Chapter - 10

CONCLUSIONS

The area investigated by the author located south and southeast of Bhuj covers the Mesozoic rock sequence in the mainland of Kutch having a total thickness of about 1000.0 m, covering 400.0 sq. km of the area in the region.

The important contributions of the authors' study include the following:

1. The Mesozoic sedimentary sequence, as a whole, in the study area is developed on a shallow siliciclastic shelf related to overall linear clastic shoreline.

2. Mapping of the study area on 1:50000 scale and presentation of a geological map on the basis of the information gathered in the field.

3. Preparation of a geomorphological map of the study area incorporating major geomorphological features.

4. Detailed measurements of 28 stratigraphic sections. This enabled the author to draw important conclusions, further towards the demarcation of various stratigraphic units, their sedimentological and biological contents with special emphasis on trace fossil occurrences, and their relationships to the sediment strata in space and time.

5. In all nine Members have been recognized within four Formations of the Mesozoic sequence (viz. Chari Formation, Katrol Formation, Umia Formation and Bhuj Formation). The Members are (1) **Jamaywadi Member**, (2) **Gangeshwar Member**, (3) **Ler Member**, (4) **Dhosa Oolite Member**; (5) **Gunawari River Member**, (6) **Marutonk Dungar Member**, (7) **Jadura Member**; (8) **Tapkeshwari Member**; (9) **Bharapar Member.**

6. Ten lithofacies have been identified and termed on the basis of their distinctive lithological characteristics including textures and mineral constituents, bedding features and physical and biogenic sedimentary structures. The lithofacies and subfacies are: (A) **Rhythmic Shale Siltstone Sandstone facies** [(a) Laminated Shale Siltstone sub-facies, (b) Sheet Sandstone sub-facies, (c) Dark Shale Siltstone Sandstone sub-facies, (d) Rippled Ferruginous Sandstone Siltstone Shale sub-facies]; (B) **Felspathic Sandstone facies** [(a) Massive Sandstone sub-facies, (b) Herringbone Sandstone sub-facies]; (C) **Wave Rippled Calcareous Sandstone facies** [(a) Bivalve Sandstone sub-facies, (b) Oyster Sandstone subfacies); (D) **Bioclastic Limestone facies**; (E) **Intraformational Conglomerate facies**; (F) **Oolitic Limestone facies**; (G) **Extrabasinal Conglomerate Facies**; (H) **Bioturbated Sandstone facies**; (I) **Variegated Shale facies**; (J) **Cross Bedded Coarse Grained Sandstone facies.**

7. The various depositional environments include intertidal (beach, tidal flat, lagoon, barrier), subtidal, shallow shelf and locally deltaic, estuarine and marsh set ups.

8. Cyclic development of these environment is observed throughout the stratigraphic record.

9. Facies associations in various Members suggest fluctuations in depositional environments due to ultimate short and long term transgressions and progradations in the basin.

10. The sediments as a whole contains a rich and varied assemblage of trace fossil fauna that represent a wide range of behavioral patterns.

11. These traces are further identified as a number of well defined genera and species.

12. In all 50 ichnogenera and 75 ichnospecies have been identified and interpreted by the author.

13. All these traces are further described in terms of their diagnostic characters, nature of preservation, facies characteristics, stratigraphic distribution and associations with other trace fossil forms. The descriptions are supplemented with appropriate photographic plates.

14. A classification of behavioral activities based on the trace fossil morphology has enabled the author to recognize five ethological groups including *Cubichnia, Repichnia, Pascichnia, Fodinichnia and Domichnia.* Distribution diagrams based on this information are found useful to identify the feeding structures characteristic of particular environments of deposition.

15. The highest diversity and density of trace fossils is found in RFSSS sub-facies in Tapkeshwari Member, while highest density of trace fossils is found in BTS facies in Bharapar Member.

16. For palaeoecological interpretations and ichnological events, following eleven trace fossil assemblages (ichnocoenoses) have been suggested by the author: (1) ***Asteriacites*** ichnocoenose, (2) ***Chondrites*** ichnocoenose, (3) ***Diplocraterion*** ichnocoenose, (4) ***Gyrochorte*** ichnocoenose, (5) ***Gyrolithes*** ichnocoenose, (6) ***Muensteria*** ichnocoenose, (7) ***Ophiomorpha*** ichnocoenose, (8) ***Rhizocorallium*** ichnocoenose, (9) ***Skolithos*** ichnocoenose, (10) ***Thalassinoides*** ichnocoenose, and (11) ***Zoophycos*** ichnocoenose. The distribution of the ichnocoenoses is important in these regard, in different

stratigraphic units of the Mesozoic sequence.

17. The ichnocoenoses, when interpreted in terms of their trophic structures have shown that most of the trace fossil associations have responded well to the changing patterns of the environment of deposition. Variations in ichnological assemblages reflect the complexity and combinations of environmental parameters - depositional cyclicity and heterogenity which seems to have expanded strong effects on the existence and distribution of trace making organisms.

18. Various types of events such as physical, biological, stratigraphic, climatic, catastrophic, cyclic and tectonic, have been categorised, identified and discussed.

19. Total ten transgressive-regressive cycles have been recognised in the rock record with six unconformable contacts, three non-depositional to minor erosional contacts and one gradational contact. Majority of the lithofacies repeat number of times in the sequence.

20. Total 18 catastrophic or storm events have been identified in Chari, Katrol and Umia Formations, while several high energy - storm events represented by BTS facies and few flood events represented within CBCGS facies have been recognised in the Bhuj Formation.

21. The integration of sedimentological and ichnological analysis provides a framework for interpretation in terms of depositional environment and finally for eraction of sedimentation model.

22. Finally all these studies synthesized by the author lead to present

a transgressing and prograding linear clastic shoreline and shallow shelf complexes model in a regressive mega sequence, with localised development of deltaic and estuarine conditions, sedimentation in which filled a slowly subsiding basin. These are associated with deepening and shallowing transgressive-regressive cycles. A complete transgressive-regressive cycle in the study area is represented by cyclic changes of environments: intertidal/tidalflat/beach-->lagoonal-->barrier--->subtidal to shallow shelf-->subtidal-->barrier-->lagoonal-->beach/intertidal/ tidalflat. Rate of transgresion or regression, rate of sediment supply and tectonics considered to be responsible for omission or piling of individual facies. Ephemeral T-R events have produced incomplete inherent cycles and stagnation of environment over one or two facies. Episodic storm events are responsible for repeatition of some and omission of other facies. Erosional events have often found to have played their role during the depositional cycles.

Development of deltaic and estuarine conditions have, upto certain extent, diversified normal cycles related to overall set up.

Such cycles are interpreted as resulting from both the autocyclic and eustatic changes. The major cycles have been attributed to the eustatic sea level changes, tectonic implications and changes in basinal geometry.

Finally, It is postulated that many of the episodes in the depositional system could have been the result of the plight of the Indian Subcontinent after its break up from the Pangea.