MORPHOLOGICAL AND MICRO MORPHOLOGICAL STUDIES OF COASTAL SOIL SAMPLES OF WEST COAST OF KANYAKUMARI DISTRICT

S.S.SAJITHA[1], P.METILDA[2], S.MUTHUMARIAPPAN[3], G.ALDOUS JENIN[4].
1. Department of Chemistry, Annai Velankanni College, Tholayavattam.
2. Department of Chemistry, Nesamony Memorial Christian College, Marthandam.
3. Department of Chemistry, V.O.Chidamabram College, Tuticorin.
4. Department of Bio Chemistry, Lekshmipuram College of Arts and Science, Neyyoor.

Abstract:

Coastal soil samples contain the most economically important mineral accumulations. Coastal soil structure is defined as the shape, size and spatial arrangement of individual soil particles, cluster of particles and combination of different types of pores with solid particles. Morphology, micro morphology and elemental mapping analysis were carried out to determine the ultra structure and composition of elements present in coastal soil samples by Scanning Electron Microscope (SEM), Atomic Force Microscope (AFM), EDAX with elemental mapping and Light Microscopic techniques. SEM analysis showed the coastal soil samples have different morphological structures like spherical (Al-Si-O), tubular (Si-O), triangular (Fe-Al-Si-O), platy (Ca-Si-O), nearly spherical (Fe-Ti-O) and irregular (Ca-Al-Si-O) shapes. Elemental analysis (EDAX) confirmed the presence of silicon in large quantities than the other oxides such as Al, Ca, Fe and Ti. Elemental mapping showed the enriched elements clearly. AFM studies confirmed the ultra structure of soil samples. Light Microscopic studies confirmed the micro morphological studies of soil samples of west coast of Kanyakumari District.

Keywords: Scanning Electron Microscope (SEM), Light Microscope (LM) and Atomic Force Microscope (AFM).

1. Introduction:

Soils are complex of minerals, organic materials, living organism, water and gases. The size, shape and chemical composition of soil minerals are highly variables (Takahashi et al., 2001). The Morphology of a beach is mainly controlled by wave, climate, tide and sediment characteristics. An equilibrium beach results from a balance of distractive and constructive force acting on the beach (Bagnold, 1940). Soil structure is defined as the shape, size and spatial arrangement of individual soil particles and cluster of particles and combination of different types of pores with solid particles. The genesis of soil structure depends on the presence of cementing substances (Sequi, 1978). The importance of microbial activity in the formation of soil aggregates during wetting and drying cycle is related to soil porosity (Utomo and Dexter (1982). The complex interrelationship of physical, biological and chemical reactions involved in the formation of soil aggregates is very wide (Harris et al.,1966). The main evidence for the role of cations bridges has been based on the increased disaggregation of soil after treatment with

complexing agents or after treatment with acids (Hamblin and Greenland, 1977). The morphological studies of coastal soil samples can be identified by scanning electron microscopy (Reetu Sharma et al., 2016). Scanning electron microscopy with energy-dispersed X-ray analysis (SEM/EDAX) provides useful information on the morphology and elemental composition of coastal soil samples (Tripti pachauri et al., 2013). To characterize the micro porosity (pores less than 50 µm) the thin sections must be covered by a layer of carbon, in order to allow conductivity to the electron beam, and analyzed by a scanning electron microscope (SEM) with a module for backscattered electron scanning images (BESI) (Pagliai et al., 1980, Pagliai et al., 1983a). The thin sections can be examined by the SEM at several magnifications (Pagliai,1988). The two-dimensional nature of AFM technique is largely describing the shape and aggregate structure (Gard 1971; Smart and Tovey 1981; Grabowska-Olsezewska et al., 1984). The availability of AFM has now proved a second imaging technique for studies of surface morphology with atomic resolution on ideal surfaces (Hochella 1995; Smart 1998).

