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clay minerals are a diverse group of hydrous layer aluminosilicates that constitute the greater part of the Phyllosilicate family of minerals. they are commonly defined by geologists as hydrous layer aluminosilicates with a particle size < 2 um, while engineers and soil scients define clay mineral are as any mineral particle less than < 4 um. However clay minerals are commonly less than 2 um or even 4 um in at least one dimension. Their small size and large ratio of unique properties, including high cation exchange capacities, catalytic properties and plastic behaviour when moist.

Clay minerals are composed essentially of silica, alumina or magnesia or both and water, but iron substitutes or aluminium and magnesium in varying degrees and appreciable quantities of potassium, sodium and calcium are frequently present as well.

clay mineralogy is the scientific discipline of all aspects of clay minerals including their composition, properties classification, crystal structures and occurance in nature.

Some clay minerals may be expressed using ideal chemical formulas as the following;

$2SiO_2 \cdot Al_2O_3 \, 2H_2O$ (kaolite)

$4SiO_2 \, Al_2O_3 \, H_2O$ (pyrophlite)

$4SiO_2 \cdot 3MgO \cdot H_2O$ (talc)

$3SiO_2 \cdot Al_2O_3 \cdot 5FeO \, 4H_2O$ (Chamesite)

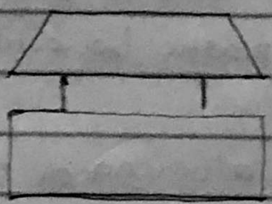
The SiO_2 ratio in a formula is the key factor determining clay mineral types. these minerals can be classified on the basis of variations of chemical composition and atomic structure into a different groups.

1 Kaolin - serpentine (kaolinite, halloysite, lizardite, chrysotile).

2 Pyrophylite - talc.

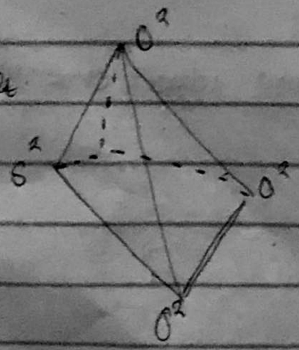
3 mica (glauconite, celadonite)
4 vermiculite
5 smectite (montmorillonite, nontronite, saponite).
6 chlorite (clinchore, chamosite)
7 sepiolite - palygorskite
8 Interstratified clay minerals (e.g. corrensite, tosudite)
9 allophane - imogolite.

Structure of some clay minerals.
These consist of two units, octahedral sheet
tetrahedral sheet

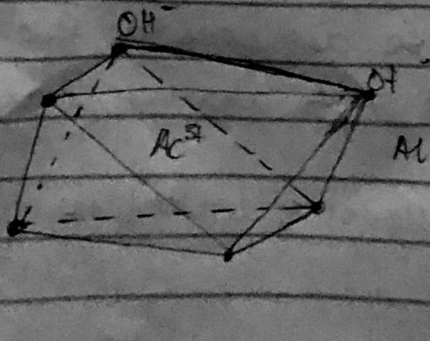


The silicate tetrahedron is the foundation of all silicate structures it consists of four O^{2} cons.
The minerals in the orthedrou sheets are baucite $Mg(OH)_2$ and gibbsite [$Al(OH)_3$

Silica sheet

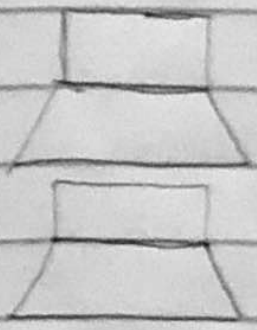


Gibbsite sheet



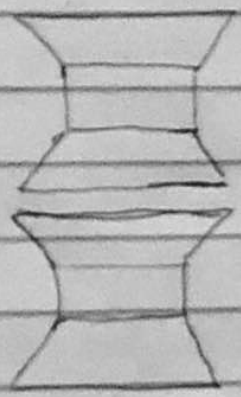
the process of replacing one structural cation for another of similar size is reffered to as isomorphous substitution

Kaolite



These structural units are joined together by hydrogen bond between hydroxyls of aluminium and oxygen

montmorillonite



Joined together by vander waal bond.

Geology in Nigeria

Basement complex: one of the 3 major litho-petrological component that makes up the geology of nigeria. the nugerian basement complex forms a part of the pan african mobile belt and lies btw the west African and congo cratons and South of the Tuareg shield. Basement rock are believed to be the result of at least a major orgenic cycles of deformation, metamorphism and remobilization corresponding to liberian (2,700ma), the eburnean (2,000ma), the Kibaran (1,100Ma) and pan-African cycles (600Ma)

Within the basement complex of Nugerian, four major petro-lithological units are distinguishable namely

- migmatite-Gneiss complex (MnGC)
- The schist belt (metasedumentary and metavolcanic rocks)
- the older granites (pan African granites)
- Undeformed acid and basic cycles.

MGC: this is the most wide spread of the component units in the nigerian basement. many areas in the nothern western and eastern nugerian are covered by the MGC these areas include, but not limited to Abuja, Koffi, Akwaga, bauchi, Kaduna, Kano, Funtua, egbe (Ajaikuta), Ibadan, Ile-Ife, Akure, Ilhere (western Nigeria) and Obudu and Oban massif areas in eastern Nigeria.

Mmigmatite-Genesis complex (migmatite, Genesis granite, gneisses)

the schist belt (metasedimentary and meta volcanic rocks)

(phyllites, schists, pettites, quartzites, marbles, amphebolites)