Chapter FIVE
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Chapter FIVE

LATERITE AND ITS MINING

5.1 INTRODUCTION

Laterite occurs principally as a cap over the summits of Basaltic hills and plateaus and is the characteristic feature of tropical monsoon regions. It is best developed in the Western Ghats and its foothills. Vast stretches of laterite-capped hillocks are characteristic features of Kannur-Kasaragod Districts of Kerala. Laterite stone was used as building material in Kerala for centuries. Ancient buildings like temples are examples. Its geological nature was described only later by Francis Hamilton Buchanan, a medical officer of East India Company. From Angadipuram in Malappuram District of Kerala, he discovered a type of weathered material which was indurated clay, full of cavities and pores, containing large quantity of iron in the form of red and yellow ochre. It was soft when fresh and could be cut easily and when exposed, it became hard and resisted air and water much better than bricks (Buchanan 1807). He used the term laterite to designate this material (laterite in Latin means ‘brick stone’). He defined it as “a residual product of weathering, rich in secondary oxides of iron and aluminum or both-nearly devoid of bases and primary silicates and commonly found with quartz and kaolin and developed in tropical or warm temperate climatic regions”.

In the areas of extensive laterite formations, its mining has emerged as a major economic activity of the local people. Now mining is more mechanized and intensive mining of bricks, its transportation and marketing brought tremendous changes in the physical as well as socio-economic set up of the region. This chapter examines the properties of laterites and their mining from a geographical point of view.

5.2 GENERAL FEATURES OF LATERITE

Laterite has the peculiar property of being soft when newly quarried, but being hard and compact on exposure to the air; also, loose fragments and pebbles of rock tend to re-cement themselves into solid masses as compact as the original rock. On account of this property it is usually cut in the form of bricks for building purposes. Laterite brick is generally red in color. It is porous and shows vermicular structure. In vernacular, it is
called as “chenkallu”, “Ishtikkallu”, “cheekkallu”, “vettukallu” etc. Laterite can occur at every altitude from sea level to about 2500 m. Laterite is found in the region of mean annual temperature of 23 to 26°C and rainfall 1200 to 4000 mm and with the number of rainy months 6 to 9.

5.3 PHYSICAL PROPERTIES OF LATERITE

Laterites are residual sedimentary rocks, reddish or brownish coloured, comparatively soft rocks, containing high degree of porosity and are carrying vermiform structures. The porosity is due to the in situ weathering of parent rocks. The laterite profiles show that its exposed layers are much harder than the sub surface layers. Two or three layers differing in their texture, physical properties and associations are usually found below the hard, indurated cap.

Lateritic terrain may be subjected to problem like landslide and slumping. The role of ground water in such disturbances is found to be similar to that of catalytic agent. The reason for such forms of mass wasting is due to the excess accumulation of ground water in the pores of formation. The lubricating nature of the interface between permeable and impermeable beds might be causing gravity movement of overburden in the form of landsliding and consequent slumping.

5.4 LATERITE PROFILES

The general pattern of lateritic profile is similar at all locations, although the individual units of the profiles are not uniform. In the ascending order the parent rock passes through a zone of the partly altered bedrock, followed by a zone of lithomarge, blocky laterite and vermicular laterite. The vermicular laterite represents the uppermost zone of Laterization, which may or may not have a later formed cover of lateritic gravel and/ or a humus zone.

5.5 HYDROLOGICAL PROPERTIES

Laterite, apart from its use as a promising natural resource as building material, is also regarded to act as ground water recharging source because of its physical properties particularly porosity. Laterite constitutes one of the important hydrological provinces in Kerala, as it holds roughly 55% of the total dynamic ground water storage.
The laterite terrain receives heavy rainfall during every monsoon season and is getting recharged year after year. The high porosity of it enhances quick infiltration of rain water. The peculiar vesicular structure is a favourable factor in the vertical infiltration of rain water to join ground water reserve. But the lithomargic clay occurring in between lateritic cap and underlying weathered bedrocks has a low permeability and prevents easy downward movement. This may facilitate retention of water in the pores of laterite for a long period. The ground water condition of laterite is always in a dynamic state due to fluctuations of water table.

5.6 ECONOMIC VALUE

Laterite has immense economic value as it contains the ores of iron, aluminium and manganese. The use of laterite as an ore of iron is of very old standing, but its recognition as a source of aluminium is due to the work of Holland and of manganese to the work of Fermor. Contents of gold placer deposits are found in Nilambur valley of Malappuram district in Kerala (Narayanaswamy, 2004). In several parts of southern India and Burma laterite is quarried for use as a building stone. Laterite soils are very poor in lime and magnesia and deficient in nitrogen. Occasionally the phosphate content may be high, probably present in the form of iron phosphate but potash is deficient. There is occasionally a higher content of humus.

5.7 LATERITE GENESIS

Though many hypotheses have been advanced by different geologists, the origin of the laterite is as yet a much debated question. One source of difficulty lies in the chemical and segregative changes which are constantly going on in the rock and which obliterate the previously acquired structures and produce a fresh arrangement of the constituents of the rock. It is probable that laterites of all the different places have not had one common origin and that widely divergent views are possible for the origins of the different varieties.

