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# Clay Mineralogy of Groundnut Growing Soils Formed on Different Parent Material of Srikalahasti Division of Chittoor District, Andhra Pradesh, India

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**A B S T R A C T**

Mineralogy of clay fractions and characteristics of Groundnut growing soils developed from granite-gneiss parent material in Srikalahasti division in Chittoor district of Andhra Pradesh were studied. The clay fraction of these soils exhibited the characteristic peaks of smectite, illite and kaolinite. Semi-quantification of clay fractions based on relative areas under corresponding peaks indicated that the pedon 3 and 6 was dominated by kaolinite followed by illite, smectite and Quartz. Pedons 1 and 2 were dominated by smectite followed by kaolinite, illite and Quartz whereas Pedon 5 was dominated by smectite followed illite, kaolinite and Quartz. Pedon 4 dominated by illite followed by kaolinite, smectite and feldspars.

## Introduction

Clay is an important soils constituent that controls its properties and also influences its management and productivity (Davies *et al.*, 1972). Clay with cementing agents contributes structural stability that helps in resisting the destructive effects of rain and wind.

Moreover, clays have a large specific that is mostly negatively charged and these sites retain nutrients like $K^+$ and $NH^+$ ions and also adsorb many toxic elements. The mineralogy of soil clays is the result of several factors interacting with the parent material. In certain combination of circumstances soil forming processes exhibit their effects on the clay mineralogy viz., Oxisols, Vertisols and Andisols (Newman, 1984). Soil mineralogy, which is closely linked to soil texture, is a major determinant of physical and chemical properties of soils (Sumner, 2000).

Soil mineralogy defines the capacity of soil minerals to adsorb and protect organic carbon, which depends on the specific surface area and surface charge characteristics of the mineral (Krull *et al.*, 2001, Zinn, 2005). Knowledge of clay minerals in soils is thus critical to our understanding and use of soil. However, there is no information available on the clay mineralogy of groundnut growing soils of Srikalahasti division of Chittoor district. Hence, the present investigation was carried out to identify the clay minerals in these soils for their sustainable management.

## Materials and Methods

### *Study Area*

The study area lies in between $13^o.25"$ and $14^o.05"$ N latitude and $79^o.12"$ and $80^o$ 08" E longitude. The climate of the area is semi-arid monsoonic with distinct summer, winter and rainy seasons. The annual precipitation was 888.74 mm of which 94.21 per cent was received during May to December. The mean annual soil temperature was $27.66^oC$ with a mean summer and winter temperatures of $33.32^oC$ and $27.66^oC$, respectively. The area qualifies for isohyperthermic temperature regime. The soil moisture control section remains dry for more than 90 cumulative days or 45 consecutive days in four months following summer solistice and qualifies for ustic soil moisture regime. The soils of the study area are developed from granite-gneiss parent material. The natural vegetation of the study area was *Parthenium hysterophorus, Calotropis gigantia, Tridax procumbens, Pongamia pinnata, Azardirachta indica, Lantana camera, Cyperus rotundus* and *Cynodon dactylon*

Six representative pedons (P1 to P6) in groundnut growing soils of Chittoor district in Andhra Pradesh were selected after surveying the area. The horizon-wise soil samples were collected for analysis of chemical parameters whereas the samples collected from control section (25-100cm) of the pedons were analysed for clay minerals. The samples were air-dried at room temperature and stored in polyethylene bags. The air-dried samples were crushed, passed through a 2 mm sieve, mixed and stored for analysis.

The chemical parameters were determined by following standard procedures. The clay fractions were fractions were separated by sedimentation technique (Jackson, 1979). The clays (< 2μm) were isolated by removing organic matter, sesquioxides and allophones. Basically oriented clay samples (Ca-air, Ca-glycerol, K-air, K-25, K-110, K-300 and K-$550^OC$ heated) were subjected to X-ray diffraction studies. The X-ray diffractograms were recorded in Philips diffractometer (Model 1140) using Ni-filtered Cu-Kα radiation at a scanning speed of $2^O$ 2θ per min. Identification and semi-quantitative estimation of clay minerals were carried out (Jackson 1976 and Manoj Kumar *et al.*, 2002).

## Results and Discussion

The general characteristics of the study area have been represented in the table 1. The soils were developed on granite-gneiss and alluvium parent material. P1, P2, P3 and P5 were located on plains while P4 and P6 were developed on uplands. Slight erosion was observed in pedons 4, 5 and 6 while others did not show any erosion. The drainage was moderately well drained.

### *Chemical composition*

The data on chemical composition (table 2) revealed that, the pH of the soils ranged from 5.54 (Moderately acidic) to 8.16 (strongly alkaline). Cation exchange capacity of the soils varied between 8.02 to 46.26 cmol $(p^+)$ $kg^{-1}$ in different horizons and was positively and significantly correlated with clay (r = +0.756**) and was negatively and significantly correlated with sand (r = -0.669**). The base saturation ranged from 55.91 to 90.14 per cent. The higher base saturation in some pedons might be due to higher amount of $Ca^{+2}$ occupying exchange sites on the colloidal complex and also may be due to recycling of basic cations through vegetation. The values of $SiO_2$ and $Al_2O_3$ indicated the occurrence of appreciable amounts of 2:1 type of clay minerals. The

$Fe_2O_3$ content of clays in these soils suggested the presence of iron-bearing minerals. Values of MgO and CaO indicate the presence of minerals rich in magnesium and calcium. The $K_2O$ content in all the pedons indicates the presence of K-bearing clay minerals (Raina *et al.,* 2006). Relatively higher values of $P_2O_5$ in the soil might be due to the presence of P-bearing minerals such as calcium apatite and also due to use of higher doses of phosphatic fertilizers (Table 2).

