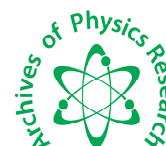




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FTIR characterisation of minerals in charnockite rocks of Kalrayan Hills, India

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ABSTRACT

Fourier transform infrared (FTIR) spectroscopic technique was used to characterise the minerals in the charnockite rock samples from Kalrayan Hills, South India. Sixty-five rock samples were collected at various locations in Kalrayan Hills. Sixteen minerals such as quartz, feldspar in different structures (orthoclase, microcline and albite), hematite, kaolinite, maghemite, magnetite, gibbsite, illite, calcite, aragonite, montmorillonite, palygorskite, biotite and organic carbon were identified and characterised. Among these quartz, microcline feldspar, orthoclase feldspar and hematite are considered as major minerals and others are minor minerals. The relative distribution of major minerals was determined by calculating extinction coefficient.

Keywords: FTIR, Kalrayan hills, minerals and extinction coefficient.

INTRODUCTION

Infrared spectroscopy has been extensively used in detailed investigations of molecular structure and as diagnostic tool since every species for which the molecular motion causes a change in dipole moment has a spectrum characteristic of its own structure. Although infrared techniques are most commonly developed for qualitative studies, careful examination of intensities leads to a most useful tool for quantitative analysis as well [1]. Using the infrared spectra, unique information about the group of minerals to which the specimen belongs, the degree of crystalline and non-crystalline impurities and reactions of minerals with chemicals in their environment can also be inferred. For mineral analysis IR in the range of 4000-400cm⁻¹ is of importance [2]. FTIR techniques are most powerful tool in rock and soil mineralogy. Also, it is used by mineralogist and sedimentary pathologists in the aspect of mineralogical applications.

In India, Hills areas are increasingly being used for mining, recreation, forestation, building and road traction materials and agriculture. The charnockite group rocks are extensively developed in the north - eastern sector of the Tamilnadu in India [3]. The main scope of the present study is to characterize the minerals present in rock samples from Kalrayan hills, south India and calculate the relative distribution of major minerals using FTIR technique.

MATERIALS AND METHODS

Study area

The Kalrayan is one of the major hill ranges of Eastern Ghats situated to the north east of Tamilnadu. It lies between 11° 20' to 12° 05' N latitude and 78° 28' to 79° 05' E longitude (Figure 1). It spreads over an area of 1095 Sq.km. and is endowed with rich natural resources. The vegetation types of Kalrayans are scrub jungles of altitude 400m, deciduous forests between 800 to 1300m and shoals at the sheltered pockets on the plateau.

Sample collection and preparation

Sixty five rock samples were collected from different locations of the study region. The sample location were recorded in terms of degree - minute – decimals (Latitudinal and Longitudinal position) using Hand-held Global Positioning System (GPS) (Model: GARMIN GPS-12) unit. Each location is separated by a distance of 5-6 km approximately and is numbered as S₁ to S₆₅. The procedure adopted by Ramasamy *et al.* (2012) [4] was followed for the collection.

Sample preparation

All the collected samples were subjected to various pretreatment in order to remove organic matter and certain other materials for improving the quality and for resolution of the spectra. The KBr pellet technique was used in the present investigation. All chemicals used were of spectroscopic grade.

Materials required for KBr pressed-pellet method are potassium bromide (KBr), acetone, die for making pellets, laboratory hydraulic press for creating pressure on the confined sample, small hand agate mortar and pestle and mechanical vacuum pump. Wet grinding was carried out by placing 30 to 50 mg of the sample in an agate mortar along with 20 to 25 drops of ethanol. The ground samples were dried in an hot air oven at 110°C to remove the moisture content. Using the KBr pellet technique, each grain sized sample was mixed with KBr at various ratios viz., 1:10, 1:20, 1:30, 1:40 and 1:50. The mixture was then pressed into a transparent disc in an evacuable dye at sufficiently high pressure. The samples in the ratio 1:30 (sample: KBr) was taken for further analysis, since it gives rise to maximum transmittance and observable peaks [5]. This ratio was checked for 2 to 3 times for its accuracy.

Instrument used and Procedure

Using the Perkin Elmer RX1 FTIR spectrometer, the infrared spectra for all rock samples were recorded in the region 4000-400 cm⁻¹ at room temperature. It scans the spectra 100 times in 1 minute. The resolution of the instrument is 0.001cm⁻¹ and the accuracy is ±4 cm⁻¹. At each and every time, this instrument was calibrated for its accuracy with the spectrum of a standard polystyrene film.

RESULTS AND DISCUSSION

The FTIR spectra for all the collected samples were recorded. The observed wave numbers are analyzed and the minerals are assigned using available literatures ([4-23]). The observed wave numbers from all the spectra are given in the table 1 along with their corresponding mineral names.