The origin of laterite is intimately connected with the physical, climatic and denudational processes of a particular region. Laterite can be formed from any type of rock. Laterite provides important information on tropical weathering process by which
alkali and alkaline earth metals and silica are leached leading to the enrichment of either iron or aluminium or both. Laterites are the result of the sub-aerial decomposition \textit{in situ} of rocks under a warm, humid and monsoonic climate. Under such conditions of climate the decomposition of the silicates, especially the aluminous silicates of crystalline rocks, goes a step further and instead of kaolin being the final product of decomposition, it is further broken up into silica and the hydrated oxide of aluminium (bauxite). The silica is removed in solution and the salts of alkalis and alkaline earths are dissolved away by the percolating water. The remaining alumina and iron oxides become more and more concentrated and become mechanically mixed with other products liberated in the process of decomposition. The vesicular or porous structure, occurs among the products left behind. Removal of top soil (alkaline upper horizon) creates an acidic environment which further accelerates the laterization process.

5.8 LATERIZATION- A COMPLEX PROCESS

Laterization is the process of transformation of an existing rock into laterite. A variety of ideas are prevailing on the Laterization process and even today a conclusive explanation on laterite genesis is lacking.

From its vesicular structure and its frequent association with basalts, it was at first thought to be a volcanic rock. Its sub-aerial nature was however soon recognized beyond doubt and later on it was thought to an ordinary sedimentary formation deposited either in running water or in lakes and depressions on the surface of the traps. Still later views regard the rock as the result of the subaerial decomposition \textit{in situ} of basalt and other aluminous rocks under a warm, humid and monsoonic climate.

Maclaren (1906) explains that laterite deposits are formed due to the metasomatic replacement (in some cases the mechanical replacement) of the soil or subsoil by the agency of mineralized solutions, brought up by the underground percolating waters ascending by capillary action to the superficial zone. He concludes that laterites are essentially replacement deposits.

According to Martin and Doyne (1927), laterite is a typical tropical weathering product of intensive in situ weathering of surfacial rocks. Marbut (1932) suggested that
the laterite zone is considered proportional to the zone of fluctuation of the water table, which also upholds the idea that laterite is an *in situ* weathering product.

Wadia (1975) stated that the laterite distribution is restricted mainly to Koeppen’s ‘A’ climatic zone, extending from 30 ° N to 30 ° S latitudes. Major part of Indian peninsula lies within this zone, which also enjoys typical monsoon climate with alternative wetting and drying conditions. Laterite is a residuum, being formed by physico-chemical weathering that leads to the concentration of iron and aluminum oxides and to the removal of silica and alkalis. Favourable weathering conditions needed for the in situ development of laterites are available in tropical regions with monsoon climate where the temperature and rainfall are the highest and with maximum seasonal contrasts. Invariably all rock types under such weathering conditions ultimately give rise to laterite residuum.

McFarlane (1976) viewed that the laterites are essentially residual accumulations of chemically resistant materials. He envisaged that laterization process had remained suspended temporarily during the glacial episodes of Pleistocene period due to the unfavourable climate but had resumed during the interglacial periods.

Mabutt (1961) stated that pedimented surfaces which typically comprise the low amplitude topography characterised by sheet flow, sluggish drainage and very slow rate of erosion but are often associated with deep weathering cause widespread laterization.

The role of climate in the laterization process is very significant. The laterization process operates at well under warm and humid warm and tropical climates with seasonal rainfall (Widdowson and Gunnel, 1999). They argued that the west coast laterite of the country are developed from the prolonged alteration of exposed pedimented surfaces, resulting from the recession of Western Ghat escarpment, when climatic and tectonic conditions favourable to deep weathering reached an acme. They uphold the requirement of hot and humid tropical climate with good rainfall and seasonal contrasts for the effective laterization and envisaged that the laterization processes along the west coast intensified after the inception of present monsoon climate, after late Miocene.
From the highly variable nature of this peculiar rock, it is possible that every one of the above causes may have operated in the production of the laterites of different parts according to particular local conditions and that no one hypothesis will be able to account for all the laterite deposits of the Indian Peninsula.

Laterite rocks, besides are subject to secondary changes, a fact which introduces further complexity. Under conditions of free drainage and high rainfall (2,500 mm. per year, or more) the laterite may accumulate without much further change, the soluble products of hydrolysis being rapidly lost by leaching. On the other hand, under impeded drainage conditions and alterations of wet and dry seasons, the fluctuating ground water, carrying dissolved silica and bases, may effect a complete change in the laterite.

5.9 TYPES OF LATERITES

On the basis of nature of gradational process leading to the origin of laterite it is classified into two groups: Primary and Secondary laterites (Thomas Varghese and Byju, 1993). Primary laterites are formed by aerial weathering and are known as residual laterite whereas Secondary laterite or detrital laterite is formed by partial or complete consolidation of lateritic material.

Based on altitudes laterite has been classified as low level laterite and high level laterite (Wadia, 1975). High level laterites are those that occur on situations above 600 m. above sea-level. The rock characteristic of these occurrences is of massive homogeneous grain and of uniform composition. The low-level laterite occurs on the coastal lowlands. Low level laterite differs from the high-level rock in being much more massive and in being of detrital origin, from its being formed of the products of mechanical disintegration of the high-level laterite.

Young (1976) analysed the physical properties of laterite and has distinguished the following five main types and sub-divisions of laterite:

(1) **Massive laterite**: possesses a continuous hard fabric, sub-divided into:

(a) Cellular laterite – cavities are approximately rounded.