### *X-ray Diffraction*

The X-ray diffraction pattern of clay fraction indicated that pedon 1 contains smectite (65%) (dominant), kaolinite, illite and Quartz (Fig. 1). The peak position at 1.400 nm d-spacing in Ca-saturated sample shifted to 1.674nm upon ethylene glycol solvation suggested the presence of smectite. The intense dominant peak at 0.713 nm and 0.355 nm d-spacing in Ca-saturated ethylene glycol solvated treatment indicated the presence of kaolinite. A sharp large peak was observed at 1.000 nm d-spacing followed by higher order peaks at 0.490 and 0.335 nm d-spacings in Ca-saturated ethylene glycol solvation treatment and in K-25$^{o}$C treatment and persistence of these peaks at K-550$^{o}$C treatment indicated the presence of illite clay mineral. Presence of Quartz was identified by the characteristic peak at 0.416 nm d-spacing in Ca-saturated and Ca-saturated with ethylene glycol treatment (Table.4).

In clay fraction of pedon 2, smectite (58%) is the dominant mineral followed by kaolinite illite and quartz. A strong peak at 1.520 nm d-spacing in Ca-saturated sample which expanded to 1.710 nm d-spacing with Ca-saturated ethylene glycol solvated treatment indicated the presence of smectite. Small peaks at 0.711nm and 0.355 nm d-spacings and their persistence in all the treatments except at K-550$^{O}$C confirmed the presence of kaolinte. The presence of weak peaks at 0.993 nm, 0.492 nm and 0.330 nm is indicative of illite. A characteristic peak at 0.421 nm d-spacing indicated the presence of quartz (Fig.2).

Kaolinite was the dominant clay mineral followed by illite, Smectite and quartz. The Ca-saturated sample in pedon 3 showed peaks at 0.717 nm d-spacing and 0.359 nm in all the treatments except in K-550$^{O}$C treatment confirmed the presence of kaolinite (Fig.3). The Ca-saturated sample showed a Peak at 1.480 nm d-spacing and its shift to 1.710 nm indicated the presence of smectite. Illite was recognized by the presence of small peaks at 1.013 nm and 0.500 nm and 0.334 nm (Table.4).

The peaks at 1.003 nm, 0.500 nm and 0.335 nm in pedon 4 on glycolation, confirmed the presence of illite. A peak at 1.484 nm and the other at 1.710 nm on glycolation, confirmed the presence of smectite (Table.4). The sharp peak at 0.713 nm followed by a high angle diffraction maxima at 0.355 nm in different treatments confirmed the presence of kaolinite as explained earlier (Fig.4).

The Ca-saturated sample in pedon 5 showed a peak at 1.700 nm d-spacing which indicated the confirmation of smectite. Presence of a sharp peak at 1.013 nm, 0.501 nm and 0.335 nm in all the treatments suggests the presence of illite (Fig.5).

The peaks were not affected by glycerol treatment or by heating up to 550$^{O}$C, thereby confirmed that the degree of hydration of illite was not much. The peaks at 0.724 nm and 0.355 nm d-spacing in all the treatments except in K-550$^{O}$C treatment confirmed the presence of kaolinite. Very small peak at 0.415 nm confirmed the presence of quartz (Table.4).

