CHAPTER 9

CONCLUSIONS

The present study has lead to the following main conclusions:

1. The fluvial depositional history combined with tectonics and environmental studies have helped in understanding the landscape evolution of the fluvial systems. The present drainage of the lower Narmada basin is incisive as evidenced by 30-40 m high alluvial cliffs and deeply entrenched meanders. Presence of deep gullies (ravines), uplifted terraces, entrenched meanders and palaeobanks, abandoned alluvial cliffs 15-30 m high away from the present channel are suggestive of neotectonic activity in the area.
2. The upland region of the lower Narmada basin indicates a strong control of the ENE-WSW and NNW-SSE trending lineaments on the geomorphology and drainage architecture. The ENE-WSW trending ridges with southern slopes and north facing escarpments including the Narmada-Son Fault (NSF) and ENE-WSW trending narrow intramontane valleys evidence the dominant control of ENE-WSW trend.
3. Three tilt blocks have been delineated within a major tilt block formed due to differential uplifts along the NSF and two other sympathetic faults. A gradual decrease in the ruggedness of the topography towards south, preferential locations of river ponding, gorges and increased fluvial incision suggest continued southward tilting of the fault blocks due to differential uplift along ENE-WSW trending faults.
4. The alluvial zone to the north of the Narmada Son Fault is made up of Late Pleistocene to Holocene sediments and indicates two phases of river incision in the Karjan river basin, a tributary river basin of lower Narmada basin which, are attributed to uplifts during Early and Late Holocene. Morphometric analyses of parameters sensitive to tectonics substantiate the

field observations on active tectonics. The field evidence from the upland and alluvial zone and the morphometric analyses point to differential uplift of the Karjan basin along ENE-WSW trending faults during Holocene.

5. The lower Narmada basin has been the site of thick Quaternary sedimentation due to rapid to slow synsedimentary subsidence in a thrusting environment. The synclinal folds in the northern subsided block and corresponding anticlinal folds to the south of NSF indicate the existence of compressive stresses during this period which were responsible for the transformation of the E-W Narmada-Son Fault into a reverse fault at the onset of Quaternary.
6. The alluvial plain in the lower Narmada basin is characterised by four distinct geomorphic surfaces termed as S_1 (alluvial plain), S_2 (ravine/gullied surface), S_3 (Early Holocene fan surface) and S_4 (Mid-Late Holocene valley fill terrace surface). The sediments forming the S_1 and S_2 surface date back to Late Pleistocene.
7. The sedimentation in the lower Narmada basin commenced with the deposition of the marine basal clays during the last interglacial high sea at ~125 ka. The overlying fluvial sediments indicate deposition in two fluvial macroenvironments– the alluvial fan environment and the alluvial plain environment.
8. Two large alluvial fan (Fan 1 and 2) were formed in a compressive tectonic environment. This could be the reason for the fact that the maximum thickness of the fan sequences is about 70-80 m only of which about 35 m is exposed.
9. The Late Pleistocene alluvial plain sequence overlying the alluvial fan sediments reveal fluvial characteristics that are at variance with the present day channel characteristics of the Narmada River. The alluvial plain sequence in the lower Narmada basin is dominated by the overbank sediments and comprise large channel fills, horizontally stratified sands, massive sand sheets, crevasse splay and backswamp deposits.
10. The thick palaeosol marks a phase of pedogenesis of the overbank sediments. Chronologic data on this regionally recorded pedogenic phase indicates that it is pre-LGM. The overlying thinly stratified sands and silts therefore appear to have been deposited during the arid phase of the Last Glacial Maximum. These deposits therefore mark significant reduction in fluvial activity due to considerably depleted water supply which is directly related to the onset of aridity. Continued sedimentation indicates that the river retained a large catchment during the arid phase. Lack of root structures and dessication cracks also suggest that the flow was perennial.
11. The exposed sediments of the lower Narmada basin indicate two distinct phases of changes in the fluvial regime. One is the multidistributary channel system that deposited the alluvial fan sediments, followed by the deposition of finer alluvial plain sequence by a large river in an

alluvial plain setting. The observed sedimentary characteristics of the alluvial plain sequence discussed above indicate a low sinuosity, single channel large river that was hyperavulsive.

12. A period of tectonic uplift followed during the Early Holocene in the lower Narmada basin resulted in the formation of gorge-like, deeply incised river valleys, extensive ravines, entrenched meanders and the exhumation of the Late Pleistocene sediment. The Late Pleistocene sediments were exposed by incision accompanied by extensive gully erosion triggered by tectonic uplift during Early Holocene.
13. Differential uplift along the NSF is evidenced by the occurrence of Late Pleistocene sediments at elevations upto 100 m across the NSF as seen near Gora and Jitnagar in the Narmada and Karjan valleys respectively. At these places, sediments occur well above the present high discharge levels and overlie the basalts which also show vertical downcutting by the river. The Late Pleistocene sediments generally attain elevations of 30-50 m along the Narmada River. NNW directed tilting of these sediments observed in the area to the south of Narmada provides additional evidence for differential uplift along the NSF. The displaced Late Pleistocene sediments across NSF in the Narmada River indicate a displacement of about 35 m along the NSF during Early Holocene. The tectonic uplift of the lower Narmada basin during Early Holocene marks the structural inversion of an earlier subsiding basin.
14. The palaeohydrological analysis of the lower Narmada basin has shown that the Early Holocene discharge of the river was about 3.76 times more than the present confirming the globally recorded higher precipitation levels during Early Holocene.
15. A major tectonic uplift along the Narmada Son Fault (NSF) caused a sudden change in gradient, resulting in the accumulation of S_3 surface where the particles are derived from steep drainage basins in the subsiding basin with an alluvial fan environment. Uplift of adjacent areas along the NSF and the other two faults trending NNW-SSE and NW-SE have controlled the fan stratigraphy in terms of both accommodation of space and sediment supply. Tectonics and climate appear to be the two main factors responsible for the erosional and depositional processes that built the architecture of these early Holocene fans.
16. The S_4 surface is a wide flat topped terrace comprising tidal estuarine sediments in the lower reaches and fluvial sediments in the upper reaches. The palynological studies of this surface at Baruch have indicated shallow estuarine environment. The tidal estuarine terrace sequence is dominated by tidal muds indicating their deposition in tide dominated estuarine conditions. The Mid-Late Holocene valley complex is the product of a high sea level induced deposition in a deeply incised fluvial valley.

17. The present study indicates that the various surfaces evolved during Late Pleistocene-Holocene primarily due to vertical tectonic movements along the ENE-WSW trending NSF in a compressive environment. Two major phases of tectonic activity along the NSF are recorded. The first phase includes the Late Pleistocene when slow synsedimentary subsidence of the basin took place along the NSF. The second phase includes the Holocene, which is marked by basin inversion due to differential uplift along the NSF.
18. The NSF has been characterised by compressive stress regime throughout Quaternary, variations in the degree of compression, which can in turn be interpreted in terms of varying rates of plate movement, alone are responsible for the Late Pleistocene subsidence and Holocene tectonic inversion in the lower Narmada basin. Studies from other parts of the NSF are needed to confirm the continuity of these movements along the length of the fault.