2. Materials and Methods

2.1 Study Area

The study area chosen for the present work is west coast of Kanyakumari District which is covering a distance of **75**km from Vattakottai to Vallavilai of Kanyakumari coast.

Sample site no	Location	Sample site no	Location
S1	Vattakottai	S6	Kottilpaadu
S2	Chotthavilai	S7	Kurumpanai
S3	Rajakkamangalam	S8	Pattanam
S4	Muttam	S9	Thoothoor
S5	Manavalakurichi	S10	Vallavilai

Table 1. Sample site number and location

2.2. Soil Samples Collection and Preparation:

Coastal soil samples were collected using Peterson grab at all the designated locations during low tide. The samples collected from ten different sites near sea shore regions. The distance between each site falls around 5kms (Table.1).The collected soil samples were initially sundried for seven days followed by drying in hot air oven at 383 +- 1K for two days. The dried soil was crushed, sieved and stored in sterile closed glass bottles till further investigation.

2.3. SEM, EDAX with Elemental mapping, Light Microscopy (LM) and AFM analysis:

Samples were prepared by dispersing dry powder on the double sided conductive adhesive tape. Samples were coated with carbon by arc discharge method for SEM-EDAX with Elemental Mapping. Then samples were scanned in secondary electrons for morphology and back scattered

electrons mode for compositional (Galan Marin et al., 2012). Microstructures and Micro morphological studies were performed by Scanning Electron Microscope (SEM) with JEOL JSM 6390 model and Light Microscope (LM) Leica Stereo fluorescent microscope, Model M165FC (Made in Germany) with the HD camera model DFC310FX. Ultra structure of coastal soil samples were performed by multimode AFM with Nanosurf Easy Scan 2 controller (Switzerland) in tapping mode.

3. Results and discussion:

3.1. SEM analysis:

The scanning electron microscopy (SEM) pictures of coastal soil sample were taken at 20 Kv with different magnifications shown in Fig 1. It depicts the tubular, spherical, platy shape, triangular, rectangular, nearly triangular and sun flower like appearance of the soil samples. SEM investigations represent stack of cards shape shows good kaolinite and Quartz structure. The crumb structure represents the aggregates are small porous weakly held together. The triangular and rectangular shapes represented crystals structure with enrich of quartz / silica. SEM observations have been used successfully in the studies of the soil crust formed by raindrop impact and of the effect of soil crusts on infiltration rates. (Chen et al., 1980; Tarchitzky et al., 1984). The importance of SEM as a tool in understanding soil micro morphology and soil-water relationships was point out by Bisdom (1981).

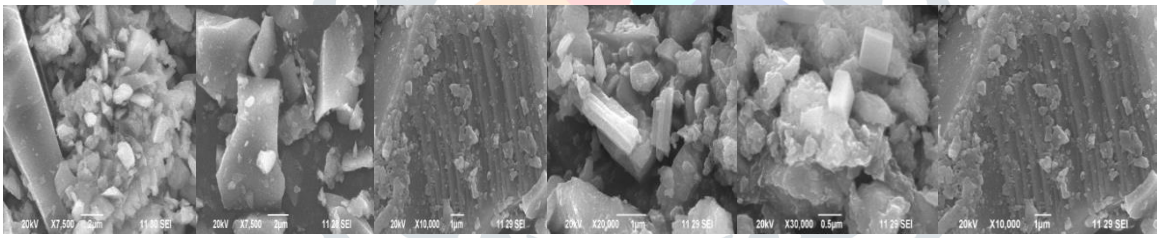


Figure 1. SEM images of coastal soil samples

3.2. Energy Dispersive Spectral Analysis (EDAX):

The weight percentage of each element present in the spectrum was identified. The EDAX peaks of elements in the soil samples are shown in Figure 2. The dominant elements present in coastal regions are O, Si, Ca, Fe, Al, Cl, Na, Mg, K and Ti.

