# MORPHOTECTONIC SETTING AND NEOTECTONIC EVOLUTION OF SW SAURASHTRA, WESTERN INDIA

**Executive Summary**
of the thesis submitted

By

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## INTRODUCTION

The Saurashtra peninsula in Gujarat, western India, also known as the Kathiawar uplift is a quadrangular SW titled uplifted horst block between three coinciding rift basins viz., Kachchh at the north, Cambay at the east and Narmada at the south. It is a distinct tectono-geomorphic entity bounded by major faults like North Kathiawar Fault (NKF) at north, extension of West Coast Fault (WCF) at west, extension of Narmada-Son Fault (NSF) at south and Western Cambay Basin Margin Fault (WCBMF) at east trending NE, NW, ENE and NNE respectively. Most part of Saurashtra shows rugged erosional topography comprising hills and ridges along with several volcano-plutonic complexes with varying composition and abundant dykes. Geomorphologically, this plateau drains major rivers in a radial drainage pattern. The region has also been experiencing swarm type of earthquake activity deciphered since 1800s with low to moderate magnitude earthquakes recorded mainly from eastern, northern and southern part of this region. However, maximum number of shocks is experienced by the southern margin of the peninsula which is largely occupied by structurally controlled dyke swarms, trappean lava flows and Quaternary carbonate deposits. The peninsula is affected by major tectonic events that occurred after the breakup of Gondwanaland i.e., from Middle to Late Jurassic till the Late Cretaceous, evolving rift basins, reactivation of tectonic trends and numerous intrusions. Previous workers provided the age of the Deccan Traps, Bouger anomaly map, magnetotelluric (MT) studies for trap thickness and deep seismic profiles based on geophysical data. Moreover, studies related to the coastal geomorphology had shown the component of neotectonic uplift as well as sea level change. However, there is scanty of published data from the southern margin of Saurashtra on morphotectonic evolution and tectonic controls on the landscape apart from the coastline. Also, there are not any previously mapped faults and the data regarding regional fault patterns from this area. The present study is, hence, focused towards the detailed understanding of geology, geomorphology and structural aspects on southern part of the peninsula and to delineate morphotectonic evolution of SW Saurashtra.

## REGIONAL GEOLOGY AND STRUCTURAL SET-UP

The Saurashtra peninsula is a distinct morphotectonic unit at the western continental margin of India that forms a rocky plateau bordered by Tertiary and Quaternary carbonate deposits. Structurally, the Saurashtra horst is a large fault block that has settled

between Kachchh graben at the north and Surat (Dahanu) depression at the south bounded by major faults in all four sides. The northern limit is marked by the North Kathiawar Fault (NKF), the West Cambay Basin Margin Fault (WCBMF) in the east, the Narmada-Son Fault (NSF) in the offshore towards the south and NW-SE trending offshore fault parallel to the coastline in the southeast. Three major Precambrian trends coincides in the Saurashtra region viz., Dharwar trend (NNW-SSE) in the southern part, Aravalli trend (NE-SW) in the northeastern part and Satpura trend (ENE-WSW) in the central part. The extension of West Coast Fault (WCF) follows the straight western coastal belt of Saurashtra peninsula also known as Saurashtra Fault is a NW trending fault extended from N-S trending WCF in the western coastal margin of India. In the eastern part of Saurashtra, between Palitana and Gulf of Cambay, large mafic dyke swarms crops out trending ENE-WSW which represents the Precambrian trend of Narmada-Son lineament.

The area predominantly comprises of trappean lava flows of Deccan trap formation since upper Cretaceous period forming on the rocky plateau at the central part. Subsequently, Tertiary sediments got deposited on the margin of these flows which is observed in patches at few places with overlying Quaternary sediments that deposited later. The northeastern part of the region exposes Mesozoic sedimentary rocks comprising Dhrangadhra-Wadhwan Formation. Several studies on the occurrence, age and composition of the trappean lava flows have been studied showing various geophysical anomalies. Numerous circular highs and lows of different magnitudes associated with these volcanic plugs were observed in the Bouguer anomaly map. These are connected with the NE oriented structural trend indicating deep seated faults or fracture zones in the SE part of the Saurashtra. The magnetotelluric (MT) studies have revealed that the thickness of trap decreases from west to east. Towards the coastal zone, the traps are underlain by Tertiary and Quaternary rocks and alluvial deposits. The most extensive of these are the alluvial deposits along the east and southeast coast of the peninsula, where they are thought to be chiefly estuarine or marine, even though not fossiliferous. The coastal tract of the region consisting erosional as well as depositional landforms comprises of sandy and/or rocky beaches, mudflats, sea caves, sea cliffs, notches etc.