(b) Vesicular laterite – cavities are predominantly tubular.
(2) **Nodular laterite:** consists of individual approximately rounded concretions (also called pisolithic laterite) sub-divided into:

a)  Cemented nodular laterite – individual concretions can be seen but are strongly joined together by the same iron-stone material.

b)  Partly cemented nodular laterite.

c)  Non-cemented nodular laterite – concretions from over 60 percent by weight of the total soil.

d)  Iron concretions – concretions are separated by soil but form less than 60% by weight of the total horizon.

(3) **Re-cemented laterite:** contains fragments of massive laterite and wholly or partly cemented.

(4) **Ferruginized laterite:** rock structure is still visible but with substantial isomorphous replacement by iron.

(5) **Soft laterite:** mottled iron-rich clay which hardens irreversibly on exposure to air or to repeated wetting and drying.

5.10 DISTRIBUTION OF LATERITES

Laterites are distributed widely in the tropics and sub tropics of Africa, Australia, India, Southeast Asia and South America. Their distribution does not necessarily correspond to existing conditions of genesis. Many of these occurrences are sub recent or fossil, even in inter tropical regions. Their extension indicates that conditions were favorable to their formation at some time or other in the history of the world, but not necessarily simultaneously at all points. It is now universally recognized that laterites must have evolved over extremely long periods of thousands of years. The Tertiary period provided conditions particularly favorable to the processes of laterization.

Laterites are widely distributed in the semi humid and humid inter-tropical regions of the globe and in the fossil state are found in drier climates and sometimes even in the temperate climates (Maignien, 1966). As indurated occurrences, laterites extend beyond sub-humid tropical climate to desert regions (African and Australian deserts), where they are an indication of more humid influences in the past. The following
discussion is intended for providing a general outline of global distribution of indurated laterites.

**Africa**

Laterites are widely distributed in Africa. Laterites are extensively distributed in South Africa, Nigeria, West Africa, Sierra Leone, Eastern Guinea, Zimbabwe, Angola, southern Congo, Mozambique and Uganda approximately between 750 mm and 1200 mm isohyets. They are to be found in the north towards the Sahara, submerged beneath aeolian deposits (Maignien, 1966). Sombrock (1971) has made detailed studies on different laterites and laterite soils of Nigeria.

**North America**

The laterite described by Buchanan is quite uncommon in North America. But it is present as cellular, slag like ironstone in certain beds of the Dakota group in Nebraska. This material overlies reticulated, mottled, red and slight grey kaolinitic clay beds. In Central America, laterites are totally absent which may be ascribed to the rough terrain and to volcanic activity.

**South America**

In South America, laterites occupy a large area in Brazil and in the Guianas. Marbut (1932) reported that the flat plateau in the central Brazil is invariably underlain by a layer of indurated iron oxide locally known as Canga. He observed slag like masses of indurated ferruginous illuvial horizons in some of the soils of Amazon basin where ground water is present at shallow depth. These formations were more or less akin to those in India and Africa and since it was associated with relatively shallow ground water, it was designated by him as ‘ground water Laterite’. Being a tropical country with numerous ultramafic massifs submitted to several erosional cycles, Brazil presents good condition for having nickeliferous laterites.

**Australia**

Darwin (1844) was probably the first to give a scientific description of the laterites of western Australia, who referred to the superficial ferruginous beds in that area. One characteristic feature of laterites in Australia is their close topographic
correlation with the so called ‘sand plains’ which contains ironstone gravel in the profile and acidic reaction in spite of low rainfall. Laterites are found in the coast of New South Wales, Queensland, Brisbane, eastern Australia and Tasmania. A few small patches are found in more humid areas of south Australia, western Australia and Norfolk island (Twidale et al. 1974).

**Southeast Asia**

Laterite occurs widely in the plains of Thailand and Cambodia. The laterites in Thailand occur as a characteristic illuvial horizon and have been exposed in several places by erosion of the sea where they are found as reefs along the seashore. In those areas, laterites were the most generally used building material for permanent buildings like palaces and temples.

Laterite is associated with iron ore deposits in the northeastern regions of Mindanao in the Philippines. In Indonesia, laterites are found on old geological formations and are believed to have been formed under climatic conditions not necessarily similar to those current at present.

**Russia**

Laterites have a limited distribution over Russia. All of them are old as the present climatic environments are not ideal for their formation. In Russia, the lateritic deposits are categorized into three groups – lateritic bauxite, rich iron ore and iron ochres. Rich iron ores are mainly associated with the Voronezh anticline of the Russian platform. The lateritic bauxites are also associated with them. Some isolated patches are distributed over Ukraine shield and Siberian platform. The ochre composes the upper zone of the complete sequence of weathering crust. The lateritic deposits of Russia are, as rule, buried under the mantle of younger sediments and are rarely exposed (Thomas Varghese and Byju 1993).

**Sri Lanka**

In Sri Lanka, laterite is known as *Cabook* which is formed in the areas of the southwest where the igneous rock charnockite occurs in a region with annual rainfall of over 2500 mm per annum with dry intervals. It occurs at various depths with an average
height of about 60 cm from the surface and is usually formed on low hillocks at elevations not much more than 30 to 60 m. above mean sea level.

5.11 LATERITES IN INDIA – OCCURRENCES AND CHARACTERISTICS

Laterite and lateritic soils are formations peculiar to India and some other tropical countries with intermittently moist climate. In India laterites and laterite soils cover an area of 2,48,000 sq. km. area (Wadia, 1975) and are well developed on the summits of Deccan hills, Karnataka, Kerala, Eastern Ghats, west Maharashtra, Central Odisha and Assam. They are known to be derived from varied geological formations including Precambrian and younger rocks. The major part of the Indian peninsula falls well within Koeppen’s ‘A’ climate to which formation of laterite in the present day is confined.