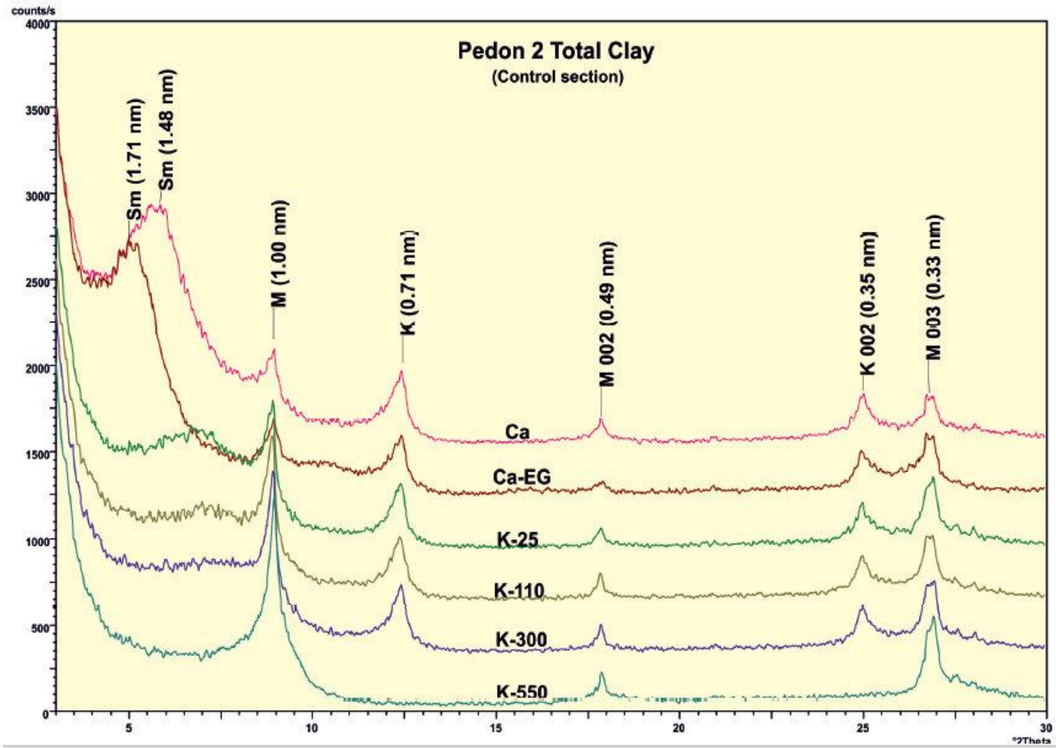


**Fig.1** Representative XRD diagrams of of Pedon 1

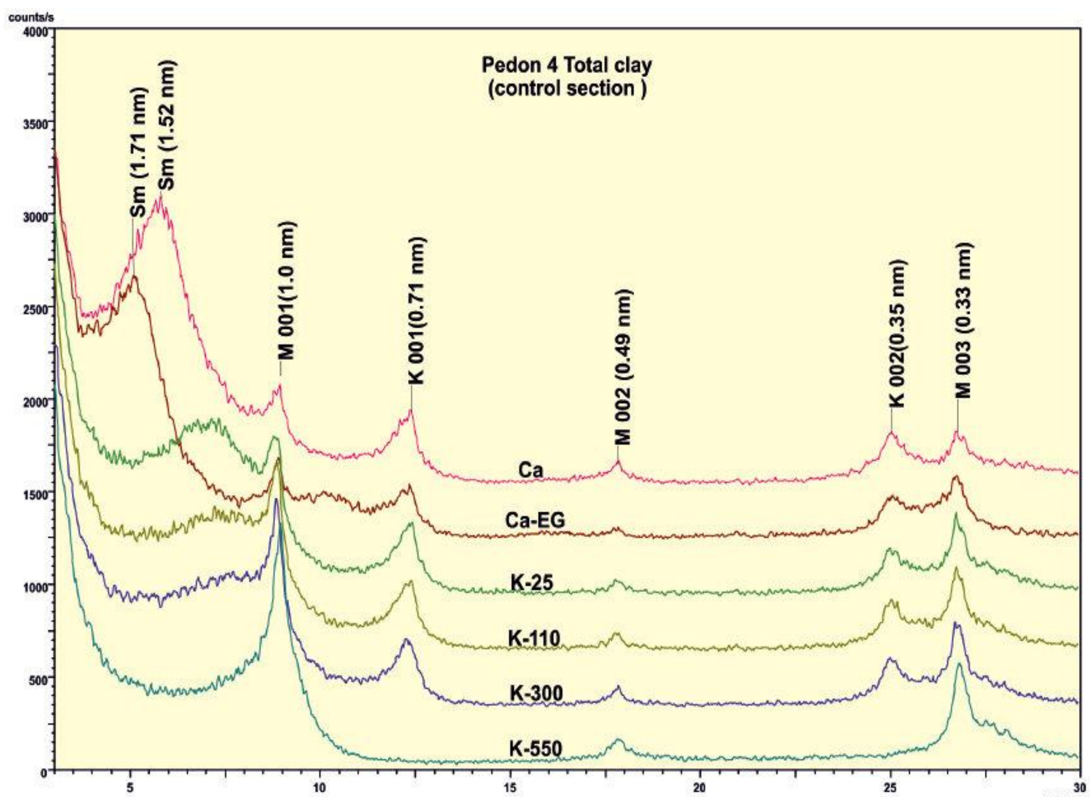


**Fig.2** Representative XRD diagrams of Pedon 2

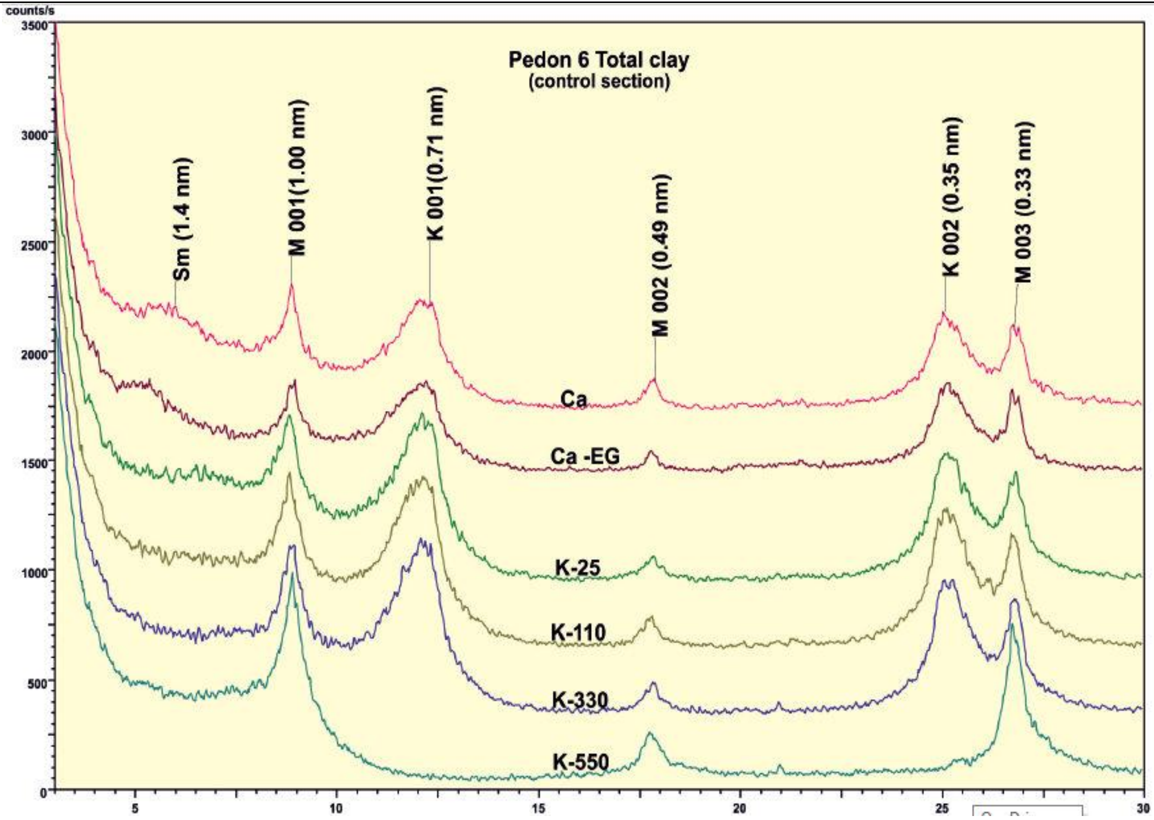


**Fig.3** Representative XRD diagrams of Pedon 3

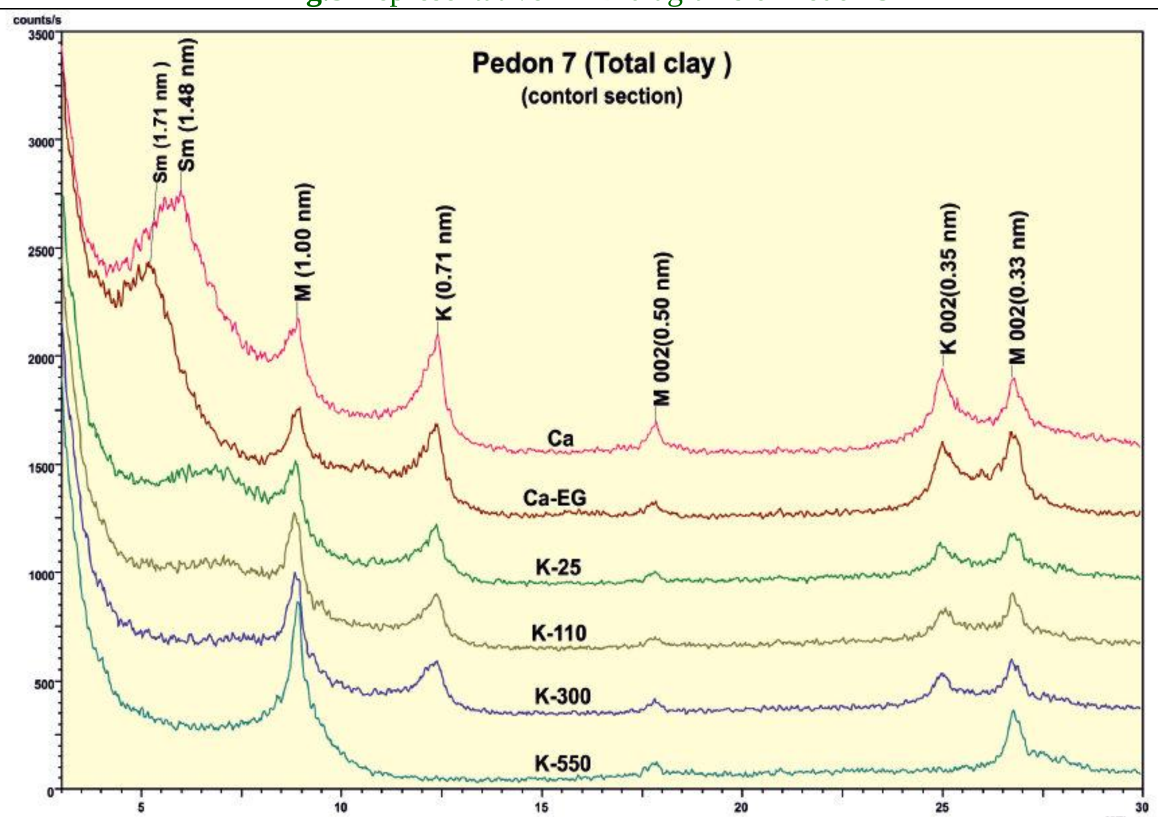


**Fig.4** Representative XRD diagrams of Pedon 4

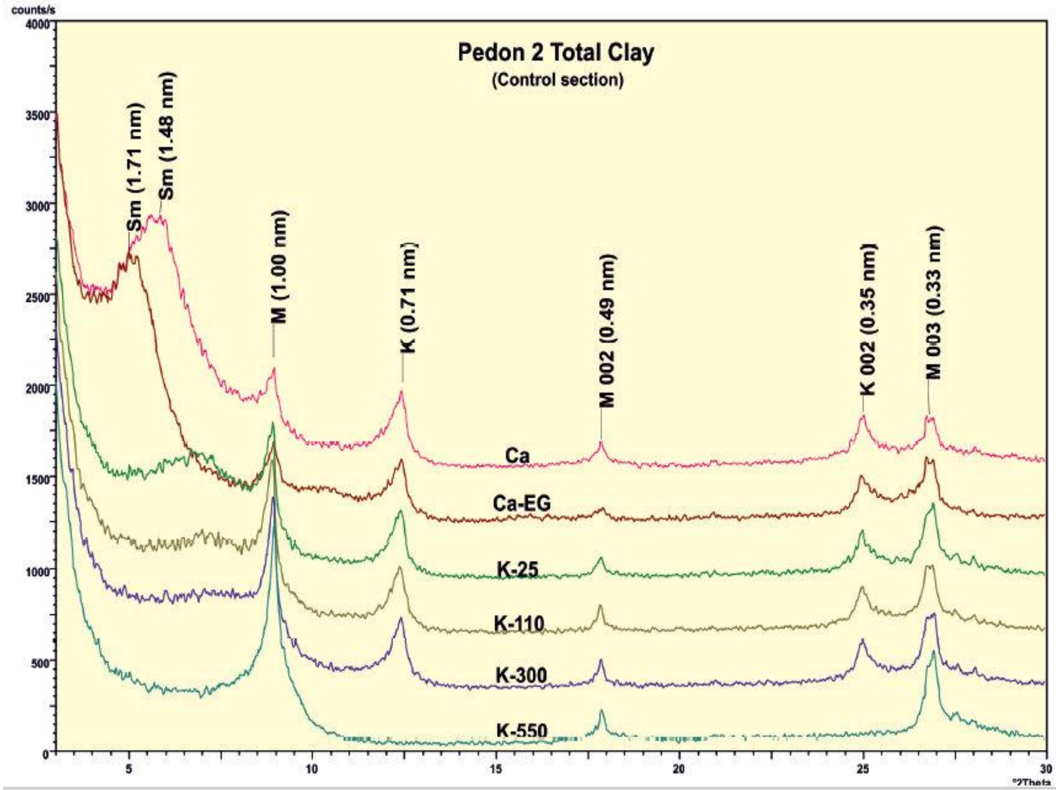


**Fig.5** Representative XRD diagrams of Pedon 5

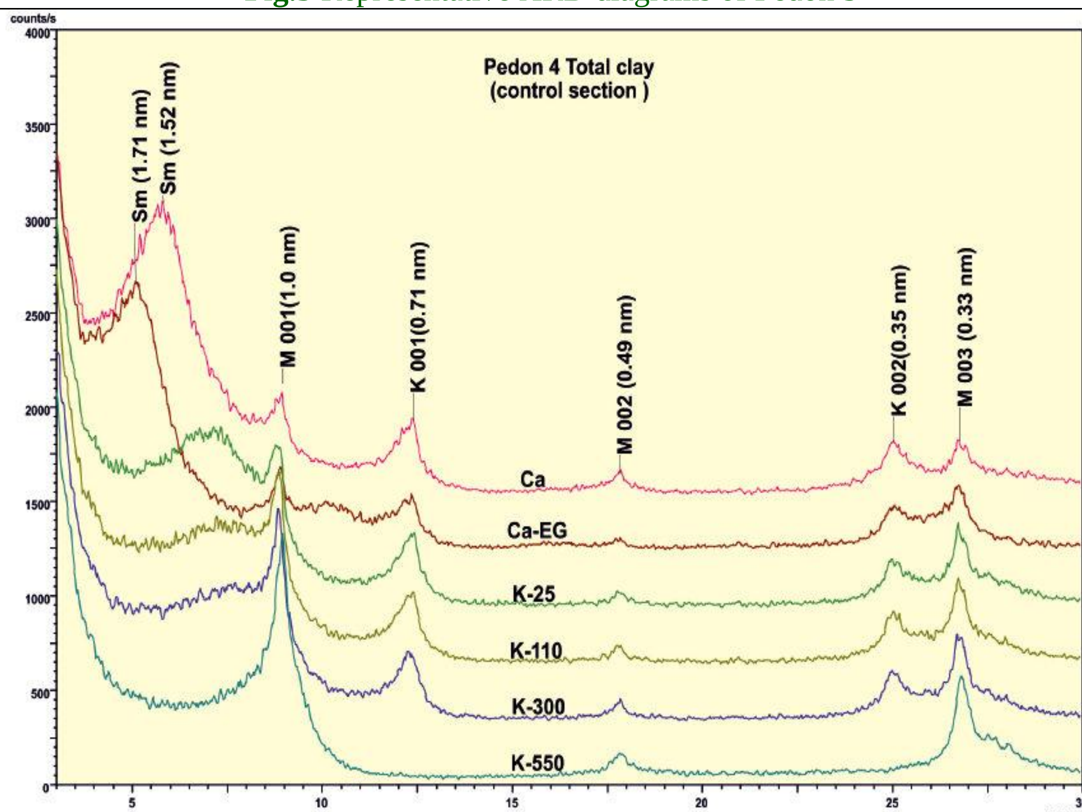


**Fig.6** Representative XRD diagrams of Pedon 6

**Table.2** Chemical composition of the groundnut growing soils

| Pedon No. & horizon | Depth (m) | pH (1:2.5) | EC (dS $m^{-1}$) | CEC [cmol $(p^+)kg^{-1}$] | $SiO_2$ (%) | $Fe_2O_3$ (%) | $Al_2O_3$ (%) | $P_2O_5$ (%) | $K_2O$ (%) | $Na_2O$ (%) | CaO (%) | MgO (%) | LOI (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Pedon 1** | | | | | | | | | | | | | |
| **Ap** | 0.00-0.30 | 7.44 | 0.03 | 18.62 | 77.24 | 3.79 | 4.42 | 0.09 | 0.18 | 1.98 | 3.29 | 0.80 | 3.60 |
| **E** | 0.30-0.60 | 7.18 | 0.02 | 14.78 | 73.12 | 5.10 | 4.58 | 0.10 | 0.21 | 1.47 | 3.72 | 2.02 | 3.06 |
| **Bt1** | 0.60-0.90 | 7.34 | 0.02 | 23.66 | 78.70 | 3.79 | 4.28 | 0.10 | 0.28 | 1.87 | 2.21 | 0.70 | 3.64 |
| **Bt2** | 0.90-1.10 | 7.84 | 0.02 | 25.37 | 78.29 | 4.78 | 3.43 | 0.07 | 0.34 | 1.44 | 3.04 | 0.40 | 5.04 |
