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Clay minerals are hydrous aluminium phyllosilicates, sometimes with variable amounts of iron, magnesium, alkali metals, alkaline earths, and other cations found on or near some planetary surfaces.

Clay minerals form in the presence of water and have been important to life, many theories of abiogenesis involve them. They are important constituents of soils, and have been useful to humans since ancient times in agriculture and manufacturing.

Most clay minerals are the product of chemical weathering of rock-forming minerals such as feldspar and mica. The three major clay minerals are halloysite, chlorite and vermiculite.

Halloysite: is an aluminosilicate clay mineral with the empirical formula $Al_2Si_2O_5(OH)_4$. Its main constituents are oxygen, silicon, aluminium and hydrogen. Halloysite typically forms by hydrothermal alteration of aluminosilicate minerals.

Chlorite: chlorite is a widespread group of layer silicate minerals occurring in both macroscopic and clay grade sizes. They are hydrous aluminium silicates, usually of magnesium and iron. The name from Greek means "Green", which refers to the chlorites typical colour.

Vermiculite: is a hydrous phyllosilicate mineral which undergoes significant expansion when heated. Exfoliation occurs when the mineral is heated sufficiently, and commercial furnaces can routinely produce this effect. Vermiculite forms by the weathering or hydrothermal alteration of biotite or phlogopite.

PROPERTIES OF CLAY MINERALS

Physical Properties

- **Size and shape:** These two properties of clay minerals have been determined by electron micrographs. Well-crystalline kaolinite occurs as well formed, six-sided flakes, frequently with a prominent elongation in one direction.
- **High-temperature reactions:** When heated at temperatures beyond dehydration, the clay mineral structure may be destroyed or simply modified, depending on the composition and structure of the substance. In the presence of fluxes, such as iron or potassium, fusion may rapidly follow dehydration.
- **Solubility:** The solubility of the clay minerals in acids varies with the nature of the acid-to-clay ratio, the temperature, the duration of treatment, and the chemical composition of the clay mineral attacked.

Chemical Properties

- **Ion exchange:** Depending on deficiency in the positive or negative charge balance (locally or overall) of mineral structures, clay minerals are able to absorb certain cations and anions and retain them around the outside of the structural unit in an exchangeable state.
- **Clay-water relations:** Clay minerals contain water in several forms. The water may be held in pores and may be removed by drying under ambient conditions.
- **Interactions with inorganic and organic compounds:** Smectite, vermiculite and other expansible clay minerals can accommodate relatively large, inorganic cations between the layers. Because of this multivalency, the interlayer space is only partially occupied by such inorganic cations that are distributed in the space like islands.

Geology of Nigeria

The geology of Nigeria formed beginning in the Archean and Proterozoic eons of the Precambrian. The country forms the Nigerian Province and more than half of its surface is igneous and metamorphic crystalline basement rock from the Precambrian. Between 2.9 billion and 500 million years ago, Nigeria was affected by three major orogenic mountain building events and related igneous intrusions following the Pan-African orogeny, in the Cambrian at the time that multi-cellular life proliferated, Nigeria began to experience regional sedimentation and witnessed new igneous intrusions.

Nigeria has tremendous oil and natural gas resources housed in its thick sedimentary basins, as well as reserves of gold, lead, zinc, tantalite, columbite, coal and tin. Most of Nigeria's large sedimentary basins have intergranular flow, rainwater recharge and few water quality issues. Within the Chad Basin, the Chad formation is unconfined in some locations, with artesian flow from some deeper layers, and a water table depth of 10 to 15 meters.

Nigeria has extensive natural resources and is the largest crude oil producer in Africa and 20 billion barrels of reserves. As such, petroleum is central to the economy of Nigeria, producing 80 percent of government revenues and 95 percent of export earnings.