Clay minerals are a diverse group of minerals that are fine grained and crystalline and ultimately form from the aqueous alteration of primary igneous minerals at or near the surface of the Earth. They have a layered structure, commonly consisting of repeating sheets of Si tetrahedra and Al octahedra . The wide diversity of clay minerals stems from the way that these sheets stack together and the identity of ions that commonly substitute into the clay mineral structure. Due to their unique layered structure and their effectiveness as ion exchangers, the formation of clay minerals can have a significant impact over the chemical and isotopic compositions of solid and fluid phases during weathering.

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. The classification of the phyllosilicate clay minerals is based collectively, on the features of layer type (1:1 or 2:1), the dioctahedral or trioctahedral character of the octahedral sheets (i.e. 2 out of 3 or 3 out of 3 sites occupied), the magnitude of any net negative layer charge due to atomic substitutions, and the nature of the interlayer material.

Clay minerals include the following groups:

- Kaolin group which includes the minerals kaolinite, dickite, halloysite, and nacrite (polymorphs of $Al_2Si_2O_5(OH)_4$).[6]
    - Some sources include the kaolinite-serpentine group due to structural similarities.
- Smectite group which includes dioctahedral smectites, such as montmorillonite, nontronite and beidellite, and trioctahedral smectites, such as saponite. In 2013, analytical tests by the Curiosity rover found results consistent with the presence of smectite clay minerals on the planet Mars.
- Illite group which includes the clay-micas. Illite is the only common mineral.
- Chlorite group includes a wide variety of similar minerals with considerable chemical variation.
- Other 2:1 clay types exist such as palygorskite (also known as attapulgite) and sepiolite, clays with long water channels internal to their structure.

Mixed blue layer clay variations exist for most of the above groups. Ordering is described as a random or regular order and is further described by the term reichweite, which is German for range or reach. Literature articles will refer to an R1 ordered illite-smectite, for example. This type would be ordered in an ISIS fashion. R0 on the other hand describes random ordering, and other advanced ordering types are also found (R3, etc.). Mixed layer clay minerals which are perfect R1 types often get their own names. R1 ordered chlorite-smectite is known as corrensite, R1 illite-smectite is rectorite.

THE GEOLOGY OF NIGERIA

The basement complex is one of the three major litho-petrological components that make up the geology of Nigeria (Fig. 1.1). 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 (Black, 1980). It is intruded by the Mesozoic calc-alkaline ring complexes (Younger Granites) of the Jos Plateau and is unconformably overlain by Cretaceous and younger sediments. The Nigerian basement (Fig.1.3) was affected by the 600 Ma Pan-African orogeny and it occupies the reactivated region which resulted from plate collision between the passive continental margin of the West African craton and the active Pharusian continental margin (Burke and Dewey, 1972; Dada, 2006). 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 (2,700 Ma), the Eburnean (2,000 Ma), the Kibaran (1,100 Ma), and the Pan-African cycles (600 Ma).

Within the basement conplex of nigeria, we have 4 majot lithro-pethrological units.

1. Migmatite (gneiss comples)
2. The schist belt (meta sedimentary and meta volcanoic rocks)
3. the older granites (pan african granitoids)
4. Uniformed acid and basic clykes

The Migmatite-Gneiss Complex differs in the Ibadan area, in the southwest. Banded gneiss, schist and quartzite formed from the metamorphism of greywacke, shale and interbedded sandstones. Some amphibolite layers record the metamorphosed remains of a tholeiitic magma series. The early folding and metamorphism in the Ibadan area was followed by the emplacement of aplite schist and microgranodiorite dikes during the Liberian orogeny 2.75 billion years ago. More intense deformation followed 2.2 billion years ago during the Eburnean orogeny.

SEDIMENTARY BASIN

Nigeria is overlayed with 7 major sedimentary basins:

1. Calabar Flank
2. Benue Trough
3. Chad Basin
4. SE Lullemmedun (sokoto) basin

5. Dahomey basin
6. Niger Delta basin