| **Bt3** | 1.10-1.50 | 7.96 | 0.03 | 26.79 | 78.07 | 4.59 | 4.09 | 0.06 | 0.28 | 1.53 | 2.35 | 0.35 | 3.68 |
| **Bt4** | 1.50-1.80+ | 8.16 | 0.02 | 32.31 | 83.85 | 4.28 | 1.19 | 0.07 | 0.31 | 1.92 | 2.50 | 0.41 | 5.15 |
| **Pedon 2** | | | | | | | | | | | | | |
| **Ap** | 0.00-0.23 | 7.37 | 0.02 | 23.77 | 80.27 | 2.16 | 5.74 | 0.10 | 0.42 | 1.20 | 1.61 | 0.60 | 0.87 |
| **2A1** | 0.23-0.55 | 7.30 | 0.01 | 8.02 | 80.13 | 2.87 | 5.30 | 0.08 | 0.18 | 1.11 | 1.96 | 0.20 | 1.53 |
| **3A2** | 0.55-0.90 | 7.05 | 0.01 | 19.20 | 80.58 | 3.96 | 3.78 | 0.06 | 0.25 | 1.56 | 1.77 | 0.30 | 2.62 |
| **3A3** | 0.90-1.20 | 6.98 | 0.01 | 22.11 | 82.65 | 5.32 | 1.17 | 0.05 | 0.35 | 1.69 | 1.83 | 0.45 | 3.51 |
| **4A4** | 1.20-1.60 | 7.03 | 0.01 | 30.03 | 78.95 | 1.69 | 7.22 | 0.04 | 0.16 | 1.41 | 1.47 | 0.15 | 3.69 |
| **5A5** | 1.60-2.00 + | 7.07 | 0.01 | 21.82 | 75.11 | 4.28 | 6.12 | 0.04 | 0.27 | 1.60 | 1.83 | 0.35 | 2.94 |
| **Pedon 3** | | | | | | | | | | | | | |
| **Ap** | 0.00-0.25 | 7.58 | 0.05 | 21.20 | 79.46 | 1.82 | 5.46 | 0.12 | 0.12 | 1.23 | 3.36 | 1.15 | 1.92 |
| **C1** | 0.25-0.58 | 7.32 | 0.04 | 14.20 | 86.86 | 0.49 | 3.58 | 0.07 | 0.15 | 1.97 | 2.31 | 0.50 | 0.81 |
| **C2** | 0.58- 0.99 | 7.28 | 0.04 | 16.07 | 85.98 | 1.42 | 2.79 | 0.06 | 0.13 | 1.57 | 2.59 | 1.25 | 0.77 |
| **C3** | 0.99-1.33 | 7.46 | 0.05 | 15.02 | 84.25 | 1.52 | 5.36 | 0.05 | 0.11 | 1.29 | 1.47 | 1.00 | 0.75 |