Two forms of laterites are found in India. High level and low level, the later frequently supposed to be of detrital origin. The high level form was found to cap the summits of hills and plateau on the highlands of central and western India whereas the low level laterites are associated with the large tracts in the neighborhood of both coasts of Deccan peninsula.

Laterite occurs principally as a cap on the summit of the basaltic hills and plateaus of the highlands of the Deccan, central India and Madhya Pradesh. In its best and most typical development it occurs on the hills of Mumbai region of the Deccan. In all these situations it is found capping the highest flows of the Deccan Traps. The height at which laterite is found varies from about 600 m. to 1,500 m. and sometimes considerably higher, if the ferruginous clays and lithomarges of the Nilgiri mountains are to be considered as one of the many modifications of this rock. In thickness the lateritic caps vary from 15 to nearly 60 m. Some of these are of small lateral extent, but others are very extensive and individual beds are often seen covering an immense surface of the country continuously (Wadia, 1975).

Laterite is by no means confined to the Deccan Trap area, but is formed to extend in isolated outcrops from as far north as the Rajmahal hills in Bihar to the southern extremity of the peninsula. It extends to Sri Lanka where it forms a thick cap covering the gneiss and khondalite. In these localities the laterite rests over formations of various ages
and of various lithological compositions, e.g. Archaean gneiss, Dharwar schist, Gondwana clays, etc. In Tamil Nadu, there are both high level and low level laterites which are formed from a variety of rock materials. The soils are rich in plant nutrients. The higher the elevation, the more acidic the soils are.

In Maharashtra, laterites are found only in Ratnagiri extending to Kanara in Karnataka. The soils of Kanara are coarse, poor in lime but fairly good in organic matter and nitrogen and potash (Thomas Varghese and Byju, 1993). In the soils of Ratnagiri, coarse material is found in large quantities. These are rich in plant food constituents, except lime.

The laterite and laterite soils in Karnataka occur in the western parts of the districts of Shimoga, Hassan, Kadur and Mysore. In Coorg, laterite appears sporadically almost all over the region. All the soils are comparable to the laterites and to similar formations found in Malabar. They are very low in bases like lime, due to severe leaching and erosion. They also are poor in phosphate (Thomas Varghese and Byju, 1993).

In West Bengal, the area between the Damodar and the Bhagirathi is interspersed with some basaltic and granitic hills with a laterite capping. Laterites are found in Midnapur, Bankura, Burdwan and Birbhum. The contents of potash, phosphorus and nitrogen are very low.

In Bihar, laterite occurs principally as a cap on the higher plateaus but is also found in fair thickness in some valleys. The laterites of Odisha are found largely capping hills and plateaus occasionally in considerable thickness. Large areas in Khurda are occupied by laterites; those of Balasore are gravelly and appear to be detrital. Two types of laterites have been distinguished in Odisha: (i) the laterite murrum and (ii) the laterite rock. These types are also found to occur together.

In Kerala, both high level and low level laterites are met with; high level laterites growing plantation crops are rich soils because of their proper management. The laterites on lower elevations have a poor nutrient status. The soils are generally poor in plant nutrients and organic matter.
5.12 LATERITES IN KERALA

Kerala forms the ‘type locality’ of laterite. The laterite terrain of Kerala occupies the midland region of the State and this tract can be considered as the backbone of the State as its economy depends upon this laterite terrain which produces a variety of cash crops like coconut, cashew, pepper, rubber, etc. Laterite covers about 15% of the total geographic area of the State (Table 5.1). These laterite terrains extend between the lowlying coastal plain and the highlands in the Western Ghats (Fig. 5.1).

Table 5.1
Kerala – Distribution of laterites

<table>
<thead>
<tr>
<th>Sl No.</th>
<th>District</th>
<th>Total area in sq.km.</th>
<th>Area of laterite in sq.km.</th>
<th>% share</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Kasaragod</td>
<td>1992</td>
<td>534</td>
<td>26.8</td>
</tr>
<tr>
<td>2</td>
<td>Kannur</td>
<td>2966</td>
<td>842</td>
<td>28.4</td>
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<tr>
<td>3</td>
<td>Wayanad</td>
<td>2131</td>
<td>75</td>
<td>3.5</td>
</tr>
<tr>
<td>4</td>
<td>Kozhikode</td>
<td>2345</td>
<td>166</td>
<td>7.1</td>
</tr>
<tr>
<td>5</td>
<td>Malappuram</td>
<td>3550</td>
<td>1125</td>
<td>31.7</td>
</tr>
<tr>
<td>6</td>
<td>Palakkad</td>
<td>4480</td>
<td>560</td>
<td>12.5</td>
</tr>
<tr>
<td>7</td>
<td>Thrissur</td>
<td>3032</td>
<td>1155</td>
<td>38.1</td>
</tr>
<tr>
<td>8</td>
<td>Ernakulam</td>
<td>2951</td>
<td>333</td>
<td>11.3</td>
</tr>
<tr>
<td>9</td>
<td>Idukki</td>
<td>4474</td>
<td>22</td>
<td>0.5</td>
</tr>
<tr>
<td>10</td>
<td>Kottayam</td>
<td>2202</td>
<td>214</td>
<td>9.7</td>
</tr>
<tr>
<td>11</td>
<td>Alappuzha</td>
<td>1414</td>
<td>55</td>
<td>3.9</td>
</tr>
<tr>
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<td>Pathanamthitta</td>
<td>2642</td>
<td>301</td>
<td>11.4</td>
</tr>
<tr>
<td>13</td>
<td>Kollam</td>
<td>2492</td>
<td>264</td>
<td>10.6</td>
</tr>
<tr>
<td>14</td>
<td>Thiruvananthapuram</td>
<td>2192</td>
<td>136</td>
<td>6.2</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>38,863</strong></td>
<td><strong>5792</strong></td>
<td></td>
<td><strong>14.9</strong></td>
</tr>
</tbody>
</table>