The minerals such as quartz, feldspar in different structure (orthoclase, microcline and albite), hematite, Kaolinite, maghemite, magnetite, gibbsite, illite, calcite, aragonite, montmorillonite, palygorskite, biotite and organic carbon are identified. The various bands in the region 3000 - 3800 cm⁻¹ are all due to OH stretching and in the region 1600 - 1700 cm⁻¹ are due to OH bending modes of water or hydroxyls. No additional features are observed in this region. The bands in the region 1420 - 1460 cm⁻¹ are due to the presence of carbonate minerals. The variations in the values of OH stretching and bending wave numbers from sample to sample are usually attributed to the varying strength of hydrogen bonding between OH and H₂O molecules and some oxygen in the structure. The present results with few exceptions are in fairly good agreement with the absorption maxima in the recorded survey of silicate, non-silicate and carbonate minerals by Stubican and Roy, (1961a&b) ([8-9]), Farmer and Russell, (1964) [10], Ramasamy *et al.*, (2010) [5] and Russell *et al.*, (1970) [11].

Quartz

The silicate minerals are of primary concern because of their relative abundance and importance. Quartz is a non-clay mineral, which is common and invariably present in all the samples. The Si-O bonds are the strongest bonds in the silicate structure and can be readily recognized in the infrared spectra of such minerals by very strong bands in

the region 900 to 1100 cm^{-1} (stretching) as well as less intense bands in the 400 to 800 cm^{-1} region (bending). The presence of quartz in the samples can be ascribed by the observation of the peaks in the ranges 460 - 462 and 510 - 514 cm^{-1} due to Si-O asymmetrical bending vibrations, 693 - 695 cm^{-1} due to Si-O symmetrical bending vibrations and 777 - 779 and 794 - 796 cm^{-1} due to Si-O symmetrical stretching vibrations, while the 1080-1084 and 1160-1164 cm^{-1} absorption region arises from Si-O symmetrical stretching vibrations due to low Al for Si substitution. These assignments are in good agreement with the observation on the quartz mineral obtained by Hlavay *et al.* (1978) [13]. With the view of Keller and Pickett (1949) [24], the observed absorption peaks in the ranges 1610-1614 and 1870-1875 cm^{-1} indicate the presence of quartz weathered from metamorphic origin.

Feldspar

Feldspar group of minerals are also frequent constituents in rocks. These are of several types having different compositions such as orthoclase, microcline and albite. These three feldspars such as orthoclase and microcline are having the same chemical formula (KAlSi_3O_8), they differ in structure (orthoclase – monoclinic, microcline – triclinic). The FTIR spectra are sensitive both to structural and compositional variations in the minerals. The peak pertaining in the range 585-588 cm^{-1} due to O-Si-(Al)-O bending vibration in all the samples indicates the presence of microcline feldspar. The peak in the range 636-638 cm^{-1} due to Al-O coordination vibration indicates the presence of orthoclase feldspar in all sites. According to Bahat (1970) [25], the observation of the peak in the range 537-540 cm^{-1} (S_4 , S_{39} , S_{41} and S_{48}) indicates the presence of albite ($\text{NaAlSi}_3\text{O}_8$; Na- feldspar) mineral [14].

Clay minerals

The presence of the band at around 3398-3400 cm^{-1} is due to the kaolinite clay mineral ([14] and [26]). The intensity of the bands varies from sample to sample indicates the quantity. The observations made in the present study show the broad absorption band at around 3398 is cm^{-1} due to OH-stretching vibration of water in the kaolinite structure. For montmorillonite, a peak in the range 875-878 cm^{-1} is observed in S_{33} , S_{46} , S_{53} and S_{55} samples. The three pure kaolinite polymorphs, kaolinite, dickite and nacrite can be readily distinguished by differences in position and relative intensity of their OH-stretching bands [14].

A striking feature of palygorskite is the complex nature of absorption band in stretching and bending region of water molecule. It displays pattern of bands originating in bound molecular water directly coordinated to Al or Mg ions at edges of the 2:1 ribbon layer in the range 1626-1630 cm^{-1} and unbound zeolite water molecules within the channels in the range 1676-1680 cm^{-1} [27]. In the present study, a peak in the range 1676-1680 cm^{-1} is observed in four sites such as S_{19} , S_{30} , S_{36} and S_{53} .

Carbonate minerals

The mid infrared region (1400-1500 cm^{-1}) of the spectra is dominated by the vibrational modes of carbonate ions. According to Adler and Kerr (1962) [28], calcite mineral predominates in an aggregate the peak appears in the range 1423 cm^{-1} . Broadening of the absorption peak in the 1423-1476 cm^{-1} region to include both the aragonite and calcite band positions appears also to be related to intergrowth of the two minerals. But calcite is the most common carbonate mineral in natural samples. From the existence of a diagnostic peak in 1425 cm^{-1} , it is easily recognized that the calcite is present in following samples S_8 , S_{13} , S_{26} , S_{30} , S_{31} , S_{35} , S_{37} , S_{54} and S_{55} . Similarly, the appearance of a peak in the range 1784-1789 cm^{-1} may be due to the presence of another carbonate mineral aragonite in five samples such as S_{34} , S_{42} , S_{46} , S_{54} and S_{55} .