| **C4** | 1.33-1.60+ | 7.69 | 0.05 | 12.33 | 86.36 | 1.40 | 3.67 | 0.03 | 0.12 | 1.93 | 0.98 | 0.44 | 0.61 |
| **Pedon 4** | | | | | | | | | | | | | |
| **Ap** | 0.00-0.15 | 7.04 | 0.03 | 11.55 | 85.92 | 2.90 | 1.92 | 0.14 | 0.23 | 1.39 | 1.78 | 0.90 | 3.83 |
| **Bw1** | 0.15-0.46 | 7.14 | 0.02 | 34.76 | 79.30 | 3.98 | 3.67 | 0.10 | 0.48 | 1.43 | 1.94 | 1.45 | 4.95 |
| **Bw2** | 0.46-0.86 | 7.22 | 0.02 | 26.51 | 80.41 | 4.43 | 2.82 | 0.08 | 0.44 | 1.50 | 1.78 | 1.29 | 6.66 |
| **BW3** | 0.86-1.00 | 7.70 | 0.02 | 37.30 | 83.77 | 1.89 | 4.22 | 0.06 | 0.57 | 1.78 | 0.95 | 0.65 | 7.11 |
| **Cr** | **1.00** | **Weathered gneiss mixed with soil** | | | | | | | | | | | |
| **Pedon 5** | | | | | | | | | | | | | |
| **Ap** | 0.00-0.15 | 5.91 | 0.01 | 34.63 | 83.04 | 4.60 | 2.12 | 0.12 | 0.27 | 1.08 | 1.25 | 0.80 | 4.04 |
| **Bw1** | 0.15-0.33 | 6.07 | 0.01 | 31.60 | 77.30 | 4.32 | 4.75 | 0.08 | 0.28 | 1.58 | 1.67 | 0.95 | 4.38 |
| **Bw2** | 0.33-0.64 | 5.54 | 0.01 | 32.23 | 74.58 | 4.26 | 7.15 | 0.11 | 0.20 | 0.69 | 1.25 | 0.35 | 4.15 |
| **Bw3** | 0.64-0.86 | 5.89 | 0.01 | 33.63 | 76.50 | 4.20 | 5.83 | 0.08 | 0.25 | 1.43 | 1.18 | 0.50 | 4.45 |
| **Bw4** | 0.86-1.10 | 6.41 | 0.02 | 29.96 | 74.86 | 1.46 | 8.93 | 0.09 | 0.07 | 1.73 | 1.82 | 0.65 | 3.18 |
| **Bw5** | 1.10-1.50 | 6.45 | 0.02 | 22.23 | 75.00 | 3.98 | 6.98 | 0.03 | 0.20 | 1.15 | 1.10 | 0.60 | 3.51 |
| **Cr** | **1.50** | **Weathered gneiss mixed with soil** | | | | | | | | | | | |
