



GOVERNMENT OF KERALA

# DISTRICT SURVEY REPORT OF MINOR MINERALS (EXCEPT RIVER SAND)

## KOZHIKODE DISTRICT

Prepared as per  
Environment Impact Assessment (EIA) Notification, 2006 issued  
under Environment (Protection) Act 1986  
by

DEPARTMENT OF MINING AND GEOLOGY  
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# DISTRICT SURVEY REPORT OF MINOR MINERALS

## KOZHIKODE DISTRICT

(This report is to be submitted along with application for Environmental Clearance (EC) for mining of all minor minerals except river sand)

### 1 Introduction

The district of Kozhikode is one of the coastal districts of Kerala. Kozhikode district is bounded on the north by Kannur district, on the east by Wayanad district, on the south by Malappuram district and on the west by Lakshadweep Sea. It lies between North latitudes 11° 08' and 11° 50' and East longitudes 75 ° 30' and 76 ° 8'. It is falling in parts of Survey of India Toposheets 58 A and 49 M.

### 2 Administration

The district is divided into 3 taluks and 12 developmental blocks and 77 panchayats for administrative purposes. The district has one corporation (Kozhikode) and two Municipalities namely Quilandy and Badagara. It has a total of 117 revenue villages. Out of the total area of 2344 Sq. Kms 336 Sq. Kms fall under urban area and the remaining 2008 Sq. Kms falls under rural area.

The district has a total population of 30, 89,543 persons as per 2011 census. As in the case of many other districts of Kerala, the female population exceeds the male population and in Kozhikode District for every 1000 males there are 1097 females. The density of population is 1318. The decadal population (2001-2011) growth rate of the district is 7.31%. The district has a literacy rate of 95.24 % as per 2011 census.

### 3 Drainage and Irrigation

The district is drained by six rivers of which one is of medium nature and all others are minor ones namely *Chaliyar, Kuttiyadi, Mahe, Kadalundi, Kallayi and Korapuzha*. The Chaliyar River is a medium river and originates at a height of 2066 m amsl in Ilambalari hills of Western Ghats of Gudallur district, Tamil Nadu. The Chaliyar drains in to Beypore estuary. It is a sixth order stream with a length of 169 km. At its upper reaches it is formed by *Punnurpuzha, Pandiyur, Karimpuzha, Cherupuzha, Kanhirampuzha, Kurumbanpuzha, Vathatpurampuzha & Iruvantipuzha*. At its lower reaches near Cheruvannur, it is flowing as a broad river developing inlets.

The *Kuttiadi* River originates at a height of 1334 m amsl on the western slopes of Wayanad plateau. The river is also known by the name of Murat River. It has a length of 75 km and flows through Badagara and Quilandy taluks. It flows in northerly direction at first then bends and takes southwesterly direction of flow. At Turaiyur it is

joined by the Agalapuzha. Further it takes a “U” turn and flow northwesterly direction as the Murat River developing lagoons and joins the sea at Kottakkal near Badagara.



The river is dammed at Kakkayam for the hydroelectric project and the tail end waters of the project are stored at Peruvannamamuzhi, for irrigation.

The Mahe River originates at a height of 910 m amsl at Vanchimagate hills of Wayanad in Western Ghats and flows in the northeastern corner of the district. The course is forming northern boundary of the district. Near its lower reaches it bends and turns at Kariyad and flow in northwesterly direction and join the sea at Mahe.

The Kadalundi River formed by the union of Olipuzha and Veliyarpuzha has a length of 130 km. It enters the district at near its mouth of flow with only 14 km length in the district.

The Kallayi River has a length of 22 km. It originates at Cherukulathur, which is at a height of 45 m amsl and drains the district, joining the sea near Kozhikode. It is connected by man-made Buckingham Canal with the river Chaliyar.

The Korapuzha is a small river with a length of 40 km formed by the union of Agalapuzha and Punnurpuzha. It drains into the Arabian Sea at Elathur

There is only one major irrigation project in the district namely the Kuttiyadi irrigation project across the Kuttiyadi River. The Kuttiyadi irrigation project (KIP) partially completed in 1972 comprises a main dam 35.5m high across Kuttiyadi at Peruvannamamuzhi form a reservoir of storage capacity 113.28 MCM for regulating the yield from the catchment below the Kuttiyadi hydel dam and the tail waters of Kuttiyadi power station. Besides the major irrigation schemes, the district is irrigated by number of minor irrigation schemes, lift irrigation schemes, community irrigation schemes, wells and tanks.

### **3.1 Rainfall and climate**

Kozhikode district experienced annual rainfall of 3698 mm in the year 2006. The high rainfall areas in the district are Kakkayam dam site and Kakkayam Power House. Kakkayam dam site has been experiencing more than 4500 mm of annual rainfall since 2000. It has been noticed that rainfall displays an increasing trend towards north-eastern areas of the district.

The climate of the area is divided in to four seasons – summer, South West Tropical Monsoon period, North East Tropical Monsoon period and winter. The SW and NE monsoons mainly contribute rainfall in the area with 82.77 % of the rainfall. In 2006 during winter (January to March), summer (April and May), SW tropical monsoonal (June to October) and NE tropical monsoonal seasons, Kozhikode district received 0.49%, 16.74%, 72.15% and 10.63% rainfall respectively. The month of June experiences maximum rainfall. The months of July, August and October also receive

heavy rainfall. The agricultural activity of the district depends on the onset of SW tropical monsoon.

## **4 Other meteorological parameters**

### **4.1 Temperature**

The minimum temperature ranges between 22 and 25.8° C and the maximum between 28.2 and 32.9° C. The temperature reaches its peak in the month of April and attains minimum in January.

### **4.2 Relative Humidity**

The relative humidity ranges from 74 to 92 % during morning hours and from 64 to 89% in evening hours. The monsoon months record high humidity.

### **4.3 Wind speed**

The wind speed ranges from 8.1 to 12.6 km/h. The maximum wind speed is during April and minimum in November.

### **4.4 Potential Evapotranspiration**

The annual Potential Evapotranspiration (PET) is 1505.7 mm. The monthly PET ranges from 92.9 to 170.2 mm. The PET is less than the rainfall during May to November and hence the possibility of recharge to ground water regime is more during these months.

## **5 Geology**

The district can be divided into three geological belts viz., (i) a linear NW-SE trending gneissic belt, along the middle extending from north to south, (ii) a charnockite belt occupying areas in the northeast and south, extending to the adjacent districts and also occurring as pockets within the gneissic terrain and (iii) a narrow coastal belt.

Granite gneiss belonging to the Peninsular Gneissic Complex is the oldest unit of the area and occurs north of Alampore. Charnockite belonging to the Charnockite Group has a very wide distribution, especially in the northeast and south with variations like biotite-hypersthene gneiss, biotite-hornblende-hypersthene gneiss and hornblende-hypersthene gneiss. Magnetite quartzite, another unit of this group, occurs as narrow linear bodies within charnockite. Hornblende-biotite gneiss of the Migmatite Complex extends from north to south and is well foliated. Garnetiferous quartzo-feldspathic gneiss, another member of Migmatite Complex, occurs as lenses within charnockite, in the east. NW-SE trending dolerite dykes. These dykes are 10-20m wide.

Pebble beds occur on the coast and along banks of the Beypore river. The pebble bed is associated with grit and clay and it is lateritised. It comprises well rounded pebbles of

quartz, granite, quartzite and granulite. It is considered to be of Pleistocene origin. Sporadic laterite is recorded from the charnockite country to the southwest. Quaternary deposits are of marine and fluvial origin. Periyar Formation is a fluvial deposit comprising an admixture of sand, silt and clay. Guruvayur Formation is a strand line deposit of palaeo-marine origin and mostly comprises medium- to fine sand. Kadappuram Formation represents contemporary marine deposits, constituting the present and barrier beach (*Figure 1*). The geology of the district given above may be read with the “Geology of Kerala” which is given as Annexure 1 for better understanding of geological succession and stratigraphic sequence.



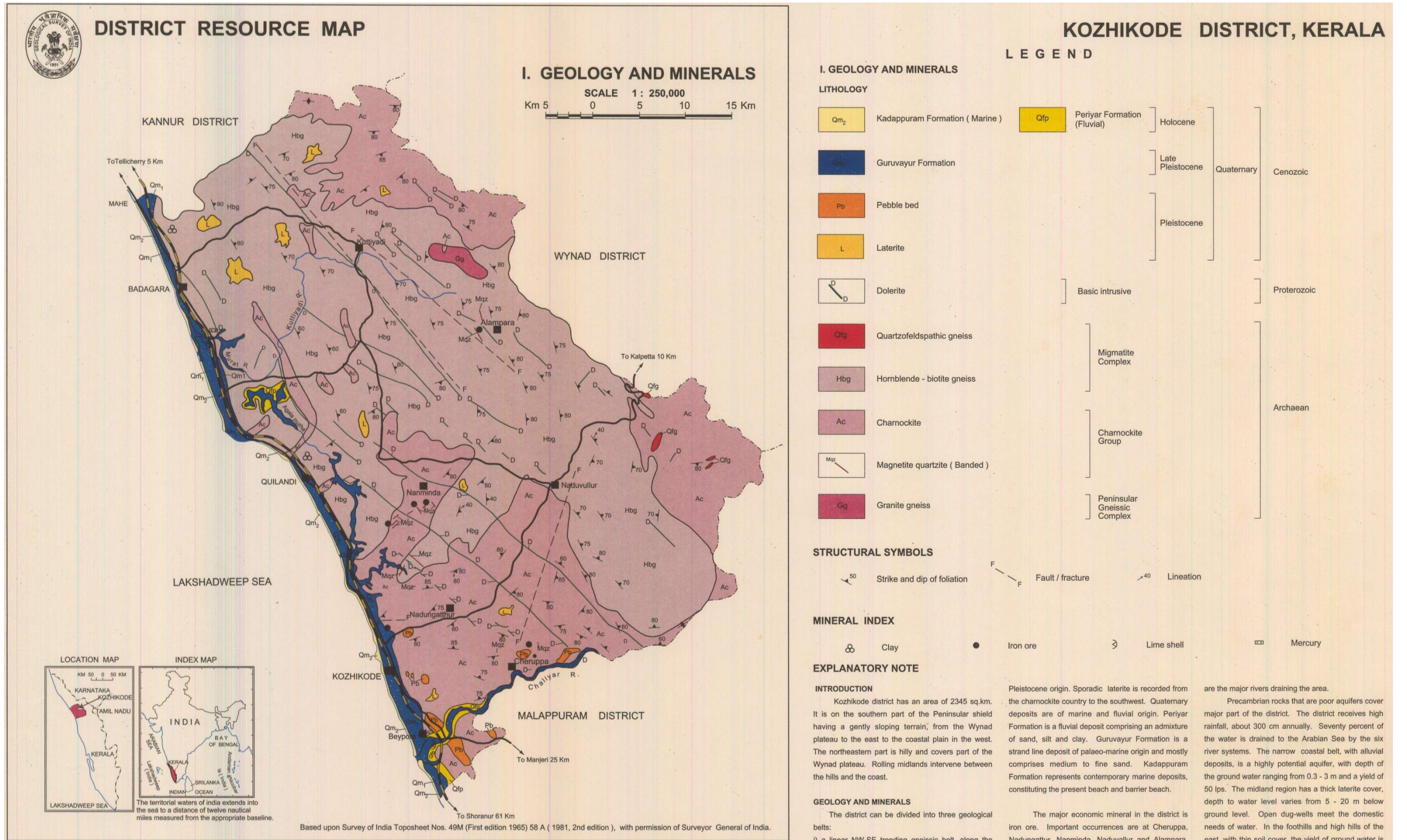


Figure 1: Geology and mineral resources of Kozhikode. (Source: District Resource map, Kozhikode district, Geological Survey of India)

## 6 Geomorphology

The physiographic divisions of Kozhikode district from west to east viz., (i) coastal plain - low land (<7.6 m amsl), mid land (7.6 to 76 m amsl) and high land – hilly terrain (above 76 m amsl).

The coastal plain is very narrow, 5 – 10km wide, gently sloping with a maximum height of about 10m in the east. It comprises depositional landforms of marine, fluvial and fluvio-marine origin. There is a well-developed beach all along the coast with sea cliffs and rocky beaches near Quilandy, Elattur and Kappad. The low land extends as a narrow stretch of land lying along the coast from South Kadalundi to North Mahe. The plain is interrupted by steep laterite cliffs and rock outcrops. The low land forms 6.7% of the total area of the district.

The midland area lies at a height between 7.6 and 76 m amsl. It may be further classified into low rolling terrain and moderately undulating terrain. The low rolling terrain has a slope of less than 15%. It consists of rolling laterite hills surrounded by valleys. The valleys are flood plain alluvium and red loamy soil. The moderately undulating terrain covering large area of the district has a slope between 15 and 25%. In addition to the agricultural crops of paddy and coconut, cash crops like rubber and arecanut are cultivated.

Area with elevation above 76 m amsl is called the highland. It is in the eastern part of the district. The area is prone to landslides and land slips and comprises of steep slopes and barren rocks. The highest elevation of the district is 1935 m amsl at Nilamala in north-eastern corner of the district.

The landform units identified in Kozhikode are alluvial plain, flood plain, valley fill, linear ridge, hillcrest, sloping terrain, rocky slope (scarp face) and hilly terrain. The flood plain and valley fill are the major fluvial landforms whereas moderately sloping terrain, highly sloping terrain, rocky slope (scarp face), linear ridge and hillcrest are major denudational landform units. The fluvial and gently sloping terrains are promising zones of groundwater. Denudational landforms are unproductive zones (*Figure 2*).

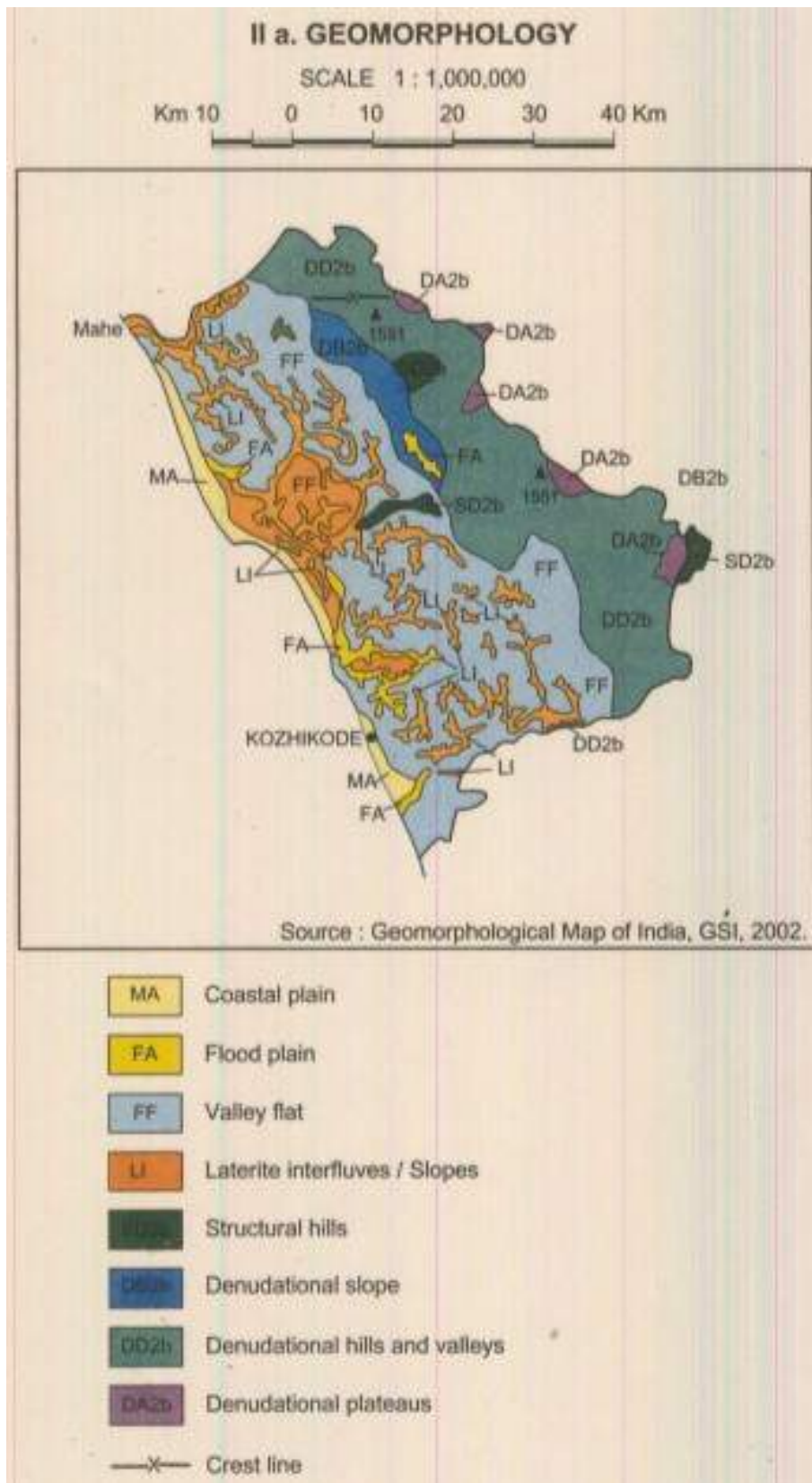
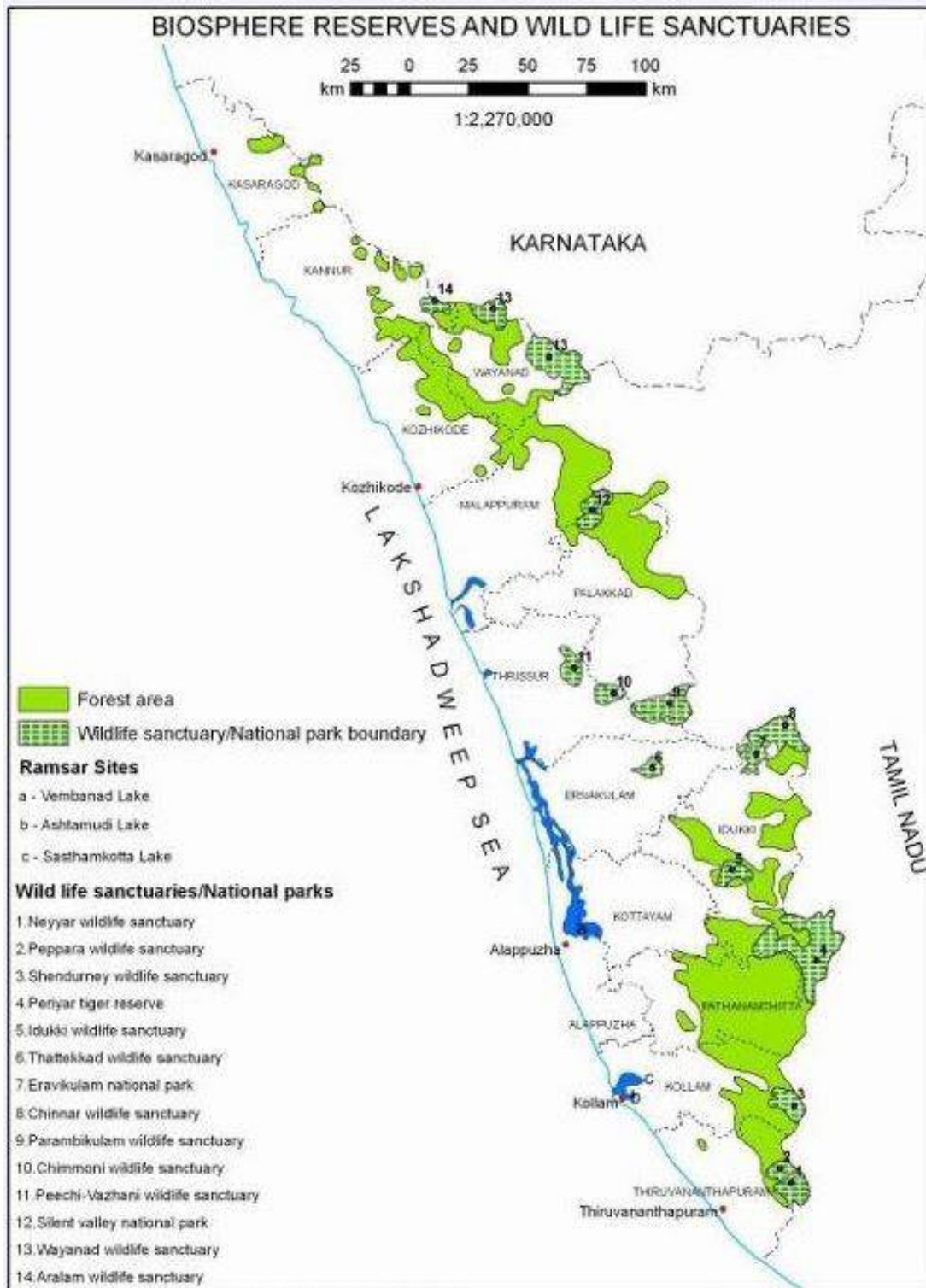


Figure 2: Geomorphology of Kozhikode. (Source: District Resource map, Kozhikode district, Geological Survey of India)



Source : Department of Forests, Govt. of Kerala, 2010

## 7 Soil types

The soils of the district are alluvial soil, lateritic soil and forest loam. Alluvial soil is seen mostly along the coastal plain and valley. They are coastal alluvial soil and river alluvial soils. They are excessively drained to moderately drained and are of sandy to clayey

textures. Majority of the area under riverine alluvium was once occupied by paddy cultivation. But those areas are now utilised for the cultivation of various crops especially plantain. The riverine alluvium contains moderate organic matter, nitrogen, phosphorous and potash.

Lateritic soil is derived from the laterite under tropical climate with alternate wet and dry conditions. It is reddish in colour and well drained gravelly to clayey. They are found mostly along the midland portion of the district. The organic matter in the soil is very less with moderate nitrogen, phosphorous and potash. The pH of soil ranges between 5.5 and 6.5 and texture is clayey loam to silty loam with 5 to 20% coarse fragments. Laterites on high grounds are more compact when compared to the low-lying areas.

Forest loam is deep or very deep and well drained loamy to clayey textures. They are rich in organic matter, nitrogen and humus. Forest loam is dark reddish brown in colour formed by weathering under forest cover with loamy to silty loam texture. The pH of the soil ranges between 5.3 and 6.3 and is slightly acidic in nature.

## **8 Groundwater scenario**

Groundwater occurs in the weathered, fractured, crystalline and alluvial formations in the district. Phreatic conditions exist in weathered formation and are mostly developed by dug wells for domestic and irrigation purposes. Semi-confined conditions exist in deep fractures and storage and movement of groundwater is mainly controlled by the fracture system. Deep high yielding bore wells are located along fractures / lineaments (*Figure 3*).

The district is divisible into two hydrological provinces viz., (i) the eastern Wayanad Plateau where dug wells give moderate yield and bore wells are feasible along fracture planes and (ii) the western mountains, which are generally unsuitable for groundwater development but the valleys with thick alluvium sustain dug wells. All the four blocks in the district are having similar hydrogeological conditions. The major water bearing formations in the district are weathered/fractured crystallines, alluvium and valley fills.