The Quaternary miliolite deposits studies shows the coastal miliolites in the SW region representing coastal ridges and dune fields are of late-middle Pleistocene while inland miliolites occurred as obstacle dunes, valley fills and sheet deposits. The age of the

well-studied miliolites of marine, fluvial and aeolian carbonate deposits ranges from Middle to Late Pleistocene inferring tectonic instability and coastal uplift ranging 0.12 to 0.58 mm/year during Quaternary period. The gently southward dipping miliolite rocks in the coastal region of southwest Saurashtra observed as high cliffs showing presence of raised platforms and notches. Two raised notches, identified and dated to ~125 ka BP and 6 ka BP, along the coastline of Jafarabad (SW Saurashtra) suggests 7 m coastal margin uplift after correcting for the sea level fluctuation since the last ~125 Ka. The Tertiary and Quaternary rocks shows two sets of prominent joints. The principal stress direction based on joint patterns found to be NE in Quaternary miliolite deposits in SW Saurashtra coastal belt.

Overall, the structure of the Saurashtra block is the result of several phases of tectonic activity since the separation of the Indian plate along with rifting and further fragmentation of its western continental margin as it drifted northward and Deccan volcanic eruptive phase attributed to the Reunion plume. This suggests that the region has undergone significant changes in stress patterns ranging from extension and compression. The current state of compression is well evidenced by the contemporary stress patterns worked out from the seismically active neighboring areas of Kachchh and Narmada rift zones. However, delineation of faults and reconstruction of their tectonic history have not been carried out so far in Saurashtra. This has resulted in poor understanding of Saurashtra in the context of the tectonic and seismic instability of the western continental margin of India. The Saurashtra region has been considered as neotectonically stable for a long period of time. However, few studies in the last 2-3 decades have shown imprints of tectonic activity from the study of Quaternary landforms especially from SW Saurashtra coastline.

Saurashtra region falls under seismic zone III and IV of Seismic Zoning Map of India, Bureau of Indian Standards (BIS, 2002). Hundreds of low to moderate magnitude shocks were experienced by this region deciphered. Such types of earthquake swarm activities has occurred worldwide and some workers have previously measured the swarm activities and determined focal mechanism. The history of earthquakes recurring have been experienced by most of the places in Saurashtra region. The southwest Saurashtra peninsula experienced a shock of magnitude 4.3, an offshore earthquake happened near Rajula with 5.0 magnitude, an earthquake of 4.3 magnitude has occurred in the region of Girnar Hills near Una and Bhavnagar region experienced a tremor of 3.6 magnitude followed by nearly

132 aftershocks of magnitude 0.5 to 3.8. These swarm type earthquake activities are still experienced at many places indicating presence of active tectonic elements which have not been identified so far.

## APPROACH AND METHODOLOGY

1. Relevant literature available on geological, geomorphic, structural and tectonic characteristics of the Saurashtra region were analytically studied to primarily understand the geological and structural set up and its influence on Quaternary landscape.
2. Interpretation of the satellite images for identifying seismotectonic landforms, faults, drainage patterns and base map preparation with the help of Survey of India (SOI) toposheets.
3. Detailed geomorphic mapping was carried out demarcating structural elements and aeolianite ridge system with the help of SOI toposheets and DEM analysis.
4. Digital elevation models (DEMs) of 30 m resolution were used to produce slope data, aspect data and lineament map to observe the tectono-geomorphic features associated with the landscape evolution of the study area.
5. Extensive field investigations were carried out to map several geomorphic features, erosional and depositional landforms, fluvial characteristics, faults and Quaternary miliolite deposits to reconstruct the landscape evolution of the study area.
6. Paleostress analysis carried out from fault-slip data in trappean terrain and joint sets data of exposed Tertiary and Quaternary deposits to deduce SHmax (maximum horizontal stress) and to comprehend regional stress trend.
7. Aeolianite ridges were identified and mapped with the help of remote sensing analysis, DEM data and detailed field exploration to know its morphological characteristics.
8. Morphotectonic analysis were carried out using several geomorphic indices of ten drainage basins to evaluate tectono-geomorphic evolution with respect to structural deformation of the SW Saurashtra.
9. The data generated through field studies, remote sensing analysis, lineament mapping and quantitative analysis were synthesized and critically evaluated to reconstruct the tectono-geomorphic setting and morphotectonic evolution of SW Saurashtra.