| **Pedon 6** | | | | | | | | | | | | | |
| **Ap** | 0.00-0.15 | 7.96 | 0.01 | 34.58 | 81.95 | 3.36 | 4.00 | 0.10 | 0.18 | 1.10 | 1.05 | 0.50 | 4.00 |
| **Bt1** | 0.15-0.34 | 7.99 | 0.03 | 41.39 | 71.99 | 1.80 | 10.83 | 0.08 | 0.12 | 0.96 | 1.47 | 0.75 | 4.80 |
| **Bt2** | 0.34-0.80 | 8.14 | 0.02 | 46.26 | 78.62 | 3.82 | 5.17 | 0.10 | 0.26 | 1.53 | 1.26 | 0.25 | 6.99 |
| **Cr** | **0.80** | **Weathered gneiss** | | | | | | | | | | | |

**Table.1** Salient site characteristics of the profiles in the study area

| Features | Pedon 1 (M.D. Puttur*) | Pedon 2 (Bonupalle*) | Pedon 3 (Kommanagradu*) | Pedon 4 (Durgiperi*) | Pedon 5 (Vedam*) | Pedon 6 (Kanamanambedu*) |
|---|---|---|---|---|---|---|
| **Physiography** | Plain | Plain | Plain | Upland | Plain | Upland |
| **Slope (%)** | 0-1 | 0-1 | 0-1 | 1-3 | 1-3 | 1-3 |
| **Elevation (msl)** | 120m | 100 m | 89 m | 112 m | 98 m | 112 m |
| **Drainage** | Moderately well drained | Well drained | Well drained | Moderately well drained | Moderately well drained | Well drained |
| **Parent material** | Granite - gneiss | Alluvium | Alluvium | Granite - gneiss | Granite - gneiss | Granite – gneiss |
| **Erosion** | Very slight | Very slight | Very slight | Slight | Slight | Slight |
| **Land use** | Groundnut crop | Groundnut crop | Groundnut crop | Groundnut crop | Groundnut crop | Groundnut crop |