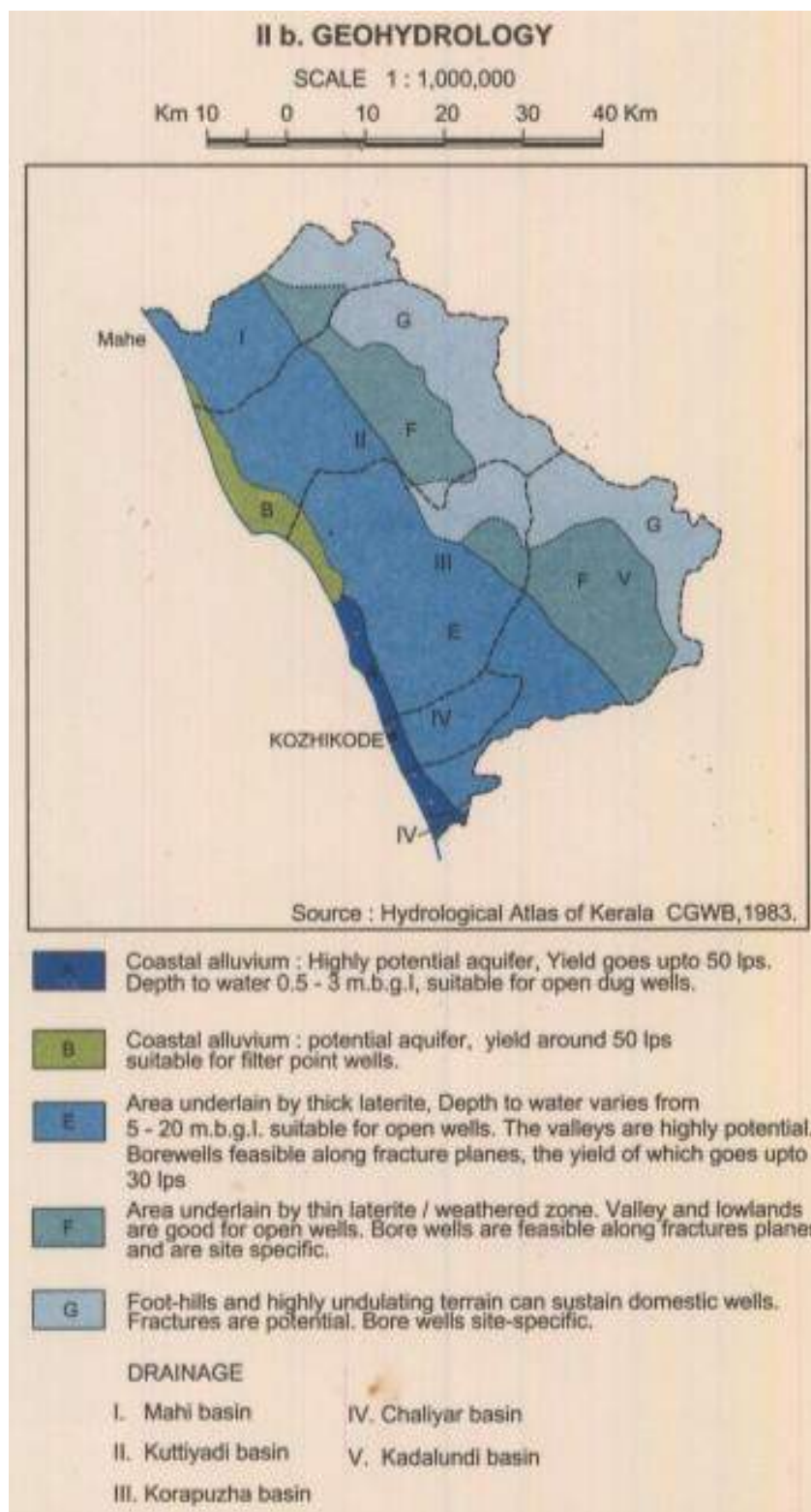


Figure 4: Geohydrology of Kozhikode. (Source: District Resource map, Kozhikode district, Geological Survey of India)

## 9 Natural hazards

Due to steep slopes, a large part of the district is prone to landslides, especially during the rainy season. The district falls under seismic zone III of ISI Classification (*Figure 5*).

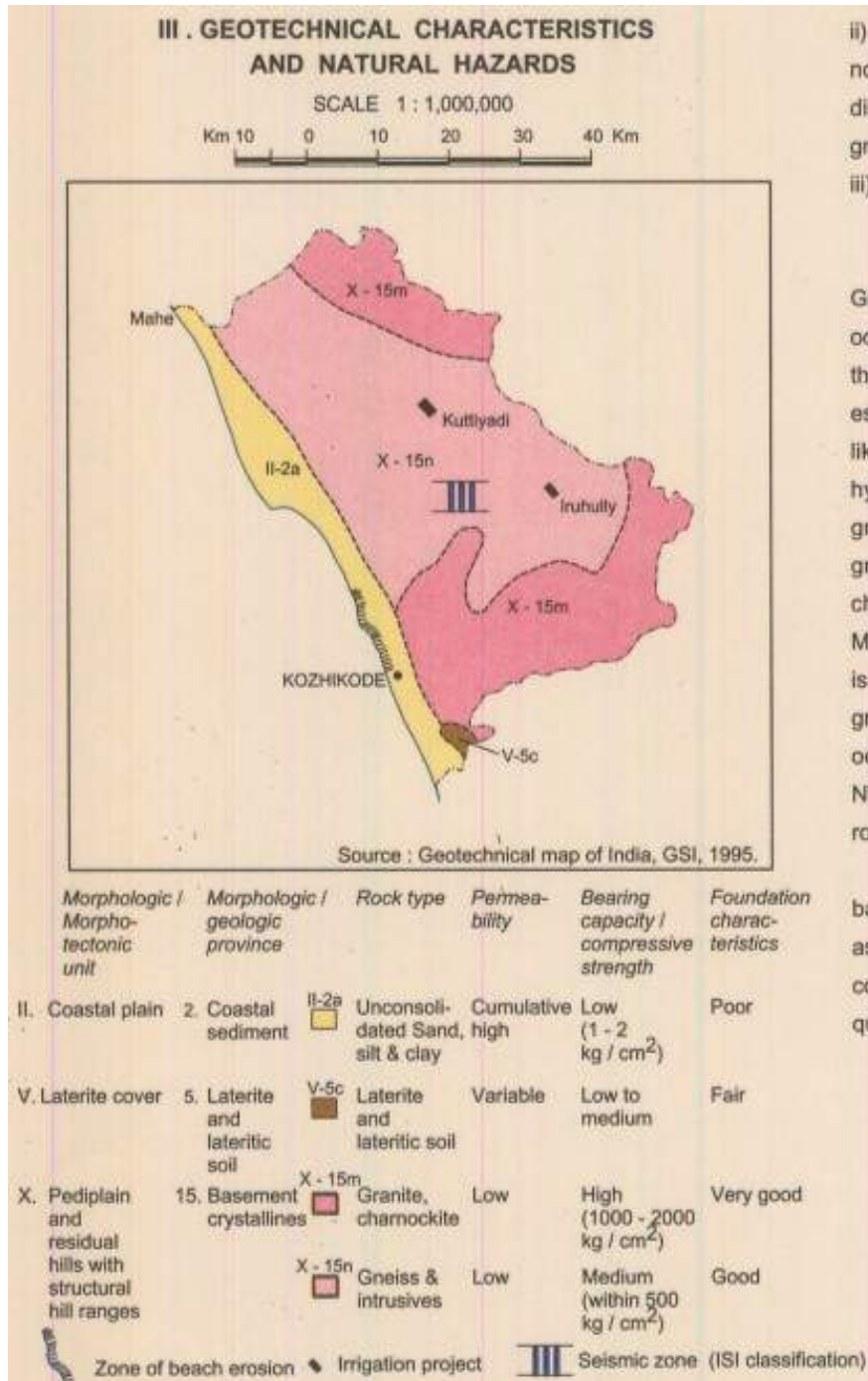


Figure 5: Geotechnical characteristics and natural hazards map of Kozhikode.

(Source: District Resource map, Kozhikode district, Geological Survey of India)

## 10 Mineral Resources

### 10.1 Major minerals

The major economic mineral in the district is iron ore. Important occurrences are at Cheruppa, Nadungattur, Nanminda, Naduvallur and Alampara. Mercury occurs in the native state as minute globules in laterite, capping the hornblende-biotite gneiss at Murat, southeast of Badagara. Primary clay (china clay) occurs at a number of places in the midland region. Large quantity of lime shell is reported from the lower reaches of Beypore, Korappuzha, Murat and Agalapuzha river beds. One mining lease is in force for mining of iron ore to M/s General Mining Corporation in Thalakolathur, Atholi villages of Koyilandy taluk in 86.06 ha of land.

### 10.2 Minor Minerals

#### 10.2.1 Ordinary Earth

Ordinary earth is the common name used for the soils. Soil is made up of three main components – minerals that come from rocks below or nearby, organic matter which is the remains of plants and animals that use the soil, and the living organisms that reside in the soil. The proportion of each of these is important in determining the type of soil that is present. But other factors such as climate, vegetation, time, the surrounding terrain, and even human activities (e.g. farming, grazing, gardening, landscaping, etc.), are also important in influencing how soil is formed and the types of soil that occur in a particular landscape. The formation of soils can be seen as a combination of the products of weathering, structural development of the soil, differentiation of that structure into horizons or layers, and lastly, of its movement or translocation. In fact, there are many ways in which soil may be transported away from the location where it was first formed. Soils represent one of the most complex and dynamic natural systems and are one of the three major natural resources, other than air and water. Knowledge of their chemical, physical and biological properties is a prerequisite both for sustaining the productivity of the land, e.g. agriculture, and for conservation purposes. Soil is an integral part of a terrestrial ecosystem and fulfils numerous functions including the capacity to generate biomass and the filtering or buffering activities between the atmosphere and the groundwater in the biosphere. Soils have many important functions. Perhaps the best appreciated is the function to support the growth of agricultural and horticultural crops. Soil is the mainstay of agriculture and horticulture, forming as it



does the medium in which growth and ultimately the yield of food producing crops occurs. Farmers and gardeners have worked with their soils over many centuries to produce increasing amounts of food to keep pace with the needs of a burgeoning world population. The soil's natural cycles go a long way in ensuring that the soil can provide an adequate physical, chemical and biological medium for crop growth. As well as being essential to agriculture, horticulture, forestry and natural and semi-natural systems, soil also plays an important role for our fauna. The soil itself contains millions of organisms, the exact nature and role of which we are still trying to determine. Undoubtedly, the soil flora and fauna play a vital role in cycles which are fundamental to the ability of the soil to support natural and semi-natural vegetation without additions of fertilizer and other support mechanisms. They breakdown plant debris, take in components from the atmosphere, aerate the soil together with many other functions that make the soil such an important medium.

#### *Classification of soils (ordinary earth) commonly found in the district*

The topo-lithosequence along with variation in rainfall, temperature and alternate wet and dry conditions particularly from the western coast to high ranges in the east and swift flowing rivers lead to the development of different types of natural vegetation and soil. The soils can be broadly grouped into coastal alluvium, mixed alluvium, acid saline, kari, laterite, red, hill, black cotton and forest soils. Soil map given below may be referred to find out its occurrences.

#### *Coastal Alluvium*

These soils of marine origin are identified along the coastal plains and basin lands as a narrow strip. The elevation of the coastal area is generally below 5m MSL. The area has high water table and in some areas it reaches above the surface during rainy season. The soils of the coastal plains are very deep with sandy texture. The texture generally ranges from sand to loamy sand with greyish brown to reddish brown and yellowish red colour. Sand content ranges from 80% and clay up to 15%. Even though these soils have high water table, the water holding capacity is poor due to the predominance of sand. Coconut is the major crop in the area. Cashew and other fruit trees are also grown.

#### *Mixed Alluvium*

These soils are developed from fluvial sediments of marine, lacustrine and riverine sediments or its combinations. They occur below 20m MSL in the lowland plains, basins, valleys and along the banks of major rivers. The mixed alluvium is mainly noticed close to coastal alluvium, Kuttanad and adjacent area and kole lands of Thrissur district. The soils are frequently flooded and submerged. The soils of depressions and broad valleys are

subject to occasional flooding and stagnation. The ground water table of these soils is generally high and it reaches above the surface during rainy season. A wide variation in texture is noticed in these soils. Sandy clay loam to clay is the predominant texture. Sandy loam soils are also met with. Light grey to very dark brown is the common colour of the soil. Paddy, other annuals and seasonal crops like banana, tapioca and vegetables are grown here.

#### *Laterite soil*

Laterite and laterite soil are the weathering products of rock in which several course of weathering and mineral transformations take place. This involves removal of bases and substantial loss of combined silica of primary minerals. In laterite and laterite soils, over acidic rocks, induration and zonation are more pronounced. This induration is greater if the iron content is higher. These soils mainly occur in the midlands and part of lowlands at an elevation of 10 to 100m above MSL as a strip between the coastal belt and hilly mid-upland. The area comprises of mounds and low hills with gentle to steep slopes. Laterite soils are generally suitable for most of the dry land crops. It is mainly cultivated with coconut, arecanut, banana, tapioca, vegetables, yams, pepper, pineapple, fruit trees etc. The percentage of gravel content in the soil and reduced soil depth limits the choice of crops. In laterite outcropped area with shallow soils, only cashew can be grown with vegetables.

#### *Hill Soil*

The hill soils mostly occur above an elevation of 80m MSL. The area is hilly and has highly dissected denudational hills, elongated ridges, rocky cliffs and narrow valleys. The general slope range is above 10%. The texture of these soils generally ranges from loam to clay loam with average gravel content of 10 to 50%. In addition, stones and boulders are noticed in the subsoil. These soils have reddish brown to yellowish red/strong brown colour. Generally, increase in clay content is noticed down the profile. The depth of the soil varies considerably from 60 to 200 cm depending on erodability of soil and past erosion. These soils are mostly friable and subject to heavy soil erosion. The area is suitable for all dry land crops like rubber, coconut, arecanut and fruit trees based on the topography. Crops such as banana, pepper, pineapple, vegetables can be grown in foot slopes.

#### *Forest Soil*

These soils are developed from crystalline rocks of Archaean age under forest cover. They occur along the eastern part of the State, generally above an elevation of 300m above MSL. The area is hilly and mountainous with steep slopes, escarpments, elongated rocky summits and narrow 'V' shaped valleys. The depth of the soil varies considerably depending on

erosion and vegetative cover. The soils are generally immature due to slow weathering process. Rocky outcrops and stones are noticed on the surface. Gneissic boulders under different stages of weathering are noticed in the subsoil. The texture of the soil ranges from sandy clay loam to clay with reddish brown to very dark brown colour. Forest trees, shrubs and grasses are grown here.

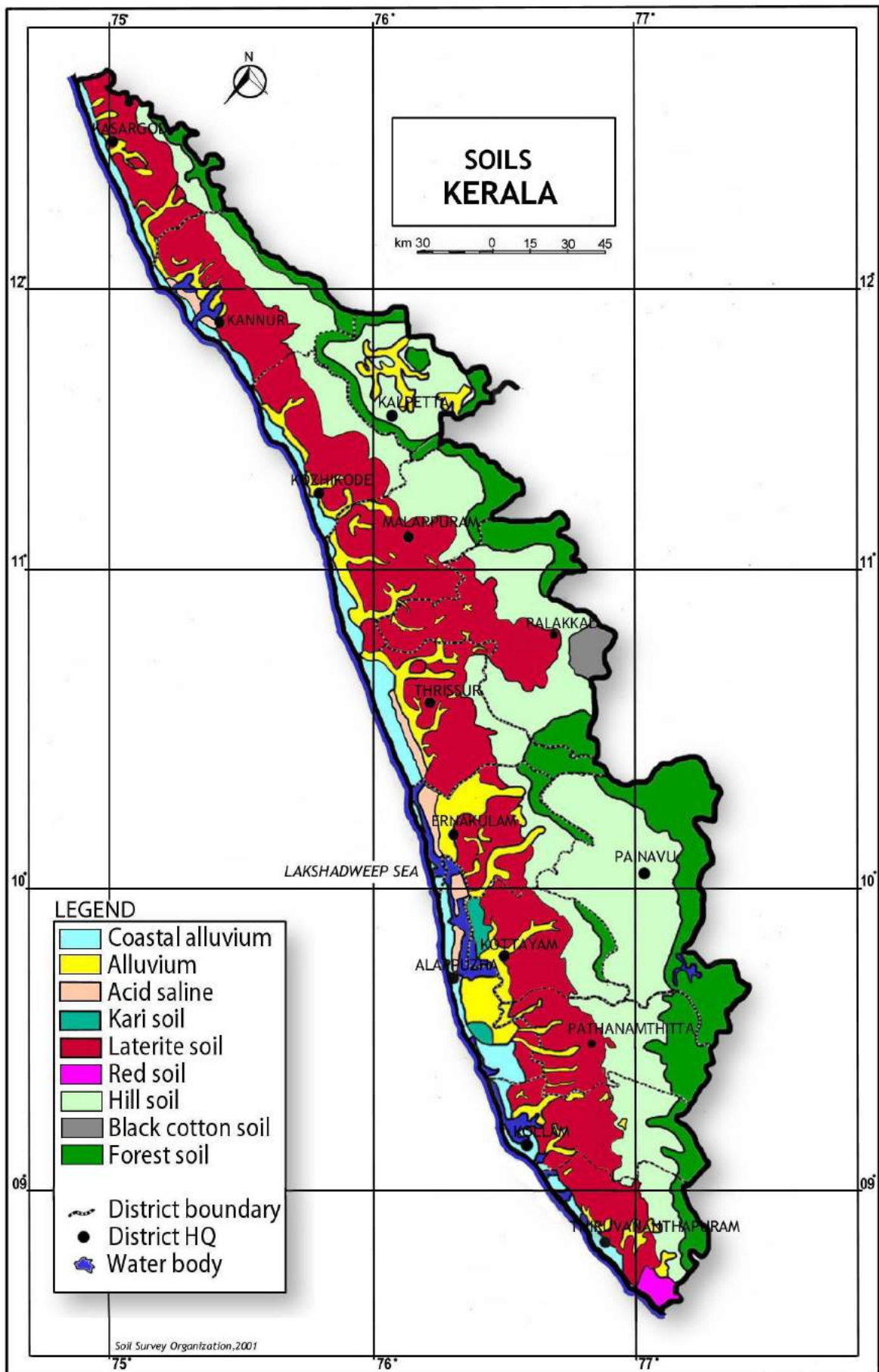


Figure 5: Soils of Kerala

### *Mining of ordinary earth*

Usually ordinary earth is mined for levelling of ground for construction of buildings. Since ordinary earth is very important to mankind, it is not wise to mine ordinary earth for filling purposes alone. However, for the construction of roads and other infrastructure, ordinary earth is mined after obtaining quarrying permit from the Department of Mining and Geology. Mining and transporting ordinary earth/soil without the permission of Department of Mining and Geology is an offence. Department issues pass for transport of ordinary earth. Dealer's license is not issued for ordinary earth as it is not considered as a mineral mined for commercial purposes.

#### **10.2.2 Ordinary Clay (tile/brick clay)**

Clays and clay minerals occur under a fairly limited range of geological conditions and are produced by weathering of silicate minerals containing calcium, magnesium, sodium, or potassium reacting with carbonic acid, carbonates, and bicarbonates. These soluble products are removed by ground water, while the remaining elements, aluminium, silicon, and oxygen combine with water to produce stable clay minerals. The environment of formation include soil horizons, continental and marine sediments, geothermal fields, volcanic deposits, and weathering rock formations. Extensive alteration of rocks to clay minerals can produce relatively pure clay deposits that are of economic interest. Clay formed at the site of the parent rock is known as primary or residual clay; the one carried away or transported and deposited elsewhere is known as secondary clay. For obvious reasons, the former is purer with less impurity (5%–15%), while the latter may contain mica, quartz, and iron oxide as impurities. Geological factors such as conditions at the time of deposition and post-depositional changes have an important influence on the properties of sediment.

Buildings and utensils made of clay date back to the earliest periods of man's civilized development, and the use of clay is intimately associated with his history. Tile and brick kilns are closely associated with Kerala's culture and traditional architecture, which is continued in modern buildings as well.

In Kerala, tile/brick clay occurs in the wetlands/paddy fields in the lowlands and midlands. The clay extracted is used for a variety of purposes such as manufacture of roofing, flooring, and decorative tiles, wire cut (mechanically made) and ordinary bricks (manually made), and pottery wares. Studies carried out in clay mining areas of Kerala have proved that unprecedented increase in the development needs of the state and the subsequent increase in the resource extraction scenarios, especially that of clay mining, have led to rapid degradation

of the wetlands (paddy fields), which is significantly reflected in the declining agricultural productivity of the state. Mining of clays several meters below the prescribed levels, water draining from the unaffected paddy lands into the adjacent mine pits, and subsequent pumping of water for further mining impose severe problems on the hydrological regime, lowering the water table and creating severe water shortage problems in the mining areas. The additional expenditure incurred to meet the freshwater requirements of the people living in areas adjacent to mining sites is increasing year after year, which undermines the short-term economic benefits of resource extraction.

Tile and brick clay mining and its processing provide employment opportunities to a considerable section of the people in the midland and lowland areas of Kerala. Adding to this, thousands of labourers in the construction industry also indirectly depend on the products manufactured from these clays. Under these circumstances and also with respect to the demand incurred, complete restriction of extraction activities does not prove to be viable.

In the study report published by National Center for Earth Science Studies on the impact of clay mining, following recommendations were given with respect to tile/brick clay mining:

“It is of imminent importance to regulate random mining from the paddy fields/wetlands of Kerala by allowing only location-specific resource extraction under well-conceived guidelines. It is also crucial to limit the extraction of tile and brick clays to meet indigenous and local demand only. This is to save the prime agricultural land and also to increase the rice production in the area. The depth of mining should be demarcated so as to regulate mining with respect to the water table condition in the summer season. Also, adequate measures are to be taken to regenerate the natural ground water table using the stored water in the clay mine pits for irrigating the agricultural crops of the hinterland areas. This will enhance the net agricultural productivity of the area in addition to saturating the aquifer systems in the hinterlands. Awareness creation among the public about the adversities of clay mining and as well as the economic benefits of using clay bricks for construction purposes will serve in the protection of our wetlands/paddy fields. Recycling of building materials should also be considered in order to reduce mining of tile and brick clays. The abandoned clay mine areas left behind as fallow lands or water logged areas can be used for productive purposes such as fish farm ponds or irrigation ponds that promise some utility to the society. Also, suitable guidelines should be framed to streamline the tile and brick clay mining activities of the state on an eco-friendly basis.”

The Kerala Conservation of Paddy Land and Wetland Act, 2008 and Rules made thereunder which was enacted for conservation of paddy land and wetlands of Kerala imposes restrictions

in mining of tile/brick clays in such areas. The said Act and Rules are implemented by Revenue Department. In addition, Government have setup District Expert Committee to monitor and control the mining activities of ordinary clay. In Kerala Minor Mineral Concession Rules 2015, it is mandated that No Objection Certificate from the District Collector concerned, based on the recommendation of the District Expert Committee constituted by the Government in this regard, is to be produced by the applicant in the case of application for extraction of ordinary clay. In addition, Bank guarantee from any Nationalized or Scheduled Bank at the rate of Rs. 300/- (Rupees three hundred only) per cubic metre for the purpose of reclamation of pits that will be formed after quarrying in the area permitted, in respect of application for extraction of ordinary clay. Based on the request of the entrepreneurs working in tile/brick clay based industry, Government have instructed the Department of Mining and Geology to carry out survey to identify the mineable tile/brick clay deposits of Kerala and the work in this respect is progressing.

### **10.2.3 Ordinary Sand**

In Kerala Minor Mineral Concession Rules, 2015, the ordinary sand is defined as sand used for non-industrial purpose. This includes both river sand and sand excavated from inland areas like palaeo-channels. Since a separate Act has been enacted by Government of Kerala namely, The Kerala Protection of River Banks and Regulation of Removal of Sand Act, 2001 (hereafter referred to as Sand Act, 2001) and since the mining of river sand is controlled by Revenue Department by virtue of the powers conferred by the said Act and the Rules made thereunder, the Department of Mining and Geology now regulates the mining of sand which do not comes under the purview of Sand Act, 2001.