Compiled by the investigator from Fig. 5.1

Laterites are found all along the midland region of the State. Even then they are found extensively in the central and northern parts of the State. Thrissur (38.1%), Malappuram (31.7%) Kannur (28.4%) and Kasaragod (26.8%) districts are having
Kerala
Distribution of Laterites

Source: Resource Atlas, Kerala, CESS 1984

Fig. 5.1
comparatively larger concentration of laterites (Table 5.1). Idukki, Wayanad, Alappuzha, Thiruvananthapuram and Kozhikode districts are having a lower share.

Laterites in Kerala are mostly confined to an elevation of less than 600 m. They form low flat topped ridges and hills, between the foothills of Western Ghats and Arabian Sea. Vast stretches of laterite-capped hillocks are characteristic features of Kannur and Kasaragod Districts. They are of 60 to 140 m thickness. Along the coast, hard laterite cover is exposed to marine terraces which are also seen in southern region (Chattopadhyay, 2004).

In physiographic terms laterites of Kerala broadly corresponds to the interface of the coastal plains and lowlands of this region. Such extensive blanket cappings are observed more in the north and central Kerala regions than in south Kerala (Chattopadhyay, et al. 1998). The vast dissected lateritic mesas of Nilambur valley in Malappuram District are at relatively higher elevations (60 to 230 m.).

Nair et al. (1981, 1987) and Narayanaswamy and Ghosh (1986) have identified two periods of laterization involved in the laterites of Kerala – one during pre-Warkalai period and the other in post-Warkalai period. However Chattopadhyay et al. (1998) reported three laterization cycles in Kerala – pre Oligocene cycle, a post Tertiary cycle and thirdly a post Pleistocene cycle based on field evidences.

Laterites developed over the Neogene sediments of south Kerala and the khondalite suits of rocks have a buff colour. They appear soft and variegated and exhibit yellow and white patches intersected by a network of red, purple or brown colours. Induration in the upper crust is less prominent. Laterites over the sedimentary formations also contain free silica (quartz) and relics of current-bedding (Soman 2002). Laterite blocks subjected to wave action show honey-comb structure (as in Varkala). Laterites developed over charnockite/charnockitic gneiss are reddish brown in colour, compact, hard and ferruginous in nature. In both the varieties, vermicular structure is well developed, with the cavities filled with clay and limonitic material. As the colour is due to the presence of iron oxides in various stages of hydration, estimation of colour gives a rough idea of composition. The predominantly ferruginous laterites seen in parts of
Malappuram, Kozhikode, Kannur and Kasaragod districts are indurated, with formation of a relatively thick iron crust at the top, making agriculture difficult and labour-intensive. This leaves substantial areas in these districts uncultivated and most of the wastelands in Kerala are within these districts.

Laterite occurs in various geomorphic levels in parts of the State. In Kannur district, well-preserved laterite mesas occur mainly at 60 to 210 m. elevation. Along the coast, hard laterite covers are exposed as marine terraces. Laterite occurrence at 60 to 140 m. elevation has generally been observed in the north Kerala region and conforms to the Malabar upland surface identified at 75 m. In parts of Thrissur, Palghat and Malappuram districts, laterite occurs at 60 to 150 m. and 165 to 230 m. altitude, forming two planation surfaces ((Chattopadhyay, 2004). In south Kerala, he demarcated laterites in two geomorphic levels at 30 to 70 m. and 90 to 110 m., in parts of Thiruvananthapuram district. In parts of Kollam district, an extensive laterite surface at 25 to 120 m. was demarcated (Soman, 2002).

Laterite also occurs as cliffs or scarps along the sea-coast (as in Bekal, Kannur, Varkala and Chowwara) as well as along the fringes of Backwaters (as in Ashtamudi, Sasthamkotta, Paravur and Vellayani Kayals). This indicates that the extensive lateritic mesas were dissected due to neotectonic movements (Soman, 2002). Laterite is also observed at higher elevations above 2000 m. in parts of the Munnar plateau. Both residual and detrital components are represented.

**5.13 LATERITE HILLS IN KANNUR DISTRICT**

Two types of laterite hills are seen in this region – laterite rock hills and laterite soil hills. The rock hills are covered by laterite rocks. The exposed laterite in contact with air is converted into hard black coloured rocks having an uneven surface. According to Buchanan’s description ‘it looks like the skin of a person suffering from skin disease’. Beneath this surface, upto a certain depth the laterite stone continues. As it goes deeper, the laterite becomes soft. Beneath it is clay. Such laterite rock hills generally have flat top surface. Madayipara, Moorkhanparamba and Kalliattuparamba are examples. Plant growth is possible only in spaces among the laterites where a little soil remains. Usually the top surface is covered with grass, herbs, shrubs and some smaller trees. Madayipara is
endowed with most rare species of flora and fauna. Rock pools and lakes are present on some of such hills. Eg: Madayi, Meenkulam, Peringome, Eramam, Oorathur, Peruvalathuparamba, etc.