*Name of the village

**Table.3** Semiquantitative estimates of clay minerals (%)

| Pedon No. | Tentative soil series | Smectite | Kaolinite | Illite | Quartz |
|---|---|---|---|---|---|
| **1** | M.D. Puttur | 65.34 | 20.95 | 11.77 | 1.94 |
| **2** | Bonupalle | 57.73 | 22.64 | 17.57 | 2.06 |
| **3** | Kommanagradu | 17.36 | 40.46 | 39.37 | 2.81 |
| **4** | Durgiperi | 28.33 | 28.50 | 43.17 | - |
| **5** | Vedam | 54.66 | 11.84 | 31.90 | 1.60 |
| **6** | Kanamanambedu | 24.02 | 46.12 | 28.25 | 1.61 |

'-': refers to nil

**Table.4** d-spacing (nm) of X-Ray diffract ograms in clay fraction (less than 2 micron fraction)

| Pedon No. | Calcium saturated | | K- saturated | | | | Clay mineral |
|---|---|---|---|---|---|---|---|
| | Ethylene glycol | Room temperature | Room temperature | 110°C | 300°C | 550°C | |
| 1. | 1.674 | 1.400 | 1.113 | 1.002 | 1.000 | 0.991 | Smectite |
| | | | | | | | |
| | 1.000 | 1.000 | 0.985 | 0.995 | 0.998 | 0.991 | Illite (Mica) |
| | 0.490* | 0.491* | 0.491* | 0.494* | 0.490* | 0.490* | |
| | 0.335* | 0.331* | 0.332* | 0.332* | 0.331* | 0.331* | |
| | | | | | | | |
| | 0.713 | 0.711 | 0.712 | 0.711 | 0.710 | - | Kaolinite |
| | 0.355* | 0.356* | 0.354* | 0.355* | 0.354* | - | |
| | | | | | | | |
| | 0.416 | - | - | - | - | - | Quartz |
| | | | | | | | |
| 2 | 1.710 | 1.520 | 1.145 | 1.004 | 1.002 | 0.989 | Smectite |
| | | | | | | | |
| | 0.993 | 1.000 | 0.991 | 1.002 | 1.004 | 0.986 | Illite (Mica) |
| | 0.492* | 0.495* | 0.493* | 0.499* | 0.493* | 0.490* | |
| | 0.330* | 0.333* | 0.331* | 0.332* | 0.331* | 0.332* | |
| | | | | | | | |
| | 0.710 | 0.716 | 0.714 | 0.712 | 0.713 | - | Kaolinite |
| | 0.355 | 0.354 | 0.356 | 0.357 | 0.354 | - | |
| | | | | | | | |
| | 0.421 | - | - | - | - | - | Quartz |
| | | | | | | | |
| 3. | 1.710 | 1.480 | 1.227 | 1.004 | 1.001 | 0.992 | Smectite |
| | | | | | | | |
| | 1.013 | 1.000 | 0.998 | 1.000 | 0.995 | 0.980 | Illite (Mica) |
| | 0.500* | 0.501* | 0.501* | 0.501* | 0.501* | 0.494* | |
| | 0.334* | 0.331* | 0.334* | 0.331* | 0.331* | 0.329* | |
| | | | | | | | |
| | 0.717 | 0.717 | 0.711 | 0.705 | 0.702 | - | Kaolinite |
| | 0.359* | 0.357* | 0.356* | 0.355* | 0.355* | - | |
| | | | | | | | |
| | | | | | | | |
| 4. | 1.710 | 1.484 | 0.999 | 0.995 | 0.990 | 0.980 | Smectite |
| | | | | | | | |
| | 1.003 | 1.000 | 0.985 | 0.9854 | 0.984 | 0.981 | Illite (Mica) |
| | 0.500* | 0.490* | 0.491* | 0.490* | 0.491* | 0.490* | |
| | 0.335* | 0.331* | 0.331* | 0.331* | 0.330* | 0.330* | |
| | | | | | | | |
| | 0.713 | 0.711 | 0.713 | 0.710 | 0.710 | - | Kaolinite |
| | 0.355* | 0.355* | 0.355* | 0.355* | 0.354* | - | |
| | | | | | | | |
| | | | | | | | |

* Higher order peaks

Cont…

| Pedon No. | Calcium saturated | | K- saturated | | | | Clay mineral |
|---|---|---|---|---|---|---|---|
| | Ethylene glycol | Room temperature | Room temperature | 110°C | 300°C | 550°C | |
| | | | | | | | |
| 5. | 1.700 | 1.500 | 1.112 | 1.002 | 0.999 | 0.956 | Smectite |
| | | | | | | | |
| | 1.013 | 1.000 | 0.998 | 0.994 | 0.991 | 0.956 | Illite (Mica) |
| | 0.501* | 0.500* | 0.502* | 0.495* | 0.492* | 0.490* | |
| | 0.335* | 0.335* | 0.336* | 0.334* | 0.335* | 0.323* | |
| | | | | | | | |
| | 0.724 | 0.722 | 0.701 | 0.700 | 0.700 | - | Kaolinite |
| | 0.355* | 0.335* | 0.355* | 0.355* | 0.354* | - | |
| | | | | | | | |
| | 0.415 | - | - | - | - | - | Quartz |
| | | | | | | | |
| 6. | 1.647 | 1.434 | 1.279 | 1.006 | 1.001 | 0.988 | Smectite |
| | | | | | | | |
| | 1.000 | 0.100 | 0.993 | 1.001 | 1.006 | 0.988 | Illite (Mica) |
| | 0.496* | 0.500* | 0.491* | 0.497* | 0.497* | 0.494* | |
| | 0.331* | 0.332* | 0.331* | 0.333* | 0.333* | 0.332* | |
| | | | | | | | |
| | 0.718 | 0.715 | 0.714 | 0.712 | 0.715 | - | Kaolinite |
| | 0.356* | 0.355* | 0.355* | 0.354* | 0.354* | - | |
| | | | | | | | |
| | 0.414 | - | - | - | - | - | Quartz |

* Higher order peaks

Kaolinite was recognized by a large intense peak at 0.718 nm in all the treatments, but it disappeared in K-saturated sample heated to 550°C in pedon 6. Presence of large peaks at 1.003 nm, 0.504 nm and 0.332 nm d-spacing in all the treatments suggests the presence of illite. An intense large peak at 1.434 nm in Ca-saturated sample which expanded to 1.647 nm on ethylene glycolation confirmed the presence of smectite. A characteristic peak at 0.414 nm d-spacing confirmed the presence of quartz (Fig.6).