The ordinary sand (other than river sand) occurs in the palaeo-channels. The word palaeo-channel is formed from the words “palaeo” or “old,” and channel; i.e., a palaeo-channel is an old channel. Palaeo-channels are deposits of unconsolidated sediments or semi-consolidated sedimentary rocks deposited in ancient, currently inactive river and stream channel systems. These are typical riverine geomorphic features in a location representing drainage streams, rivers, rivulets which were flowing either ephemeral or perennial during the past time and now stands either buried or lost or shifted due to tectonic, geomorphologic, anthropogenic process/activities, as well as climatic changes. When a channel ceases to be part of an active river system, it becomes a palaeo-channel. In order to tap the ordinary sand occurring in palaeo-channels, the Department entrusted the study of identification of palaeo-channels in major river basins of Kerala to Geological Survey of India (GSI). GSI resorted to remote

sensing studies using satellite imageries and delineated some of the palaeo-channels. However, since such deposits falls in paddy land/wetlands of Kerala, it is difficult to extract such sand on account of restrictions imposed by various Acts and Rules.

The Kerala Conservation of Paddy Land and Wetland Act, 2008 and Rules made thereunder which was enacted for conservation of paddy land and wetlands of Kerala imposes restrictions in mining of ordinary sands occurring in wetlands and paddy fields. The said Act and Rules are implemented by Revenue Department. In addition, Government have setup District Expert Committee to monitor and control the mining activities of ordinary sand. In Kerala Minor Mineral Concession Rules 2015, it is mandated that No Objection Certificate from the District Collector concerned, based on the recommendation of the District Expert Committee constituted by the Government in this regard, is to be produced by the applicant in the case of application for extraction of ordinary sand. In addition, Bank guarantee from any Nationalized or Scheduled Bank at the rate of Rs. 300 (Rupees three hundred only) per cubic metre for the purpose of reclamation of pits that will be formed after quarrying in the area permitted, in respect of application for extraction of ordinary sand.

The mining of ordinary sand from palaeo-channels also case some environmental concerns. Since sand is a good aquifer, the mining of aquifer system poses threat to ground water availability in surrounding areas. However in certain cases, the mining of such sand from paddy lands increase the productivity of paddy as excess sand in the paddy lands are not good for paddy.

In Kerala, due to shortage of river sand and ordinary sand occurring in palaeo-channels, the construction industry now uses manufactured sand obtained by crushing of crystalline rocks.

**It may be noted that since the Revenue Department is taking care of all types of mining activities related to river sand and since sand auditing and other studies are carried out under the aegis of the Revenue Department, this report shall not be used for the purpose of obtaining prior environmental clearance for mining of river sand.**

### *Laterite*

Laterite is a soil and rock type rich in iron and aluminium, and is commonly considered to have formed in hot and wet tropical areas. Nearly all laterites are of rusty-red coloration, because of high iron oxide content. They develop by intensive and long-lasting weathering of the underlying parent rock. Tropical weathering is a prolonged process of chemical weathering which produces a wide variety in the thickness, grade, chemistry and ore mineralogy of the resulting soils. The majority of the land area containing laterites is between the tropics of Cancer and Capricorn.



Angadipuram Laterite is a National Geological Monument identified in Angadipuram town in Malappuram district. The special significance of Angadipuram to laterites is that it was here that Dr. Francis Buchanan-Hamilton, a professional surgeon, gave the first account of this rock type, in his report of 1807, as "indurated clay", ideally suited for building construction. This formation falls outside the general classification of rocks namely, the igneous, metamorphic, or sedimentary rocks but is an exclusively "sedimentary residual product". It has a generally pitted and porous appearance. The name laterite was first coined in India, by Buchanan and its etymology is traced to the Latin word "letritis" that means bricks. This exceptional formation is found above parent rock types of various composition namely, charnockite, leptynite, anorthosite and gabbro in Kerala. The laterite profiles in different types of rocks vary depending on the composition of parent rock. For example in Charnockites, the thickness of the profile ranges from 2 m to 10 m with humus zone on the top with thin pebbly zone (with ferruginous pellets in clayey matrix), underlain by vermicular laterite with tubular cavities of various shapes and size filled with kaolinitic clay. This is followed by thin layer of lithomarge. Further below completely weathered, partly weathered or fresh parent rock occur. In some places one can see hard duricrust at the top.

The mineralogical study of laterites reveals that all the silicate minerals have been transformed to a mixture of goethite, hematite and kaolinite in laterite samples developed over charnockite. Further studies revealed that pyroxenes have been altered to goethite while feldspars gave rise to kaolinite. Quartz is cracked, eroded and disintegrated. Monazite and Zircons are found as accessory minerals.

Laterite and bauxite show a tendency to occur together. Aluminous laterites and ferruginous bauxites are quite common. The most common impurity in both is silica. Laterite gradually passes into bauxite with decrease in iron oxide and increase in aluminium oxide. The laterite deposits may be described on the basis of the dominant extractable minerals in it: (i) aluminous laterite (bauxite), (ii) ferruginous laterite (iron ore), (iii) manganiferous laterite (manganese ore), (iv) nickeliferous laterite (nickel ore) and (v) chromiferous laterite (chrome ore). Laterite with  $Fe_2O_3:Al_2O_3$  ratio more than one, and  $SiO_2:Fe_2O_3$  ratio less than 1.33 is termed as ferruginous laterite, while that having  $Fe_2O_3:Al_2O_3$  ratio less than one and  $SiO_2:Al_2O_3$  ratio less than 1.33 is termed as aluminous laterite. Laterite can be considered as poly-metallic ore as it is not only the essential repository for aluminium, but also a source of iron, manganese, nickel and chromium. Furthermore, it is the home for several trace elements like gallium and vanadium which can be extracted as by-products. In Kerala laterites are extracted as building stones which are used for construction of building.

Laterite as a building stone possesses one advantage that it is soft when quarried and can be easily cut and dressed into blocks and bricks which on exposure to air become hard. In addition, laterite (aluminous laterite) is extracted for industrial purposes (for e.g. Cement industry). In addition to aluminous laterite, bauxites are also mined in Kerala. Hence, while granting mineral concession for laterite it is necessary to carry out the chemical analysis to establish whether the mineral is bauxite or aluminous laterite.

#### **10.2.4 Granite Dimension Stone and Granite (building stone)**

For administrative purpose the hard crystalline rocks which do not have any economic minerals are classified as granite dimension stones and granite (building stones). The definition given in the Kerala Minor Mineral Concession Rules 2015 is as follows:-

‘Granite dimension stones include all types of granites, dolerite, charnockite, leptynite and other crystalline rocks of Acid, Intermediate, basic and ultra-basic groups of igneous and metamorphic origin which are suitable for cutting to pre-determined sizes, polishing, carving and amenable for making value-added products in decorative monumental and ornamental fields of industry as a high-value item. Granite (building stone) include all those group of rocks specified above which are not suitable for using as dimension stones as specified therein, but can be used as ordinary building stones, road metal, rubble and ballasts after breaking into irregular pieces by blasting or otherwise as low value item. The Rules insists that the rocks having the quality of granite dimension stone shall not be quarried for granite building stone as these two types of rocks have different values/royalties’. The granite dimension stone belt on the basis of its geologic setting belongs to the category of Dolerite-Gabbro dykes, Proterozoic intrusive hypabasal dyke swarms (colour: dark greenish blue, black and dark gray with black spots).

All Archaean and Proterozoic rocks of Kerala (refer section on Geology of Kerala) which are not listed above as granite dimension stone falls under the category of granite (building stone) and are found below ordinary earth/laterites/and other sedimentary rocks. In some cases such rocks are exposed as hillocks without any overburden.

## **11 Details of minor mineral concessions and revenue collection**

Permission for mining will be granted on case to case basis on ascertaining the availability at the site and only if conditions stipulated in the KMMC Rules 2015 are satisfied (The reader may refer the KMMC Rules 2015 available in the website [www.dmg.kerala.gov.in](http://www.dmg.kerala.gov.in) for more

details in this regard). The concession will be granted only if other statutory licenses like Environmental Clearance, Explosive Licence, consent to operate issued by State Pollution Control Board, NOC issued by Revenue Department (as the case may be), Dangerous and Offensive Trade Licence issued by Local Self Government Institutions, NOC related to Coastal Regulation Zone (as the case may be), NOC issued by Forest (as the case may be) etc. The mineral concession will not be granted in the ecologically sensitive areas, ecological fragile zones etc. The details of valid minor mineral concessions issued and revenue collected by the Department are given in the table below:-

**Table1: Details of revenue collection for the period 2013-'14, 2014-'15 and 2015-'16 (Amount in Rs.)**

**2013-'14**

No.	Particulars	Granite Building Stone	Laterite Building Stone	Brick Clay	River sand	Ordinary sand	Sea Shell	Ordinary Earth	Total (Rs)
1	Royalty	3,60,000	61,200	3,07,750	36,24,268	9,95,770		35,000	81,53,738
2.	Arrear royalty	9,34,024	15,170						9,49,194
3.	Surface Rent	7049	1790	220		130		60	
4.	Arrear Surface rent	0	-						
5.	Dead Rent	3072	-						3,072
6.	Arrear Dead rent	0	-						
7.	Fee for Q.P	55,400	40,200	9,400		2400		1800	1,09,200
8.	Fee for Q.L	2000	-						2,000
9.	Fee for Prospecting Licence		-						
10	Fee for D.L	6,02,000	2000			2,15,000			8,19,000
11.	Consolidated Royalty (CRPS)	83,25,000	16,85,000						1,00,10,000
12.	Compounding	10,81,880	11,03,020	2,23,400		1,73,500	10,000	12,69,080	38,60,880
13.	Other Department	0	-						
14.	Other Receipts	200	100						300
15.	RMCU Compounding	23,00,000	-						23,00,000
Total		<b>1,36,70,625</b>	<b>29,08,480</b>	<b>33,10,520</b>	<b>36,24,268</b>	<b>13,86,800</b>	<b>10,000</b>	<b>13,05,940</b>	<b>2,62,16,633</b>
<b>Grand Total (Minor)</b>		<b>2,62,16,633</b>	<b>Two Crore Sixty Two Lakhs Sixteen Thousand Six Hundred and Thirtythree Only</b>						

2014-'15								
No.	Particulars	Granite Building Stone	Laterite Building Stone	Brick Clay	River sand	Ordinary sand	Sea Shell	Ordinary Earth
1	Royalty	3,86,720	41,300	17,22,160	34,06,277	21,31,480	12600	17,31,380
2.	Arrear royalty	8,60,094	7,18,792	0	0	0	0	0
3.	Surface Rent	7000	1,070	0	0	0	20	20
4.	Arrear Surface rent	0	0	0	0	0	0	0
5.	Dead Rent	0	0	0	0	0	0	0
6.	Arrear Dead rent	0	0	0	0	0	0	0
7.	Fee for Q.P	27,600	25,400	600	0	0	200	400
8.	Fee for Q.L	6000	0	0	0	0	0	0
9.	Fee for Prospecting Licence	0	0	0	0	0	0	0
10	Fee for D.L	14,79,000	2000	0	0	1,30,000	0	8000
11.	Consolidated Royalty (CRPS)	70,45,000	9,80,000	0	0	0	0	0
12.	Compounding of offence	15,33,140	7,54,080	1,42,038	0	69,440	0	14,18,936
13.	Other Department	0	0	0	0	0	0	0
14.	Other Receipts	300	0	0	0	0	0	0
15.	RMCU Compounding	77,00,000	0	0	0	0	0	0
16	App.Fee for DL	14,500	0	0	0	500	0	0
17	Fee for Registration	49,000	0	0	0	14,000	0	0
18	Appl.Fee for RMCU	8,000	0	0	0	0	0	0
Total		<b>1,91,16,354</b>	<b>25,22,642</b>	<b>18,64,798</b>	<b>34,06,277</b>	<b>23,45,420</b>	<b>12,820</b>	<b>31,58,736</b>
<b>Grand Total (Minor)</b>		<b>3,24,27,047/- ( Rupees Three Crores Twenty Four Lakhs Twenty Seven Thousand and Forty Seven Only)</b>						

2015-'16								
No.	Particulars	Granite Building Stone	Laterite Building Stone	Brick Clay	River sand	Ordinary sand	Sea Shell	Ordinary Earth
1	Royalty	43,26,000/-	2,40,200/-	1,15,080/-	5,66,632/-	72,73,480/-	0	27,43,142/-
2.	Arrear royalty	50,09,193/-	1,94,521/-					
3.	Surface Rent	4,985/-	1,380/-	20/-				160/-
4.	Arrear Surface rent							
5.	Dead Rent	2,714/-						
6.	Arrear Dead rent							
7.	Fee for Q.P	1,75,000/-	1,08,000/-	16,000/-				2,000/-
8.	Fee for Q.L	1,80,000/-						
9.	Fee for Prospecting Licence							
10	Fee for D.L	21,28,000/-	8000/-			2,28,000/-		
11.	Consolidated Royalty (CRPS)	1,52,60,000/-	53,25,000/-					
12.	Compounding of offence	40,01,216/-	10,08,486/-	4,10,760/-		6000/-		10,72,620/-
13.	Other Department							
14.	Other Receipts	5,000/-	1,000/-			2,200/-		
15.	RMCU Compounding	1,02,00,000/-						
16	App.Fee for DL	47,000/-	1000/-			14,000/-		
17	Fee for Registration	71,000/-	2,000/-			22,000/-		
18	Appl.Fee for RMCU	10,000/-						
Total		<b>4,14,20,108/-</b>	<b>68,89,587/-</b>	<b>5,41,860/-</b>	<b>5,66,632/-</b>	<b>75,45,680/-</b>	<b>0</b>	<b>38,17,922/-</b>
<b>Grand Total (Minor)</b>		<b>Rs: 6,07,81,789/-</b> <b>( Rupees Six Crores SevenLakhs Eightyone Thousand Seven hundred and Eightynine Only)</b>						

**Table 2a: List of quarrying lease granted for Granite building stone (valid as on 31.10.2016)**

Sl. No.	Name & address of Lease Holder	Sy.Nos	Village	Taluk	Area (hectares)	Panchayat	Tenure of land	Lease Sanction Order No.	Date of execution	Date of registration	Valid up to	Status	EC (yes/no)
1	V.P. Mehboob, Alpha Bricks and Metals, Karassery	41/1A	Kakkad	Kozhikode	2.1287	Karassery	Private Land	273/05-06/6288/M3/05 Dt. 18.05.05	29.08.2005	07.12.2005	28.08.2017	working	Yes
2	K.H. Abbas, Nadira Manzil, NIT Campus Post	21/2D1	Chathamangalam	Kozhikode	0.2024	Chathamangalam	Private Land	762/05 – 06/2508/M3/06 Dt. 25.03.2006	03.05.2006	25.11.2006	02.05.2018	working	No
3	M/S Poabs Rock Products Pvt. Ltd, Gothambu Road, Nellikaparamba Post	172 Pt	Kodiyathur	Kozhikode	6.437	Kodiyathur	Private Land	763/05-06/2317/M3/06 Dt. 25.03.2006	19.04.2006	12.06.2006	11.06.2018	Not working	No
4	M/S Poabs Rock Products Pvt. Ltd, Nellikaparamba Post	172 Pt	Kodiyathur	Kozhikode	5.463	Kodiyathur	Private Land	124/08-09/4694/M3/08 Dt. 25.03.2008	15.04.2009	11.08.2009	14.04.2021	Not working	No
5	Royal Rocks Industries, Abhaya Giri Post, Elampayil, Valayam	114	Chekiad	Vatakara	1.2146	Chekiad	Private Land	22/07-08/3508/M3/08 Dt. 07.04.2008	30.05.2008	20.09.2008	29.05.2018	Not working	No
6	M.M.Ajas, Mg: Partner, Ponoorpoyil Granites, Koodaranhi Post	Unsurvey	Kumaranelur	Kozhikode	2.632	Karassery	Private Land	177/08-09/5827/M3/08 Dt. 17.06.2008	14.07.2008	30.09.2008	13.07.2018	working	Yes
7	E. Indira, Managing Partner, Geo Enterprises, Iyyade Post	29/Pt.	Sivapuram	Koyilandy	2.6305	Unnikulam	Private Land	696/09-10/9758/M.3/09 Dt. 22.03.2010	19.04.2010	24.06.2010	18.04.2022	working	No
8	Managing Director, Palakkal Granite Products (P) Ltd, KP8/308/ Shakeena Industries, Kunnmangalam Post	172 Pt	Kodiyathur	Kozhikode	5.868	Kodiyathur	Private Land	512/10-11/8823/M3/10 Dt. 11.11.2010	18.11.2010	10.01.2011	17.11.2022	working	Yes
9	M/s.Selva Bricks & Metals, Nellikaparambu.PO, Mukkam	67 Part	Kakkad	Kozhikode	2.0235	Karassery	Private Land	236/10-11/2759/M3/2010 Dtd:07.07.2010	13.08.2010	04.01.2011	12.08.2022	working	No
10	Sri.Sanfir.K.P. Mg:Partner Sedeer Granites, Feroke.PO	175 part	Kavilumpara	Vatakara	0.8094	Kavilumpara	Private Land	864/10-11/1446/M3/2011 Dtd:17.03.2011	06.04.2011	04.07.2011	05.04.2023	Not working	No

11	Sri. K.S. Ramachandran, Director, Emerald Rock Product Pvt. Ltd, Mullanpath Post, Kozhikode	123/1A 1A, 159/1A 1	Thinur	Vatakara	4.3361	Thinur	Private Land	931/10-11/1593/M3/2011 Dtd:30.03.2011	18.04.2011	02.08.2011	17.04.2021	Not working	No
12	M/S Poabs Rock Products Pvt. Ltd, Nellikaparamba Post	172	Kodiyathur	Kozhikode	4.838	Kodiyathur	Private Land	278/11-12/2540/M3/11 Dt. 06.08.2011	31.08.2011	29.11.2011	30.08.2021	working	Yes
13	P.P. Kunhimammed, Puthanpurayil House, Koodathai Bazar Post, Kozhikode	15/1	Kodanchery	Kozhikode	4.047	Kodanchery	Private Land	261/11-12/5250/M.3/2011 28.07.2011	09.08.2011	09.11.2011	08.08.2020	Not working	No
14	Sukumaran. E, Managing Partner, Tristar Stone Crusher, Pannimukku, Parathode Post, Kozhikode	78/2A	Kumaranellur	Kozhikode	4.0232	Karassery	Private Land	300/2014-15/8368/M3/2014. Dtd: 13.08.2014	20.08.2014	01.10.2014	19.08.2026	Working	Yes
15	M/s. Profile Granites, Parathode, Mukkam Post, Kozhikode	78/2A	Kumaranellur	Kozhikode	4.286	Karassery	Private Land	735/2014-15/131/M3/2015. Dtd: 22.01.2015	24.01.2015	04.03.2015	23.01.2027	Working	Yes
16	M/s. Payyoli Granites Private Limited, Thankamala Estate, Keezhariyur Post, Kozhikode	80/1A1	Keezhariyur	Koyilandy	2.428	Keezhariyur	Private Land	736/2014-15/250/M3/2015. Dtd: 22.01.2015	24.01.2015	03.03.2015	23.01.2027	Working	Yes
17	The Uralungal Labour Contract Co-operative Society Ltd 10957, Madappally CollegePost, Kozhikode- 673 102	172	Kodiyathur	Kozhikode	4.6984	Kodiyathur	Private Land	727/2014-15/14688/M3/2014 . Dtd:17.01.2015	04.02.2015	04.03.2015	03.02.2027	Working	Yes
18	Power Stone Products, Eranhimaavu, Pannikode Post, Kozhikode 673 602	186	Kodiyathur	Kozhikode	3.2483	Kodiyathur	Private Land	778/2014-15/569/M3/2015. Dtd:07.02.2015	20.02.2015	09.03.2015	19.02.2027	Working	Yes
19	Thankachan.M.S, Mathalikunnel House, koombara Bazar post, Koodaranhi, Kozhikode-673 604	2442 pt	Koodaranhi	Thamarassery	3.38	Koodaranhi	Private Land	165/2015-16/2846/M3/2015. Dtd:28.05.2015	05.06.2015	17.06.2015	04.06.2027	Working	Yes



20	Habeebu Rahiman. P.M, Managing Partner,Profile Sands, Pannimukku, Mukkam, Kozhikode-673 602	78/2A	Kumaranellur	Kozhikode	2.911	Karassery	Private Land	830/2015- 16/5549/M3/2015. Dtd: 18.03.2016	21.03.2016	28.03.2016	20.03.2028	Workin g	Yes
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**Table 2b: List of quarrying permits opting CRPS granted for Granite building stone (valid as on 31.10.2016)**

Sl.No.	Concession no.	Date of grant	Name & address of permit holder	Sy.Nos	Village	Taluk	Area (Ares)	Panchayat	Tenure of land	Valid up to	EC (yes/no)
1	36/2015-16/GS/CRPS/DOZ/M-1444/15.	04.11.2015	MUHAMMED ISMAIL MAKKI, ANAPPARAKKAL HOUSE, UNNIKULAM POST, KOZHIKODE	44/1	Keezhariyur	Koyilandy	9.717	Keezhariyur	Private Land	03.11.2016	No
2	37/2015-16/GS/CRPS/DOZ/M-1232/15	11.11.2015	PHILIP. T.S, S/o. SKARIYA, THANIYANIKKAL HOUSE, KOORACHUNDU POST, BALUSSERY (VIA), KOZHIKODE	1/3	Kayanna	Koyilandy	4.048	Koorachundu	Private Land	10.11.2016	No
3	38/2015-16/GS/CRPS/DOZ/M-953/15	11.11.2015	RAJESAN, VELLARAMKUNNATH HOUSE, MUKKAM POST, KOZHIKODE	6/1	Raroth	Thamarassery	49 cent	Thamarassery	Private Land	10.11.2016	No
4	39/2015-16/GS/CRPS/DOZ/M-1000/15	18.11.2015	SHAHUL HAMEED, MANAGING PARTNER, SAFA STONE CRUSHER, OMASSERY, MUKKAM POST, KOZHIKODE	147/2A2	Thazhakode	Kozhikode	19.43	Kattipara	Private Land	17.11.2016	No
5	40/2015-16/GS/CRPS/DOZ/M-1057/15.	16.11.2015.	SMT. CHOROTH AYISHABI, MANAGING PARTNER, M/s. STAR GRANITES, K.P.8/415, PULLANHIMEDU, THAMARASSERY, KOZHIKODE	2/1B	Kedavoor	Thamarassery	9.717	Kattipara	Private Land	15.11.2016	No
6	41/2015-16/GS/CRPS/DOZ/M-1487/15.	18.11.2015	P.M. ABOOBACKER, MANAGING DIRECTOR, PALAKKAL GRANITE PRODUCTS PVT.LTD, KUNNAMANGALAM POST, KOZHIKODE	172	Kodiyathur	Kozhikode	14.575	Kodiyathur	Private Land	17.11.2016	No
7	42/2015-16/GS/CRPS/DOZ/M-1376/15.	23.11.2015	C.P. MUHAMMED, MELEPOOLAKKAL HOUSE, KUNNAMANGALAM POST, KOZHIKODE	172	Kodiyathur	Kozhikode	9.717	Kodiyathur	Private Land	22.11.2016	No