Biotite

The peak present in following site numbers S_5 , S_6 , S_9 , S_{10} , S_{12} , S_{13} , S_{16} , S_{18} - S_{20} , S_{23} , S_{29} , S_{31} , S_{32} , S_{45} , S_{48} , S_{50} , S_{53} , S_{59} , S_{60} and S_{62} observed at 724 cm^{-1} compared with the literature indicates the presence of biotite ([14] and [6]). The characteristic absorption peak observed at 724 cm^{-1} agrees with the peak at 728 to 720 cm^{-1} observed by Ghosh *et al.* (1978) [29] for biotite.

At 500°C to 700°C the biotite lattice has to longer thermodynamically stable. In the symmetry of crystal, the tetrahedral is more stable than the octahedral layers to low thermal impact. Hence it is more probable to believe that the inter sheet and octahedral layers are frequently decomposed then the tetrahedral layers. However, when the temperature becomes higher, Si-O bonds in the tetrahedral layers will begin to break. The bending vibrations of Si-O – Si in the tetrahedral symmetry becomes insignificant and the Si-O bond force is unable to withstand the impact of thermal energy.

Magnetic Minerals

According to Fysh and Fredricks (1983) [30], hematite ($\alpha\text{-Fe}_2\text{O}_3$) is the most abundant forms of the iron containing species found in rocks and sediments. The ionic replacement of Fe has been widely reported ([31], [32] and [33]) and a variety of techniques have been employed to characterize such substituted minerals ([34] and [35]).

According to Russell (1987) [14], the appearance of the narrow shoulder near 754cm^{-1} in the samples of sites no. S₁₉, S₂₄, S₃₀, S₃₆, S₃₉, S₅₃ and S₅₅ show the presence of illite. The present of weak absorption bands at $570\text{-}575\text{cm}^{-1}$, exhibits the presence of magnetite in the spectra of the samples of sites no. S₅, S₆, S₁₂, S₁₆, S₁₈ - S₂₀, S₂₃, S₂₉, S₃₁, S₅₃, S₅₆, S₅₉ and S₆₀.

The formation of new stable phases may also be expected to be dependent on the mobility of the ions, forming the daughter minerals, the energy nucleation etc.,. So the nuclei produced by small octahedral ions like Fe^{2+} , Mg^{2+} , Al^{3+} and O^{2-} are formed much easier than the nuclei formed by the comparatively large SiO_4 tetrahedral. Therefore, the magnetic crystallises at lower temperature and at shorter periods of time than those for the crystallisation of silicates. During the ejection and downfall of the crater materials the temperature would be generally quenched so rapidly to 600°C to 700°C [36]. This temperature and rapid cooling will allow the magnetite to crystallise. At the same time, SiO_4 , tetrahedral will not attain a crystalline state preformed in an amorphous silicate phase.

Other minerals

According to Russell (1987) [14], the trihydrate aluminium mineral gibbsite is identified by the observation of the peaks in the range $667\text{-}670$ and $962\text{-}965\text{cm}^{-1}$. Appearing peaks at 2854 and 2924 cm^{-1} in all the samples show the presence of organic carbon [4].

Relative Distribution of Quartz, Microcline and Orthoclase Feldspar and Hematite

From the above analysis, it is observed that the minerals such as quartz, microcline feldspar, orthoclase feldspar and hematite are invariably present and are considered as major minerals. Therefore, in the present study, the author is interested to study the relative distribution of quartz, microcline and orthoclase feldspar and hematite. The relative distribution can be quantified by calculating the extinction co-efficient for the characteristic peaks of quartz, microcline and orthoclase feldspar and hematite at around 777 , 587 , 637 and 538 cm^{-1} respectively for all sites using the formula ([27] and [5]).

$$K=DA/m$$

Where K is the extinction co-efficient, A is the area of the pellet and m is the mass of the pellet. D is the optical density; it can be calculated using the relation

$$D = \log (I_0/I)$$

Where I_0 is the intensity of incident radiation and I is the intensity of transmitted radiation.

The extinction co-efficient values for quartz, microcline feldspar, orthoclase feldspar and hematite are calculated and the values are tabulated in table 2. From this, it is observed that these minerals are distributed randomly. The maximum extinction co-efficient values of quartz, microcline and orthoclase feldspar and hematite are 212.31, 130.77, 84.78, and 93.59 in the site no. S₃₇, S₁₂, S₃₉ and S₂₀ respectively. Similarly, the minimum extinction co-efficient value for quartz, microcline and orthoclase feldspar and hematite are 3.71, 11.89, 1.17 and 1.17 in the site no. S₂₆, S₃₃, S₅₄ and S₅₄ respectively. With these upper and lower limits of the above minerals, the other sites may be arranged in an order quantitatively. In overall view, the amount of hematite is lesser than feldspar and very much lesser than quartz in all the sites which are visually indicated in the figure 2.