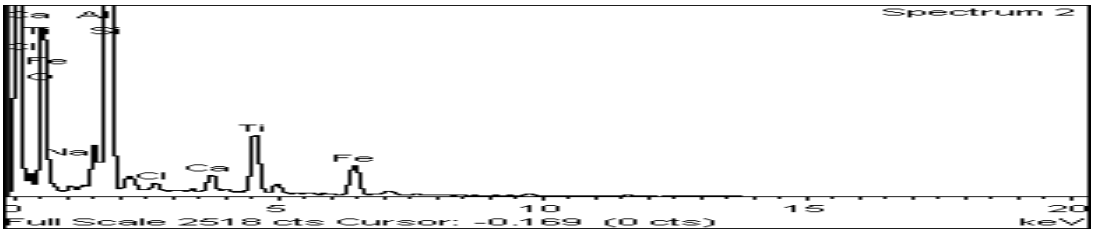


Figure 2. EDAX spectrum of coastal soil samples

Geogenic particles	Sub groups	Possible phase	Morphology of particle
Quartz/silica	Si-O	Sandy	Tubular shape
Quartz/silica	Al-Si-O	Fly ash	Spherical shape
Quartz/silica	Ca-Al-Si-O	Grossular	Irregular shape
Quartz/silica	Fe-Al-Si-O	Alamandine	Triangular
Alumino silicates	Ca-Al-Si-O	Ca-Feldspar	Irregular shape
Calcium rich particles	Ca-Si-O	Wollastonite	Platy shape
Fe/Ti Oxide	Fe-Ti-O	Iron-Titanium oxide	Nearly spherical
Chloride particles	Ca-Cl	Calcium chloride	Triangular
Chloride particles	K-Cl	Potassium chloride	Irregular shape

Table 2. SEM/EDAX confirmation of coastal soil samples

The SEM-EDAX results confirmed the geogenic particles, sub groups, possible phase and morphology of coastal soil samples of Kanyakumari district are shown in Table 2.

3.3. Elemental Mapping of coastal soil samples of Kanyakumari district:

The elemental mapping confirmed the enriched elements of west coast of Kanyakumari district is Silicon, Oxygen, Calcium, Aluminum, Iron, Potassium, Sodium and chlorine are shown in the Figure 3 and 4.

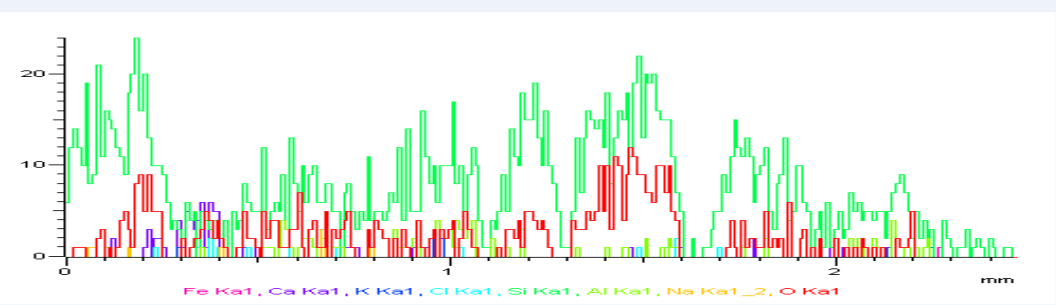
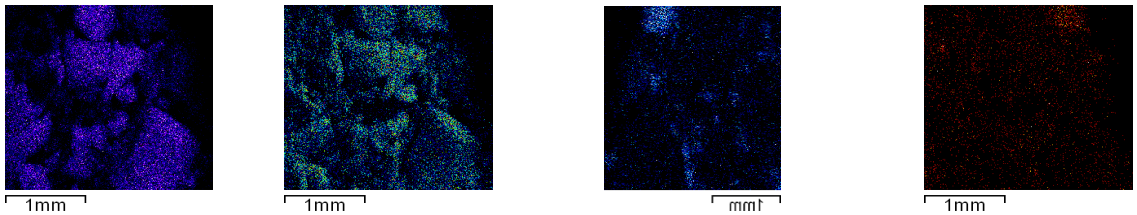