8	44/2015-16/GS/CRPS/DOZ/M-1969/15	30.11.2015.	SMT. V.P. SAINABA, MANAGING PARTNER, SAINABA GRANITES, THARIPAMALA, INDIRA NAGAR POST, KOZHIKODE	159/1A1	Thinur	Vatakara	19	Naripatta	Private Land	29.11.2016	No
9	45/2015-16/GS/CRPS/DOZ/M-1183/15	02.12.2015	SHERRY JOSEPH, PAZHAYA PARAMBIL HOUSE, CHEMBANODA POST, KOZHIKODE	104/2A, 6/1	Perambra	Koyilandy	38.06	Chakitapara	Private Land	01.12.2016	No
10	46/2015-16/GS/CRPS/DOZ/M-819/15	02.12.2015	ABDUL RAHMAN, VADAKKINIYEDATH HOUSE, MAVOOR POST,	304/2	Poolakkode	Kozhikode	10	Chathamangalam	Private Land	01.12.2016	No
11	52/2015-16/GS/CRPS/DOZ/M-2060/15	21.12.2015	IBRAHIM HAJI. N.K, S/o. MOIDU HAJI, NADUVILAKANDY HOUSE, KURUNHALIYODE POST, KARTHIKAPPALLY, KOZHIKODE	159/1A1	Thinur	Vatakara	9.717	Naripatta	Private Land	20.12.2016	No
12	53/2015-16/GS/CRPS/DOZ/M-1950/15	21.12.2015	JOJI JOSEPH, ETTUMANOOKKARAN HOUSE, THOTTUMUKKAM POST, AREACODE (VIA), KOZHIKODE	188/2	Kodiyathur	Kozhikode	9.717		Private Land	20.12.2016	No
13	55/2015-16/GS/CRPS/DOZ/M-1201/15	21.12.2015.	ABDURAHMAN, MANAGING DIRECTOR, MARVA GRANITES Pvt. Ltd, NELLIKKAPARAMBA POST, MUKKAM KOZHIKODE	188/2	Kodiyathur	Kozhikode	21.05	Kodiyathur	Private Land	20.12.2016.	No
14	56/2015-16/GS/CRPS/DOZ/M-2087/15	21.12.2015.	P.M. ABOOBACKER, PALAKKAL MEETHAL HOUSE, KUNNAMANGALAM POST, KOZHIKODE	67	Kakkad	Kozhikode	39.66	Kodiyathur	Private Land	20.12.2016	No
15	57/2015-16/GS/CRPS/DOZ/M-1326/15	22.12.2015.	HARIDASAN. T, S/o. DAMODHARAN, THAROL HOUSE, EKAROO POST, UNNIKULAM, KOZHIKODE	81/1	Nochad	Koyilandy	6.073	Nochad	Private Land	21.12.2016	No
16	58/2015-16/GS/CRPS/DOZ/M-1111/15	23.12.2015	MOHANAN NAMBIAR, SOUPARNIKA, CHORODE POST, KOZHIKODE	99/1	Kozhukkallur	Koyilandy	4.858	Meppayyur	Private Land	22.12.2016	No

17	59/2015-16/GS/CRPS/DOZ/M-981/15.	23.12.2015	P.J. VARGHESE, PATTERNIYIL HOUSE, KUMARANELLOOR POST, MUKKAM, KOZHIKODE	56/1	Kumaranelloor	Kozhikode	9.717	Karassery	Private Land	22.12.2016	No
18	60/2015-16/GS/CRPS/DOZ/M-1019/15	23.12.2016	RAJESAN. K, S/o. RAGHAVAN, VELLARAMKUNNATH HOUSE, MUKKAM POST, KOZHIKODE	93	Raroth	Thamarassery	29.96	Thamarassery	Private Land	22.12.2016	No
19	61/2015-16/GS/CRPS/DOZ/M-1096/15	23.12.2015	K. P. PRASHOB, KAMMANGATTU HOUSE, KUNNAMANGALAM POST, KOZHIKODE	172	Kodiyathur	Kozhikode	10	Kodiyathur	Private Land	22.12.2016	No
20	62/2015-16/GS/CRPS/DOZ/M-1374/15	28.12.2015	SUDHAKARA MENOKI, S/o. GOPALAN NAIR, THANKA NIVAS, VELLIPARAMBA POST, KOZHIKODE	178/1	Perumanna	Kozhikode	8.097	Perumanna	Private Land	27.12.2016	No
21	63/2015-16/GS/CRPS/DOZ/M-1099/15	30.12.2015	O.A. SEBASTIAN, OLIMALAYIL HOUSE, PANAMBILAVU POST, AREAKODE (VIA), KOZHIKODE	188/2	Kodiyathur	Kozhikode	40	Kodiyathur	Private Land	29.12.2016	No
22	64/2015-16/GS/CRPS/DOZ/M-973/15	30.12.2015	SHAHUL HAMEED, MANAGING PARTNER, SAFA STONE CRUSHER, OMASSERY, MUKKAM POST, KOZHIKODE	147/2A2	Thazhakode	Kozhikode	9.717	Mukkam	Private Land	29.12.2016	No
23	65/2015-16/GS/CRPS/DOZ/M-2007/15	01.01.2016	ROSLI SMILE, W/o SMILE, MANGALASSERY HOUSE, MARUTHONKARA POST, KAVILUMPARA, KOZHIKODE	425/3	Maruthonkara	Vatakara	9.717	Maruthonkara	Private Land	31.12.2016	No
24	66/2015-16/GS/CRPS/DOZ/M-1406/15	11.01.2016	NOUFAL. K.K, S/o. USSAIN KUTTY, KAMMALAN KUNNATH HOUSE, THAMARASSERY POST, KOZHIKODE	67	Kakkad	Kozhikode	14.575	Kodiyathur	Private Land	10.01.2017	No
25	67/2015-16/GS/CRPS/DOZ/M-2136/15	13.01.2016	T. HARIDASAN, THAROL HOUSE, EKAROO POST, KOZHIKODE	21/2A	Kozhukkallur	Koyilandy	38.462	Meppayyur	Private Land	12.01.2017	No

26	68/2015-16/GS/CRPS/DOZ/M-2135/15	13.01.2016	T. HARIDASAN, THAROL HOUSE, EKAROO POST, KOZHIKODE	8/1 D	Sivapuram	Thamarassery	18.004	Unnikulam	Private Land	12.01.2017	No
27	69/2015-16/GS/CRPS/DOZ/M-2158/15	13.01.2016	P.C. MUHAMMED BASHEER, P.C. HOUSE, EKAROO POST, UNNIKULAM, KOZHIKODE	28/2	Kinaloor	Thamarassery	9.717	Panangad	Private Land	12.01.2017	No
28	70/2015-16/GS/CRPS/DOZ/M-2329/15	27.01.2016	SAJI JOSE, KATTARATH HOUSE, MUKKAM POST, KOZHIKODE	19/2	Koodathai	Thamarassery	19.838	Omassery	Private Land	26.01.2017	No
29	71/2015-16/GS/CRPS/DOZ/M-2544/15	01.02.2016	K.A. SHAMEENA, MANAGING PARTNER, ABBA M SAND AND GRANITES, N.I.T. CAMPAS POST, KOZHIKODE	79	Balusserly	Koyilandy	44.52	Balusserly	Private Land	31.01.2017	No
30	72/2015-16/GS/CRPS/DOZ/M-2067/15	04.02.2016	N.C. ABDUL MAJEED, MANAGING PARTNER, MUKKOM GRANITES, POOTHAMPARA POST, KOZHIKODE	5/5A2	Kavilumpara	Vatakara	14.574	Kavilumpara	Private Land	03.02.2017	No
31	73/2015-16/GS/CRPS/DOZ/M-2071/15	04.02.2016	N.P. PADMANABHAN, MANAGING PARTNER, KUTTIADI JELLY MAKING INDUSTRIES, KAVILUMPARA POST, KOZHIKODE	5/5A2	Kavilumpara	Vatakara	9.717	Kavilumpara	Private Land	03.02.2017	No
32	74/2015-16/GS/CRPS/DOZ/M-905/15	04.02.2016	SIJO. P. SIVADASAN, POTTAKULATHIL HOUSE, PERUMPALLY POST, THAMARASSERY, KOZHIKODE	93	Rarooth	Thamarassery	50	Kattipara	Private Land	03.02.2017	No
33	75/2015-16/GS/CRPS/DOZ/M-2504/15	04.02.2016	P.C. MUHAMMED BASHEER, P.C. HOUSE, ANAPPARA, EKAROO POST, KOZHIKODE	28/2	Kinaloor	Thamarassery	8.502	Panangad	Private Land	03.02.2017	No
34	76/2015-16/GS/CRPS/DOZ/M-1022/15	08.02.2016	SASEENDRAN. K, KANIYARAKKAL HOUSE, KIZHAKKUMMURI POST, KAKKODI (VIA), KOZHIKODE	84/4	Atholy	Koyilandy	4.858	Atholy	Private Land	07.02.2017	No

35	77/2015-16/GS/CRPS/DOZ/M-2088/15	18.02.2016	V.P. BABU, MANAGING PARTNER, KUNDUTHODE QUARRY GROUP, KUNDUTHODE POST, KOZHIKODE	262	Maruthonkara	Vatakara	9.717	Kavilumpara	Private Land	17.02.2017	No
36	78/2015-16/GS/CRPS/DOZ/M-1228/15	18.02.2016	JOHNSON GEORGE, EDAPPATTU HOUSE, KOODARANHI POST, KOZHIKODE	U/S	Koodaranhi	Thamarassery	4.858	Koodaranhi	Private Land	17.02.2017	No
37	79/2015-16/GS/CRPS/DOZ/M-2063/15	18.02.2016	SASEENDRAN. K, KANIYARAKKAL HOUSE, KIZHAKKUMMURI POST, KAKKODI, KOZHIKODE	386/1	Nanminda	Kozhikode	9.717	Nanminda	Private Land	17.02.2017	No
38	80/2015-16/GS/CRPS/DOZ/M-1921/15.	18.02.2016	VARKEY ENNA VARGHESE, THUNDATHIL HOUSE, VAYALADA POST, UNNIKULAM, KOZHIKODE	U/S	Kanthalad	Thamarassery	9.717	Panangad	Private Land	17.02.2017	No
39	81/2015-16/GS/CRPS/DOZ/M-2363/15	18.02.2016	NANU. K.K, KOROTH PUNATHIL HOUSE, THIRUVALLOOR POST, VATAKARA (VIA), KOZHIKODE	56/1	Kottappalli	Vatakara	8.91	Thiruvallur	Private Land	17.02.2017	No
40	82/2015-16/GS/CRPS/DOZ/M-983/15	22.02.2016	SREELATH. T, S/o. SREEDHARAN NAIR, THOTTATHIL HOUSE, VAKAYAD POST, KOZHIKODE	93	Raroth	Thamarassery	19.43	Thamarassery	Private Land	21.02.2017	No
41	83/2015-16/GS/CRPS/DOZ/M-247/16	22.02.2016	MUHAMMED THAMEEM, S/o. ABDULLA, POYILIL HOUSE, KARUVANPOYIL POST, KOZHIKODE	18/2B	Vavad	Thamarassery	4.858	Koduvally	Private Land	21.02.2017	No
42	84/2015-16/GS/CRPS/DOZ/M-1917/15	24.02.2016	SHAJI MATHEW, MANAGING PARTNER, MATHA INDUSTRIES, PUNNAKKADAVU ROAD, KOOMBARA BAZAR POST, KOZHIKODE	U/S	Koodaranhi	Thamarassery	14.17	Koodaranhi	Private Land	23.02.2017	No

43	85/2015-16/GS/CRPS/DOZ/M-1615/15	29.02.2016	ANDRU. K, A.N.S. STONE, KODIYANGOTH HOUSE, CHELAKKAD POST, KALLACHI, KOZHIKODE	122/2	Kayakkodi	Vatakara	9.71	Kayakkodi	Private Land	28.02.2017	No
44	86/2015-16/GS/CRPS/DOZ/M-2166/15	29.02.2016	K.K. RAVEENDRAN, S/o. CHANDAN, KAYALUKANDATHIL HOUSE, VENGARI POST, KOZHIKODE	21/1	Chelannur	Thamarassery	28.283	Chelannur	Private Land	28.02.2017	No
45	87/2015-16/GS/CRPS/DOZ/M- 35/16	29.02.2016	THANKACHAN. M.S, MATHALIKUNNEL HOUSE, KOOMBARA BAZAR POST, KODARANHI (VIA), KOZHIKODE	U/S	Koodaranhi	Thamarassery	22.267	Koodaranhi	Private Land	28.02.2017	Yes
46	88/2015-16/GS/CRPS/DOZ/M- 85/16	09.03.2016	M.K. BABU, S/o. KANNAN, MARUTHULLA PARAMBIL HOUSE, KUNDUTHODE POST, KOZHIKODE	9/1	Kozhukkallur	Koyilandy	9.72	Meppayyur	Private Land	08.03.2017	No
47	89/2015-16/GS/CRPS/DOZ/M-1464/15	09.03.2016	A.L. PREMRAJ, S/o. APPU, LANKAYIL HOUSE, KARASSERY POST, MUKKAM, KOZHIKODE	67	Kakad	Kozhikode	20	Karassery	Private Land	08.03.2017	No
48	90/2015-16/GS/CRPS/DOZ/M-2112/15	09.03.2016	K.K. RAVEENDRAN, S/o. CHANDAN, KAYALUKANDATHIL HOUSE, VENGARI POST, KOZHIKODE	40/1B	Chelannur	Kozhikode	9.717	Chelannur	Private Land	08.03.2017	No
49	91/2015-16/GS/CRPS/DOZ/M-1062/15	14.03.2016	NAZEER. N.P, NAYADIPOYIL HOUSE, UNNIKULAM, EKAROO POST, KOZHIKODE	16/1	Koodathai	Thamarassery	9.716	Kodancherry	Private Land	13.03.2017	No
50	92/2015-16/GS/CRPS/DOZ/M-1896/15	16.03.2016	ABDUL MUNEER, S/o. KUTTY, KUNNATH HOUSE, KARASSERY POST, KOZHIKODE	U/S	Koodaranhi	Thamarassery	4.86	Kodaranhi	Private Land	15.03.2017	No
51	93/2015-16/GS/CRPS/DOZ/M-1531/15	16.03.2016	ABDURAHIMAN. T, S/o. ALI, THIRIKKOTTU HOUSE, PAZHOOR POST, MAVOOR (VIA), KOZHIKODE	172	Kodiyathur	Kozhikode	9.717	Kodiyathur	Private Land	15.03.2017	No
52	94/2015-16/GS/CRPS/DOZ/M-260/16	23.03.2016	K. RAJESAN, S/o. RAGHAVAN, VELLARAMKUNNATH HOUSE, MUKKAM POST, KOZHIKODE	93	Raroth	Thamarassery	39.99	Thamarassery	Private Land	22.03.2017	No

53	95/2015-16/GS/CRPS/DOZ/M-950/15.	23.03.2016	K. RAJESAN, S/o. RAGHAVAN, VELLARAMKUNNATH HOUSE, MUKKAM POST, KOZHIKODE	6/1	Raroth	Thamarassery	19.8	Thamarassery	Private Land	22.03.2017	No
54	96/2015-16/GS/CRPS/DOZ/M-261/16	23.03.2016	K. RAJESAN, S/o. RAGHAVAN, VELLARAMKUNNATH HOUSE, MUKKAM POST, KOZHIKODE	93	Raroth	Thamarassery	29.99	Thamarassery	Private Land	22.03.2017	No
55	97/2015-16/GS/CRPS/DOZ/M-952/15	23.03.2016	K. RAJESAN, S/o. RAGHAVAN, VELLARAMKUNNATH HOUSE, MUKKAM POST, KOZHIKODE	6/1	Raroth	Thamarassery	19.9	Thamarassery	Private Land	22.03.2017	No
56	98/2015-16/GS/CRPS/DOZ/M-100/2016	26.03.2016	SAJI MATHEW, S/o. MATHEW, VAZHAKKA MALAYIL HOUSE, CHERUKAD POST, KOZHIKODE	1/1	Kayanna	Koyilandy	9.717	Koorachundu	Private Land	25.03.2017	No
57	99/2015-16/GS/CRPS/DOZ/M-2134/15	28.03.2016	SAHEER KUTTUVAN, MANAGING DIRECTOR, MERDEKA INDUSTRIAL PARK, KHARAAJ, KOTACHERY LANE, THANA POST, KANNUR	5/5A2	Kavilumpara	Vatakara	9.717	Kavilumpara	Private Land	27.03.2017	No
58	100/2015-16/GS/CRPS/DOZ/M- 24/16	30.03.2016	THANKACHAN. M.S, MATHALIKUNNEL HOUSE, KOOMBARA BAZAR POST, KOZHIKODE	U/S	Koodaranhi	Thamarassery	48.58	Koodaranhi	Private Land	29.03.2017	Yes
59	01/2016-17/GS/CRPS/DOZ/M-2535/15	04.04.2016	HABEEB RAHIMAN, S/o. MUHAMMED, PUTHOOR MADATHIL, MUKKAM POST, KOZHIKODE	172	Kodiyathur	Kozhikode	9.717	Kodiyathur	Private Land	03.04.2017	No
60	02/2016-17/GS/CRPS/DOZ/M-2195/15	11.04.2016	SMILE.M.ANTO, MANGALASSERY HOUSE, MARITHONKARA POST, KOZHIKODE	425/1	Maruthonkara	Vatakara	38.056	Maruthonkara	Private Land	10.04.2017	No
61	03/2016-17/GS/CRPS/DOZ/M-2054/15	18.04.2016	AHAMMED FAHAD, PARACHALIL HOUSE, MANGAD POST, KOZHIKODE	133/2	Narikuni	Thamarassery	9.717	Narikuni	Private Land	17.04.2017	No
62	04/2016-17/GS/CRPS/DOZ/M-1466/15	20.04.2016	U.T.RAVEENDRAN, UMMANATHAZHA HOUSE, PANANGAD POST, KOZHIKODE	134	Kayanna	Koyilandy	9.717	Kayanna	Private Land	19.04.2017	No



63	05/2016-17/GS/CRPS/DOZ/M-2243/15	18.05.2016	T.K. ABDUL SALAM, NELLIYOTTU HOUSE, PALERI POST, KUTTIADY (VIA), KOZHIKODE	523/1	Maruthonkara	Vatakara	19.84	Maruthonkara	Private Land	17.05.2017	Yes
64	06/2016-17/GS/CRPS/DOZ/M-888/15	23.05.2016	ABDUL RAHIM, S/o. MOYIN KUTTY, CHANDANA PARAMBIL HOUSE, NEELESWARAM POST, KOZHIKODE	147/2A2	Thazhakode	Kozhikode	9.712	Mukkam Municipality	Private Land	22.05.2017	No
65	07/2016-17/GS/CRPS/DOZ/M.698/16	13.06.2016	O. SIVARAJAN, ODAMANNIL HOUSE, MUKKOM POST, KOZHIKODE	172	Kodiyathur	Kozhikode	30.76	Kodiyathur	Private Land	12.06.2017	No
66	08/2016-17/GS/CRPS/DOZ/M.597/16	15.06.2016	B.P. SIDDIQUE HAJI, MANAGING PARTNER, CHELUPARA GRANITES, NOOR MAHAL, MEDICAL COLLEGE POST, KOZHIKODE	172	Kodiyathur	Kozhikode	9.717	Kodiyathur	Private Land	14.06.2017	No
67	09/2016-17/GS/CRPS/DOZ/M.1265/16	15.06.2016	SASI. K.K, S/o. ANDI, KAREKANDY HOUSE, IRINGATH POST, PAYYOLI (VIA), KOZHIKODE	156/3	Menhaniem	Koyilandy	4.858	Perambra	Private Land	14.06.2017	No
68	10/2016-17/GS/CRPS/DOZ/M.257/16	15.06.2016	M.K. BABU, S/o. KANNAN, MARUTHULLA PARAMBIL HOUSE, KUNDUTHODE POST, KOZHIKODE	41	Nadapuram	Vatakara	9.717	Nadapuram	Private Land	14.06.2017	No
69	11/2016-17/GS/CRPS/DOZ/M.1413/15	22.06.2016	RAJESH. C, THANKAPURI HOUSE, NITC POST, KOZHIKODE	63/1A3	Chatha mangalam	Kozhikode	4.858	Chatha mangalam	Private Land	21.06.2017	No
70	12/2016-17/GS/CRPS/DOZ/M.1021/16.	29.06.2016	T.K. ABDUL SALAM, NELLIYOTTU HOUSE, PALERI POST, KUTTIADI, KOZHIKODE	523/1	Maruthonkara	Vatakara	40.47	Maruthonkara	Private Land	28.06.2017	Yes
71	13/2016-17/GS/CRPS/DOZ/M.1164/15	10.08.2016	U.T. RAVEENDRAN, S/o. CHANDUKUTTY, UMMANATHAZHA HOUSE, PANANGAD POST, KOZHIKODE	28/1	Kayanna	Koyilandy	4.8583	Kayanna	Private Land	09.08.2017	No

72	14/2016-17/ GS/CRPS/DOZ/M.1025/16	10.08.2016	MUNEER. P.M, S/o. MOIDHU, KAPPUMMAL HOUSE, PALERI TOWN POST, KOZHIKODE	104/5	Kayakkodi	Vatakara	9.7	Kayakkodi	Private Land	09.08.2017	No
73	15/2016-17/ GS/CRPS/DOZ/M.1110/16	10.08.2016	SHAJI MATHEW, MANAGING PARTNER, MATHA INDUSTRIES, PUNNAKADAVU ROAD, KOOMBARA BAZAR POST, KOZHIKODE	Un survey	Kooddaranji	Thamarassery	14.17	Kooddaranji	Private Land	09.08.2017	No
74	16/2016-17/ GS/CRPS/DOZ/M.647/16	17.08.2016	A. SAJEEVAN, S/o. CHATHAN, AVARATTU HOUSE, KOTTUR POST, KOZHIKODE	1/3A	Kayanna	Koyilandy	18.093	Kayanna	Private Land	16.08.2017	No
75	17/2016-17/ GS/CRPS/DOZ/M.2079/15	17.08.2016	N.P. PADMANABHAN, MANAGING PARTNER, KUTTIYADI JELLY MAKING INDUSTRIES, KAVILUMPARA POST, KOZHIKODE	6/1	Kavilumpara	Vatakara	9.717	Kavilumpara	Private Land	16.08.2017	No
76	18/2016-17/ GS/CRPS/DOZ/M.22/16	22.08.2016	ASHOKAN. P, S/o. PERACHAN, PALAKADI HOUSE, CHOOLOOR POST, NIT (VIA), KOZHIKODE	86/1	poolakode	Kozhikode	9.717	Chatha mangalam	Private Land	21.08.2017	No
77	19/2016-17/ GS/CRPS/DOZ/M.1247/15	31.08.2016	E.P. KRISHNAN KUTTY, S/o. CHOYI KUTTY, NOONIYIL MEETHAL HOUSE, PANTHEERANKAVU POST, KOZHIKODE	67/2A	Perumanna	Kozhikode	4.4534	Perumanna	Private Land	30.08.2017	No
78	20/2016- 17/GS/CRPS/DOZ/M- 1570/16	09.09.2016	HABEEB RAHIMAN, S/o. MUHAMMED, PUTHOOR MADATHIL HOUSE, MUKKAM POST, KOZHIKODE	67	Kakad	Kozhikode	30	Karassery	Private Land	08.09.2017	No
79	21/2016-17/ GS/CRPS/DOZ/M.1580/16	23.09.2016	MUNEER. P.M, S/o. MOIDU, KAPPUMMAL HOUSE, PALERI TOWN POST, KUTTYADI, KOZHIKODE	105/1	Kayakodi	Vatakara	4.78	Kayakodi	Private Land	22.09.2017	No

