CHAPTER IV

PLANATION SURFACES

4.1. Introduction:

King (1950) remarked that low relief surfaces "record in a relatively simple manner the geomorphological history of a Planation surfaces. Raghavan (1988) described Planation Surfaces as low relief plains that are normally characteristic of the regional geomorphic environment. Planation surfaces intrinsically possess features that allow two important aspects to be identified: them being the processes that operate and time involved in the evolution of landforms. Planation surfaces are excellently developed in tropical environments of which the Vengara terrain adheres to.

The concept and genesis of Planation surfaces have centered around the peneplanation concept (Davis 1909) which focuses on slope decline to produce a rolling or undulating surface of low relief dominated by convexities. These ideas were skimmed from the earlier work of Powell (1875), Dutton (1880-81) and Gilbert (1877). However, the fragility of this concept has been well exemplified by Penck (1924, 1953), Lehman (1953), and Wood (1940).

The theorization through a synthesis in terms of terrain evolution of different regimes led to the concept of 'pediplanation' by King (1942, 1953, 1957, 1962, and 1984). Evidences reflecting the processes of pediplanaion has been described systematically in the discourse of landform evolution in Gondwanaland by various workers especially by King (1962); Budel (1965); Twidale (1981) and Twidale and Van Zyl (1980).
The evolution of the Western Ghats of Kerala and the Vengara terrain in particular encompasses the regional implications too. It is attempted to demonstrate in this study the acceptance of the concept of pediplanation (King, 1953) in terms of Scarp retreat and pedimentation. However Raghavan (1998) in describing the area, around 13° N latitude, North West of the study area, provides regional evidence for the evolution of Planation surfaces.

The basic concept being- "Inherent in the doctrine of pediplanation is the persistence of older surfaces without any significant alternation for a long period into the currency of the new cycle. The two cyclic surfaces are for long co-existent, the older above the retreating scarp and the younger below" King (1953). An application of this concept i.e. the pediplanation concept in the Vengara terrain, provides for an identification of two major Planation surfaces: (Fig. 4.1) the Kerala Pediplain described in this study as the Vengara Surface and the older surface the Karnataka-Kerala
Fig. 4.1. Wireframe 3D depicting the two major planation surfaces - Peninsular and the Pediplain.
Consequently, "Comparative" ages (see King, 1953) have made the evolution of the Planation surfaces more easily discernable. The 'thesis' and 'anti thesis' environment prevailed since Davis' (1905) 'Geographical Cycle, through Pencks (1924) Die morphologisch Analyse' (see Raghavan 1988 and references therein). Re-orienting geomorphological thought is largely attributed to the work of King (1984). His 'Canons of landscape evolution (1953) remains as the precursor to re-interpretation of landforms, especially in the Gondwanaland fragments. Palaeomagnetic reconstructions depict India to be an integral component of the southern 'Super Continent' as shown by Smith and Hallam (1970).

A reasonably acceptable fit on both morphological and geological criteria (McElhinny, 1973) implies that the present day Indian coastline was yet to be generated in the pre Mesozoic time. India fragmented from the Gondwanaland in the mid-Jurassic (Mc Dougall, 1963). This was the precursor tectonic episode in defining the configuration of the present day coasts of India. The initial rift between Antarctica and India being mid-late creataceous, concomitant with the extrusion of the Rajmahal Traps (McElhinny, 1970; Sreedhara Murthy and Raghavan, 1994). The scenario of the west Coast and that of the study area is deemed apt to be explained in relation to Madagascar. In light of the geometrical fit of Madagascar and India, along with consistent Precambrian trends, lothologies and age (see Katz and Premoli, 1979; Crawford, 1978) along with the palaeomagnetic data that support the general fit, it is suggested that Madagascar and India remained unrifted upto late cretaceous poles for India, confirming their proximity atleast till late cretaceous, about 70-80 M.a. ago (McElhinny, 1973).

