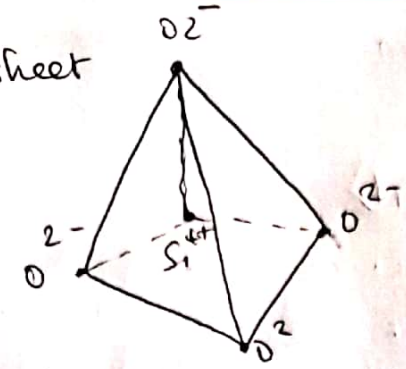
The diagram of Structure of Clay minerals:



The Silicates tetrahedron is the foundation of all Silicate Structures it consist of four O^2 ions, (Si^{4+})

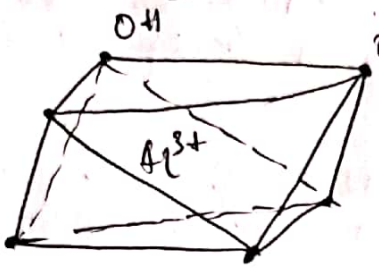
The minerals in the octahedral sheet are brucite $Mg(OH)_2$ and gibbsite $Al(OH)_3$

Silica sheet



Si^{4+} at the centre.

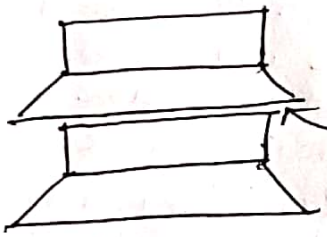
Gibbsite Sheet :-



Al^{3+} at the centre

The process of replacing one structural cation for another similar size is referred to as isomorphous Substitution.

(*) Kaolinite

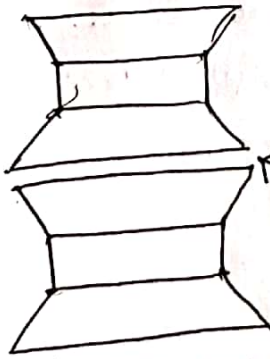


O-H - - - - O

Hydrogen bond

These Structural unit are joined together by hydrogen bond between hydroxyls of aluminium & oxygen

(*) Montmorillonite



Vander waal force (bond).

These structural unit are joined together by Vander waal bond

* we also have vermiculite (trioctahedral) and chlorite (trioctahedral)

PROPERTIES OF CLAY MINERAL

We have the Chemical properties and the physical properties.

Chemical properties:

(1) Ion exchange..... eg Kaolinite has an exchange Capacity of 3-15, illite <10-40>, Chlorite <10-40>.

(2) Clay-water relations

(3) Interaction with morganic and Organic compounds.

Physical properties

(1) Size and shape, high temperature reaction, Solubility.

QUESTION 2:

GEOLOGY OF NIGERIA.

The Basement Complex: This is one of the three major litho-petrological components that make up the geology of Nigeria. The Nigerian basement complex forms a part of the pan-African mobile belt and lies between the west African and congo cratons and south of the Tuareg shield. It is intruded by the mesozore calc-alkaline ring complexes of the jos plateau and is uncomformably overlain by Cretaceous and younger Sediments. The Nigerian basement was affected by the 600 ma Pan-African orogeny and it occupies the reactivated region which resulted from plate collision between between the passive continental margin of the west African craton and the active Phanerian continental margin.

The basement rocks are believed to be the results of at least four major orogenic cycles of deformation, metamorphism and remobilization, corresponding to the Liberian <2,700Ma>, the Eburnean <2,000Ma>, the Kibaran <1,100Ma>, and the Pan-African cycles <600Ma>

THE SEDIMENTARY BASINS

The Sokoto basin: The Iullemmeden Basin in north-western Nigeria is known as sokoto Basin. It consist predominantly of a gently undulating plain with an average elevation varying from 250-400m above sea level. This plain is occasionally interrupted by low mesas. A low escarpment known as the Dange Scarp is the most prominent feature in the basin.