## MORPHOTECTONIC EVOLUTION

The SW Saurashtra region is divided into two distinct zoned based on the varying geomorphic characteristics which are controlled by the tectonic elements in the Deccan Traps. The eastern part is identified as morphotectonic domain-I comprises the region around Rajula encompassing the area drained by the Dhantarvadi, Malan and Raidi River. The western part is morphotectonic domain-II encloses the area drained by the Hiran, Saraswati, Singwada, Sanagwadi, Rupen, Machundri and Rawal River. Both the domains were investigated and studied extensively to locate and map the faults, brittle shear zones and to identify various geomorphic evidences of neotectonic deformation. A detailed drainage basin analysis of all the drainage basins was also carried out to work out the regional scale pattern of neotectonic deformation.

## MORPHOTECTONIC DOMIAN – I

This domain comprises the region around Rajula and mainly consists of the rugged hilly topography developed over the Deccan Traps and the south sloping costal segment with miliolite deposits of late Quaternary age and present day mudflats. The Tertiary rocks occurs in a coast parallel thin belt to the south of Rajula between the Deccan Traps and miliolite while further west they are buried under miliolites. The area around Rajula, comprises a large zone of structurally controlled dykes, cuesta ridges, symmetrical dyke ridges and fault scarps. This zone is an extension of the dyke swarm that starts from the area to the west of Bhavnagar. The coastal cliffs shows raised notches around Jafarabad suggesting a tectonic uplift of ~7 m during the last ~125 ka B.P. However, no causative faults responsible for uplift or earthquake swarm are known from the area.

### Tectonic geomorphology

The morphotectonic domain-I is divided into three geomorphic zones from north to south viz, northern upland zone, pediment zone and coastal zone. The northern upland zone is covers two-third of the domain shows rugged hilly topography and consists of Deccan Trap southeast tilted lava flows which are profusely intruded with dykes. The dominant landforms observed here are mainly asymmetrical cuesta ridges with steep scarp side and gentle southeast directed dip slopes and symmetrical dyke ridges with intervening rocky plains. All cuesta ridges and majority of dyke ridges trend in NE-SW direction. Apart from the dyke swarms and dipping lava flows, there are several faults cut across the trappean terrain. All these faults are not reported previously in any literature. The fault zones show sheared zones with prominent vein activity, displacement of the quartz and calcite veins,

slicken fabrics, striations, and knickpoints along rivers. The pediment zone comprising coast parallel narrow strip of south to southeastward sloping rocky surface developed over the Laterites and Tertiary rocks. The Tertiary rocks comprise fossiliferous limestones and sandstones belonging to Gaj Formation of Miocene age. The rocks are dipping in SSE direction and are highly jointed. The rocks are mostly buried under thin cover (1-3 m) alluvial sediments. The coastal zone is largely occupied by late Quaternary miliolites forming 10-15 m high cliffs along the coastline interrupted by indentation of coastline with wide mudflats extending behind the coastal cliffs and sandy beaches. Several geomorphic features observed in this domain are tilted lava flows, linear structurally controlled ridges, fresh fault scarps, coastal cliffs, raised mudflats, notches, which indicates prominent control of structure and active tectonics in the evolution of the landscape.

**Fault pattern**

During the present study, several faults were mapped in the trappean hilly region in the morphotectonic domain-I which are previously unreported and there is no information available on the tectonic and structural set up of the area. All the faults are mapped and their impact on the landscape has been described. Since the faults are well exposed, GPR studies were required to the bare minimum. The paleostress analyses was performed on the collected fault-slip data to derive the stress tensors of the region. In the present study, four faults were identified and mapped with prominent all three types of striations and closely spaced multiple fault planes.

