Kachchh, a pericratonic rift basin, in Western India displays fault-controlled first-order topography. The five denudational cyclic surfaces identified indicate major episodes of tectonic movements responsible for evolution of the present landscape. The rift basin is defined by E-W trending master faults which bound the tilted upthrown blocks. A transverse fault system cuts across the E-W structural fabric. Geomorphic highs related to domes, anticlines, intrusive bodies and fault scarps associated with these faults suggest their active nature. The most striking feature of the basin is a NE-SW trending first order basement high or ridge across the master faults. This central high defined as Median High (MH) is active since Mid-Jurassic and plays a major role in the geomorphic evolution of the area. Present research highlights development of geomorphic signatures associated with neotectonic activity along master faults. The various tectono-geomorphic features confirms the basin is tectonically active in Quaternary period.

**KEYWORDS:** Geomorphic Marker, Rift, Median High, Master fault, half-graben.

**Introduction**

The Kachchh pericratonic rift basin of Western India is featured by impressive rugged and rocky hilly terrains scattered over vast plains. The basin evolved during Late Triassic-Early Jurassic period. It is bound by two major basin-bounding faults, the Nagar Parkar Fault (NPF) to the north and Kathiyawar Fault (KF) to the south. The Basin has been under compressional stress regime since Late Cre taceous leading to uplifts along E-W trending intra-rift master faults (Biswas, 2005): Island Belt Fault (IBF), Kachchh Mainland Fault (KMF), and upthrust blocks. A transverse fault system cuts across the E-W structural fabric. Geomorphic highs related to domes, anticlines, intrusive bodies and fault scarps associated with these faults suggest their active nature. The most striking feature of the basin is a NE-SW trending first order basement high or ridge across the master faults. This central high defined as Median High (MH) is active since Mid-Jurassic and plays a major role in the geomorphic evolution of the area. Present research highlights development of geomorphic signatures associated with neotectonic activity along master faults. The various tectono-geomorphic features confirms the basin is tectonically active in Quaternary period.

**ABSTRACT**

Kachchh, a pericratonic rift basin, in Western India displays fault-controlled first-order topography. The five denudational cyclic surfaces identified indicate major episodes of tectonic movements responsible for evolution of the present landscape. The rift basin is defined by E-W trending master faults which bound the tilted upthrown blocks. A transverse fault system cuts across the E-W structural fabric. Geomorphic highs related to domes, anticlines, intrusive bodies and fault scarps associated with these faults suggest their active nature. The most striking feature of the basin is a NE-SW trending first order basement high or ridge across the master faults. This central high defined as Median High (MH) is active since Mid-Jurassic and plays a major role in the geomorphic evolution of the area. Present research highlights development of geomorphic signatures associated with neotectonic activity along master faults. The various tectono-geomorphic features confirms the basin is tectonically active in Quaternary period.

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**Neotectonic and seismicity of Kachchh Rift Basin**

Kachchh is an active tectonic zone which possesses fault-controlled first-order topography and several geomorphic features indicative of neotectonic activities (Maurya et al 2003b). The basin developed through varying stages of movement of Indian plate. Initiated as a rift basin in Early Jurassic, it passed through several tectonic cycles ending up as an active shear zone in the present neotectonic cycle under transpressional stress regime caused by plate collision and anticlockwise plate rotation (Biswas, 2005). Neotectonic activities in Kachchh reflect through evidences of structural inversion viz. First order topography, local thrusts on the back limbs of uplifts, local occurrences of fault-propagated folds, overturned limbs of the flexures (Biswas, 2005). Neotectonic activities along E-W and transverse faults are reflected in morphotectonic features viz. horizontal offsetting streams and switching of streams, sharp angular turns in the courses and beheading of streams. Tectonic landforms along faults including deflection of rivers and ridges, knick points, alignment of fault scarp, unpaired terraces, alluvial fans, development of gorges and intense incision in bedrock and Quaternary deposits along faults (Thakkar et al, 2006)(Fig. 3).

**Activity of median high in neotectonic cycle is evident in an elevated central part of the Banni plains which is a geomorphic high separating this depression into two subsidiary basins (Fig. 2).** Four polycyclic denudational land surfaces identified in the present landscape are the evidences of repeated uplift and erosion (Biswas, 1974). The eastern segment of the KMF and the western segment of the SWF zone are laterally growing, whereas the anticlines on the western segment of the KMF and eastern segment of the SWF have coalesced, thereby presently being inhabited for active lateral growth (Mathew et al., 2006).