The laterite soil hill is comparatively at an early stage of metamorphosis in which the process of laterisation is not completed (Jayarajan 2004). There is no rocky structure. The top as well as lower layers are formed of soil only. Surface consists of red laterite soil. After certain depth the soil becomes clayey. White clay remains at the bottom. On the surface of such hills, certain isolated blocks of laterite stones are also seen in some places. Pools are not seen on such hills. Water percolates to deeper layers at a faster rate. Such hillocks are present more towards the coastal area. Madikunnu, Kotholikunnu, Vettukunnu, Veethukunnu, etc., are examples.

5.14 GEOMORPHOLOGY OF LATERITIC LANDSCAPE

Isolated but extensive lateritic mesas are the characteristic feature of Kannur district. Southern part of Kerala does not show such extensive laterite mesas which can be attributed to the differential surface weathering that operated in the two areas. The highly undulating eastern and southeastern parts of the district have undergone laterization and in a number of places hard crust - mesa like lateritic landforms have been developed. Laterite profiles of the area generally show two units of vermiform structures which represent two spells of laterization process in pre and post Tertiary. (Narayanaswamy and Chattopadyay, 1996) It is observed that in between two vermiform laterite profiles, a layer of clay or sandstone is found generally.

Lateritic cappings over the erosional surface has played a significant role on the denudational processes of the study area. The top surfaces are flat to gently rolling with centripetal slope and no significant drainage line and the river valleys that normally follow the lineaments cutting across the laterite are narrow, steep sided but flat bottomed. The erosional intensity on these hard crust duricrusts is comparatively less. The process of valley formation in the laterite mesa region conforms more to the scarp retreat or pediplanation than peneplanation (Narayanaswamy and Chattopadyay, 1996). Although the humid tropics are mainly dominated by peneplanation process the occurrence of hard crust laterites and consequent edaphic arid situation has been conducive for scarp retreat.
Moreover, soft clay layer underneath the hard laterites provides favourable condition for lateral widening of stream valleys and scarp retreat. Headward erosion of certain streams is another factor in shaping the mesas (Chattopadyay, 2004). Similar features are also reported in the lateritic terrain of Australia (Twidale, 1984)

The physical properties of laterite as a unique humid-tropical rock formation have been discussed so far. The spatial distribution and nature of laterites in different parts of the world has also been described. In many places its mining has became an important economic activity. On account of its chemical properties, in some areas laterites are mined for extracting the ores of Iron and Aluminium. At the same time it is mined out as bricks for constructional purposes also. In northern Kerala, laterite blocks are used commonly for constructional purposes and its mining has evolved as a major activity of the people. The following discussion portrays an overview of mining in Kerala with special reference to laterite mining.

5.15 MINING IN KERALA

Mining is one of the oldest professions of the world and it grew with the evolution of man and the civilization. Mining occupies a paramount place in the advancement of any society. In Kerala, mining is confined to certain pockets only. Salient features of extraction and mining of certain minerals in Kerala are discussed below.

**Mineral sand:** It is found in the western shoreline of the State, mainly in the belt between Neendakara (Kollam) to Thottappalli (Alappuzha). This belt is also called as Chavara Mineral sand Reserve. It consists of precious minerals like Ilmenite, Loocoxin, Monolite, Siliminite, Circon, Garnet, etc. It is estimated that the total mineral sand reserve of the State is 127 million tonnes.

**Clay:** There are generally three types of clays mined in the state. They are:

(i) China clay: Mining of china clay is confined mainly to some pockets in the districts of Kollam, Thiruvananthapuram, Kannur and Kasaragod. Veyloor, Azhoor, Andoorkonam, Pallipuram and Thonnackal are major china clay mining centers in Thiruvananthapuram. In Kollam district, Kundara, Mulavana, Palliman and Velichakkala are mining areas. In Kannur district, Pazhyangadi, Kannapuram,
Madayi, Cheruthazham and Pattuvam are well known for china clay mining. In Kasaragod district, Kandamcode, Erikulam, Nileshwar, Seethamgoli, Maipadi, etc., are the major mining areas. It is estimated that a total reserve of 172 million tonnes of china clay is available in the State.

(ii) Ball clay: Nadayara in Thiruvananthapuram is a notable mining area for ball clay. Kumbalam, Kanjottussery and Mulavana are major mining centers in Kollam. Pattuvam, Karivellur, Eripuram and Pazhayangadi in Kannur district are also notable here in the case of ball clay mining. Total reserve is estimated as 1.67 million tonnes.

(iii) Fire clay: Coastal belt of Kollam, Alappuzha, Ernakulam, Thrissur and Kannur are major extractors. Kundaman and Pulickal regions in Kollam district are the major producers. In Alappuzha, Thamaramkulam is a major center. Amballore, Kanjiramattam and Keezhmad in Ernakulam are also well known for clay mining. Poomangalam in Thrissur and Pattuvam in Kannur are also important mining centers of fire clay.

**Silica sand:** It is concentrated mainly in the coastal areas of Cherthala, Kanhikkuzhi and Panavalli regions of Alappuzha district. Total resources are estimated as 12.5 million tonnes.