Katar Fault (F1), is an ~E trending which is well exposed for about one kilometer to the west of Katar village, cuts across the NE-SW trending dyke swarm and the strike of the southeastward tilted Deccan Trap lava flows. Slickenside striations with kinematic indicators like fractures perpendicular to the fault surface in the direction of movement were observed on the megascopic-scale to identify the slip sense. The steps or peaks face upslope indicating the slip sense and asymmetric curved elevations, peaks and step like features on the rock surface have also been observed in oblique striated planes. Depending on the friction between the slipping fault blocks, the orientation of steps rises towards the motion of the opposite block. Oblique striations observed on this fault plane mostly indicate reverse faulting and in few cases normal faulting. The sense of shear at these sub-vertical fault planes appears to be dominantly either horizontal (i.e. strike-slip) or oblique (i.e., oblique-slip).

The ~NE-SW trending fault (F2) marks the western limit of this domain as the dyke swarm province abruptly terminates against it. The Malan river flows along the fault and it is also exposed in the river sections of Dhantarvadi and Rawal River. Along the fault, evidences like prominent striations on vertical to sub vertical fault plane, brittle shear zones, vein displacement, slicken fabrics etc. were observed in the field. These evidences strongly infers that this is a large fault which swings from ~NE-SW trend in the north to ~NNE-SSW fault trend in the south. The shear zones along with strong vein activity and several knickpoints was also detected where the fault plane was exposed. The fault shows normal dip slip as indicated by the smoothness and roughness criteria on the vertical fault plane. Several parallel ridges observed where other fault planes (F3) were exposed with prominent multiple striations in multiple fault planes. These were well exposed between the Malan and Raidi River basin. The slip sense were identified for all the new faults that were documented in the present study. Several ~ENE-WSW to E-W trending faults (F4) were also observed exposing vertical to sub vertical fault plane with prominent oblique and horizontal striations. However, apart from all other faults observed, the nature of these faults shows strike slip movement and is inferred as pure dextral strike slip fault.

**Paleostress Analyses**

Paleostress analyses was performed on the collected fault-slip data to derive the stress tensors for all the new documented faults. The fault-slip data includes fault plane orientation, sense of slip (normal/reverse/dextral/sinistral) and slickenside orientation. More than 200 fault-slip data (attitudes of fault planes and slickensides) was used for fault slip analyses, using T-Tecto Studio X5, Win-Tensor (v5.8.7) and FaultKin (v7.7.2). The analyses indicated the Katar Fault is an oblique slip reverse fault with sinistral slip and suggest two phases of reactivations under transpressional stress regime. Faults F2 is normal dextral fault and F3 is normal sinistral fault with strike slip component shows NE to NNE compression. All the new faults exposed in the trappean terrain were analyzed and inferred that the maximum principal stress trend shows prominent NNE-SSW, NE-SW and NW-SE oriented compression.

**Morphotectonic analyses**

The drainages in this domain flows over steep slopes in the hilly region with significant stream deflections. The drainage pattern is dendritic over the uneven rugged terrain and trellis due to presence of dykes and parallel near the coastal zone sue to sloping

surface. All drainages show deeply incised channels and strong tectonic control. The drainage parameters investigated for each basin includes the various linear, areal and relief aspects such as Basin length (Lb), Area (A), Perimeter (P), Stream order (U), Stream length (Lu), Bifurcation ratio (Rb), Drianage density (Dd), Stream Frequency (Fs), Drainage Texture (T), Form Factor (Ff), Circulatory ratio (Rc), Elongation ratio (Re), Shape index (Sw), Basin relief (r), Relief ratio (Rr) and Ruggedness number (Rn). The morphotectonic parameters were also calculated like Valley floor width-to-height ratio (Vf ratio), Asymmetry Factor (AF), Hypsometric Curve, Hypsometric Integral (HI) and Stream-Length Gradient index (SL).

All the basin parameters for all three basins shows extremely significant values indicating some sort of geological control and the geological structures altering the drainage pattern. It also infers that the drainage has been affected by structural instabilities in the central southward gently sloping pediment zone which is indicative of strong structural control on the drainage. All the basin are highly elongated and suggesting deeply dissected terrain with highest erosion among three and tectonically active river basin. The SL index values infers that the sudden changes in the gradient of the river bed indicative of structurally controlled terrain probably due to the presence of faults with multiple planes and slip direction due to reactivation. All three drainage basins are highly asymmetrical and showing prominent southeastward tectonic tilt which resulted in shifting the main trunk stream. Low values of hypsometric integral is indicative of highly dissected topography with the presence of tectonically active region. The hypsometric curves suggests moderately developed drainage basin with ongoing denudation. All the basin is comparatively younger with moderately eroded terrain showing narrow channels, deep valleys and few meters of channel incision.

