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Sand Mineralogy of Some Tamil Nadu Soils

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ABSTRACT

A study of the sand mineralogy of some typical soils representing black, red alluvial and laterite series of Tamil Nadu has been takenup to understand the nature of parent material, degree of weathering and also the fertility status. The minerals were identified and counted using standard properties. The mineralogical make up of the soil samples studied revealed the inherent characters of these soils and also found to agree with the geological formations from which these soils have been formed.

INTRODUCTION

Study of the sand mineralogical make up of the soils is an important step in the soil research to understand the nature and uniformity of the parent material, degree of weathering and the nature and stage of profile development. Further from the mineralogical data, the soil fertility can be better evaluated. As reported by Baren Van and kiel (1956) and Baren Van (1972) relationships existing between the soil fertility and sand mineralogy can be better utilised in the investigation of soil fertility evaluation. Many of the pedogenic processes, past and present, can be easily brought out from the informations available from mineralogical investigations. Further the study will aid in the better soil classification. Hence with a view to provide some basic informations on the mineralogical make up of some Tamil Nadu soils, the work has been taken up and data obtained are discussed below.

MATERIALS AND METHODS

Forty soil samples (0-20 cm) representing the typical black, red, alluvial and laterite soils of Tamil Nadu were used. The details of the samples are furnished in Table 1 (Soil types andl ocations).

TABLE 1.

Black	Red	Alluvial	Laterite
Bhavani	Annur	Ambasamudram	Tambaram
Peelamedu	Sinniyampalayam	Adanur	Red Hills
Dharmapuri	Gudiyathum	Thamarakulam	Nanjanad
Rasipuram	Thirunagar	Srivaigundam	Kothagiri
Kallakurichi	Tenkasi	Sirugamani	Tekkadi
Mandapam	Musiri	Aduthurai	Pattukottai
Thirumangalam	Namakkal	Kilpakkam	Sakkimangalam
Koilpatti	Omalur	Melalathur	Kodaikanal
Sivakasi	Melur	Villianur	Sivagangai
Ramanathapuram	Kalappanaickenpatti	Thevur	Gudalur

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The single grains in the coarse and fine fractions were separated and studied as per the procedure outlined by Brewer (1964) and Cady (1965). The coarse and fine sand fractions were separated by dispersing the air dry soil with ammonia (5 N). The clay and silt were removed using the sedimentation principle as adopted in the mechanical analysis of soils. Clay and silt free sand fractions were subjected to sieving to separate coarse and fine sand fractions which were taken for mineralogical analysis. The fine sand fractions were examined under petrological microscope after preparing permanent slides with canada balsam ($\mu = 1.53$). A drop of canada balsam was taken on a slide and cooked over a hot plate at mild temperature. When the canada balsam became transparent (colourless) and non-stiky, a small quantity of fine sand fraction was sprinkled over the cooked canada balsam over which a cover glass was placed and pressed in such a way that the grains were uniformly distributed without air bubles. The excess canada balsam outside the cover glass was removed using xylol. The slide was then examined under a petrological microscope under polarised as well as non-polarised light under parallel and also crossed nicols. The minerals were identified on the basis of colour, size, shape, degree of rounding, relief, pleochroism, isotropism and anisotropism, angle of extinction and other similar properties. First the different minerals were identified and then quantitatively estimated by counting the mineral grains using a mechanical stage (approximately 300-400 grains were counted in each slide and approximate percentage was calculated).

RESULTS AND DISCUSSION

The result of the qualitative and quantitative mineralogical analysis of fine and coarse sand fractions are presented in Table 2 and 3 below.

In general quartz was the dominent mineral in all the soils. Opaque iron minerals, illmenite, zircon, garnet, chlorite and tourmalin were found to occur in traces to moderate amounts. Other minerals like muscovite, biotite, pyroxene, glauconite, sphene etc., occured in traces. The coarse fractions from all the soil samples registered a variety of minerals and also contained some minerals which were not present

TABLE 2. Minerals identified in coarse sand fractions.

I	Black soils:	Quartz, haematite, chlorite, zircon, magnetite, illmenite, olivine, biotite, limestone, feldspar.
II	Red soils:	Quartz, opaque iron minerals, tourmalin, biotite, garnet, limestone, feldspar.
III	Alluvial soils:	Quartz, haematite, mica, illmenite, sphene, opaque iron minerals, feldspar.
IV	Laterite soils:	Quartz, limonite, magnetite, kaolin, mica, zircon, ferrugenous nodules, garnet, pyroxene, illmenite.