Table 1: The observed absorption wave numbers and corresponding minerals from FTIR spectra of Charnockite rocks, Kalrayan hills, India

Sl.No.	Name of the minerals	Site number	Observed wave numbers (cm ⁻¹)
1	Quartz	S ₁ -S ₂₉ , S ₃₁ -S ₅₂ , S ₅₄ -S ₆₅	460-462
		S ₄ , S ₁₄ , S ₂₄ , S ₂₇ , S ₃₀ , S ₃₄ , S ₃₅ , S ₃₇ , S ₃₉ S ₄₁ , S ₄₃ , S ₄₄ , S ₄₉ , S ₅₃ , S ₅₅ -S ₅₈ and S ₆₁	510-514
		S ₁ -S ₁₈ , S ₂₀ -S ₂₃ , S ₂₅ -S ₂₉ , S ₃₁ -S ₃₅ , S ₃₇ -S ₃₈ , S ₄₀ -S ₄₃ , S ₄₇ -S ₅₅ , S ₅₇ -S ₆₅	693-695
		S ₁ -S ₆₅	777-779
		S ₁ -18, S ₂₂ , S ₂₃ , S ₂₅ -29, S ₃₄ -35, S ₄₁ , S ₄₃ S ₄₅ -52, S ₅₄ -55, S ₅₇ , S ₆₅	1080-1084
		S ₃₄ , S ₄₂ , S ₅₄ and S ₅₅	1160-1164
		S ₂₃ , S ₃₄ , S ₃₇ , S ₃₈ , S ₄₆ , S ₅₄ , S ₅₅ and S ₆₁	1610-1614
S ₁₃ , S ₁₄ , S ₂₀ , S ₂₃ , S ₂₇ , S ₂₉ , S ₃₄ , S ₃₇ , S ₄₃ , S ₄₅ , S ₄₇ , S ₄₈ , S ₅₀ , S ₅₂ , S ₅₉ , S ₆₀ , S ₆₅	1870-1875		
2	Palygorskite	S ₁ , S ₂₉ , S ₅₂ and S ₅₄	516-518
		S ₁₃ , S ₂₁ , S ₃₉ , S ₄₀ , S ₅₆ and S ₂₄	1626-1630
3	Hematite	S ₁₉ , S ₃₀ , S ₃₆ and S ₅₃	1676 – 1680
4	Magnetite	S ₁ -S ₆₅	537-540
		S ₂₄ , S ₃₀ , S ₃₆ , S ₅₅ -56	630-634
5	Maghemite	S ₅ , S ₆ , S ₁₂ , S ₁₆ , S ₁₈ -20, S ₂₃ , S ₂₉ , S ₃₁ , S ₅₃ , S ₅₆ , S ₅₉ and S ₆₀	572
6	Microcline Feldspar	S ₅ , S ₁₆ , S ₂₀ , S ₂₃ , S ₅₉ and S ₆₀	723-728
6	Microcline Feldspar	S ₁ -S ₆₅	585-588
7	Orthoclase Feldspar	S ₁ -S ₆₅	636-638
8	Gibbsite	S ₁ -S ₆₅	667-670
		S ₂₀ , S ₂₄ , S ₃₀ , S ₃₃ , S ₃₆ , S ₄₂ , S ₄₆ and S ₅₃	962-965
9	Montmorillonite	S ₁₉	789
		S ₃₃ , S ₄₆ , S ₅₃ and S ₅₅	875 -878
10	Biotite	S ₅ , S ₆ , S ₉ , S ₁₀ , S ₁₂ , S ₁₃ , S ₁₆ , S ₁₈ -20, S ₂₃ , S ₂₉ , S ₃₁ , S ₃₂ , S ₄₅ , S ₄₈ , S ₅₀ , S ₅₃ , S ₅₉ , S ₆₀ and S ₆₂	720 -724
11	Kaolinite	S ₁ -S ₃ , S ₅ , S ₁₈ , S ₂₃ , S ₂₅ , S ₂₉ , S ₃₁ -S ₃₅ , S ₃₈ , S ₄₅ S ₄₇ , S ₅₂ , S ₅₇ , S ₅₈ , S ₆₀ , S ₆₅	1012-1016
		S ₁₉ , S ₂₁	1036-1038
		S ₂ , S ₁₈ , S ₂₅ , S ₃₂ , S ₅₁ and S ₆₅	3418-3421
		S ₁ , S ₂₉ and S ₅₅	3398-3402
		S ₂₇ , S ₂₉ , S ₃₅ , S ₃₉ , S ₅₇ and S ₅₈	3652-3656
S ₁₉ , S ₂₇ , S ₂₉ , S ₃₅ , S ₃₈ , S ₄₁ , S ₄₅ , S ₅₀ , S ₅₃ , S ₅₇ , S ₅₈	3692-3696		
12	Albite	S ₄ , S ₃₉ , S ₄₁ and S ₄₈	1008-1112
13	Calcite	S ₈ , S ₁₃ , S ₂₆ , S ₃₀ , S ₃₁ , S ₃₅ , S ₃₇ , S ₅₄ and S ₅₅	1423-1427
14	Aragonite	S ₃₄ , S ₄₂ , S ₄₆ , S ₅₄ , S ₅₅	1784-1789
15	Illite	S ₁₉ , S ₂₄ , S ₃₀ , S ₃₆ , S ₃₉ , S ₅₃ and S ₅₅	752 -756
16	Organic carbon	S ₁ -S ₆₅	2854-2857
		S ₁ -S ₆₅	2924-2928