**Bauxite:** In Kasaragode district, Kumbala, Ananthapuram, Seethamgoli, Neeleshwar, Kanjangad and Cheemeni are major bauxite mining areas. In Kannur district Pattuvam is the largest producer. Puravazhi and Sasthamangalam are important bauxite mining areas in the Kollam district. In Thiruvananthapuram district, Mangalapuram, Chilambil and Sasthavattam are important in this regard.

**Limestone:** Limestone is mined mainly from Valayar in Palakkad. Naduvakai, Kozhinjampara and Vannamada are also important limestone mining centers in Palakkad.
Granite building stone: It includes granite, charnockites, khondoloite and gneisses. As a building stone it is mining from 7255 quarries (Dept. of Mining and Geology 2009).

Laterite: The State of Kerala is distinctive in having a cover of laterite. Midland hillocks of Kasaragod, Kannur, Malappuram, Kozhikod, Wayanad, Kottyam and Ernakulam are major centers of laterite mining. The salient features of distribution of laterites in these areas have been discussed already.

5.16 MINING IN KANNUR DISTRICT

The district is endowed with rich deposits of clay. Various types are mined at many places for pottery, tile and ceramic industries. China clay is found in abundance in Thaliparamba and Kannur Taluks. This resource is not fully utilized in the district. China clay in mined from Pazhayangadi and nearby areas of Kannur district. Kannapuram, Cheruthazham, Ramapuram, Pattuvam and Madayi are having mining of china clay. Ball clay is mined from Pattuvam, Korom, Perumba, Karivellur and Eripuram regions of the district.

Some lateritic areas of the district are rich in Bauxite content and they are extracted from Pattuvam, Ariyil, Koonam, Chuzhali, and Keezhattoor. Cheruvanchery near Thalassery also has rich bauxite reserves. Now its mining has emerged as a major economic activity. Good quality Kaolin occurs below the laterite capping around Pilathara and Thaliparamba.

The horizons of lignite are noted in the cliff section of the Kannur coast, Meenkunnu, and Pazhayangadi (District hand book, 2004). Beach sands containing Illmanite, Monazite, Zircon and Thorianite occur along the coast, especially to the south of Valapatanam river mouth and near Azhikode. Other minerals discovered recently are Sillimanite near Chandirukunnu, Graphite near Payyavoor, Mankkadavu, and minor bands of Iron ore near Kannapuram railway station. Many occurrences of Bauxite deposits have been brought to light in the regions of Madayi, Korom, Payyavoor and Pattuvam. Lime shells used for the manufacture of white cement and industrial purposes are found in the backwaters of the Ponniyam River, Dharmodom puzha, Ancharakkandy.
River around Thalassery and Dharmodom as well as in the Valapatanam River to the east of Azhikal Ferry.

The eastern part of the district has igneous and metamorphic intrusions and a number of quarries and stone crushers are located in these areas. Quarrying is mainly concentrated in the regions like Padiyotchal, Rajagiri, Thirumeni, Peringala, Thimiri, Udayagiri, Thadikkadav, Pathanpara, Naduvil, Oduvalli, Vanjiyam, Kudiyanmala, Nediyenga, Mattara, Kacherikkadav, Vaniyappara, Velimana, Keezhpalli, Adakkathod, Kolithattu Manathana and Nedumpoyil.

5.17 LATERITE MINING IN KANNUR

Laterite mining is confined mainly in Payyannur, Thaliparamba and Irikkur blocks. Though extensive lateritic duricrusts are the characteristic feature of the Payyannur block, there are limited mining areas in the block. The bricks of these regions are not so good as compared to the other blocks. Lateritic duricrusts extend upto several km. in Peringome, Padiyotchal, Mathamangalam and Thimiri regions of Payyannur block. Important mining areas in this block are Padiyotchal, Kakkara, Vellora, Olayambadi, Peruvamba, Mathamangalam and Eramam.

In Thaliparamba block, Kanjirangad, Vayattuparamba, Pushpagiri, Chorkala and Mangattuparamba are characterised with extensive lateritic duricrusts. Oduvalli, Chapparapadav, Thrichambaram, Kanjirangad, Kooveri, Mangad, Anchammail, Kurumathoor, etc., are major mining areas.

Laterite bricks of Irikkur block are of good economic value and are in great demand. Hectares of lateritic areas are under intensive mining. The distribution of laterite mines in this block and their multifaceted dimensions are discussed in the subsequent chapter.

5.18 HISTORY OF MINING

Though the study area was blessed with extensive lateritic sheets the local people failed to recognize its economic value for centuries. They used mud bricks for constructional purposes. Lateritic areas were left as it is as barren without any economical
use. In Irikkur and Payannur blocks lateritic duricrusts were spread over extensive areas. A special variety of tall grasses locally called as *Neypullu* was spread everywhere over the lateritic outcrops. The locals used it for yearly thatching of their roofs. In the areas where some topsoil is available cashew trees were cultivated here and there. Laterite being very hard in the surface the human activities over them were highly restricted. People left the land as barren and treated them as wasteland. Most of them sold their “wastelands” to the rich merchants of Irikkur for very cheap prices. Some of them had lateritic areas in their holdings and began to cut out manually with sharp axes. They used it for building purposes. It was first used for making the foundations of mud brick buildings. Thereafter laterites are used for constructing pillars and corner walls of buildings made of mud bricks. By realizing the durability and easy availability the locals began to use laterite bricks for all their constructional purposes. The chemical components in the laterite and cement will mingle together and adhere strongly. People realized that laterite constructions are very strong and long lasting than that of mud bricks. People’s attitude towards the “wasteland” changed tremendously and the utility of laterite as an ideal building stone was widely accepted.