Figure 3. Over all Elemental mapping of coastal soil samples



Silicon **Oxygen** **Aluminum** **Sodium**

Figure 4. Elements mapping images (Si,O,Al,Na) in coastal soil samples

3.4. Light Microscopic Studies of Coastal soil Samples of Kanyakumari district:

In Light Microscopy (LM) study reveals that the different micro morphological structure of coastal soil samples of Kanyakumari district. It is clearly shown the Figure 5. Crystal piece of ice microstructure clearly indicates the coastal soil samples of Kanyakumari district enriched silicate minerals like quartz. In Figure 5 represents the yellow colour glassy appearance confirmed the presence of carbonate mineral like aragonite. Light green small dusty particles show the presence of aventurine, black with yellow structure confirms azurite mineral. Rounded microstructure

Figure 5. Light microscopy images of coastal soil samples

shows the enrichment of cuprites. An orange colour glassy image confirms the calcite mineral. Fully black rounded spots microstructure shows the soil samples contain hematite mineral.

3.5. AFM Studies of Coastal soil Samples of Kanyakumari district:

Considering the scanning probe microcopies, AFM (Atomic Force Microscopy) represents an extra ordinary tool for the detailed characterization of submicron-size structure as the surface functionalization at the atomic scale.

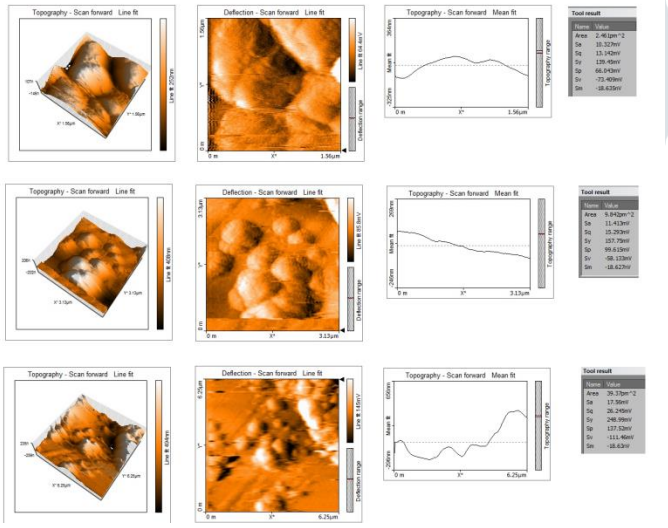


Figure 6. AFM images of coastal soil samples of Kanyakumari district

In Figure 6 shows more detailed nano morphology and surface structure of coastal soil samples of Kanyakumari district. AFM images of the well crystallized and massive cascade growth structures show well developed euhedral, hexagonal crystallites (300-900 nm lateral dimensions) again with relatively smooth surfaces and well defined edges.

4. Conclusion:

Beaches are one of the important land forms and the most important feature of coastal morphology. Our survival is threatened the non-biodegradable wastes were accumulated in the coastal region. The morphology of a beach is mainly controlled by wave, climate, tide and sediment characteristics. The SEM, LM and AFM evidence the ultra structure, morphology and micro morphology of coastal soil samples of west coast of Kanyakumari district. The EDAX spectrum and elemental mapping confirm the enriched elements are Silicon, Oxygen, Calcium, Aluminum, Iron, Potassium, Sodium and Chlorine. SEM-EDAX and also elemental mapping confirms the possible phase, morphology of particles and elemental composition of each samples. In west coast of Kanyakumari district the accumulation of elements, ultra structure, morphology and micro morphology differ in each region due to tidal variations. Accumulation of non-biodegradable wastes also affects tides. Tides, one of the most important phenomena in the world, affect the morphology and ultra structure of coastal soils. The enhanced human awareness will protect the coastal regions of west coast of Kanyakumari District.