**Fig. 2 Satellite image of Kachchh basin showing Morphotectonic features**

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**Fig. 1 Tectonic map of Kachchh Basin (after Biswas 2005) showing Master, Secondary and Transverse Faults.**

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Kachchh is seismically the most sensitive zone and experienced several moder-ate to large earthquakes such as the 2700 BC Dholavira earthquake (Mw 6.5), 1668 AD Indus Delta earthquake (Intensity X) (Bisht, 2011), 1819 Allah bund earthquake (Mw 7.8), 1956 Anjar earthquake (Mw 6.0) and 2001 Bhuj earth-quake (Mw 7.7) (Oldham, 1926, Chung and Gao, 1995, Yagi and Kikuchi, 2001, Johnston, 1996 and Rajendran, et al. 2001 and 2008). Fault plane solution of 2001 Bhuj and 1956 Anjar earthquake suggest south dipping reverse fault (Chung and Gao, 1995; Negishi et al., 2001). Recent stochastic studies of earth- quakes in Kachchh using Weibull, Gamma and Log-normal models have indi-cated recurrence interval of earthquakes with M_2 > 5 to be 13 years (Yadav, et al., 2008). 

Geomorphic Marker and Paleoseismic features

A wide variety of geomorphic features, such as fault scarps, valley shapes and drainage patterns indicate past or ongoing tectonic movements (Burbank and Anderson, 2001; Keller and Pinter, 2002). Effects of vertical deformation is reflected by degradation or destruction, knick points, surface faulting of ter-races, changing river patterns, deflected river courses. Effects of strike-slip deformation are reflected by faulting in terraces, offset river courses. Effects of regional tilting are represented by tilted terraces and lateral channel movements. The complex drainage pattern in Kachchh is due to streams switching or aban-doning outlets as they cross the E-W trending Master faults. It indicates that there is strike slip movement along transverse faults. Tectonic landforms along fault trend including systematic deflection of stream channels and ridges, alignment of fault scarps, knick points, unpaired terraces, and displacement in the basement rocks along incised Quaternary deposits reflects that the area is undergoing active deformation driven by E-W and transverse faults system. Tectonic active-ness in the Kachchh basin is also revealed by marine terraces, alluvial fans and erosional surfaces, ridge crest, knick points, bedrock gorges and tectono-erosional terraces near structural elements (Fig. 3).

Fig. 3 A). ~35m E-W trending knick point on southern strand of KHF. B). North facing active fault scarp along the KHF. C). Displaced Holocene flu-vial sediments in the vicinity of KHF. D). N-S trending gorge in Khar River showing activeness of Median High.

Paleoseismology is the study of prehistoric earthquakes, especially their location, timing, and size. Various paleoseismic features like soft sediment deformations, liquefactuations, seismites, displaced Quaternary Sediments, terrain flexuring and subsidence of Rann of Kachchh have been documented in the basin (Fig. 3) (Thakkar and Goyal, 2004; Thakkar et al 2012a, 2012b).

Conclusions

The basin has been tectonically active since its formation in Late Triassic–Early Jurassic till date in response to the plate movement through various tectonic cycles. It has break up from the break off of the Indian plate fragment, medium high ridge uplift, thermody-namic subsidence, plate drifitng, collision with Eurasian plate, and post collision transpressional stress due to continuing subduction, ridge push and anticlockwise plate rotation. The geomorphic signatures associated with neo-tectonic activity along master faults and median high like channel deflec-tions, ridge offsets, fault scarps, knick points, gorges, displaced Quaternary deposits, unpaired strath terraces, sag ponds, truncated alluvial fans, triangular fault facets, back tilting of alluvial surfaces, incision of Quaternary cover and gorges formed on the youngest erosion surface along with several paleoseismic features like soft sediment deformations, liquefactuations, seismites and large scale terrain changes have been documented in Kachchh. The Neotectonic and paleoseismic features indicate that faults have been active since rising and inver-sion stages in Mesozoic time and continues to be active in the responsible for highly active basin in the neotectonic cycle. It can be concluded that repeated acti-vation of primordial faults is present stage of neotectonic cycle.

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Fig. 3 A). ~35m E-W trending knick point on southern strand of KHF. B). North facing active fault scarp along the KHF. C). Displaced Holocene flu-vial sediments in the vicinity of KHF. D). N-S trending gorge in Khar River showing activeness of Median High.