80	22/2016-17/ GS/CRPS/DOZ/M.1173/15	23.09.2016	BABU. M.K, S/o. KANNAN, MARUTHULLA PARMBATH, KUNDUTHODE POST, KAVILUMPARA, KOZHIKODE	509/1	Ayancheri	Vatakara	9.717	Ayancheri	Private Land	22.09.2017	No
81	23/2016-17/ GS/CRPS/DOZ/M.1029/16	26.09.2016	P.C. MUHAMMED BASHEER, S/o. MOIDEENKOYA, P.C. HOUSE, EKAROO POST, KOZHIKODE	1	Sivapuram	Thamarassery	19.4331	Unnikulam	Private Land	25.09.2017	No
82	24/2016-17/ GS/CRPS/DOZ/M.1213/15	28.09.2016	MUHAMMED ALI, S/o. KOYAKUTTY, VALIYAPEEDIYEKAL HOUSE, THAMARASSERY POST, KOZHIKODE	16/1	Koodathai	Thamarassery	9.717	Kodenchery	Private Land	27.09.2017	
83	25/2016-17/ GS/CRPS/DOZ/M.2379/15	05.10.2016	A.M. MATHEW, S/o. MATHEW, ETTIYIL HOUSE, KALLANODE POST, KOORACHUNDU (VIA), KOZHIKODE	Un survey	Koorachundu	Koyilandy	4.859	Koorachundu	Private Land	04.10.2017	
84	26/2016-17/ GS/CRPS/DOZ/M.570/16	05.10.2016	ABDUL RAZAK. V.K, S/o. MOYIN KUTTY HAJI, VARUVIN KALAYIL HOUSE, VALIYAPARAMBA POST, KOZHIKODE	16/1	Koodathai	Thamarassery	9.717	kodanchery	Private Land	04.10.2017	
85	27/2016-17/ GS/CRPS/DOZ/M.2215/15	17.10.2016	LINEJ. T.P, S/o. CHANDRAN, THANDALAM PARAMBATH HOUSE, PILASSERY POST, KOZHIKODE	Un survey	Koodaranhi	Thamarassery	9.717	Koodaranhi	Private Land	16.10.2017	
86	28/2016-17/ GS/CRPS/DOZ/M. 497/16	17.10.2016	SUDHAKARA MENOKI, S/o. GOPALAN NAIR, THANKA NIVAS, VILLIPARAMBA POST, KOZHIKODE	201	Perumanna	Kozhikode	9.717	Perumanna	Private Land	16.10.2017	
87	29/2016-17/ GS/CRPS/DOZ/M. 352/16	19.10.2016	LINEJ. T.P, S/o. CHANDRAN, THANDALAM PARAMBATH HOUSE, PILASSERY POST, KOZHIKODE	98	Kunna mangalam	Kozhikode	9.717	Pilassery	Private Land	18.10.2017	

88	30/2016-17/ GS/CRPS/DOZ/M. 1269/15	19.10.2016	FAISAL. P.P, S/o. MAMMU HAJI, PUTHUPARAMBIL HOUSE, PARAMMALANGADI POST, MALAPURAM	2/1B	Kedavoor	Thamarassery	9.717	Kattiipara	Private Land	18.10.2017	
89	31/2016-17/ GS/CRPS/DOZ/M. 1943/16	21.10.2016	I.P. JATHEENDRAN, MANAGING PARTNER, ASSOCIATED QUARRIES, ROOM No. K.P. 10/605, KAKKODI POST, KOZHICODE	21/1	Chelannur	Kozhikode	13.99	Chelannur	Private Land	20.10.2017	
90	32/2016-17/ GS/CRPS/DOZ/M. 1983/16.	24.10.2016	ABDULLA KOYA THANGAL C.P, MANAGING PARTNER, RUBY STONE CRUSHER, CHAMAL POST, THAMARASSERY, KOZHICODE	1	Kattipara	Thamarassery	39.63	Kattiipara	Private Land	23.10.2017	
91	33/2016-17/ GS/CRPS/DOZ/M. 1978/16	24.10.2016	C.P. MUHAMMED, S/o. ALAVI, MELEPOOLAKAL HOUSE, KUNNAMANGALAM, KOZHICODE	172	Kodiyathur	Kozhikode	14.575	Kodiyathur	Private Land	23.10.2017	
92	34/2016-17/ GS/CRPS/DOZ/M. 1657/16.	31.10.2016	B.P. SIDHIQUE HAJI, MANAGING PARTNER, CHELUPARA GRANITES, PUTHIYANIDAM, THOTTUMUKKAM POST, KOZHICODE	172	Kodiyathur	Kozhikode	9.717	Kodiyathur	Private Land	30.10.2017	

**Table 2c: List of quarrying permits opting CRPS granted for Laterite building stone (valid as on 31.10.2016)**

Sl.No.	Concession no.	Date of grant	Name & address of permit holder	Sy.Nos	Village	Taluk	Area (Ares)	Panchayat	Tenure of land	Valid up to
1	39/2015-16/LTS/CRPS/DOZ/M-1894/15	11.11.2015	SAJITH. B. K, BALARAJAM HOUSE, CHULLOOR POST, N.I.T. (VIA),	2/1	Rarooth	Thamarassery	9.717	Kattipara	Private Land	10.11.2016
2	40/2015-16/LTS/CRPS/DOZ/M-1792/15	23.11.2015	PRAJEESH. R.P, RAMAPURAM PARAMBIL HOUSE, CHULLOOR POST, KOZHICODE	172	Kodiyathur	Kozhikode	9.717	Kodiyathur	Private Land	22.11.2016
3	41/2015-16/LTS/CRPS/DOZ/M-2059/15	09.12.2015	MARIYUMMA, W/o. MUHAMMED, THURAYANPILAKKAL HOUSE, THIRUVAMBADY POST, KOZHICODE	48/2	Thazhakode	Kozhikode	9.717	Mukkam	Private Land	08.12.2016
4	42/2015-16/LTS/CRPS/DOZ/M-2137/15	14.12.2016	MOHAMMED. P.P, S/o. ABDULLA. P.P, PAYIMBALAPPURATH HOUSE, CHENNAMANGALLOOR POST, MUKKAM, KOZHICODE	165/1	Thazhakode	Kozhikode	9.717	Mukkam	Private Land	13.12.2016
5	43/2015-16/LTS/CRPS/DOZ/M-2244/15	21.12.2014	VISWANATHAN.K, POROLI HOUSE, THALAKULATHUR POST	77	Atholi	Koyilandy	9.717	Atholi	Private Land	20.12.2016
6	44/2015-16/LTS/CRPS/DOZ/M-2324/15	21.12.2014	RAFEEQUE. K.K, EDAKKUDI KUNNUMMAL, THURUTHIAD POST	31/3	Balussery	Koyilandy	9.73	Balussery	Private Land	20.12.2016
7	45/2015-16/LTS/CRPS/DOZ/M-2326/15	21.12.2015	ABHILASH.T.K, RAJKAMAL, MAKKADA POST, KOZHICODE	5	Atholi	Koyilandy	9.717	Atholi	Private Land	20.12.2016
8	46/2015-16/LTS/CRPS/DOZ/M-2262/15	23.12.2015	SUNIL.K.K, KADUNGON KANDY, NANMINDA POST	90/6	Kakkur	Kozhikode	9.717	Kakkur	Private Land	22.12.2016
9	47/2015-16/LTS/CRPS/DOZ/M-2241/15	30.12.2015	HANEEFA. P.P, PERINGAPURATH, PANNIKOTTUR POST	7/2	Narikuni	Thamarassery	7.89	Narikuni	Private Land	29.12.2016
10	48/2015-16/LTS/CRPS/DOZ/M-2327/15	11.01.2016	AHAMMED, KUNNUMMEL HOUSE, KOTTAMPARAMBA POST, MEDICAL COLLEGE (VIA), KOZHICODE	485/2	Kunnamangalam	Kozhikode	19.433	Kunnamangalam	Private Land	10.01.2017

11	49/2015-16/LTS/CRPS/DOZ/M-2345/15	11.01.2016	SURESH BABU, S/o. UNNI, 15/244, KALLUMPURATH MEETHAL, KUNNATHARA POST, KOZHIKODE	62/1B3B	Ulliyeri	Koyilandy	9.717	Ulliyeri	Private Land	10.01.2017
12	50/2015-16/LTS/CRPS/DOZ/M-2508/15.	11.01.2015	RUMEESH. T.V, S/o. MOIDEEN KOYA, VELLAPPADAN KANDY, ANNASSERY POST, KOZHIKODE	34/1	Kakkur	Kozhikode	9.717	Kakkur	Private Land	10.01.2017
13	51/2015-16/LTS/CRPS/DOZ/M-23/2016	13.01.2016	THE SECRETARY, PHARMACEUTICAL SOCIETY OF KERALA, PHARMACY BHAVAN, THIRUVANANTHAPURAM	238/1	Olavanna	Kozhikode	9.717	Olavanna	Private Land	12.01.2017
14	52/2015-16/LTS/CRPS/DOZ/M-2471/2015	18.01.2016	SURESH. T, S/o. ACHUTHAN, THADATHIL HOUSE, CHOOLOOR POST, N.I.T, KOZHIKODE	26/1	Mavoor	Kozhikode	9.717	Mavoor	Private Land	17.01.2017
15	53/2015-16/LTS/CRPS/DOZ/M-2167/15	18.01.2016	DEVADASAN, S/o. CHOYI, POOTHAKUZHIYIL HOUSE, CHOOLOOR POST, KOZHIKODE	12/2A2A	Thalakkulathur	Kozhikode	9.717	Thalakkulathur	Private Land	17.01.2017
16	54/2015-16/LTS/CRPS/DOZ/M-1634/15	20.01.2016	T. SREENIVASAN, S/o. APPU, VADAKKE PARAMBIL HOUSE, NEELESWARAM POST, KOZHIKODE	90/1A1	Thazhakode	Kozhikode	9.717	Mukkam	Private Land	19.01.2017
17	55/2015-16/LTS/CRPS/DOZ/M-28/16	20.01.2016	SHAJI MICHAEL, KALLIDUKKIL HOUSE, VENAPPARA POST, KOZHIKODE	79/1	Thiruvambady	Thamarassery	4.858	Thiruvambady	Private Land	19.01.2017
18	56/2015-16/LTS/CRPS/DOZ/M-34/2016	25.01.2016	SABITH. T, THOTTOLI HOUSE, NANMINDA POST, KOZHIKODE	272/2	Nanminda	Kozhikode	9.717	Nanminda	Private Land	24.01.2017
19	57/2015-16/LTS/CRPS/DOZ/M-2383/15	25.01.2016	BINEESH. N.P, S/o. SREEDHARAN , NHAERAL PADIKKAL HOUSE, EDAKKARA POST, CHELANNUR, KOZHIKODE	12/2A2A	Thalakkulathur	Kozhikode	9.717	Thalakkulathur	Private Land	24.01.2017
20	58/2015-16/LTS/CRPS/DOZ/M-1919/15	25.01.2016	SUNIL KUMAR. K, KARIYATHANKUZZHI HOUSE, CHERUVAYUR POST, VAZHAKKAD, MALAPPURAM	155	Thazhakode	Kozhikode	9.717	Mukkam	Private Land	24.01.2017

21	59/2015-16/LTS/CRPS/DOZ/M-2547/15.	27.01.2016	RAMACHANDRAN, S/o. PACHU, PERADIMANNIL HOUSE, CHATHAMANGALAM POST, KOZHIKODE	41/3	Thazhakode	Kozhikode	9.717	Mukkam	Private Land	24.01.2017
22	60/2015-16/LTS/CRPS/DOZ/M-25/16	27.01.2016	SHIJU KUMAR. M.K, S/o. DIVAKARAN NAIR, MANNIN KUTTIYIL HOUSE, KOTTAMPARAMBA POST, KOZHIKODE	317/1A1A	Poolakkode	Kozhikode	9.72	Chathamangalam	Private Land	26.01.2017
23	61/2015-16/LTS/CRPS/DOZ/M-2456/15	01.02.2016	ABDULLA P, PULIYASSERY HOUSE, VELLALASSERY POST, REC (VIA), KOZHIKODE	113/2	Mavoor	Kozhikode	9.717	Mavoor	Private Land	31.01.2017
24	62/2015-16/LTS/CRPS/DOZ/M-2003/15	04.02.2016	SHIBU. M.K, S/o. SANKARAN (LATE), MANNARAKUNNATH HOUSE, VAKAYAD POST, KOZHIKODE	72/5	Avitanelloor	Koyilandy	4.0485	Kottoor	Private Land	03.02.2017
25	63/2015-16/LTS/CRPS/DOZ/M-222/16	18.02.2016	ANEESH KUMAR. K.M, KOMMOTTU MEETHAL HOUSE, KAKKANCHERY POST, KOYILANDY, KOZHIKODE	45	Ulliyeri	Koyilandy	9.717	Ulliyeri	Private Land	17.02.2017
26	64/2015-16/LTS/CRPS/DOZ/M-203/16.	22.02.2016	RAMESH. P, PULIKKOOL HOUSE, THURUTHIAD POST, BALUSSERY, KOZHIKODE	11/2	Balussery	Koyilandy	4.858	Balussery	Private Land	21.02.2017
27	65/2015-16/LTS/CRPS/DOZ/M-202/16	22.02.2016	AIMAN, S/o. ABDURAHIMAN, PULPARAMBIL HOUSE, PERUMANNA POST, KOZHIKODE	239	Perumanna	Kozhikode	9.717	Perumanna	Private Land	21.02.2017
28	66/2015-16/LTS/CRPS/DOZ/M-348/16	29.02.2016	DEVADASAN, KURUPPASSAN KANDIYIL, KONOTTU POST, KOZHIKODE	72/2	Kuruvattoor	Kozhikode	8.097	Kuruvattoor	Private Land	28.02.2017
29	67/2015-16/LTS/CRPS/DOZ/M-1963/15	02.03.2016	SHAJI. P.C, PARACHOTTIL HOUSE, KEEZHARIYUR POST, KOZHIKODE	77/1	Keezhariyur	Koyilandy	9.717	Keezhariyur	Private Land	01.03.2017
30	68/2015-16/LTS/CRPS/DOZ/M-322/2016.	14.03.2016	JOHN. C.J, S/o. JOSEPH, CHEENKALLEL HOUSE, KAYANNA POST, PERAMBRA (VIA), KOZHIKODE	104/2A	Perambra	Koyilandy	9.717	Chakkittapara	Private Land	13.03.2017

31	69/2015-16/LTS/CRPS/DOZ/M-536/16	30.03.2016	ABDUL SHUKKUR. V.K, S/o. KALANTHAN KUTTY, EROKKANDI HOUSE, KAKKUR POST, KOZHIKODE	41/3	Chelavoor	Kozhikode	8.097	Chelannur	Private Land	29.03.2017
32	01/2016-17/LTS/CRPS/DOZ/M-319/16.	04.04.2016	ANEES. M.K, S/o. MUHAMMED HAJI, MOOSARIKKANDY HOUSE, PAZHOOR POST, MAVOOR (VIA), KOZHIKODE	25/1A2	Poolakkode	Kozhikode	9.717	Chathamangalam	Private Land	03.04.2017
33	02/2016-17/LTS/CRPS/DOZ/M-717/16.	11.04.2016	BASHEER. O, S/o. MUHAMMED, ORALAKOTH HOUSE, MANIPURAM POST, KOZHIKODE	155	Thazhakode	Kozhikode	9.717	Mukkam Municipality	Private Land	10.04.2017
34	03/2016-17/LTS/CRPS/DOZ/M-691/16	13.04.2016	PREMAVALSAN, S/o. CHATHUKUTTY, KADUNGOCHANKANDY, CHOOLUR POST, KOZHIKODE	24/1	Thazhakode	Kozhikode	9.717	Mukkam Municipality	Private Land	12.04.2017
35	04/2016-17/LTS/CRPS/DOZ/M-697/16	13.04.2016	PREMAVALSAN, S/o. CHATHUKUTTY, KADUNGOCHANKANDY, CHOOLUR POST, KOZHIKODE	60	Thazhakode	Kozhikode	9.717	Mukkam Municipality	Private Land	12.04.2017
36	05/2016-17/LTS/CRPS/DOZ/M-526/16.	04.05.2016	SUBEESH, THAIKANDIYIL HOUSE, AROOR POST, KOZHIKODE	1/1A1	Perambra	Koyilandy	8.097	Chakkittapara	Private Land	03.05.2017
37	06/2016-17/LTS/CRPS/DOZ/M-871/16	04.05.2016	JAYADEVAN, MARIYATH HOUSE, CHEROOPA POST, MAVOOR, KOZHIKODE	9/2	Poolakkode	Kozhikode	9.717	Chathamangalam	Private Land	03.05.2017
38	07/2016-17/LTS/CRPS/DOZ/M-926/16	09.05.2016	SHYJU. A, S/o. KUTTYAMAN, EDAPPARAMBATH HOUSE, NAIRKUZHI POST, N.I.T, KOZHIKODE	46	Koodathai	Thamarassery	8.9068	Omassery	Private Land	08.05.2017
39	08/2016-17/LTS/CRPS/DOZ/M-564/16	25.05.2016	RAMESH BABU, S/o. SIVAN NAIR, SIVAPUSHPAM, NALLOORANGADI, FEROKKE POST, KOZHIKODE	122/2B2	Kadalundi	Kozhikode	9.717	Kadalundi	Private Land	24.05.2017
40	09/2016-17/LTS/CRPS/DOZ/M-381/16	25.05.2016	BHASKARAN KIDAVU, S/o. SANKARAN NAMBIAR, KALLUVETTUKUZHICKAL HOUSE, MODAKKALLUR POST, KOZHIKODE	20/1	Ulliyeri	Koyilandy	9.717	Ulliyeri	Private Land	24.05.2017



41	10/2016-17/LTS/CRPS/DOZ/M-700/16	25.05.2016	GIREESH. K, S/o. RAGHAVAN, KOTTARATHIL KANATTIRI HOUSE, PULIKKAL POST, MALAPPURAM	23/1B1	Perumanna	Kozhikode	9.717	Perumanna	Private Land	24.05.2017
42	11/2016-17/LTS/CRPS/DOZ/M-1108/16	01.06.2016	VIJITH. P, S/o. BALAKRISHNAN, PARAKKAL HOUSE, PERUMANNA POST, KOZHIKODE	23/1B1	Perumanna	Kozhikode	9.717	Perumanna	Private Land	31.05.2017
43	12/2016-17/LTS/CRPS/DOZ/M-1116/16.	05.06.2016	ANEESH. K.M, S/o. PERAVAKUTTY, KAVIDUKKIL MEETHAL HOUSE, MODAKKALLUR POST, ATHOLY, KOZHIKODE	2/1B2	Ulliyeri	Koyilandy	9.717	Ulliyeri	Private Land	05.06.2017
44	13/2016-17/LTS/CRPS/DOZ/M-1160/16	08.06.2016	RAJU JOHN, S/o. JOHN, THURUTHIPALLI HOUSE, KATTIPARA POST, THAMARASSERY, KOZHIKODE	Unsurvey	Kattipara	Thamarassery	9.717	Kattipara	Private Land	07.06.2017
45	14/2016-17/LTS/CRPS/DOZ/M-1152/16	13.06.2016	DINESAN. A, S/o. CHOYI, ATHOLI HOUSE, KOLATHARA POST, KOZHIKODE	110/2	Peruvayal	Kozhikode	17.8	Pervayal	Private Land	12.06.2017
46	15/2016-17/LTS/CRPS/DOZ/M-1113/16.	13.06.2016	GOKUL. M.C., MEETHALE CHANDRA VEETIL, KEEZHARIYOOR POST, KOYILANDY, KOZHIKODE	21/2	Kozhulallur	Koyilandy	9.71	Meppayur	Private Land	12.06.2017
47	16/2016-17/LTS/CRPS/DOZ/M-1278/16	11.07.2016	T.K. ABHILASH, S/o. RAJAN, RAJKAMAL HOUSE, MAKKADA POST, KAKKODI (VIA), KOZHIKODE	12/2A2A	Thalikulathur	Kozhikode	9.717	Thalikulathur	Private Land	10.07.2017
48	17/2016-17/LTS/CRPS/DOZ/M-1324/16	13.07.2016	PRAMEESH. P, S/o. GOPALAN, PARAKKUNNATH HOUSE, CHOOLOR POST, KOZHIKODE	25/1A2	Poolakkode	Kozhikode	9.717	Chathamangalam	Private Land	12.07.2017
49	18/2016-17/LTS/CRPS/DOZ/M-1248/16	18.07.2016	CHERUNNI. K, S/o. CHANDU KUTTY, BELLARI, DIVYA NIVAS, NAIRKUZHI POST, N.I.T, KOZHIKODE	28/1	Koodathai	Kozhikode	9.717	Omaseery	Private Land	17.07.2017
50	19/2016-17/LTS/CRPS/DOZ/M-1326/16	20.07.2016	ANIL KUMAR. M.K, S/o. PARAVAKUTTY, MELEKOYILOTH HOUSE, MANGAD POST, UNNIKULAM, KOZHIKODE	53	Kottur	Koyilandy	9.717	Kottur	Private Land	19.07.2017

51	20/2016-17/ LTS/CRPS/DOZ/M- 1328/16	25.07.2016	ABDULLA SHABEER, S/o. MOOSANKUTTY, KORALAYADAN HOUSE, PUTHALAM, AREECODE, MALAPPURAM	90/1A	Thazhakode	Kozhikode	19.4332	Mukkam Municipality	Private Land	24.07.2017
52	21/2016-17/ LTS/CRPS/DOZ/M- 1422/16.	25.07.2016	ABDULLA .P, S/o. ASSAIN, PULIYASSERY HOUSE, VELLALASSERY POST, R.E.C (VIA), KOZHIKODE	113/2	Mavoor	Kozhikode	9.717	Mavoor	Private Land	24.07.2017
53	22/2016-17/ LTS/CRPS/DOZ/M- 1421/16	27.07.2016	SHAJU, S/o. BALAN, MADHUVANATHU HOUSE, P.C. PALAM POST, NARIKUNI, KOZHIKODE	74/3A	Kakoor	Kozhikode	9.717	Kakoor	Private Land	26.07.2017
54	23/2016-17/ LTS/CRPS/DOZ/M- 1420/16	03.08.2016	MUJEEB, S/o. AHAMMED KUTTY, VADAKKE PARAMBIL HOUSE, UNNIKULAM POST, KOZHIKODE	54	Koodathai	Thamarassery	9.717	Kodanchery	Private Land	02.08.2017
55	24/2016-17/ LTS/CRPS/DOZ/M- 1407/16	03.08.2016	SMT. MARIYUMMA, W/o. MUHAMMED, THURAYAN PILAKAL HOUSE, THIRUVAMBADY, KOZHIKODE	48/2	Thazhakode	Kozhikode	19.3887	Mukkam Municipality	Private Land	02.08.2017
56	25/2016-17/ LTS/CRPS/DOZ/M- 1503/16	08.08.2016	K. ABDUL SALAM, S/o. KOYAKUTTY, KUYADIYIL HOUSE, PANNIKOTTOOR POST, KODUVALLY, KOZHIKODE	69/1	Poolakkode	Kozhikode	9.717	Chathamangalam	Private Land	07.08.2017
57	26/2016-17/ LTS/CRPS/DOZ/M- 1480/16	10.08.2016	LALU. N, S/o. SREEDHARAN, NERATTUMMAL HOUSE, PERUMANNA POST, KOZHIKODE	259	Perumanna	Kozhikode	9.717	Perumanna	Private Land	09.08.2017
58	27/2016-17/ LTS/CRPS/DOZ/M- 1543/16.	16..08.2016	JABIR. K, S/o. IMBICHAMMED, KUNGANCHAERY HOUSE, CHENAMANGALoor POST, KOZHIKODE	90/1A1	Thazhakode	Kozhikode	9.717	Mukkam Municipality	Private Land	15.08.2017
59	28/2016-17/ LTS/CRPS/DOZ/M- 1542/16.	22.08.2016	PRABHIL KUMAR, S/o. VASU NAIR, THALECHAMANNIL HOUSE, CHATHAMANGALAM POST, KOZHIKODE	48/1	Chathamangalam	Kozhikode	6.4777	Chathamangalam	Private Land	21.08.2017
60	29/2016-17/ LTS/CRPS/DOZ/M- 1614/16	25.08.2016	UNNIKRISHNAN, S/o. Ayyappan, CHEKANA PARAMBA, AYIKARAPADI POST, MALAPPURAM	67	Kakkad	Kozhikode	9.717	Karassery	Private Land	24.08.2017

