Chapter 5

Conclusions

The study of the coastal Miliolites of southern Saurashtra with a view to decipher the underlying depositional processes vis-à-vis with the geomorphological study to understand the present and past land–sea interactions leads to the following conclusions.

(i) The Miliolite units along the southern Saurashtra coast are internally characterized by three basic lamination types: grainflow, grainfall and wind ripple laminae accounting for *ca* 80%, 10% and 10% of the sedimentary succession, respectively.

(ii) Four types of aeolian bounding surfaces (Type-I to IV) are recognized which have been compared to those described by Brookfield (1977) and Kocurek (1988).

(iii) The Miliolite sequences were deposited under dominantly dry aeolian conditions. The presence of paleosol horizons in the oldest Miliolite sequences in Gopnath indicates occasional climatic amelioration from drier to wetter phase. The wetter climatic phases gradually became redundant and dominantly arid conditions of deposition prevailed over the area during the deposition of younger Miliolite sequences of Babarkot and Diu.

(iv) The Miliolite sequences were deposited by transverse dune systems. The high percentage of grainflow strata indicate migrating dunes with well-developed avalanche slip faces.

(v) The wide variation in mean wind flow direction and frequent presence of Type-II surfaces in the Miliolite succession at Babarkot indicate towards aeolian sedimentation under chaotic wind conditions as compared to the underlying older Miliolite sequence at Gopnath. The chaotic wind conditions during the sedimentation of Babrkot aeolianites are attributed to variations in atmospheric pressures over the coastal region due to eustatic changes pre-dating the MIS-5 high sea stand. However, the wind regime, as evidenced by the aeolian architecture, got somewhat regularized during the deposition of the Miliolite sequences in Diu.

(vi) Eustasy and climate both went ‘hand in hand’ in depositing the Late Quaternary aeolianite succession in southern Saurashtra. Eustatic lowstands favoured dune building by enhancing the sediment budget and lowering of moisture content of formative south-west monsoon winds leading to drier climatic conditions. On the other hand, eustatic highstands curtailed sediment supply and, accompanied by increased precipitation from enhanced moisture contents of the south-west monsoon winds, led to dune field stabilization.

(vii) The dominantly dry and extensive dune building events in southern Saurashtra during the Late Quaternary indicate that during eustatic lowstands the formative south-west monsoon wind system did not lose its strength in terms of its capability for aeolian entrainment; however, the moisture content of these winds was significantly lowered during eustatic lowstands which could only be regained during eustatic highstands leading to dune field stabilization.

(viii) The Miliolite cliffs are non-plunging and the cliff–platform relationship of the coast fringing Miliolite rocks attests them to Type-B platform of Sunamura (1982), wherein, the platform is nearly horizontal and terminates abruptly with a cliff.

(ix) The analysis of the cliff profiles indicates that rate of marine erosion either dominates or equals the rate of sub-aerial erosion of the Miliolite cliffs. The relative role of marine erosional processes depends on the orientation of the coastline with respect to the incoming waves and tidal currents and protective action provided by the bioconstruction rims at the platform margins and talus deposits at the cliff bases. Rates of sub-aerial erosion are controlled by the extent to which solution channels can develop within the Miliolites and the presence or absence of joints and joint spacing.

(x) The present day tidal notches notches are asymmetrical in nature and belong to two different categories, viz., Type-A notches with extended roof and short, steep floor and Type-B notches with short roof and extended floor. However the Type-A notches are the dominant variety of modern day tidal notches.

(xi) The variations in the geometric parameters of the present day tidal notches are controlled by the magnitude inclination of the Miliolite cliffs, degree of exposure to incoming waves and tides as well as the intensity of the incoming waves and tides which in turn is controlled by the coastal slope and the protection at the base of the cliffs.

(xii) Bioerosion over the Miliolite cliffs and platforms is brought about by microorganisms such as algae and lichens as well as macrobioeroders such as limpets, littorinids, chitons and bivalves. Bioconstruction in the form of barnacle colonies is observed on the intertidal platforms as well as the upper intertidal portions of the Miliolite cliffs.

(xiii) Miliolite cliff erosion is brought about by mechanical erosion by waves and tides, biological agents and sub-aerial processes. The sub-aerial erosion is brought about by dislodgement of huge chunks of parent rock due to dissolution processes along the vertical joint systems present in the cliffs as well as by the lateral amalgamation of the dissolution channels formed by action of meteoric water over the exposed cliff surface.

(xiv) Erosion of the shore platform is brought about by bioeroders as well as by the force created on the walls of the joints present in the shore platform by breaking waves and tidal currents entering

into them. Intersection of joint sets already enlarged by wave and tide action leads to breaking away of huge portions of the shore platform.

(xv) The Miliolite cliff system along the coastal tracts of south-eastern and southern Saurashtra belong to the ‘active’ stage where the bedrock is exposed by continuous retreat of cliff system under the influence of both marine, biological and sub-aerial processes of erosion.

(xvi) The morphodynamic events that took place along the southern Saurashtra coastline in a time window of ~120 ka to ~3 ka can be classified into three stages. Each stage is followed by period of landform stability leading to the formation of the notches which today appear at different elevations. While Stage-I witnessed an upthrow of ~7 m, Stage-II witnessed an upthrow of ~3 m. Stage-III accounts for a very recent event of landmass upheaval and has registered an upthrow of ~1 m which is in accordance with earlier studies.