Table 2: Extinction-Coefficient for major miners of Charnockite rocks, Kalrayan hills, India

Site No.	Location	Extinction-Coefficient			
		Quartz	Microcline feldspar	Orthoclase feldspar	Hematite
S ₁	Vandagappadi	35.97	25.31	14.86	7.20
S ₂	Torangur	37.54	25.49	77.44	8.54
S ₃	Varam	39.61	27.49	8.38	7.49
S ₄	Kattivalayu	43.73	38.41	13.64	21.67
S ₅	Uppur	139.30	89.02	36.84	45.80
S ₆	Arapundi	140.70	87.95	13.00	44.88
S ₇	Vanniyur	143.80	91.76	34.50	9.51
S ₈	Kottaputhur	143.69	86.83	38.96	8.41
S ₉	Kandikkollai	159.16	94.61	30.74	12.05
S ₁₀	Valappadi	164.46	127.36	17.09	30.25
S ₁₁	Pudur	159.52	122.05	48.49	30.74
S ₁₂	Vellimalai	171.01	130.77	45.03	29.40

S ₁₃	Moypatti	157.04	126.26	50.81	30.28
S ₁₄	Kariyalur	69.35	50.52	23.08	23.24
S ₁₅	Allathi	66.25	50.04	20.89	19.04
S ₁₆	Mavadippattu	124.98	96.08	40.67	44.33
S ₁₇	Mattaiyanur	126.42	99.41	45.33	42.01
S ₁₈	Velarikkadu	130.77	93.73	42.57	42.31
S ₁₉	Erukkambatti	52.72	38.96	55.27	76.53
S ₂₀	Ennadu	179.05	99.76	19.65	93.59
S ₂₁	Vandagappadi	52.09	32.76	35.27	41.03
S ₂₂	Torangur	55.65	36.00	39.40	45.08
S ₂₃	Varam	118.24	80.66	48.84	39.23
S ₂₄	Kattivalayu	6.26	21.13	80.02	32.48
S ₂₅	Uppur	4.80	24.87	24.21	33.10
S ₂₆	Arapundi	3.71	23.14	32.94	30.35
S ₂₇	Vanniyur	141.70	88.87	45.32	29.61
S ₂₈	Kottaputhur	143.14	93.82	45.80	32.69
S ₂₉	Kandikkollai	102.53	70.78	35.51	19.94
S ₃₀	Valappadi	6.06	28.73	26.36	29.84
S ₃₁	Pudur	96.14	77.89	30.25	34.33
S ₃₂	Vellimalai	98.13	77.28	34.76	34.79
S ₃₃	Moypatti	25.47	11.89	80.11	8.48
S ₃₄	Kariyalur	88.18	13.42	9.55	9.51
S ₃₅	Allathi	64.17	40.59	28.16	19.96
S ₃₆	Nakavalayu	6.22	19.42	22.33	35.55
S ₃₇	Meladukuli	212.31	104.09	43.50	13.46
S ₃₈	Aravangadu	77.31	45.03	26.44	21.37
S ₃₉	Maniyarpalaiyam	18.31	27.49	84.78	19.23
S ₄₀	Kiladukuli	96.20	91.10	54.84	16.80
S ₄₁	Kulipuli	95.72	50.66	21.72	22.63
S ₄₂	Melnilayur	120.26	19.65	30.20	24.29
S ₄₃	Kilnilayur	185.56	66.39	32.55	8.67
S ₄₄	Vengadu	11.94	20.10	21.72	29.61
S ₄₅	Vilvathi	174.79	97.69	46.57	38.28
S ₄₆	Kannur	166.02	91.20	14.33	11.05
S ₄₇	Perumalnattam	71.44	45.99	19.04	20.51
S ₄₈	Kilakkadu	124.67	72.80	37.57	40.53
S ₄₉	Kallippadi	77.31	44.14	21.07	20.24
S ₅₀	Kattuvaiyalu	121.22	94.50	56.40	41.37
S ₅₁	Gudaram	115.84	95.19	64.60	46.89
S ₅₂	Alanur	114.85	74.16	28.77	20.79
S ₅₃	Thakampattu	7.84	26.59	22.32	32.93
S ₅₄	Cheriyapattu	183.80	30.51	1.17	1.17
S ₅₅	Kurumbalur	74.23	29.18	2.29	4.83
S ₅₆	Thaduthapalayam	5.49	29.83	3.46	24.56
S ₅₇	Mulakkadu	86.49	52.01	23.55	22.63
S ₅₈	Maankompu	95.64	51.04	29.61	24.61
S ₅₉	Valakkuli	161.13	81.86	41.90	42.87
S ₆₀	Vanjikkuli	136.87	102.36	46.57	45.99
S ₆₁	Serkkalur	66.52	57.85	29.61	25.12
S ₆₂	Perumbalur	117.88	72.48	39.89	35.03
S ₆₃	Pachcheri	119.82	71.59	41.00	31.99
S ₆₄	Pudupalapattu	115.07	77.25	14.81	32.86
S ₆₅	Kallippattu	115.84	85.48	47.16	31.87
	Average	97.97	63.87	34.52	28.54
	Maximum	212.31	130.77	84.78	93.59
	Minimum	3.71	11.89	1.17	1.17