61	30/2016-17/ LTS/CRPS/DOZ/M- 1677/16.	29.08.2016	P. DEVADASAN, S/o. CHOYI, POOTHAKUZHYYIL HOUSE, CHOOLUR POST, KOZHICODE	12/2A2A	Thalikulathur	Kozhicode	9.717	Thalikulathur	Private Land	28.08.2017
62	31/2016-17/ CRPS/LTS/DOZ/M- 1613/16	31.08.2016	ANWAR SADIQUE. K, So. ABDU RAHIMAN, KUZHIMBATTIL HOUSE, CHERUVAYOOR POST, MALAPPURAM	137/2	Kodiyathur	Kozhicode	9.717	Kodiyathur	Private Land	30.08.2017
63	32/2016-17/ CRPS/LTS/DOZ/M- 158/16	31.08.2016	VIJESH.M, S/o. SURESHAN, MANDAYIKAL HOUSE, NALLALAM POST, KOZHICODE	23/1B1	Perumanna	Kozhicode	9.717	Perumanna	Private Land	30.08.2017
64	33/2016-17/ CRPS/LTS/DOZ/M- 1707/16.	05.09.2016	MANOJ. M.P, S/o. KUNNIKANARAN, MEKKAM PARAMBATH HOUSE, KEEZHARIYOOR POST, KOZHICODE	43/1	Keezhariyoor	Koyilandy	9.717	Keezhariyoor	Private Land	04.09.2017
65	34/2016-17/ CRPS/LTS/DOZ/M- 1705/16	19.09.2016	ANEESH. K.M, S/o. PERAVAKUTTY, KAVIDUKKAL MEETHAL HOUSE, MODAKALLOOR POST, KOZHICODE	2/1B2	Ulliyeri	Koyilandy	9.717	Ulliyeri	Private Land	18.09.2017
66	35/2016-17/ CRPS/LTS/DOZ/M- 1783/16	19.09.2016	RUMEESH. T.V, S/o. MOIDEEN KOYA, THEKKEVALAPPIL HOUSE, ANNASSERY POST, THALAKULATHOOR, KOZHICODE	12/1	Thalikulathur	Kozhicode	9.717	Thalikulathur	Private Land	18.09.2017
67	36/2016-17/ CRPS/LTS/DOZ/M- 1514/16	22.09.2016	VELAYUDHAN. A, S/o. VELUMBIRA, MANNARAKKAL MEETHAL HOUSE, PALATH POST, KOZHICODE	101/4A, 92/3A	Kakoor	Kozhicode	8.7045	Kakoor	Private Land	21.09.2017
68	37/2016-17/ CRPS/LTS/DOZ/M- 1627/16	22.09.2016	SHIHABUDEEN. P, S/o. VEERAN, PALIYIL HOUSE, KANNIPARAMBA POST, KOZHICODE	188/2	Kodiyathur	Kozhicode	4.05	Kodiyathur	Private Land	21.09.2017
69	38/2016-17/ CRPS/LTS/DOZ/M- 1731/16	28.09.2016	HARIDASAN. V.C, S/o. RAMAN, VALIYARAMATH CHALIL, PAVANDOOR POST, KOZHICODE	12/2A2A	Thalikulathur	Kozhicode	9.717	Thalikulathur	Private Land	27.09.2017

70	39/2016-17/ CRPS/LTS/DOZ/M- 1852/16	28.09.2016	SIVADASAN. N.P, S/o. KUNHIRAMAN, NADUPARAMBIL HOUSE, KUNNATHARA POST, KOZHIKODE	3/2	Ulliyeri	Koyilandy	9.717	Ulliyeri	Private Land	27.09.2017
71	40/2016-17/ CRPS/LTS/DOZ/M- 1604/16	17.10.2016	SUNIL KUMAR. K, S/o. CHEKKU, KARIYATHANKUZHI HOUSE, CHERUVAYOOR POST, VAZHAKKAD (VIA), MALAPURAM	221/1A	Poolakkode	Kozhikode	19.433	Chathamangalam	Private Land	16.10.2017
72	41/2016-17/ CRPS/LTS/DOZ/M- 1706/16	17.10.2016	ANIL KUMAR. A, S/o. NARAYANAN NAIR, MREEKARA HOUSE, PAVANDOOR POST, KOZHIKODE	12/2A2A	Thalikulathur	Kozhikode	9.717	Thalikulathur	Private Land	16.10.2017
73	42/2016-17/ CRPS/LTS/DOZ/M- 1827/16	24.10.2016	ANEESHAN. K.M, S/o. GOPALAN, KUNNANATTIL HOUSE, NANMINDA POST, KOZHIKODE	8/1A2A3	Sivapuram	Thamarassery	9.717	Unnikulam	Private Land	23.10.2017
74	43/2016-17/ CRPS/LTS/DOZ/M- 2022/16	26.10.2016	SUGESH. T.M, S/o. GOVINDANKUTTY, THATTANKANDI MEETHAL HOUSE, THALAKULATHOOR, ANNASSERY POST, KOZHIKODE	12/2A	Thalikulathur	Kozhikode	9.717	Thalikulathur	Private Land	25.10.2017
75	44/2016-17/ CRPS/LTS/DOZ/M- 1989/16	26.10.2016	SAJIL. A.K, S/o. DAMODHARAN, EREMMANKANDI HOUSE, KEEZHARIYUR POST, KOYILANDY, KOZHIKODE	77/1	keezhariyur	Koyilandy	9.717	keezhariyur	Private Land	25.10.2017
76	45/2016-17/ CRPS/LTS/DOZ/M- 1419/16.	26.10.2016	SIBEESH, S/o. SREEDHARAN, THENADATH HOUSE, CHELANNUR POST, KOZHIKODE	61/1B,71/2	Kakoor	Kozhikode	9.717	Kakoor	Private Land	25.10.2017

**Table 2d: List of short term quarrying permits granted for Granite building stone (valid as on 31.10.2016)**

Sl.No.	Concession no.	Date of grant	Name & address of permit holder	Sy.Nos	Village	Taluk	Area (ARES)	Panchayat	Tenure of land	Quantity (tonnes)	Valid up to	Status	EC (yes/no)
1	06/2016-17/QP/GS/DOZ/M-1618/16	31.08.2016	The Secretary, Uralungal Labour Contract Co-operative Society Ltd 10957, Madappally CollegePost, Kozhikode- 673 102	523/1	Maruthonkara	Vatakara	50	Maruthonkara	Private Land	25,000	30.08.2017	working	Yes
2	18/2016-17/QP/GS/DOZ/M-1929/16	26.10.2016	A.M. HARIDASAN, S/o. SANKARAN KUTTY, THALIKUZHYYIL HOUSE, NANMINDA POST, KOZHICODE	372	Nanmanda	Kozhikode	19.845	Nanmanda	Private Land	1,700	06.12.2016	working	no
3	19/2016-17/QP/GS/DOZ/M-1916/16	26.10.2016	SIDHARTHAN. T., S/o. CHEKUTI, THIYYAKANDY HOUSE, CHEEKILODE POST, KOZHICODE	17/1,2,3,4,6	Nanmanda	Kozhikode	9.72	Nanmanda	Private Land	1,700	06.12.2016	working	no
4	21/2016-17/QP/GS/DOZ/M-1991/16	31.10.2016	V.P. BABU, MANAING PARTNER, KUNDUTHODE QUARRY GROUP, KUNDUTHODE POST, KOZHICODE	262/15	Maruthonkara	Vatakara	9.72	kavilumpara	Private Land	1,000	06.12.2016	working	no

**Table 2e: List of short term quarrying permits granted for Laterite building stone (valid as on 31.10.2016)**

Sl.No.	Concession no.	Date of grant	Name & address of permit holder	Sy.Nos	Village	Taluk	Area (ARES)	Panchayat	Tenure of land	Quantity (tonnes)	Valid up to	Status	EC (yes/no)
1	07/2016-17/QP/LTS/DOZ/M-1666/16.	05.09.2016	RAFEQUE. E.K, S/o. IMBICHI MAMMU, EDAKUDI KUNNUMMAL HOUSE, THURUTHIYAD POST, BALUSSERY, KOZHIKODE	7/2	Balussery	Koyilandy	4.0486 ares	Balussery	Private Land	1250 MT	04.11.2016	working	no
2	08/2016-17/QP/LTS/DOZ/M-1332/16	07.09.2016	BALAN, S/o. KUNHIRAMAN, VARAKUNNUMMAL HOUSE, KURUVANGAD POST, KOZHIKODE	133/2A1C3	Panthalayani	Koyilandy	1.6194	Koyilandy Municipality	Private Land	1000MT	06.11.2016	working	no
3	09/2016-17/QP/LTS/DOZ/M-1746/16	07.09.2016	SHEEBA P.P, W/o. SATHEESH KUMAR, KARUMBACHALIL HOUSE, PAYIMBRA POST, KOZHIKODE	125/1B	Kuruvattoor	Kozhikode	1.9433 ares	Kuruvattoor	Private Land	1660 MT	07.01.2017	working	no
4	10/2016-17/QP/LTS/DOZ/M-1785/16	22.09.2016	DILEEP KUMAR. P, S/o. ARUMUGHAN, VALIYA PARAMBIL HOUSE, PERUMUGAM POST, FEROKE, KOZHIKODE	516/7	Feroke	Kozhikode	9.3117 ares	Feroke Municipality	Private Land	2083 MT	21.02.2017	working	no
5	11/2016-17/QP/LTS/DOZ/M-1651/16	28.09.2016	SUNIL KUMAR. T, S/o. DAMODARAN NAIR, CHAITHRAM HOUSE, KUNNATHARA POST, KOYILANDY, KOZHIKODE	3/1	Ulliyeri	Koyilandy	1.417 ares	Ulliyeri	Private Land	625 MT	21.02.2017	working	no
6	12/2016-17/QP/LTS/DOZ/M-1684/16	03.10.2016	SELIN. S.R, W/o. GHOSHJITH. K, KARAYATT HOUSE, EDACKARA POST, CHELANNUR, KOZHIKODE	125/4	Thalakulathoor	Kozhikode	1.6194 ares	Thalakulathoor	Private Land	416.5 MT	02.11.2016	working	no

7	13/2016-17/QP/LTS/DOZ/M-1683/16	19.10.2016	KANNAN. S, So. Dr. K.P. SASIDHARAN, KOCHANIMOOTIL HOUSE, KETTIL, PANANGAD POST, BALUSSERY, KOZHIKODE	90/2A	Panangad	Thamarassery	2.0243 ares	Panangad	Private Land	417 MT	03.11.2016	working	no
8	14/2016-17/QP/LTS/DOZ/M-1784/16	19.10.2016	DEVADASAN. N, S/o. IMBICHI, KOTHIYAN PARAMBATH HOUSE, PAIMBRA POST, KOZHIKODE	40/2, 40/4C	Kuruvattoor	Kozhikode	2.7085 ares	Kuruvattoor	Private Land	1250 MT	18.01.2017	working	no
9	15/2016-17/QP/LTS/DOZ/M-2011/16	24.10.2016	VIJAYAN. N.P, S/o. GOVINDAN NAIR, MEETHALE KELAMANGALATH HOUSE, MANDHANKAVU POST, KOZHIKODE	32/3	Naduvannur	Koyilandy	4.76 ares	Naduvannur	Private Land	625 MT	23.12.2016	working	no
10	16/2016-17/QP/LTS/DOZ/M-2012/16	24.10.2016	VIJAYAN. N.P, S/o. GOVINDAN NAIR, MEETHALE KELAMANGALATH HOUSE, MANDHANKAVU POST, KOZHIKODE	32/3	Naduvannur	Koyilandy	8.9069	Naduvannur	Private Land	625 MT	23.12.2016	working	no
11	17/2016-17/QP/LTS/DOZ/M-1966/16	24.10.2016	ANWAR SADIQUE, S/o. ABDU RAHIMAN, KUZHIMBATIL HOUSE, CHERUVAYUR POST, KOZHIKODE	55/2A	Mavoor	Kozhikode	4.0469	mavoor	Private Land	1250 MT	23.01.2017	working	no
12	20/2016-17/QP/LTS/DOZ/M-1883/16	31.10.2016	BASHEER. T, S/o. AMMED KUTTY, THOTTOLI HOUSE, NANMINDA POST, KOZHIKODE	329/2A	Nanmanda	Kozhikode	4.0469	Nanmanda	Private Land	1650 MT	28.02.2017	working	no

**Table 2f: List of Registered Metal Crusher Units – RMCU (valid as on 31.10.2016)**

Sl.No.	Concession No.	Date of grant	Name & address of RMCU holder	Sy.Nos	Village	Taluk	Panchayat	Valid up to	No. of jaw crushers	No. of cone crushers	No. of HSI/VSI crushers	Total Consolidated Royalty (Rs.)	No. of QL linked	Status
1	14/2016-17/RMCU/KKD/2717/M3/2016	19.03.2016	M/S. Selva Bricks and Metals, Nellikaparamba Post Mukkam, Kozhikode	67	Kakkad	Kozhikode	Karassery	31.03.2017	76.20 cm X 20.32 cm ( 30"X 8") - 1 No 40.46 cm X 22.86 cm ( 16"X 9") - 2 Nos	0	0	800000	236/10-11/2759/M3/2010 Dtd:07.07.2010	working
2	29/2016-17/RMCU/KKD/2775/M3/2016	22.03.2016	V.P. Mehboob, Alpha Bricks and Metals, Karassery	41/1A	Kakkad	Kozhikode	Karassery	31.03.2017	40.64 cm X 22.86 cm ( 16"X 9") - 4 Nos	0	0	800000	273/05-06/6288/M3/05 Dt. 18.05.05	working
3	41/2016-17/RMCU/KKD/2789/M3/2016	23.03.2016	M/S Poabs Rock Products Pvt. Ltd, Nellikaparamba Post	172	Kodiyathur	Kozhikode	Kodiyathur	31.03.2017	90 cm X 26 cm ( 36"X 10") - 1 No, 75 cm X 25 cm ( 30"X 10") - 1 No, Cone Crusher (220 HP) -1 No	1	1	2800000	278/11-12/2540/M3/11 Dt. 06.08.2011	working
4	22/2016-17/RMCU/KKD/2693/M3/2016	22.03.2016	M.M.Ajas, Mg: Partner, Ponoorpyil Granites, Koodaranhi Post	Un survey	Kumaranellur	Kozhikode	Karassery	31.03.2017	76.20 cm X 20.32 cm ( 30"X 8") -3 Nos,	0	0	1200000	177/08-09/5827/M3/08 Dt. 17.06.2008	working
5	10/2016-17/RMCU/KKD/2670/M3/2016	18.03.2016	Managing Director, Palakkal Granite Products (P) Ltd, KP8/308/ Shakeena Industries, Kunnamangalam Post	172	Kodiyathur	Kozhikode	Kodiyathur	31.03.2017	76.20 cm X 20.32 cm ( 30"X 8") -2 Nos, 60.96 cm X 20.32 cm ( 24"X 8") - 1 No.	0	0	1200000	512/10-11/8823/M3/10 Dt. 11.11.2010	working



6	06/2016-17/RMCU/KKD/2419/M3/2016	14.03.2016	Sukumaran. E, Managing Partner, Tristar Stone Crusher, Pannimukku, Parathode Post, Kozhikode	78/2A	Kumaranellur	Kozhikode	Karassery	31.03.2017	40.64 cm X 22.86 cm ( 16"X 9") - 2 Nos	0	0	400000	300/2014-15/8368/M3/2014. Dtd: 13.08.2014	working
7	05/2016-17/RMCU/KKD/2418/M3/2016	14.03.2016	M/s. Power Stone Products, Eranhimavu, Pannikode Post	186	Kodiyathur	Kozhikode	Kodiyathur	31.03.2017	40.64 cm X 22.86 cm ( 16"X 9") - 2 Nos	0	0	400000	778/2014-15/569/M3/2015. Dtd: 07.02.2015	working
8	142/2016-17/RMCU/KKD/2542/M3/2016	07.04.2016	M/s. Profile Granites, Parathode, Mukkam, Kozhikode-673 602	78/2A	Kumaranellur	Kozhikode	Karassery	31.03.2017	76.20 cm X 22.86 cm ( 30"X 9") - 1 No.	0	0	600000	735/2014-15/131/M3/2015. Dtd: 22.01.2015	working
9	88/2016-17/RMCU/KKD/2866/M3/2016	01.04.2016	M/s. Uralungal Labour Contract Co.Op.Soc.Ltd, Madappally College Post, Kozhikode	172	Kodiyathur	Kozhikode	Kodiyathur	31.03.2017	Cone Crusher (214 HP)- 1 No.	1	1	1600000	727/2014-15/14688/M3/2014. Dtd: 17.01.2015	working
10	172/2016-17/RMCU/KKD/5389/M3/2016	08.06.2016	M/s. Payyoli Granites Private Limited, Thankamala Estate, Keezhariyur Post, Kozhikode	80/1A1	Keezhariyur	Koyilandy	Keezhariyur	31.03.2017	76.20 cm X 25.40 cm ( 30"X 10") - 1 No. 91.44 cm X 20.32 cm ( 36"X 8") - 1 No.	0	0	12,00,000	736/2014-15/250/M3/2015. Dtd: 22.01.2015	working

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## **Geology of Kerala**

### **Physiography**

Physiographically the state can be divided into four domains from east to west, viz., the Western Ghats, the foothills, the midland and the coastal low- land.

### **Western Ghats**

The hill ranges of the Western Ghats rise to an altitude of over 2500m above the MSL and the crest of the ranges marks the inter-state boundary in most of the places. A breach in the continuity of the ranges marks the Palghat Gap with a sinistral shift of 50 km between the shifted crests. The Wynad plateau and the Munnar (10°57'00": 77°31'00") upland fall within this zone.

### **Foothills**

The foothills of the Western Ghats comprise the rocky area from 200 to 600m.above MSL. It is a transitional zone between the high -ranges and midland.

### **Midland region**

This forms an area of gently undulating topography with hillocks and mounds. Laterite capping is commonly noticeable on the top of these hillocks. The low, flat-topped hillocks forming the laterite plateau range in altitude from 30-200m and are observed between coastal low-land and the foothills.

### **Coastal low- land**

Coastal low-land is identified with alluvial plains, sandy stretches, abraded platforms, beach ridges, raised beaches, lagoons and estuaries. The low- land and the plains are generally less than 10m above MSL.

### **Rivers**

Kerala is drained by 44 rivers, many of which originate from the Western Ghats. Except Kabini, Bhavani and Pambar which are east - flowing, the rest of rivers are west- flowing and join the Arabian Sea. A few of them drain into the backwaters. Most important rivers (with their length in km in paranthesis) of the state, are Chandragiri (105), Valapatnam (110), Achankovil (120) Kallada (121), Muvattupuzha (121), Chalakudy (130), Kadalundi(130), Chaliyar (169), Pampa (176),Bharathapuzha (209) and Periyar (244).

## **Geology**

Geologically, Kerala is occupied by Precambrian crystallines, acid to ultra basic intrusives of Archaean to Proterozoic age, Tertiary (Mio-Pliocene) sedimentary rocks and Quaternary sediments of fluvial and marine origin (Fig.I). Both the crystallines and the Tertiary sediments have been extensively lateritised.

Based on the detailed studies by GSI during the last three decades, the following stratigraphic sequence has been suggested.

	Quaternary (Q)	Pebble bed Kadappuram Formation (marine) Periyar Formation (fluvial) Viyam Formation (fluvio-marine) Guruvayur Formation (Palaeo-marine) Laterite
	Mio-Pliocene (N 12) (Tertiary Tt)	Warkalli Formation (Sandstone and clay with lignite intercalations) Quilon Formation (Fossiliferous limestone and calcareous marl).
	Mesozoic (61-144Ma.)	Gabbro / Dolerite dykes
P	Younger granites (550-390Ma)	Alkali granites, granite, Granophyres and other acid intrusives
R		
O	Charnockites (younger) (550Ma)	Massive charnockite, incipient charnockite, Cordierite charnockite
T		
E	Ultrabasic/basics (Younger) (700-600Ma)	Perinthatta anorthosite, Kartikulam gabbro, Adakkathodu gabbro, Begur diorite
R		
O	Basic Intrusives (2100-1600Ma)	Agali- Anakkatti dykes
Z		
O	Migmatite/gneiss/older granitoid (PGC II) (Ptm) (2500-2200Ma)	Gamet-biotite - gneiss with associated migmatites, quartz-felspathic gneiss, homblende gneiss, homblende-biotite gneiss, quartz-mica gneiss
I	Vengad (A Dtv) Group	Quartz-mica schist and quartzite, conglomerate
A	Charnockite (older) (Ac) 2600Ma	Mafic granulite, pyroxene granulite, Banded magnetite quartzite and gneissic charnockite
R		
C	Khondalite Group (Ak)	Quartzite, mafic granulite, calc-granulite gamet- biotite-sillimanite-cordierite gneiss, gamet-biotite- gneiss, leptynite
H	Peninsular Gneissic Complex (PGC I) (Ap) (3000Ma)	Foliated granite, homblende gneiss, pink granite gneiss, biotite gneiss
A	Layerd ultrabasic - basic Complex (3100- 3000Ma)	Peridotite, dunite, pyroxenite, anorthosite
E		
A	Wynad Schist Complex (Aw) (3200Ma)	Talc-tremolite schist, fuchsite quartzite, amphibolite, calc granulite, quartz sericite schist, kyanite quartzite, gamet - sillimanite gneiss/ schist, magnetite quartzite, kyanite mica schist
N		

Base not recognised

## **The Archaean**

Rocks of Archaean Era encompass a wide spectrum of litho-assemblages ranging from khondalite, charnockite, gneiss and meta-sedimentary rocks occupying the Western Ghats including the foothill region. The Khondalite and Charnockite Group are correlated with the Eastern Ghat Supergroup based on the overall similarity in lithology and geochronology.

## **Wynad Supracrustals**

The meta-sedimentary and ultramafic rocks occurring in the Wynad District generated keen interest among the GSI geologists in 1970s. The high-grade Wynad supracrustal rocks are correlated with the Sargur Schist Complex of the Karnataka (Nair, *et al*, 1975; Adiga, 1980). The schistose rocks are characterised by intense deformation, medium to high-grade metamorphism, migmatisation and lack of sedimentary structures. The schist complex consists of meta-ultramafites, schist, meta-pelites, meta-pyroxenite, serpentinite, talc-tremolite rock and amphibolite.

The meta-sedimentaries occur as thin linear bodies within the migmatites. These consist of pelites, psammopelites and quartzites. The predominant rock types are corundum- mica schist, kyanite schist, quartz- mica schist and iron stone.(Anil Kumar *et al*,1993).