TABLE 3. Minerals identified in fine sand fractions

Soil – Location	Quartz	Illmenite	Tour-malin	Garnet	Opaque minerals	Feldspar	Mica	Chlorite	Zircon	Sphene	Leu-coxene	Others
Alluvial:												
Adanur	A	—	Tr	—	Tr	—	Tr	—	—	—	Tr	E
Thevur	A	—	Tr	Tr	—	Tr	Tr	—	—	—	—	E
Aduthurai	A	—	Tr	Tr	—	—	Tr	Tr	—	Tr	—	D
Kilpakkam	A	—	Tr	—	—	E	Tr	—	—	—	—	E
Melalathur	A	—	Tr	—	—	E	Tr	—	—	Tr	—	E
Thamarakulam	B	—	Tr	—	—	—	Tr	—	—	—	Tr	D
Villianur	B	—	E	Tr	E	—	Tr	—	Tr	—	—	D
Ambasamudram	A	—	Tr	Tr	E	Tr	Tr	—	—	—	Tr	E
Srivaigundam	A	—	—	—	—	—	Tr	—	Tr	—	—	E
Sirugamani	A	—	—	—	Tr	—	Tr	Tr	—	—	—	E
Laterite:												
Tambaram	B	Tr	—	Tr	E-D	—	—	—	Tr	—	—	E
Red Hills	C	D	—	E	E	—	—	—	E	—	—	D
Nanjanad	B	Tr	—	Tr	E-D	—	—	—	Tr	—	—	D
Kotagiri	B	Tr	—	Tr	D	—	—	—	Tr	—	—	D
Thekkadi	B	Tr	—	Tr	D	—	—	—	Tr	—	—	—
Sakkimangalam	C	D	—	E	C	—	—	—	Tr	—	—	Tr
Pattukkottai	B	Tr	—	Tr	E-A	—	—	—	E	—	—	Tr
Kodaikanal	B	E	—	Tr	E-D	Tr	—	Tr	Tr	—	—	—
Gudalur	C	E	—	E	E-D	—	—	—	Tr	—	—	Tr

Soil – Location	Quartz	Illmenite	Tour-malin	Garnet	Opaque minerals	Feldspar	Mica	Chlorite	Zircon	Sphene	Leu-coxene	Others

Kodaikanal	B	E	—	Tr	E-D	Tr	—	Tr	Tr	—	—	—
Gudalur	C	E	—	E	E-D	—	—	—	Tr	—	—	Tr

Soil – Location	Quartz	Illmenite	Tour-malin	Garnet	Opaque minerals	Feldspar	Mica	Chlorite	Zircon	Sphene	Leu-coxene	Others
Black:												
Bhavani	A	E	E	Tr	Tr	Tr	—	—	Tr	—	—	Tr
Peelamedu	A	E	E	Tr	—	Tr	—	—	Tr	—	—	E
Dharmapuri	A	Tr	E	Tr	—	Tr	—	—	Tr	—	—	E
Rasipuram	A	Tr	—	Tr	—	Tr	Tr	—	Tr	—	—	Tr
Kallakurchi	A	E	—	Tr	Tr	Tr	—	—	—	—	—	E
Mandapam	A	Tr	—	E	Tr	Tr	—	—	—	—	—	Tr
Thirumangalam	A	Tr	—	Tr	—	E	—	—	—	—	—	E
Koilpatti	A	E	—	E	—	E	—	—	Tr	—	—	E
Sivakasi	A	E	E	Tr	—	E	Tr	—	—	—	—	E
Ramanathapuram	A	Tr	—	Tr	—	Tr	—	—	—	—	—	E
Red:												
Annur	A	—	E	Tr	—	—	—	—	Tr	—	—	E
Sinniyampalayam	B	—	E	Tr	—	—	—	—	Tr	Tr	—	E
Guidyatham	B	—	E	—	—	—	—	—	Tr	—	—	E
Thirunagar	A	—	Tr	—	Tr	—	Tr	—	Tr	Tr	—	E
Tenkasi	A	Tr	Tr	—	D	—	—	Tr	Tr	—	—	E
Musiri	B	—	Tr	Tr	—	E	Tr	—	—	—	—	D
Namakkal	B	—	—	—	—	D	—	—	—	Tr	—	D
Omalur	A	—	—	—	—	Tr	Tr	Tr	Tr	—	—	E
Melur	B	Tr	—	E	E	—	—	—	Tr	—	—	E
Kalappanaickenpatti	A	—	—	—	—	E	—	Tr	Tr	—	—	E

A — 75%
B — 50–75%
C — 25-50%
D — 5-25%
E — 5%
Tr — Traces

Black soil – others include – Pyroxene, Hornblende Calcite etc.
Red soil – others include – Pyroxene, Hornblende, Glauconite, etc.
Alluvial – others include Pyroxene, Glauconite, Hornblende.
Laterite – others include Hornblende, Pyroxene.

in the fine sand fractions. This is of course, in conformity with the theory that where the coarse fractions undergo the process of physical and chemical weathering, easily weatherable minerals present in the coarse sand will tend to disappear in the finer fractions in the course of time. Thus the fine sand fractions have registered fewer minerals when compared to coarse fractions of the same soil.

Black soils, in addition to quartz, opaque minerals, felspars, zircon etc., contained appreciable quantities of calcite (lime stone) indicating their calcareous nature and some of the red soils also registered this trend. The laterite soils contained appreciable amounts of opaque iron minerals which clearly indicated the ferrugenous nature of the soils studied and the stage of laterisation. Some of the red soils also contained good amounts of opaque iron minerals. The alluvial soils, in contrast, registered a wide variation in the mineral distribution and also contained good amounts of mica which clearly showed alluvial action in those soils.

In the present investigation, the mineral distribution in each soil type has been observed to agree with the primary geological formation from which each one of these was formed. Presence of calcite in black and some red soils, ferrugenous gravels and opaque iron minerals in laterite and a few red soils corroborate the above. Further from the amount of zircon, quartz and also tourmalin estimated in the various soils it could be concluded that maximum weathering has taken place in laterite followed by red, alluvial and black soils.

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