## MORPHOTECTONIC DOMAIN – II

The domain-II comprises of the region from Veraval in the west to the Diu Island in the east. The domain consists of highly undulating terrain over trappean lava flows and south sloping planar surface over Quaternary deposits with the presence of E-W trending aeolianite ridges with few patches of Tertiary rocks exposed. The area consists of seven southward flowing major drainages viz., Hiran, Somat, Singwada, Sangawadi, Rupen, Machundri and Rawal.

### Tectonic geomorphology

Geomorphologically, this part of the study area is divided into three zones, upland zone, buried pediment zone and coastal zone. The hilly undulating topography, abundance linear dyke ridges with multiple trends, sharp elevation changes, sharp channel bends and abrupt topographic variations observed over the upland zone. The trap-miliolite interface observed where the river channels shows sharp gradient change. The Quaternary deposits overlying on Deccan trap basalts is extensively observed on the buried pediment zone. The thin cover of Quaternary miliolites and alluvial deposits gently sloping southward with cliff sections showing. There is a significant change in drainage patterns from dendritic to parallel in this zone. The topography is majorly controlled by several E-W trending aeolianite ridges. The coastal zone consists of coastal dunes, intertidal flats, shore platforms, and present day beach dune complexes. These ridges changes the stream direction that flows as straight channel southwards and shows prominent cross-bedding.

**DEM analysis**

The DEM analyses of the domain II shows various prominent geomorphic features such ~E-W and ~NW-SE trending miliolite ridges in the southern part near coastal zone, rugged terrain of trappean rocks in the northern upland region, deeply incised rivers flowing south etc. The rivers flowing from the undulating topography incising forming deep valleys and gorges. The most prominent feature observed other than these incised rivers are the ridges parallel to the coastline with two prominent trends in the eastern part (~NW-SE) and western part (~E-W). The straight river channels bends abruptly near the transversely running miliolite ridges and flows towards south incising these ridges. In the southernmost region, near Diu, the mudflats emerging inland is also detected cutting the ~E-W trending miliolite ridge.

**Aeolianite ridge system**

The aeolianite ridges are well-preserved and mapped around the globe debated numerous times about its significances related to their Quaternary depositional history. The evidences from DEM analysis shows coast parallel aeolianite ridges around Hiran River while seven E-W trending ridges extending from inland up to coast. These are identified as longitudinal, parallel to sub parallel, fine to medium grained and well sorted carbonate ridges. The cross-beddings are well developed as observed ridge cut sections, however, the ridges show discontinuation as maximum part is either eroded by south flowing rivers or mined. Previous workers dated aeolianites ridges and the range shows that these are older

than ~125 ka expecting a break in aeolian deposition at last glacial stage, i.e., beginning of warmer period. However, the morphostratigraphy of the miliolite deposits shows that the aeolianite ridges are the oldest phase of miliolites deposition followed by valley-fill/sheet deposits and younger aeolian dune deposits in the present study area.

**Morphotectonic analyses**

The rivers are divided into two segments, drainages arising from the uplands and drainages within miliolites. However, all the drainages shows prominent tectonic and structural control over basin landscape. The higher bifurcation ratio infers strong structural disturbances over the drainage basins. The SL index values observed over the drainages arising from uplands shows abrupt peaks due to change in slope at two places, i.e., the trap-miliolite interface and the presence of E-W trending aeolianite ridges. The landscape of this domain is majorly controlled by these coast parallel aeolianite ridges. These ridges cut the river channel forming a sharp hook shaped bend and change of channel course. This feature is prominently observed in all the river channels over the gently sloping Quaternary terrain. Several SL index value peaks indicates that the area is tectonically controlled with several knickpoints and rapids formed. The formation of all the slope breaks are suggestive of lithological variation, tectonic uplift or presence of fault/deep seated fault.

## CONCLUSIONS

The present study has led to the following major conclusions.