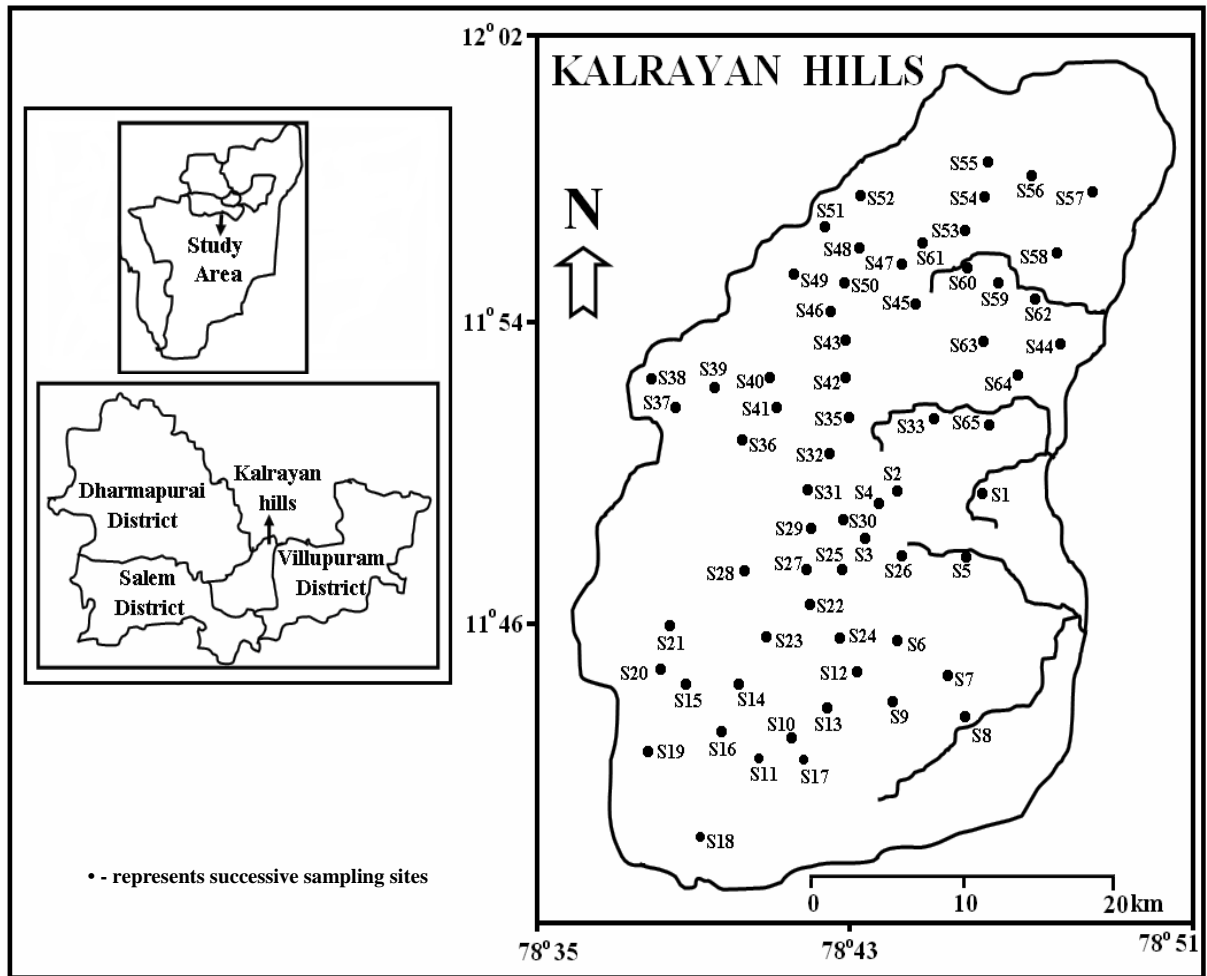


Figure 1 Location of Kalrayan hills with their experimental sites in Tamilnadu

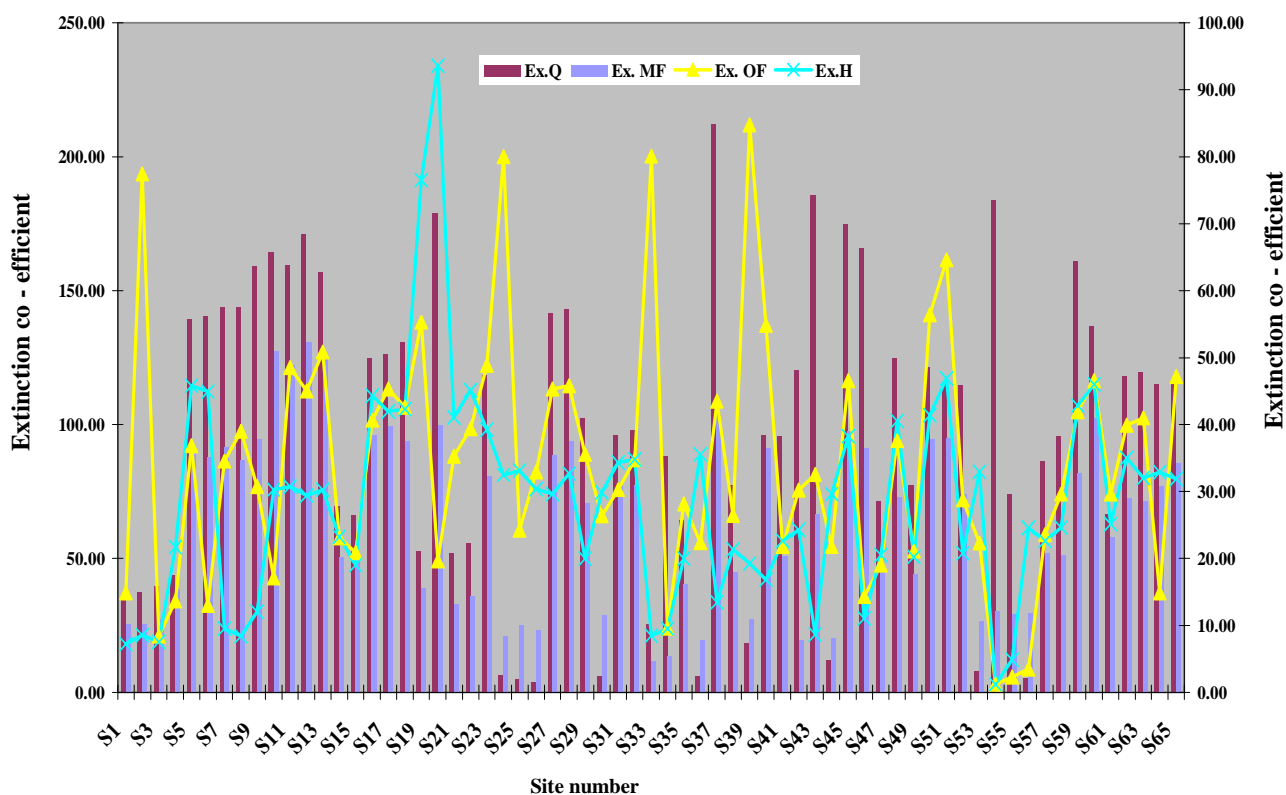


Figure 2 Extinction Coefficient of major minerals (Quartz, Microcline Feldspar, Orthoclase Feldspar and Hematite) of all sites

CONCLUSION

From the FTIR analysis, sixteen minerals such as quartz, feldspar in different structure (orthoclase, microcline and albite), hematite, kaolinite, maghemite, magnetite, gibbsite, illite, calcite, aragonite, montmorillonite, palygorskite, biotite and organic carbon are identified from the charnockite rocks of Kalrayan hills. All the minerals are characterized. Among all these minerals, quartz is invariably present in all the samples. The origin of quartz is determined using the characteristic peaks $1610-1614\text{cm}^{-1}$. The obtained result show the presence of quartz in the Kalrayan hills is from metamorphic origin. From the calculated extinction co-efficient values, the amount of hematite is lesser than feldspar and very much lesser than quartz in all the sites.

REFERENCE

- [1] Clarence Karr, Jr., (1975). "Infrared and Raman spectroscopy of lunar and terrestrial minerals", Academic Press, New York, 1-3.
- [2] Wilson, M.J., (1978). "A handbook of determinative methods in clay mineralogy", First Edition, Chapman and Hall Publications, New York, 133.
- [3] Geological survey of India, 2006.
- [4] Ramasamy, V., Senthil, S., Suresh, G. and Ponnusamy, V., (2012). *Carpathian Journal of Earth and Environmental Sciences*, 7 (4), 137-145.
- [5] Ramasamy, V., Suresh, G., Meenakshisundaram, V., Ponnusamy, V., (2010). *Carpathian Journal of Earth and Environmental Sciences*, 5(1), 41- 48.
- [6] John M. Hunt, Mary P., Wishard, Lawrence C., Bonham, (1950). *Analytical Chemistry*, 22(12), 1478.
- [7] Tuddenham W. M. and Lyaon, R. J. P., (1960). *Analytical Chemistry*, 32, 1630-1634.