People started cutting laterites as bricks from very early ages for the construction of buildings. But it was used for the constructional work of buildings of landlords and other people with high social status. The ancient temples in the study area were built on laterites with excellent sculpture works. The temples at Thaliparamba, Thrichambaram, Perlassery, Mamanikkunnu, Chedichery, Velam, Kalliad, Payyavoor and Eru vessi are examples of lateritic construction. Laterite was used by the high class people and the socially and economically deprived people had to use mud bricks for their houses. Thus there was a period in the history of the study area when use of laterite was an icon of social status.

A number of Muslim merchants had already bought the lateritic lands for very cheap prices. They employed healthy rural youth and started mining of laterites as bricks and sold according to the demand. They employed local labourers in their mines but their payments were not satisfactory. Peruvalathparamba, Kalliatuparmba and Oorathur were earlier mining centers.
5.19 MANUAL MINING TO MECHANICAL MINING

Manual mining in the block continued for five decades. It was not easy to cut the laterite as bricks with axes. Even then 30 to 40 bricks are made manually every day. By 1980s manual cutting of laterite became more popular in lateritic regions. They were paid an amount of 40 paise per brick in 1975, 60 paise per brick in 1985 and Rs. 1.20 per brick in 1995. There were 4 to 8 labourers employed in a mine. Average production of bricks from a mine was around 300 to 400 only.

In the adjoining districts of Kannur, especially in Kasaragod, the drilling machines were introduced for laterite cutting. There it was found to be most effective and profitable. Some of the entrepreneurs visited some sites where machines are used for cutting. They came back with new driller machines and engine operators from Karnataka State. They realized the potentials of mining in the study area. It was in August 1994, when the first mechanized cutting of laterite started in Chepparamba region of Sreekandapuram panchayath and Pathinaramparamba of Malappattam panchayath. Mechanization got wide support and production of laterite bricks increased tremendously.

Mechanization could increase largely the quality as well as the quantity of laterite bricks. A number of people came as new investors to this field. Mechanization offered more employment opportunities in the mines. A single drilling machine can employ 10 to 15 labourers in a mine. It can cut more than 3000 bricks daily. By the year 2000 manual mining has been stopped completely. Mechanization of laterite cutting brought many new areas under mining. Production as well as consumption of laterite bricks increased tremendously.

5.20 MINING REGULATIONS

Department of Mining and Geology under the State Government is the authority to regulate the mining activities in the State. The entrepreneur has to apply for permission and to take the license from them. The license is issued for one year and every year the entrepreneur has to renew it. He has to remit the mining fee in the treasury according to the area mined, which should be surveyed and certified by the Village Officer. Now the
Consolidated Royaltee Payment (CRP) system has been introduced in the mining sector. It is as follows

Table 5.2
Kannur district – Consolidated Royaltee Payment (CRP) for mining

<table>
<thead>
<tr>
<th>Sl No</th>
<th>Item</th>
<th>Area</th>
<th>Royaltee in Rs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Laterite</td>
<td>Up to 10r (24.7 cent)</td>
<td>15,000</td>
</tr>
<tr>
<td></td>
<td></td>
<td>10-20r (24.8 to 49.4 cent)</td>
<td>25,000</td>
</tr>
<tr>
<td></td>
<td></td>
<td>20-30r (49.5 to 74.1 cent)</td>
<td>50,000</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Above 30 r (above 74.1 cent)</td>
<td>1,00,000</td>
</tr>
<tr>
<td>2</td>
<td>Granite</td>
<td>Up to 5r (12.4 cent)</td>
<td>15,000</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5-10r (12.5 to 24.7 cent)</td>
<td>25,000</td>
</tr>
<tr>
<td></td>
<td></td>
<td>10-15r (24.8 to 37.5 cent)</td>
<td>50,000</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Above 15r (above 37.6 cent)</td>
<td>1,00,000</td>
</tr>
<tr>
<td>3</td>
<td>Sand</td>
<td>Per Tonne</td>
<td>100</td>
</tr>
</tbody>
</table>

Source: Dept. of Mining and Geology, Kannur

There are a set of rules and regulations to be followed by the miner strictly. They are:

1. The entrepreneur has to remit the required mining fee to the government treasury.
2. Site plan and property documents should be submitted before applying for the license.
3. Mining should not exceed below a depth of 8 meters.
4. Mining centre should be 50 meters away from main roads, railways and settlements.
5. Measures should be taken to control noise, dust and other type of pollution.
6. Side walls should be constructed around the mines.
7. Accounts should be kept properly and must be ready to produce the same before the authorities.
8. License should be renewed yearly.

9. The mined pits should be filled after mining.

Even though the Department of Mining and Geology has all legal regulations to direct the mining scenario into the right dimension, it is a real irony that most of the entrepreneurs are not following any of these regulations. Due to such activities, the impact of laterite mining has brought many environmental changes to the mining area which requires a detailed discussion. Among the various blocks, Irikkur is the most important block with regard to laterite mining. Hence this block has been selected for detailed explanation on laterite mining and the impact. The details are discussed in the next chapter.