The late Jurassic to early cretaceous magnetic anomalies recognized in the Somali Basin (M 25-M10, 153-121 M.a.-see Mart, 1988) suggest an early evolution of the Indian Ocean in terms of Madagascar-India separating from Somali-Kenya, preceding their movement southward (Rabinowitz et al, 1983). The subsequent sea floor spreading indicated
from the mascarene Basin suggests that India separated from Madagascar during the late Cretaceous, 85-65 Ma (Magnetic anomalies 34-28, see Mart 1988; Raghavan, 1988). This late cretaceous age is relatively more specific to the cretaceous ‘times’ given by Katz and Premoli (1979), as the time of rifting of India from Madagascar-Africa plate. In this dynamic scenario the ancient crustal material and sedimentaries of the Vengara area moved to its relative position in the northern hemisphere. The critical constraint of rifting is linked with the separation of India from Madagascar. Stages depicting the genesis of Vengara terrain could be better appreciated diagrammatically using the modified basic diagram (Fig. 4.2) of Sreedhara Murthy and Raghavan (1994). Surfaces Dating of Planation surfaces have been attempted by more than one approach. The most reliable methods have been discussed by King (1953). They are by determining the “actual” age, as defined by the superficial deposits and by “comparative” ages, which explains the landscape viewed as a whole. Thus “comparative” age more comprehensive and with objective regional connotations. The Vengara terrain presents two distinct Planation surfaces, separated by the Western Ghat scarps (Fig.4.1). The surface water divide that delineates the summit edge of the Western Ghat scarp coincides with the western extremity of the Karnataka-Kerala plateau surface (Radhakrishna, 1964; Raghavan, 1988). The Western Ghat scarp is traced from an elevation ranging from 100m to about 1400 meter in the study area. Below this retreating major Western Ghat scarp are various surfaces separated by lesser elevated scarps located on the pediplains.

The Karnataka-Kerala Plateau surface, being in existence prior to the genesis of the West coast and the Western Ghat scarp thus predates the syngenesis of West Coast and the Western Ghat Scarp i.e. it is older than late Cretaceous (>85Ma). The low lying pediplane that is growing in dimension consequent to the retreat of the scarp is younger to the Karnataka-Kerala plateau and hence younger than late Cretaceous.
Fig 4.2. Stages depicting the genesis of Vengara, modified after Sreedhara Murthy and Raghavan (1994)
The Nilgiri, are remnants of an older Planation surface with a
general elevation of around 2500 M. this is evidently the most ancient
Planation surface developed on the Archaean of peninsular India. This
probably represents the first ever cycle of subaerial Planation. The Nilgiri
plateau has been assigned a middle Jurassic age (Vaidyanadhan, 1967)
and has been equivated to the remnant of the 'Gondwana Surface'
(Radhakrishna 1967, Singh, 1967; King, 1962). The Chempuzha,
Varikkapara, Talipparamba, Srikandapuram and Vengara Surfaces are
surfaces of varying elevations (Table. 4.1) draping the ancient basement
and the modern pediment. By subjecting the terrain to simple and
conventional techniques, various surfaces have been identified. The
recognition of different Planation surfaces has been substantiated by the
altimetric frequency curve (Fig.4.3). In order to construct the altimetric
frequency curve, the elevation and number of summits were noted and
the data was then plotted by keeping the altitude on the ordinate and the
frequency of summits on the abscissa. The clustering of summits
indicated the range in elevation of the Planation surfaces.

From the study of the altimetric frequency curve, East-West profile
studies and substantiated by pertinent field investigations, Planation
surfaces at various elevations (meters above sea level) have been identified
and named as follows:

<table>
<thead>
<tr>
<th>NAME</th>
<th>ELEVATION (M)</th>
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<tbody>
<tr>
<td>PENINSULAR SURFACE</td>
<td>&gt;1250</td>
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<tr>
<td>CHEM PUZHA SURFACE</td>
<td>1200-1250</td>
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<tr>
<td>VARI AKKAPARA SURFACE</td>
<td>630–650</td>
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<tr>
<td>TALIPPARAMBA SURFACE</td>
<td>200–250</td>
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<tr>
<td>SRIKANTAPURAM SURFACE</td>
<td>100–150</td>
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<tr>
<td>VENGARA SURFACE</td>
<td>8.02-10.08</td>
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<tr>
<td>ELEVATION RANGE (m)</td>
<td>FREQUENCY</td>
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<tr>
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<td>20</td>
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<td>1350-1400</td>
<td>40</td>
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Table 4.1 Elevation frequency data obtained from toposheet as Spot-heights, Benchmarks and Ring Contours etc.