These rocks occur as narrow arcuate belts, lenses, and other forms of enclaves within Peninsular gneisses and charnockite. The group can be divided into medium-to low- grade metasedimentary rocks and meta-mafic and meta-ultramafic rocks. The lithology of the high-grade schists consists of quartz-mica schist with kyanite, quartz-sericite schists, quartzites, magnetite quartzite, fuchsite quartzite and meta-ultramafites. Their contact with the surrounding gneisses is concordant due to later co-folding. Several linear belts of such high-grade schists and ultramafite enclaves occur as isolated bands within the granulite and gneissic terrain of Kasaragod and Kannur districts.

## **Layered ultrabasic- basic complex**

Remnants of layered basic- ultrabasic complex are reported from Attappadi area(Nambiar 1982).The ultramafics are represented by meta-pyroxenite, meta-dolerite, peridotite with chromite and meta-gabbro (Lahiri *et al*, 1975). The anorthosite of Attappadi is only a few metre thick. Occurrences are around Narsimukku, Pudur and Melmulli areas. An east-west trending narrow lenticular body of serpentinitised dunite is reported from Punalur mica mine belt.

A minor body (200 m long and 10-15m wide) of anorthosite was reported within pyroxene-granulite-charnockite terrain from Katanjari *parambu* of Kasargod district (Adiga, 1979). Another dismembered layered igneous complex consisting of alternate layers of peridotite and pyroxenite within charnockite was traced around Panathadi area of Kannur District (Adiga, 1980).

### **Peninsular Gneissic Complex- I (PGC-I)**

The rocks of Peninsular Gneissic Complex (PGC) are exposed in the northern parts of Kerala adjoining Karnataka. This consists of a heterogeneous mixture of granitoid materials. The equivalent rocks of PGC in Kerala include hornblende-biotite gneiss (sheared), biotite-hornblende gneiss, foliated granite and pink granite gneiss. Granite gneiss is exposed along the intra-State boundary of Palakkad District as well as in Idukki District. Pink granite gneiss, though widespread, is best developed in Devikolam (10°04'00": 77°06'30"), and Udumbanchola (10°00'00":77°15'00") areas of Idukki District.

This consists of gneisses showing preponderance of either hornblende or biotite. The percentage of hornblende and biotite varies from place to place. This can be traced from Manantoddy to further northwest upto the west coast. West of Manantoddy, the rock is hornblende gneiss. It shows coarse granulitic to gneissic texture and is composed of hornblende, feldspar, quartz, pyroxene, biotite and garnet. Alkali feldspar shows alteration to clay and sericite. Biotite is mainly secondary after hornblende.

Around Mahe and Thalasseri, the biotite gneiss (Nair *et al.*, 1974) is medium-grained and gneissose rock consisting of alternate layers of mafics and felsics.

### **Khondalite Group**

The Khondalite Group of rocks include calc-granulites, quartzite and para-gneisses of pelitic parentage. Para-gneisses are ubiquitous and are well-developed in the southern part of the state, particularly, in Thiruvananthapuram and Kollam districts. Calc-granulite and quartzite occur as bands within the para-gneisses and amidst the Charnockite Group and migmatitic gneisses.

#### ***Calc-granulite***

Calc-granulite occurs as linear bands mainly in the eastern part of Kollam and Thiruvananthapuram District, northeast and east of Munnar in Idukki district and in parts of Palakkad District. The rock is generally medium to coarse-grained, inequigranular and granoblastic in texture. It consists of diopside and plagioclase. Minerals like wollastonite,

scapolite, calcite, garnet, spinel, sphene, quartz and apatite are also present in different proportions.

### ***Quartzite***

Quartzite occurs as linear bands amidst the khondalitic gneiss, charnockite and migmatitic gneisses. These bands are exposed between Pathanamthitta (9°15'45": 76°47'00"), and Muvattupuzha (9°59'00": 76°35'00") in Ernakulam District. The rock is coarse-grained and generally white in color with a brownish coating on the weathered surface. It consists of granular quartz with subordinate feldspar, garnet and iron oxide.

### ***Garnetiferous biotite-sillimanite gneiss***

Garnetiferous biotite- sillimanite gneiss is well-developed in the southern part of the state. It occurs in close association with the migmatitic gneisses, charnockite and charnockite gneisses, mostly as weathered outcrops. Sillimanite- rich bands occur alternating with garnet - rich portions or with quartzo-feldspathic layers. Rutile and iron oxides are the common accessory minerals.

### **Charnockite Group**

Charnockite Group shows great diversity in lithology comprising pyroxene granulite, hornblende pyroxenite, magnetite quartzite, charnockite and hypersthene-diopside gneisses and cordierite gneiss. Charnockite and charnockitic gneiss have preponderance over all other crystalline rocks covering 40 -50% of the total area of the State. The charnockites are well-exposed in the central and northern parts of Kerala including the high-hills of the Western Ghats. Charnockite has lesser predominance in Thiruvananthapuram and Kollam districts. In Attappady, the Bhavani Shear Zone is limited by the charnockite massif of the Nilgiri plateau on the north. Though the interrelationship of the Charnockite and the Khondalite is not clear, in many places there are intercalations rather than interlayering of one with the other. In Palakkad District, the Khondalite Group of rocks structurally overlies the charnockite. The occurrence of pyroxene granulite as fine and linear bodies within the charnockite of Tirur, suggests that charnockite is a product of migmatization of pyroxene granulite (Vidyadharan and Sukumaran, 1978). Charnockite and charnockitic gneiss consist of quartz, feldspar and biotite. Garnet-bearing variants are also observed. The basic charnockite is more granulitic and contains clino- and ortho- pyroxenes, feldspar, biotite and garnet whereas the acid variety (alaskite/ enderbite) is greenish black, coarse-grained, massive to poorly foliated rock consisting of quartz, feldspar and pyroxenes. Basic charnockite has low- potash feldspar and



more clinopyroxene. This is devoid of garnet and graphite, but shows a little amount of biotite (Chacko, 1922). Due to the polygenetic nature of the rock, geochemical and mineralogical variations do exist between charnockites reported from Kerala. In the Periyar valley region, in Idukki and Kottayam districts, pyroxenite and alaskite constitute the Charnockite Group (Nair, and Selvan, 1976).

The available age data indicate that the massive charnockites are older and their ages range between 2155 and  $2930 \pm 50$  Ma (Soman, 1997).

Also charnockite has been subjected to retrogression and migmatization.

## **Archaean to Palaeo-Proterozoic**

### **Vengad Group**

A succession of schistose rocks in parts of Tellicherry taluk in Kannur district is described as Vengad Group of rocks (Nair, 1976). The Vengad Group comprises of basal conglomerate, quartzite and quartz-mica schist. The contacts are highly gradational. The conglomerate shows graded bedding and quartzite shows current-bedding.

An angular unconformity marked by conglomerate horizon extending from Kuthuparamba ( $11^{\circ}49'30''$ :  $75^{\circ}34'00''$ ) to Vengad ( $11^{\circ}53'30''$ :  $75^{\circ}32'00''$ ) in Kannur district, separates the younger quartz-mica schist and quartzite from the older schistose and gneissic rocks. The lithology consists of basal oligomictic conglomerate, quartzite, quartz-biotite-muscovite schist and biotite quartzite. The schists are exposed over an area of 300 sq km having a lensoidal shape with its longer axis trending in NW-SE direction. The basement rock is gneissic or migmatitic with relicts of high-grade schists, ultramafites and quartzites of the Wynad Schist Complex. Four major occurrences of conglomerate are noticed in a NW-SE direction over a length of 10 km.

Lack of migmatization, presence of primary structures and low-grade metamorphic minerals characterize these rocks.

### **Migmatite\ Gneiss\ Granitoid (PGC-II)**

#### **Quartzo-feldspathic gneiss**

Migmatite includes variety of gneissic rocks which are next in importance to charnockite as a dominant litho-assembly. Quartzo-feldspathic gneiss occurring along the contact zone between garnet-biotite gneiss and garnet-sillimanite gneiss of Thiruvananthapuram area represents an original intrusive phase. It is a feebly foliated, fine-grained, leucocratic granulitic

rock occurring in close association with garnet-sillimanite gneiss and garnet-biotite gneiss with gradational contact relationship in the southern parts of Kerala. The origin of this rock is attributed to stress-induced injection of acid materials into the host rocks (Nageswara Rao and Raju, 1970).

### **Garnet- biotite gneiss**

Garnet-biotite gneiss is well-developed in the northeastern parts of Kollam and Thiruvananthapuram districts. This carries inclusions of pyroxene granulite and disseminations of graphite at many places (Jacob, 1965). It consists of quartz, microperthite, biotite, plagioclase and graphite. This rock also occurs in the northern parts of Palakkad District in close association with khondalite, charnockite and hornblende gneiss. These rocks are subsequently formed by retrogression and migmatization of the Khondalite Group.

East of Kottayam and Idukki districts, light grey, pink garnet-bearing biotite gneiss is widely seen. It is a gneissic granulite. The presence of biotite and concentration of garnet in layers give the rock a banded appearance. (GSI, 1995).

### **Hornblende gneiss, hornblende-biotite gneiss, quartz- mica gneiss**

These rock types occur within the migmatites and associated retrograded charnockite. The naming is purely based on the preponderance of the minerals and these rocks occur in the Periyar valley area east of Thodupuzha. (Nair and Selvan, 1976). These medium-grained, foliated, banded rocks consist of alternate layers rich in hornblende or biotite. Bands of coarse to medium-grained light grey to pink granite traverse these rocks. Hornblende- biotite gneiss showing lit par lit relationship with the granite gneisses is the dominant rock type in the Periyar valley. This is admixed with contorted bands and enclaves of pyroxene granulite, calc-granulite and hornblende- biotite granulite. These are highly deformed.

In the Palakkad gap area, these gneisses occur over a large area, showing migmatitic structures such as agmatites, nebulites, schlierens, ptygmatic folds, quartzo-feldspathic neosomes and ferromagnesian palaeosomes. (Muraleedharan and Raman, 1989).

## **Proterozoic**

### **Basic intrusives**

Basic dyke emplacements within the Archaean crystalline rocks of Kerala are spread throughout the entire length and breadth of the state. Of these, dolerite dyke occurring north of the Palakkad gap had given Proterozoic age whereas in the south this dyke is of Phanerozoic

age. The older basic dykes are metamorphosed along with the country rocks and are now recognised as epidiorite and amphibolite. Another set of dykes, apparently post-dating the regional metamorphic event are subjected to thermal metamorphism. Clouding and sericitisation of feldspars and uralitisation of pyroxenes are common in such dykes. In the absence of chronological data such dykes are considered to be of Proterozoic age. Most of the dykes are vertical in disposition and are traced as linear features. *En-echelon* pattern of some dyke swarms suggests that magmatic intrusion was controlled by shearing of the host rock., Mineralogically, the dykes are made up mostly of plagioclase feldspar and pyroxene(augite and aegirine-augite) with magnetite, apatite and olivine as accessories. The ENE-WSW dolerite dyke swarm of Agali- Anakkati area in Palakkad District within the Bhavani Shear zone showed in isotopic age from 1900 to 2000 Ma (Radhakrishna and Mathew Joseph, 1993). The rock is highly jointed and altered (Jacob, 1965). Similar basic intrusive bodies are traced in the Achankovil shear zone in Vazhamuttam (9°14'00":76°46'40"), Kulasekhara pettah (9°16'00":76°47'45") (Thomas Mathai *et al*, 1984). Sheet-like bodies of fine to medium-grained, dark coloured meta-gabbro occurs in Periyamuli (11°13'00"; 76°43'00") for about 20 km in ENE-WSW direction, Karuvarai (11°04'00"; 76°32'30") and few gabbro bodies south of Thuvapattu (11°06'30"; 76°44'45") in Attapady valley, Palakkad district. Meta-gabbro forms small hillocks east of Payyanam (10°31'00"; 76°21'00"), southwest of Kainur (10°36'00"; 76°09'00") and Chemmannur (10°41'00"; 76°01'00"), Vaga (10°35'00"; 76°06'00") and Arthat (10°37'00"; 76°03'00") in Trichur District (Mahadevan, 1962).

Dykes in north Kerala show, NW-SE, NE-SW and NNW-SSE trends. Host rocks are charnockite, gneisses and supracrustals (Radhakrishna *et al* 1991). Dykes are mainly dolerite but occasional meta-gabbro or meta-norite are also traced. In Agali- Anaikatti area of the Attapadi- Bhavani shear zone, dykes are confined within a 20-25km wide zone and extend from west of Agali to eastward for about 100km following a ENE-WSW direction.(Radhakrishna, *et al*, 1999).

The rock consists of 95% calcic plagioclase, 5% clinopyroxenes and subordinate amounts of magnetite. There are a number of concordant and discordant basic intrusive of dolerite and gabbro, meta-gabbro, meta-norite, meta-pyroxenite and anorthositic gabbro. These are not mappable and are seen in Pappinpra (11°06'20", 76°05'56") Velli (11°04'00":76°07'45"), Kalpetta (11°04'12":76°05'32). An extensive basic diorite has been mapped over an area of 25 sq km at Panavalli (11°53'30", 76 ° 2'30"; Nair, *et al* 1976).

The rock is composed predominantly of calcic plagioclase (95%) rest clinopyroxene with subordinate amount of magnetite. Another relatively small body of anorthosite is around Kalivalli (11°51'30"; 76°12'30") in south Wynad taluk, Wynad District.

#### **Ultrabasic/ basic intrusive (younger)**

##### **Perinthatta Anorthosite**

A major elliptical body of anorthosite spread over an area of more than 50 sq.km is reported from Perinthatta (12°10'00":75°17'30"; Vidyadharan *et al*, 1977). The anorthosite is with a very irregular border and a tongue-like projection into the country rock of charnockite and pyroxene granulite of Kannur District. The anorthosite is coarse to very coarse-grained, and shows variations from pure anorthosite to gabbroic anorthosite and gabbro from the centre to the periphery suggestive of zoning. The modal composition corresponds to nearly 95% plagioclase (An<sub>58-72</sub>) and <10% clinopyroxene, apatite, calcite and magnetite. The gabbroic variants have more of mafics.

The structural configuration suggests that the anorthosite was emplaced in synformal structure as a phacolith. The flow-banding in anorthosite indicates its syntectonic emplacement. The Perinthatta anorthosite is assigned a Proterozoic age.

##### **Ezhimala gabbro-granophyre complex**

The major high-relief feature proximal to the Perinthatta anorthosite is constituted by the gabbro-granophyre Complex (Nair and Vidyadharan, 1982). The granophyre massif is fringed by the gabbro to the east and south. The Bavali fault running north of the complex is presumed to have dismembered the body from the Perinthatta anorthosite. Locally, the gabbro has anorthositic differentiates within it. Veins of granophyre traverse the gabbro at places give rise to breccia-like structures. The granophyre shows a sharp contact with the gabbro into which it intrudes. Rapakivi structure is observed within the granophyre. According to Nair and Vidyadharan (1982) rocks of Ezhimala complex display bimodal character with conspicuous basic and silicic components.

##### ***Kartikulam and Karraug Gabbro***

Two gabbro bodies namely Kartikulam gabbro and Karraug gabbro are located northeast of Manantoddy bordering the Karnataka (Nair *et al*, 1975). The gabbro body at Kartikulam occupies an area of about 45 sq.km. with an elliptical shape within the gneissic terrain. The

actual contact with the gneiss is concealed but it is believed to be sharp. At many places, the gabbro is agmatized by coarse quartzo-feldspathic material.

The gabbro is coarse-grained and of uneven texture consisting essentially of plagioclase and pyroxene. Variation to anorthositic composition is noticed. The plagioclase is of labrodorite composition and shows alteration to sericite at places (Rema Warriar and Venkataraman, 1986). The pyroxenes are uraltized to varying degrees.

The Karraug gabbro body is located east of it and south of the Kabini River. It shows similar features as that of the Kartikulam gabbro. The rock shows phenocrysts of feldspar set in a fine matrix of flaky minerals.

### **Adakkathodu gabbro**

At Adakkathodu (12°31'35"; 75°10'25"), northwest of Manantoddy, a 8 km long meta-gabbro, is intrusive into the basement gneisses on three sides and the Wynad schists in the east. It occurs proximal to the Bavali fault/lineament. It encloses patches of quartz-sericite schists and biotite gneiss (Nair *et al*, 1975). The rock is mesocratic to melanocratic, medium to coarse grained consisting mainly of pyroxene and plagioclase. The rock shows sub-ophitic texture and consists of enstatite and intermediate plagioclase of andesine-labrodorite composition (Nair *et al*, 1976). While the gabbro bodies of Kartikulam and Karraug to the east are olivine-bearing, the Adakkathodu gabbro is enstatite-bearing. Olivine, augite and zoned feldspars are recorded from the eastern body while the western body is enstatite-bearing, without the zoning in feldspar.

### **Begur diorite**

An extensive basic diorite body (25 sq.km.) has been traced north of Manantoddy in the Begur Reserve Forest (Nair, *et al*, 1976). It extends from Thirunelli to the Karnataka State border. The southern contact is with augen gneisses indicating emplacement along shear zones while the northern one with sillimanite gneisses. Aplite and dolerite veins are seen traversing the rock mostly parallel to the regional foliation. The rock is mesocratic to melanocratic, coarse-grained and consists of pink to grey feldspar, hornblende and biotite.

The rock is feebly gneissic and at places porphyritic (Rema Warriar and Venkataramana, 1986). The phenocrysts are mostly plagioclase. Mafics at times swerve round the phenocrysts giving rise to augen structure. Hornblende is altered to biotite and chlorite. Accessories include epidote, apatite, zoisite and opaques.

The diorite shows tholeiitic characteristics. The diorite is considered as a transitional rock from the gabbro with which it is spatially associated in the nearby area with the plagioclase become more sodic.

### **Charnockites [younger]**

The area south of Palakkad exposes charnockite over large areas. The charnockites are represented by acid microperthitic charnockite and intermediate gneissic charnockite occurring in association with garnetiferous biotite gneiss and khondalite (Narayanaswamy and Purna Lakshmi, 1967). Massive charnockites are developed on a regional scale and occur as mappable litho-units (Raju and Gopalakrishnan, 1972), around Nedumangad. The massive charnockites in majority of the cases are acid and intermediate in composition. The rock is medium to coarse-grained and shows xenoblastic texture. It is composed of quartz, feldspar, pyroxenes, garnet and graphite with accessories like biotite, zircon, apatite and monazite.

Small patches, lenses or veins of charnockite occur in the gneisses of amphibolite facies in the Thiruvananthapuram area (Nageswara Rao and Raju, 1970). Here, the incipient charnockites are thought to have formed by transformation of paragneisses. (Hansen *et al*, 1987; Santosh *et al*, 1990). A few dominant varieties of incipient charnockites have been categorized by Ravindra Kumar and Chacko (1986) on the basis of their mode of occurrence, association and chemical processes involved in their development. At Kottavattom, north of Thiruvananthapuram, the charnockite consisting of quartz, K-feldspar, plagioclase, biotite, garnet and orthopyroxene as essential minerals and graphite, zircon, ilmenite, monazite, apatite, rutile and magnetite as accessory minerals are products of transformation of gneisses into coarse-grained charnockites along a system of conjugate fractures and foliation planes. (Saritha and Santosh, 1996).

### **Cordierite or Charnockite Gneiss**

Cordierite bearing large linear zones of charnockites was reported around Pathanamthitta (Nageswara Rao and Jacob, 1967) area. Cordierite charnockites or orthopyroxene-garnet-cordierite bearing gneisses (Sinha Roy *et al*, 1984; Santosh, 1987) occur as discontinuous bodies in the northern parts of Thiruvananthapuram and in selected stretches further south around Koliakode. The rock is composed of cordierite, orthopyroxene, plagioclase, K-feldspar, spinel and quartz and a little garnet and biotite.

The growth of cordierite and orthopyroxene took place concomitantly during the conversion of gneisses to charnockites. At Nellikala in Pathanamthitta, the cordierite occurs as anhedral grains of variable sizes in the charnockites (Nandakumar, 1996).

### **Younger granites**

The granites and its variants occur around Chengannur in Alappuzha and Pathanamthitta districts, Munnar in Idukki District, Peralimala in Kannur district and Kalpetta and Ambalavayal in Wynad District. Many of these granites occur as later emplacements along crustal fractures and faults. The Achenkovil – Tamraparni tectonic zone, the Attapadi shear zone, Bavali shear zone and the Moyar shear zone are all marked by granitic emplacements

### **Ambalavayal granite**

The Ambalavayal (11°37'15"; 76 °03'30") granite having an oval shape covers an area of 50 sq.km. The granite is light pink in color and is composed of quartz, pink feldspar, hornblende and biotite. The pegmatites traversing the granite show occasional flakes of molybdenite. The Amabalavayal granite occurring in the proximity of the Bavali lineament is thought to be emplaced during its reactivation. The granite is intrusive into the hornblende-biotite gneiss (migmatite) and the Wynad Supracrustals (Anilkumar *et al*, 1993). Four types of granites are recorded, viz. foliated granite, pink granite, grey granite and aplitic granite.

The foliated granite consists of quartz, microcline, orthoclase, plagioclase, biotite, hornblende, chlorite, calcite and zircon. The pink granite is a medium-grained consisting of quartz, microcline, plagioclase, sericite, chlorite, apatite, rutile, zircon and biotite. The grey granite is a medium-to fine-grained rock consisting of quartz, microcline, sericite, biotite, chlorite and calcite. The aplitic granite is a very fine-grained massive rock consisting of quartz, microcline, orthoclase, plagioclase, sericite, biotite, calcite, chlorite, apatite and opaques.

K-Ar age of Ambalavayal granite ( $560 \pm 30$  Ma, Nair, *et al*, 1985) is lower than Rb-Sr age ( $595 \pm 20$  m.a Santhosh *et al*, 1986), but is higher than that of U-Pb-age ( $505 \pm 20$  ma, Odom, 1982). The reason for this variation in the date may be attributed to the different techniques adopted and also to the presence of biotite of multiple generation.

### **Munnar granite**

The Munnar (10°05'00"; 77°05'00") granite with an areal extent of 50 sq km is an E-W trending irregular body emplaced within the migmatite and apophyses extend into the surrounding gneisses. The granite dated to be  $740 \pm 30$  m.y (Odom, 1982) is traversed by pegmatite, aplite

and quartz veins. Three types of granite are recorded. Foliated granite, Coarse pink granite and medium grey granite. The foliated granite consists of stringers and streaks of mafics consisting of biotite, hornblende, chlorite and magnetite alternating with felsics consisting of quartz and potash feldspar. Potash feldspar is predominantly orthoclase. The closely spaced foliations are persistent but discontinuous. This granite forms a domal structure south of Munnar. It has a sharp contact with the migmatite. Coarse pink granite consists of pink feldspar, quartz and a little amount of mafics. Mafics are biotite, sphene and hornblende. Medium grained grey granite, consists of quartz, feldspar, biotite, chlorite, zircon, sphene, epidote, calcite and sericite.

Major element data of Munnar granites do not show any significant variation amongst the three granites. Content of iron is more in medium grey granite and foliated granite. Different variation diagrams reveal a slight tendency towards alkali granite. The foliated granite shows more percentage of orthoclase than the other two granites. (Nair and Anil Kumar, 1990)

### **Ezhimala granophyre – granite complex**

A prominent granophyre body forms the hill known as Ezhimala, covering an area of 20 sq km in Kannur District. The granophyre is associated with gabbro and granite and is traversed by dolerite dykes. Two types of granophyres have been deciphered; coarse-grained leucocratic one and medium - grained one with more mafics. Drusy type, confined to higher elevation contains numerous vug lines with secondary minerals like quartz and calcite. Rocks of Ezhimala Complex display bimodal character with conspicuous basic and silicic components and total lack of rocks of intermediate composition typical of anorogenic suites (Nair and Vidyadharan, 1982). The granophyre is pink to ash grey coloured, massive, fine to coarse-grained, holocrystalline with equigranular texture. The granites are of two types. The major light pink granite with less of mafics show gradational relationships with the more greyish porphyritic variant (Varadan and Venkataraman, 1976).