## *Genesis of clay minerals*

The clay fraction of soils in the present study was found to be a mixture of four clay minerals *viz.*, smectite, kaolinite, illite and quartz. Smectite was the single most dominant mineral in pedons 1, 2 and 5 whereas kaolinite was the dominant mineral in pedon 3 and 6. In pedon 4 dominance of illite was observed. It is quite unlikely that such a high amount of smectite in these soils could be produced during the low rainfall period of the present semi-arid conditions (Bhattacharyya *et al.*, 1993). Smectite was also formed possibly from plagioclase during earlier geologic period and was an ephemeral in humid environment (Tardy *et al.*, 1973 and Bhattacharyya *et al.*, 1993), however its retention was possible because of climate change from humid to semi-arid during pleistocene transition period (Pal *et al.*, 1989).

Kaolinite was the dominant mineral in pedon 3 and 6. Kaolinite present in this pedon might had been formed from smectite (Bhattacharyya *et al.,* 1993). Kaolinite minerals could be formed by neosynthesis from the products of hydrolytic decomposition of feldspars and other primary minerals (Murali *et al.,* 1978 and Rengasamy *et al.,* 1978) and by conversion of smectite or vermiculite to kaolinite following hydroxy interlayering in the expandable mineral or mixed layering between 2:1 and 1:1 layers (Pal *et al.,* 1989 and Bhattacharyya *et al.,* 1993, 2000). Further, the kaolinite was formed in an earlier geological period with more rainfall and greater fluctuations in temperature (Pal and Deshpande, 1987). The study area had also experienced the above conditions, which lead to synthesis of kaolinite mineral in pedons 3 and 6.

Illite was present in small quantities in all the pedons and dominate in pedon 4. Illite present in the clay might have been derived by alteration of micas from the parent material. Potassium bearing minerals of rocks under the prevailing conditions of the soil formation had led to formation of illitic type of minerals (Satyanarayana and Biswas, 1970). Quartz was present in small quantities in these soils.

Clay mineralogy investigation by X-ray diffraction technique indicated that smectite was the dominant clay mineral in almost all the pedons except pedons 1, 2 and 5. Kaolinite was dominant mineral in pedons 3 and 5 and illite is dominate in pedon 4. The relative similarities in the mineralogy of these granite-gneiss derived soils irrespective of the degree of pedogenesis suggested that all the clay minerals were inherited from the parent material with very little *in- situ* transformation under prevailing conditions. The information regarding the relative proportion of various minerals is vital for effective management of soils.

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## References

Bhattacharyya, T., Pal, D.K and Deshpande, S.B. 1993. Genesis and transformation of minerals in the formation of red (Alfisols) and black (Inceptisols and Vertisols) soils in deccan basalt in the western ghats, India. *Journal of Soil Science* 44:159-171.

Bhattacharyya, T., Pal, D.K and Srivastava, P. 2000. Formation of gibbsite in the presence of 2:1 minerals: An example from Ultisols of northern India. *Clay Minerals*. 35: 847-850.

Davies, D.B., Eagle, D. and Finney, J.B. 1972. Soil Management, Ipswich: Farming Press Limited.

Gjems, O. 1967. Studies on clay minerals and clay minerals formation in soil profiles in Scandinavia. *Meddelelser fra De Norsek Skogforsoksveen*, 21: 303.

Jackson, M.L. (1976) Soil Chemical Analysis- Advance Course. Madison, USA. Department of Soil Science, University of Wisconsin.

Krull E, Baldock J, Skjemstad J. 2001. Soil texture effects on decomposition and soil carbon storage. In: Kirschbaum MUF, Mueller R (eds), *Net ecosystem exchange*. Canberra: Cooperative Research Centre for Greenhouse Accounting. pp 103–110.

Manoj Kumar, Ghosh, S.K. and Manjaiah, K.M. (2002) Components of naturally occurring organo-mineral complexes in some Inceptisols of India. *Clay Research* 21, 59-74.

Murali, V., Krishna Murti, G.S.R and Sharma, V.A.K. 1978. Clay minerals distribution in two toposequences of tropical soils of India. *Geoderma*. 20:257-269.

Newman, A.C.D. 1984. The significance of clays in agricultural soils. Philosophical Transactions of Royal Society of London. A 311: 375-389.

Pal, D.K and Deshpande, S.B. 1987. Genesis of clay minerals in red and black soil complex of southern India. *Clay Research*. 6: 6-13.

Pal, D.K, Deshpande, S.B., Venugopal, K.R and Kalbande, A.R. 1989. Formation of di-and tri-octahedral smectites as evidence for paleo-climatic changes in southern and central Peninsular India. *Geoderma*. 45: 75-184.

Raina, A.K., Sharma, S.D and Jha, M.N. 2006. Sand and clay mineralogy of salt-affected soils of Uttar Pradesh. *Journal of the Indian Society of Soil Science.* 54: 65–74.

Rengasamy, P., Sharma, V.A.K., Murthy, R.S and Krishnamurthy, G.S.R. 1978. Mineralogy, genesis and classification of ferrugenous soils of eastern Mysore plateau. *Journal of Soil Science.* 29: 431-445.

Satyanarayana, T and Biswas, T.D. 1970. Chemical and mineralogical studies of associated black and red soils. *The Mysore Journal of Agricultural Science.* 3: 253-264.

Sumner M. 2000. *Handbook of soil science*. Boca Raton: CRC Press.

Tardy, Y., Boqcquie, R G., Paquet, H and Millot, G. 1973. Formation of clay from granite and its distribution in relation to climate and topography. *Geoderma*. 10: 271-284.

Zinn YL. 2005. Textural, mineralogical and structural controls on soil organic carbon retention in the Brazilian cerrados. PhD thesis, Ohio State University, USA.

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