5. REFERENCES:

1. Bagnold, R.A. (1940). Beach formation by Waves: Some Model Experiments in Wave Tank. *Journal of Inst. CivilEngineering*. 15: 27-52.

2. Bisdom, E.B. A. (1981) A review of the application of submicroscopic techniques in soil micro morphology, I.TEM and SEM, in E.B.A.Bisdom (ed.), Submicroscopy of Soils and Weathered Rocks, Center for Agricultural Publishing and Documentation, Wageningen, pp. 67-116.

3.Chen, Y., Tarchitzky, J., Brouwer, J., Marin, J., and Banin, A. (1980) Scanning electron microscope observations on soil crusts and their formation, Soil Sci. 130, 49-55.

4. Galan-Marin, Rivera- Gomez, Bradley F.(2012) ECCMIS-15th Europian conference on composite materials, venice Italy, 24-28 .

5. Gard JA. (1971). The electron-optical investigation of clays. Mineral Soc Monographs 3. London: Miner Soc. 157 p.

6. Grabowska-Olszewska B, Osipov V, Sokolov V.(1984). Atlas of the microstructure of clay soils: Warszawa:PWN (pub). 414 p.

7. Hamblin, A.P. and Greenland, D.G. (1977). Effect of organic constituents and complex metalions on aggregate stability of some East Anglian soils. *Journal of Soil Science*, 28: 410-416.

8. Harris, R.F., Chester, G. and Allen, O.N. (1966). Dinamic of soil aggregation. Advances in Agronomy, 18: 107.

9. Hochella MF Jr. (1995). Mineral surfaces: Their characterization and their chemical, physical and reactive nature. In: Vaughan DJ, Pattrick RAD, editors. Mineral surfaces. Mineral Soc Series 5. London: Chapman and Hall. P 17-60.

10. Pagliai, M., Guidi, G. and La Marca, M. (1980). Macro and micromorphometric investigation on soil dextran interactions. Journal of Soil Science, 31: 493-504.

11. Pagliai, M. (1988). Soil porosity aspects. *International Agrophysics*, 4: 215-232.

12. Pagliai, M., Bisdom, E.B.A. and Ledin, S. (1983a). Changes in surface structure (crusting) afterapplication of sewage sludges and pig slurry to cultivated agricultural soils in northernItaly. Geoderma, 30: 35-53.

13. Reetu Sharma, Khageshwar Singh Patel, Lesia Lata, Huber Milson, (2016). *American journal of analytical chemistry* 7, 724-736.

14. Smart P, Tovey NK . (1981). Electron microscopy of soils and sediments: Examples. *American journal of analytical chemistry*. 7, 724-736Oxford: clarendon Pr. 177p.

15. Smart RStC. (1998). Minerals, ceramics and glasses. In: Riviere JC, Myhra S, editors. Problem-solving methods for surfaces and interfaces. London and NY: Marcel Dekker.

16. Sequi, P. (1978). Soil structure - An outlook. Agrochimica, 22: 403-425.

17.Takahashi, T., Dahlgren, R.A., Theng,B.K.G., Whitten, J.S. and Soma, M.(2001) Potassium-Selective, Halloysite-Rich Soils Formed in Volcanic Materials from North California. *Soil Science Society of America Journal*, 65,516.

18. Tarchitzky, J., Banin, A., Morin,J., and Chen, Y. (1984). Nature formation and effects of soil crusts formed by water drop impact, Geoderma 33, 135-155.

19. Tripti pachauri, Vyomo Single, Aparna Satssangi, Anita Lakhani, (2013).Aerosol and air Quality Research 13:523-536,

20. Utomo, W.M. and Dexter, A.R. (1982). Changes in soil aggregate water stability induced by wetting and drying cycles in non-saturated soil. *Journal of Soil Science*, 33: 623-637.

……