- [8] Stubican, V. and Roy, R., (1961). *Z. Kristallogr. Kristallogenom*, **115**, 200-214.
- [9] Stubican, V. and Roy, R., (1961). *Journal of American Ceramic Society*, **44(12)**, 625. Farmer, V.C. and Russell, J.D., (1964). *Spectro Chemical Acta*, **20**, 1149-1173.
- [10] Farmer, V.C. and Russell, J.D., (1964). *Spectro Chemical Acta*, **20**, 1149-1173.
- [11] Russell, J.D., Farmer, V.C., Velde, B., (1970). *Mineralogical Magazine*, **37**, 869-879.
- [12] Joe L. White., (1971). "Interpretation of Infrared spectra of soil minerals", *Soil Science*, **112(1)**, 22.
- [13] Hlavay J., Jonas, K., Elet, S. Inczedy, J., (1978). *Clays and Clay Minerals*, **26(2)**, 139.
- [14] Russell, J.D., (1987). "Infrared methods- A Hand Book of determinative methods in clay mineralogy", Ed. by Wilson, M.J., Blackie and Son Ltd., New York, 133.
- [15] Madejova, J., (2003). *Vibrational Spectroscopy*, **31**, 1.
- [16] Saikia, N.J., Bharali, D.J., Sengupta, P., Bordoloi, D., Goswamee, R.L., Saikia, P.C., Borthakur, P.C., (2008). *Applied Clay science*, **24**, 93-103.
- [17] Ramasamy, V., Dheenathayalu, M., Ponnusamy, V., Murugesan, S., Mullainathan, S., (2003). *Journal of Current Sciences*, **3(1)**, 181-190.
- [18] Ramasamy, V., Ananadalakshmi, K., Ponnusamy, V., (2003). *Indian Journal of Physics*, **77A (4)**, 347-352.
- [19] Ramasamy, V., Dheenathayalu, M., Ponnusamy, V., Hemalatha, J., Presannalakshmi, P., (2003). *Indian Journal of Physics*, **77B (4)**, 443-450.
- [20] Ramasamy, V., Ponnusamy, V., Dheenathayalu, M., Palani, G., (2004). *Indian Journal of Physics*, **78 (7)**, 563-568.
- [21] Ramasamy, V., Ponnusamy, V., Jayanthi, M., (2005). *Journal of Current science*, **7(2)**, 309-316.
- [22] Ramasamy, V., Rajkumar, P., Ponnusamy, V., (2006). *Bulletin of pure and Applied Sciences*, **25D (1)**, 49-55.
- [23] Ramasamy, V., Rajkumar, P., Ponnusamy, V., (2009). *Indian Journal of Physics*, **83(9)**, 1295-1308.
- [24] Keller, W.D. and Pickett, E.E., (1949). *The American Mineralogist*, **34**, 855-868.
- [25] Bahat, D., (1970). *Journal of Geological Society of Australia*, **17**, 93.
- [26] Ramaswamy, K. and Venkatachalapathy, R., (1992). *Indian Journal of Pure and Applied Physics*, **30**, 171.
- [27] Ramasamy, V., Suresh, G., Meenakshisundaram, V and Gajendran, V., (2009). *Research Journal of Applied Sciences, Engineering and Technology*, **1(3)**, 140-144.
- [28] Adler, H.H. and Kerr, P. F., (1962). *American Mineralogist*, **47**, 700.
- [29] Ghosh, S.V., (1978). *Journal of Material Science*, **13**, 1877-1886.
- [30] Fysh, S.A. and Fredericks, P.M., (1983). *Clays and Clay Minerals*, **31(5)**, 377-381.
- [31] Norrish, K. and Taylor, R.M., (1961). "The isomorphous replacement of iron by aluminium in soil goethites", *Journal of Soil Science*, **12**, 294-306.
- [32] Schwertmann, U. and Taylor, R.M., (1977). "Minerals in soil environment", soil science society of America, Inc., Madison, 145.
- [33] Yariv, S.H. and Mendelovici, E., (1979). *Applied Spectroscopy*, **33(4)**, 410-411.
- [34] Fysh, S.A. and Clark, P.E., (1982). *Physics and Chemistry of Minerals*, **8**, 180-187.
- [35] Fysh, S.A. and Clark, P.E., (1982). *Physics and Chemistry of Minerals*, **8**, 257-267.
- [36] Dheenathayalu, M., Arumugam, M. and Ramasamy, V., *Acta Cienc. Indica*, **2000, XXVIII**, 179.