Granophyre shows a typical granophyric intergrowth of quartz and feldspar forming the ground mass with phenocrysts of potash feldspar and some zoned plagioclase. The groundmass is totally of orthoclase. Augite is the chief ferro-magnesium mineral. Accessories include apatite, sphene, epidote, calcite and magnetite. Texturally the rock shows variation from coarse-grained leucocratic types with less mafics in the southern portion of the hill and medium to coarse grained type towards northern parts.



Minor outcrops of rapakivi granites are recorded within the granophyres of Ezhimala Complex. Anorthosites of Perinthatta and Kadannappally and granite, granophyre of Ezhimala together form the Ezhimala Complex. The light pink granite with less mafics is the major variety showing a gradational relationship with the more greyish porphyritic variety. The porphyritic variety, at places, shows rapakivi structure. The porphyritic granite shows mantled feldspar megacrysts. This variety grades into porphyritic granites without mantled feldspar and at higher levels grades into granophyre. The granite contains 60% of orthoclase feldspar, 5-10% of plagioclase, 20-25% of quartz with 4% of biotite, epidote, magnetite and fluorite. The low initial  $Sr_{87}/Sr_{86}$  ratio indicate that the rocks have a relatively minor amount of older sialic material. The Rb-Sr age of the granophyre is estimated to be 678 m.y. (Nair and Vidyadharan, 1982). The Ezhimala Complex lies in close proximity to the Bavali lineament suggesting reactivation along the lineament and intrusion of the body.

### **Kalpatta granite**

The Kalpatta ((11°36'15"; 76°05'15")) granite is an oval-shaped intrusive into the Wynad schist and covers an area of 44 sq km (Rao and Varadan, 1967). The rock is grey coloured, medium-grained, homogenous biotite granite and has sharp contact with the country rock. A feeble foliation is imparted to the granite at places by biotite flakes. Xenoliths of amphibolite / hornblende gneiss are visible near the periphery. Irregular veins of pegmatite / aplite traverse the granite and also the enclaves. The K-Ar age of the biotite from the Kalpatta granite is dated as  $512 \pm 30$  m.a. (Nair *et al*, 1985) and 527 m.a (GSI). Presence of enclaves and absence of significant replacement textures along with the geochemical characteristics assign a magmatic parentage for the granite. The proximity of the pluton to the Bavali lineament probably suggests intrusion along this fracture.

Three types of granites such as coarse grained biotite-granite, fine grained biotite granite, and porphyritic granite are mapped on the basis of texture, colour and mode of occurrence. Coarse-grained granite is a massive bluish grey rock with large xenoblasts of quartz and feldspars. The accessories include biotite, zircon, apatite and sphene. Blastesis of feldspar and sphene are common. Microcline, orthoclase, and plagioclase are seen as the major feldspar. Plagioclase composition varies from albite to oligoclase. This rock is exposed in Trikkaiappetta (11°35'04":76°08'41":), Manikkunnu (11°35'41":76°07'09"), Kuttamangalam (11°30'08":76°07'11":) (Anilkumar *et al*, 1993).

Fine biotite-granite is a fine grained massive rock exposed around Muttimala (76°06'38":11°37'06"). It consists of orthoclase, quartz, microcline, biotite, sericite, zircon, sphene, apatite and opaques. Myrmekitic quartz is recorded. Pophyritic granite consists of myrmekitic quartz, microcline, sericite and biotite. Very coarse grained biotite with included crystals of orthoclase, microcline and albite are common. Except for the texture, all the three granites show similar characters. (Anilkumar, *et al* 1993). Based on Rb-Sr dating, Kalpatta granite is dated 765 Ma. (Odom 1982).

### ***Chengannur granite***

The Chengannur (9°18'45"; 76°31'00") granite in Pathanamthitta District is an oval shaped body with the long axis trending in east-west direction covering an area of 15 sq.km in and around Chengannur. The granite is intrusive into the charnockite gneisses. The body is emplaced close to the Achankovil shear zone. K-Ar date of the hornblende indicates an age of 550 m.a. (Soman *et al*, 1983). The Chengannur granite is inferred to be a post kinematic granite of magmatic parentage.

Two types of granites are recorded. One is medium-grained pink granite and the other is coarse-grained grey granite. The former consists of quartz, perthitic feldspar, plagioclase, biotite, hornblende, apatite and zircon. The composition of plagioclase varies from albite to oligoclase. Microcline perthite is also seen. The coarse grained grey granite consists of perthite, plagioclase, hornblende, biotite, quartz with occasional occurrence of hypersthene, apatite and zircon. Hornblende and biotite are less common by occurred minerals than hypersthene. Relicts of hypersthene are also seen. This granite may be a product of granitisation of charnockite. K<sub>2</sub>O content always exceeds that of Na<sub>2</sub>O. The high SiO<sub>2</sub>, high alkali, high Fe/Mg ratio, high values of Gallium indicate that the granite belongs to alkali type. It might have an origin from recycled and rehydrated continental crust. (Nair and Anil Kumar, 1990).

### ***Peralimala granite***

The Peralimala (11°09'19":75°38'46") alkali granite is a linear intrusive body emplaced along the axial trace of a mega fold in EW direction. Peralimala intrusive body occurs as a diatreme of alkali composition with a maximum linear extension of 15 km and a width of 3 km. Based on colour, texture, composition and mode of occurrence four types of granites are identified. These are pink gneissic granite, porphyritic granite, grey granite and pink granite. Pink alkali granite is a coarse-grained rock consisting of microcline, orthoclase, plagioclase, quartz,

hornblende, epidote, aegirine, sphene, calcite, perthite and apatite. Quartz is present in only subordinate amounts. Feldspar content is very high. The preferred orientation of feldspar gives a crude alignment. At Perumpunna, (75°44'00":11°55'28") pink gneissic granite shows preferred orientation of biotite and pyroxene. The porphyritic granite occurs as a lensoidal body containing quartz, feldspar, pyroxene and hornblende. Feldspar forms the phenocrysts in a matrix of quartz-feldspar and mafics. Grey granite is a coarse- to medium- grained rock with microcline, quartz, orthoclase, perthite, hornblende and zoisite. Light grey granite is a medium-grained rock consisting of microcline, orthoclase, plagioclase (albite to oligoclase), epidote, aegirine, hornblende and rutile. The major element chemistry of the granite do not show much variation. The pink granite shows high content of potash. A negative correlation for K<sub>2</sub>O content with respect to SiO<sub>2</sub> is very pronounced for pink granite owing to its alkaline nature. Barium and strontium show very high values for Peralimala granite. (Anilkumar *et al*,1993).

### **Sholayur granite**

The Sholayur (11°04'15";76°42'00") granite, is exposed around Kuttiyadikal Mala (11°01'52":76°42'00") and Vachchpathi (11°04'15":76°44'00"). It is a homophanous medium-grained, pink coloured granite, consisting of quartz, orthoclase, microcline, oligoclase, perthite, aegirine augite, biotite, hornblende and sphene. In some places, calcite, apatite, sericite are also observed. The schlierens mark the contact zone of the granites with the host rock. This granite is emplaced within the Wynad supracrustals. SiO<sub>2</sub> varies from 58.76 to 73%, Al<sub>2</sub>O<sub>3</sub> 14% to 17%, Na<sub>2</sub>O 1.8% to 2.4% and K<sub>2</sub>O 0.8 to 1.5%. The distribution of SiO<sub>2</sub> is highly non-uniform within the same type of granite. The pink granite is becoming alkali granite at places.(Anil Kumar and Nair,1992).

### **Intermediate intrusives**

The syenite body at Mannapra (10°30'00";76°32'00") is exposed as an elongated NW-SE trending body covering an area of 8 sq km in Thrissur District. The syenite intrusive makes sharp contact with the charnockite near the charnockite-migmatite contact. The rock is medium to coarse-grained at its peripheries and tends to be coarse-grained towards the centre. Mineralogically, the rock is composed of alkali feldspar, orthopyroxene, clinopyroxene and amphibole with minor amounts of plagioclase, biotite and opaques. A small syenite (Angadimugar syenite) body is located in Kumbala village (12°35'15"; 76°07'00") and about 20 km east of Kumbla in Kasaragod District. The intrusive body has an elliptical outline and covers an area of 5 sq km. The body is intrusive into the Khondalite Group and encloses

enclaves of amphibolite in the peripheral parts. The rock is medium to coarse grained, light grey and massive.

## **Mesozoic intrusives**

### **Basic intrusives**

Basic intrusives in Kerala, mainly represented by dyke swarms in NNW-SSE to NW-SE trend, cut across all the metamorphic rocks and the earlier structural trends. Their unmetamorphosed nature and stratigraphic relation with the country rocks prompted their correlation to the Deccan Trap volcanism.

The basic dykes have been emplaced into the migmatites and charnockite in NNW-SSE to NW-SE and ENE-WSW directions along distensional and shear fractures respectively. Dolerite dykes of Kerala are mostly quartz tholeiites rarely clinotholeiite. The basic dykes of Pathanamthitta ( $9^{\circ}15'45''$ : $76^{\circ}45'30''$ ) are genetically unrelated types. These dykes have not undergone any internal differentiation during intrusion.

The variation in the chemistry of individual dykes may be due to the cogenetic differential sequence. Dolerite dykes intrude the country rocks at an angle greater than  $80^{\circ}$ . The dolerite dykes of Kuttuparamba ( $11^{\circ}49'30''$ : $75^{\circ}34'00''$ ) in Kannur District shows cross cutting relationship with all the formations. The basic dykes of Vamanapuram ( $8^{\circ}43'00''$ : $76^{\circ}54'00''$ ) are either gabbroic or doleritic intruding the gneissic rocks. These are trending NNE to SSW and NNW to SSE directions and are unmetamorphosed. Mineralogically all these dykes show more or less same composition except the meta-dolerites. Variation in the trace elements like Ti, Zr can be attributed to the differential degree of partial melting of the mantle material. (Nair and Gopala Rao, 1989).

The unmetamorphosed Idamalayar gabbroic dyke with a NNW-SSE trend is traced for over 80 km in the central part of Kerala. The rock is mesocratic, medium-grained, porphyritic and is composed of plagioclase (andesine to labradorite), hornblende and opaques. The reported age of 75 m.y. for the Idamalayar dyke (Subramaniam, 1976) links it in time-relationship with Deccan Trap volcanism.

The NNW-SSE trending leucogabbro dykes in central Kerala dated by whole rock K-Ar method gave an age of  $81 \pm 2$  m.y and the NW-SE trending dolerite dyke  $69 \pm 1$  m.y. The dolerite dykes are thought to have represented the feeder system for Deccan Trap volcanic sequences (Radhakrishna *et al*, 1994).

Basic dykes of Pathanamthitta area yielded ages of 99 Ma to 117 Ma and there are dykes which have yielded ages  $104 \pm 5$  Ma,  $127 \pm$  Ma and  $476 \pm$  Ma. These wide variations may be due to a protracted history of emplacement and the effect of Eocambrian to palaeozoic tectonothermal events affecting this region (Sinha Roy and Ramakrishnan, 1983.)

In Thiruvananthapuram District, Anakudi and Nedumannur dolerite dykes are dated by K-Ar method and the whole rock ages are  $104 \pm 5$  Ma and  $127 \pm 2$  Ma respectively (Sinha Roy and Ramakrishnan, 1983).

### **Tertiary Sedimentary rocks**

Mio-Pliocene sedimentary rocks are fairly widespread in the southern coastal belt, their remnants being noticeable in the central and northern coastal areas. These sedimentary rocks consist of a series of variegated clay and sandstones with lenticular seams of lignite, known as Warkalli Formation, underlain by more compact marly sands with shell fragments and thin horizons of limestone (Quilon Formation).

The Tertiary sediments have a gentle dip towards west. The Warkalli Formation extends in a narrow belt from Thiruvananthapuram ( $8^{\circ}28'30''$ :  $76^{\circ}57'20''$ ) to Kasaragod ( $12^{\circ}30'00''$ :  $74^{\circ}59'00''$ ) between coastal and midland regions with intervening promontories of the crystalline rocks. The Quilon Formation is mainly seen at Paravur ( $08^{\circ}48'00''$ :  $76^{\circ}40'00''$ ) Padappakkara ( $08^{\circ}58'30''$ :  $76^{\circ}38'00''$ ) and some other places around Kollam and Alappuzha districts.

### **Quilon Formation**

The Quilon Formation consisting of fossiliferous shell limestone alternating with thick beds of sandy clays and calcareous clays have been reported from Padappakkara (type locality), Nedumgolam, Edavai ( $8^{\circ}45'20''$ :  $76^{\circ}42'00''$ ) and Varkala ( $8^{\circ}44'00''$ :  $76^{\circ}43'00''$ ) and Cherthala ( $9^{\circ}41'00''$ :  $76^{\circ}20'00''$ ) along the west coast of Kerala. The Quilon limestone contains numerous fossils of foraminifera, corals, echinoids and molluscs. The Lower Miocene age for lower stratigraphic horizons and the Upper Miocene age for the topmost beds of the Quilon Formation indicate the lower and upper age limits of these marine sediments. The predominance of black clays, sandstone, bluish grey brackish water shell limestone and nodular limestone clearly indicate deposition in a lagoonal condition.

### **Warkalli Formation**

The Warkalli Formation of Mio-Pliocene age extends all along the Kerala coast. The type section of the Warkalli Formation described by King (1882) is from the sea cliff at Varkala. The exposed section at Varkala cliff is 28-30 m thick consisting of unconsolidated sands of variegated clays, white plastic clays, and carbonaceous sandy clays enclosing impersistent seams and lenses of lignite. The carbonaceous clays and lignite are often impregnated with nodules of marcasite.

Fairly thick beds of carbonaceous clays with lignite seams occur around Nadayara kayal, Tamarakulam (9°08': 76°37'), Puliur (9°18'00": 76°35'00"), Payangadi (12°00'20": 75°15'40"), Nileswaram (12°15'00": 75°07'00"), Kanhangad (12°17'40': 75°05'00") and in the cliff sections near Cheruvathur (12°13'00": 75°09'50"). The most characteristic feature of the Warkalli Formation is the impersistent nature of the constituent beds, suggestive of shallow basin margin deposits.

### **Laterite**

Kerala is the home of the laterite as it was first named by the Dutch traveller, Buchanan 1807. Laterite is widespread in its distribution in the midland region of Malappuram, Kannur and Kasaragod districts where it forms well-defined mesas. The Archaean crystalline rocks and the Tertiary sedimentary rocks are extensively lateritised. The laterite has wide areal distribution in the State and occurs at all levels upto 2000 m, height though mostly restricted to an altitude of 50-150 m above MSL. in the coastal and midland region. A few bauxitic patches also occur within the laterites. The thickness of laterite cappings varies from a few metres to 50 metre at places. At Chovvara (8°21'30"; 77°01'30") in Thiruvananthapuram District and Chattannur (8°50'30"; 76°46'30") and Kundara (8°57'00": 76°40'30") in Kollam District, a zone of about 2 m thick bauxite is recognised at the contact between the crystallines and the overlying sedimentary rocks. The overlying sedimentary column is also blanketed by laterite of varying thickness. The bauxite at the base of the sedimentaries indicates an earlier pre-Warkalli spell of lateritisation. Further, the erosional features on the top part of the bauxite horizon corroborate the antiquity of the earlier spell of lateritisation (Mallikarjuna and Kapali, 1980).

Generally, the laterite after the crystalline rocks is compact and the top crust moderately indurated. The dark brown crust passes downward to pink and buff coloured soft laterite. Quartz veins, joints and fractures can be traced from the top to the bottom of the laterite profile. The laterite profile over pyroxene granulites, meta-ultramafites and gneisses are characterised by relict foliation that conforms to those of the subjacent rocks which indicate the *insitu* nature

of the laterite. Porous and spongy texture is discernible in laterites, after meta-ultramafites. Laterite after the Tertiary sedimentaries is well indurated at the top for about 2 to 5 m. Downwards, the profile grades into soft laterite with remnants of gritstone and culminates into a zone of variegated clay.

### **Quaternary sediments**

Recent to sub-Recent sediments of coastal sands, sticky black clay with carbonized wood, silty alluvium and lagoonal deposits are observed mostly in the low-lying areas from Kollam (11°27'00": 75°40'30") to Ponnani and between Kannur (11°51'30":75°21'45") and Nileswaram (12°15'30":75°08'16"). Alluvium is observed along the major river valleys. At places, along coastal tracts, there are raised sandy beaches composed of fine grained reddish sandy loam known as "terri" sands. Palaeo-beach ridges alternate with marshy lagoonal clay in the coastal area.

The sandy stretches are widest between Alappuzha (9°30': 76°20') and Kottayam (9°35': 76°31'), upto 25 km inland from the shoreline. The Quaternaries of the coastal plain have been classified into (i) the Guruvayur Formation representing the earlier strandline deposits with an elevation of 5-10 m; (ii) the Viyyam Formation of tidal plain deposits; (iii) Periyar Formation being mainly of fluvial deposits and (iv) the Kadappuram Formation representing the beach deposits (Krishnan Nair, 1989).

A pebble bed is traced in Valapattanam and Taliparamba river banks in Kannur district. It is exposed south of Valapattanam (11°55'30": 75 °21'30"), Kambil maloth (11°58':75 °24'), Morazha (11 °58'30": 75°20'30") and Arathiparamba (12°06'00": 75°15'30"). The size of the pebbles ranges in dimension from 4.5 cm x 3 cm to 7 cm x 3 cm with occasional cobbles of size 13 cm x 12 cm. The base of the pebble bed is generally 20 to 40 m above MSL and at places, the pebble bed directly rests over the basement rocks. The pebbles are mostly of quartz and rarely of granite and pyroxene granulite. The distribution of the pebble bed along the major river banks demonstrates it to be flood plain deposits, probably of early Quaternary period (Nair *et al*, 1976). In Malappuram and Kozhikode districts, the pebble bed is traced in the riverine terraces at Mavur (11°17'45":75°59'00" ), Cheruvannur (11°12'8": 75°49'35") and Chellepparambu (11°14'30":75°59'00"). In Thiruvananthapuram District, the Quaternary pebble bed occurs at an elevation of 45 to 50 m above MSL at Pothenkode (8°37'00": 76°48'56"), Idaikode (8°40'11":76°50'49"), Attingal (8°41'49": 76°48'56") and Andoorkonam (8°36'00": 76°52'30").

Submerged upright tree trunks have been reported from a number of places in the coastal area of Kottayam and Alappuzha districts, indicating neotectonic reactivation in the area. Carbon dating of a sample from the submerged forest at Iravimangalam indicates an age of  $7050 \pm 130$  B.P (Pawar *et al*, 1983).

## **Structure**

The structural grain of the southern Peninsula is controlled mainly by the NNW-SSE trending near longitudinal Dharwarian trend which had folded all earlier structures. Since Kerala State falls in the western limb of the mega-structure almost all the rock distribution is aligned in NW-SE direction. However, detailed structural studies carried out in selected parts of the Kerala (Nair and Nair, 2001) had shown that (a) the earliest folds ( $F_1$ ) which are represented both on mesoscopic and megascopic scale are tight appressed folds of asymmetrical nature which had given rise to axial plane foliations with characteristic platy mineral alignments (b) the  $F_2$  folds on these foliations (post-folial) are open symmetrical and have developed mainly on megascopic scale and control the disposition of the major lithologies. (c) Subsequent folds ( $F_3$ ) which deform  $F_1$  and  $F_2$  axial plane traces are broad folds on mega-scale identified with the longitudinal Dharwarian trends and (d) a broad swerve on these Dharwarian trends in ENE-WSW is also decipherable (Fig.2).

Detailed analysis of the remote sensing data had revealed the presence of a number of significant lineament patterns in WNW-ESE, NW-SE, NNW-SSE, NNE-SSW and ENE-WSW directions (Nair, 1990). Mega and intermediate lineaments in WNW-ESE were originally crustal fractures and shears which got sealed or obliterated by a number of igneous emplacements of alkali granite, syenite, gabbro, anorthosite, granophyre etc. The emplacements along the Bavali lineament and those along the Achenkovil lineament both of which trending in this direction had given ages ranging from 500 – 678 Ma. Hence they are identified to be the oldest lineament. The Bavali lineament forms the western termination of the Moyar shear. The NW-SE trending lineaments constitute mega lineaments and coincide with the basic dykes occurring throughout the length and breadth of the state. These dykes have given ages ranging from 61 to 144 Ma. The NNW-SSE trending lineaments are generally intermediate lineaments and are attributed to fractures, faults and major joint patterns in the area. It is recognized that the NNW-SSE trending lineaments define a weak zone along which the west coast evolved by faulting. The eastern limit of the Tertiary basin is found restricted along this lineament direction. These lineaments occurring along the west coast are be active as suggested by the progradation of the coast west of these lineaments (Nair, 1987). The



lineaments in NNE-SSW are prominent and are identified with major fractures and this together with those in NNW-SSE are taken to constitute a conjugate system of faults in a N-S compressive regime due to the collision of the Indian plate. The ENE-WSW trending lineaments are intermediate lineaments and are well- developed in the northern parts of the Kerala. Since these lineaments truncate other lineaments as evidenced especially in the coastal stretches it is considered the youngest. Many a recent tremors reported are aligned in this direction and hence considered neotectonically active.

### **Metamorphism**

The Precambrian crystalline rocks of Kerala are chiefly metapelites, charnockites with associated gneisses and granulites, schistose rocks with distinct metapelitic and metamafic / ultramafic affinity and granitic derivatives which include the Peninsular gneisses and migmatites. Except the Wynad schists and the Vengad group, the bulk of the crystalline rocks show granulite to upper amphibolite facies of metamorphism. Wynad schist displays a prograde amphibolite facies metamorphism and the retrogression of these rocks leads to lower amphibolite facies metamorphism. The vast charnockite belt occurring on either side of the Wynad schist belt, in north Kerala, shows petrographic evidences of prograde and retrograde reactions (Nambiar, 1996). The rocks of the Vengad Group show greenschist to lower amphibolite facies of prograde metamorphism. The older intrusive bodies show effects of incipient metamorphism, marked by clouding of feldspar and bending of twin lamellae.

Recent investigations on the pressure – temperature range for the formation of characteristic mineral suits within the metamorphic rocks provide a fair idea on the poly-metamorphic history of the rock suits. Rocks of the Khondalite belt of south Kerala indicate a temperature range of 650 to 850°C and pressures 5 to 6 kb (Srikantappa *et al*, 1985). In the Thiruvananthapuram area, the temperature at the peak of metamorphism indicated by the mineral assemblages of the calc-silicate rocks is about 830°C at 5 K bar considering the vapour absent garnet forming equilibria (Satish Kumar and Santosh, 1996). The scapolite equilibria indicates a peak metamorphic temperature of above 800°C. Stable isotopes in the marble bands suggest that there was no pervasive infiltration of external fluids. Local infiltration of external carbonic fluid took place during decomposition. Synthesis of such data from different lineament/shear bound segments in Kerala indicates varying metamorphic conditions and uplift history. It is also summerised that there is a progressive decline in the uplift of different segments from north to south (Soman, 1997).

 **SUSTAINABLE DEVELOPMENT GOALS**