1. The present study area is divisible into two morphotectonic domains viz., morphotectonic domain-I (eastern half) and morphotectonic domain-II (western half) identified based on variation in geomorphic and morphotectonic set up.
2. Domain-I shows largely rocky terrain controlled by intruded ENE-WSW trending dyke ridges and other structural elements in the SE tilted Deccan Trap lava flows. The dyke ridges swings to NE-SW in the study area suggesting rotation of stress orientation during post-trappean times. The narrow coastal zone is occupied by south dipping Tertiary limestone overlain by Late Quaternary miliolites.
3. Four new faults (F1 to F4) are mapped in Domain-I which were previously unmapped. E-W trending Katar Fault (F1) and other faults (F2-F4) trending in NE-SW to NNE-SSW directions cut across the NE-SW trending dyke swarm and the strike of the SE tilted lava flows. Fault slip data collected along exposed fault planes show multiple

phases of strike-slip to oblique-slip movements in these faults during post-Deccan Trap time under an overall compressional stress regime.

4. Detailed fault slip analyses indicates that the Katar Fault (F1) is an oblique slip reverse fault with sinistral slip, Fault F2 is oblique slip normal fault with dextral slip while faults F3 and F4 are oblique slip normal faults with sinistral slip movement. The analyses suggests two phases of reactivations under transpressional stress regime. The difference in SHmax trend of the offshore region to that of the present study area shows anticlockwise rotation after the main eruptive phase of Deccan Trap.
5. The faults developed under transpresssional stress regime induced by the collision and anti-clockwise rotation of the Indian plate and post-date the swing of the dyke swarm from ENE-WSW in the east to NE-SW trend in the area around Rajula in domain-I. The swing of the dyke swarm and eastward tilt of the lava flows are tentatively attributed to the stresses induced by the large Girnar intrusive body in the NW immediately after the Deccan volcanic activity. Further multiple reactivations evident from these faults including in post-Miocene and Quaternary times suggesting continuation of transpressional stress regime.
6. Three drainage basins viz. Dhantarvadi, Raidi and Malan in domain-I revealed dominating influence of the structural features in trappean lava flows on landscape configuration. Critical morphotectonic analysis indicate that the area is undergoing neotectonic uplift in response to prevailing transpressional stress regime corroborated by the miliolite cliffs along the coastline, raised notches (dated to 125 ka BP and 6 ka BP by Juyal et al., 1995) and raised mudflats.
7. Morphotectonic domain-II show geomorphic characteristics at variance with the largely rocky undulating landscape of domain-I. Geomorphic zones such as rugged trappean zone in the north and a prominently southward sloping topographic surface over the miliolites up to the coastline. The morphology of the coastline alternates laterally between well-developed beach-dune complexes and mudflats to cliffy coast comprising miliolite. The prominently sloping miliolite cover or buried pediment zone revealed significant role of tectonic uplift in the post-miliolite landscape evolution.
8. Detailed terrain analysis including remote sensing data, DEM and morphotectonic analysis of the drainage basins in domain-II was carried out. Critical evaluation of topographical maps and DEM revealed the presence of multiple miliolite ridges in

domain-II. Except around the Hiran River, the ridges curvilinear and are not parallel to the coastline. In general, the ridges possibly correlate with the different sea levels during the middle to late Pleistocene.

9. Domain-II is drained by south flowing parallel drainages that conforms to the southward prominent slope. All drainage basins comprising the Rawal, Machundri, Rupen, Sangawadi, Singwada, Somat and Hiran rivers were analysed in detail in the present study. Of these, the Rupen, Sangawadi and Somat rivers were found to be particularly revealing as major part of these drainage basin are located over the miliolite terrain. The various parameters studies for these river basins are suggestive of post-miliolite tectonic uplift of domain-II.
10. All seven major drainage basins of domain-II show high degree of basin asymmetry in which most of the river basin suggest westward tilting or inclination of the ground slope. However, the Singwada and Sangawadi river basins in the central part of the domain show opposite ground tilt i.e., towards east that is attributed to the anomalous ground slope conditions generated by morphology of the miliolite ridges. The westward tilt is attributed to the coastward curving of the ridges producing low intensity slope variations directed to the west. The curving of the ridges may be due to topography or structural elements in the Deccan Traps buried below the miliolite cover.
11. The present study shows that miliolite ridges significantly influence the channel morphology including variation in depth of incision observed in the south flowing rivers of domain two. Variations in depth of incision, development of anomalous meander bends, waterfalls and drainage parameters studied like SL index, drainage asymmetry, Vf ratios and hypsometric integral are found to correlate with ridges crossing these river channels. Continued tectonic instability of the domain-II is also evidenced by the recurrent earthquake swarm activity around Talala during the last several decades.