Fig. 4.3 Elevation frequency range of the study area.
A wire-frame 3-D mesh diagram using more than 3000 elevation points and Golden Surfer Software (Fig. 4.4) furnishes a synoptic three dimensionality of the study area. The spatial distribution of the various surfaces has been furnished (Fig. 4.5) using ERDAS Imagine 8.5 software. The spatial distribution Talipparamba and the Srikantapuram surfaces to be accounting for more than half of the spatial area while the area covered by the Peninsular plateau surface is the least. The Vengara Surface that contains datable marine shell deposits trends NW-SE as a band east of the modern surface. The Chempuzha surface is unique in having the hills as remnants of a once large planar surface. This surface occurs as an accordant of summits (Fig. 4.6) the Variakkapara surface (Fig. 4.6) is a low relief grass clad surface subjacent to the Chempuzha surface. A section of the Warkalli equivalents below which occurs the lignite/peat horizon found largely with the warkalli beds. Note the occurrence of the Talipparamba surface capping the Miocene sediments distinct on the right up corner. A typical exposure of the Warkalli formation in the china clay mine at Vengara near Pazhayangadi depicts lateratization in the uppermost horizon at the right top. Typical horizontal bedding of carbonaceous clay and lignite varies in thickness of 8 to 10m (Fig. 4.9 and 4.10). The laterite varies from 10 to 13m in thickness.
Fig. 4.4 Wireframe 3D Model of the study area
Fig. 4.5 Spatial distributions of Palaeosurfaces
THE SHRUB-GRASSLAND CLAD VARIAKKAPARA SURFACE. NOTE THE FLAT LOW RELIEF SURFACE. IN THE FOREGROUND. THE CHEMPUZHA SURFACE IS DISTINCT IN THE BACKGROUND AS HILLS. THEY OCCUR AS REMENANTS OF THE CHEMPUZHA SURFACE

Fig. 4.6 A PANAROMIC VIEW OF THE VARIAKKAPARA SURFACE AND THE CHEMPUZHA SURFACE

THE CHEMPUZHA SURFACE OCCURING AS ACCORDANT SUMMITS OF NUMEROUS REMENANT HILLS AND CO-SYNGENETIC VALLEYS, TYPICAL OF TROPICAL LANDFORM EVOLUTION.

A TYPICAL UNFOSSILIFEROUS ARKOSIC SAND-CLAY BED AT TALIPPARAMBA WITH DISTINCT LIGNITE/PEAT HORIZONS DESIGNATED AS THE WARKALLI BEDS IN THE NORTH AND SOUTH OF THE STUDY AREA. THE TALIPPARAMBA SURFACE CAPPS THE ANCIENT SEDIMENTS.

Fig. 4.7. THE SRIKANDAPURAM SURFACE AND THE TALIPPARAMBA SURFACES REPRESENTED BY ANCIENT SEDIMENTARIES.
NOTE THE LIGNITE/PEAT HORIZONS, A COMPONENT TYPICAL OF A COMPLETE TYPE SECTION OF THE WAR KALLI BEDS.

A SECTION OF THE WARKALLI EQUIVALENTS BELOW WHICH OCCURS THE LGINITE/PEAT HORIZON FOUND LARGELY WITH THE WARKALLI BEDS. NOTE THE OCCURRENCE OF THE TALIPPARAMBA SURFACE CAPPING THE MIocene SEDIMENTS DISTINCT ON THE RIGHT UP CORNER.

Fig. 4.8 A SECTION OF THE TALIPPARAMBA SURFACE.
A typical exposure of the Warkalli Formation in the China Clay Mine at Vengara near Pazhayangadi. Note the lateratization in the uppermost horizon at the right top. Typical horizontal bedding of carbonaceous clay and lignite that vary in thickness of 8 to 10m. The laterite varies from 10 to 13m in thickness.

Fig. 4.9 Pazhayangadi clays over lying the Vengara basement. Representative of the Waralli sequences.
A VARIOUS ANGLES OF THE NEAR HORIZONTAL BEDS OF THE WARALLI SEQUENCES. NOTE THE LIGNITE CARBONACEOUS CLAYS AND CHINA CLAY SEDIMENTS DISPOSED NEAR HORIZONTALLY AT PAZHYANGADI IN CANNANORE DISTRICT IN THE NORTHWEST OF THE STUDY AREA

Fig. 4.10 WARKALLI SEQUENCES LYING ON THE VENGARA BASEMENT.
A 2-D profile of the terrain summarises the disposition of the various Palaeosurfaces of the study area.


Fig. 4.11 Wireframe 2D model shows stages depicting the genesis of Vengara.
This study thus furnishes evidences of the existence of palaeosurface that are spatially distributed in the study area. It should be noted that all the surfaces are post Cretaceous in age this due to the initial surface that was provided for erosion/deposition after the genesis of the west coast of India. The Karnataka-Kerala Plate surface occurs at elevations greater than >1200m. Thus in the study area the Chempuzha Surface is the oldest and is a fragment of the Chelakkara surface of the Upper Miocene (Sambandam and Prasad, 1981). The Talipparamba surface could be correlated with that of the Kuttippuram surface whose age is given as Lower Pliocene (Sambandam and Prasad, 1981). Equivalents of the Kuttippuram surface have been traced further north along the west the coast of India (Raghavan, 1988). This study thus brings out the presence of seven palaeo surfaces in the study area.
Reference:


Desikachar, S.V. 1976. Geology and hydrocarbon prospects of the Kerala West Coast basin. Workshop on coastal sedimentaries of India south of 18°N. Oil and Natural Gas Commission, Madras.


