CHAPTER X

CONCLUDING REMARKS

1. The Jurassic sedimentry sequence of Jaisalmer Basin in Western Rajasthan offers much scope for studies to the sedimentologists, stratigraphers and petroleum geologists. The present study revealed the following salient features. This work encompasses a detailed account of the geological investigation of Jurassic sediments exposed between latitudes 26° 30' to 27° 12' N and longitudes 70° 44' to 71° 30' E occupying exposed area of approximately 3870 sq. Km.

2. The objective of the present study is to identify the different lithofacies of Jurassic sediments exposed in Jaisalmer Basin and to understand their depositional environment, sedimentary dynamics, sedimentation pattern, diagenetic history and to assess the effect of diagenesis on pore geometry of reservoir facies. An attempt has also been made to establish the lithofacies variation in selected subsurface sections with the exposed sections in the area. In order to achieve the objective, an attempt has been made to incorporate the geological findings with petrographic and microfacies studies of clastic and carbonate sediments, aided by textural, mineralogical morphological and geochemical analyses. This will enhance to reconstruct the depositional environment, sedimentation pattern, and to evolve depositional model of the Jurassic sediments in the Jaisalmer Basin of Western Rajasthan.

3. The Jurassic sediments comprising Lathi, Jaisalmer, Baisakhi and Bhadasar formations have been identified in ascending order in the exposed section while in subsurface, based on seismic data, a considerable thickening of these formations have been observed from NE to SE towards the Shahgarh basin and also from SE to NW direction along Jaisalmer-Mari Arch.

4. The Lathi Formation, the lower most formation of Jurassic sediments comprises a sequence of conglomerate, poorly sorted gritty sandstone, and siltstone with abundant fossil wood, which are ferruginised and occasionally silicified. On the basis of lithological characters it has been divided into two members, namely Odania Member and Thaiyat Member. The upper contact of member shows an intertonguing relationship with overlying Jaisalmer Formation.

5. The Jaisalmer Formation is predominantly a carbonate facies, interbedding with calcareous sandstone and shale. In view of lithological association, this formation has been divided into five members namely Hamira, Joyan, Fort, Badabag and Kuldhar members in ascending order. The carbonate facies are predominantly oolitic, pelletal and bioclastic.

6. The Baisakhi Formation comprises predominantly grey to dark grey shale with minor association of fine grained, friable sandstone and variegated claystone with streak of gypseous clays. This Formation has been further divided into three members Baisakhi, Ludharwa and Rupsi.

7. The Bhadasar Formation is characterised by a sequence of alternating ferruginous gritty sandstone and friable red sandstone with intercalation of claystone followed by brown argillaceous sandstone with broken ammonite shell fragments. It has been divided on the basis of lithological association into two members-Kolar Dungar and Mokal. The upper part of the formation is characterised by cross bedded features containing fossil wood and fragments of broken, reworked bivalves and gastropods.

8. The main skeletal particles observed in carbonates section of Jaisalmer Formation are echinoids, pelecypods, gastropods, brachipods, algae, corals and smaller forams. The non skeletal particles include pellets, oolites, intraclasts and terrigenous particles which are mainly quartz. The main microfacies indentified (Dunhan 1962) are mudstone, pelletal wackestone, bioclastic wackestone, pelloidal bioclastic wackestone, pelletal grainstone, oolitic grainstone, oncolite-oolitic grainstone and calcareous quartz arenite. The microfacies of the clastic sediments in Lathi, Baisakhi & Bhadasar formations are mainly quartz wacke, quartz arenite, lithic quartz wacke, fine grained quartz wacke and siltstone.

9. The variation and regional distribution of microfacies of carbonate section in Jaisalmer Formation shows predominance and thickening of clastic sequence in basal part of subsurface section in Bhuana, Sumarwali Talai, Bhakhari Tibba, and Sadewala structures from SSE to NNW direction (Fig. IX.1)., while this unit occurs as, thin

intercalation at the base of Hamira, Joyan, Fort and Badabag members in exposed outcrop section in SE & SSE direction of the basin. The dominance of wackestone and mudstone facies in basinal part than in shelf area and persistant occurrence of grainstone facies with association of pellets and oolites in shelf area has been observed. Such variation in microfacies suggest that during initial phase of sedimentation of Jaisalmer Formation, the basin was very unstable and frequent oscillatory condition were observed which resulted in sedimentation of both clastic and carbonate sediments. Thus the basal part of Jaisalmer Formation were deposited in near shore environment throughout the Jaisalmer Basin. The Hamira and Joyan members of Jaisalmer Formation are equivalent to basal part of Jaisalmer Formation in subsurface.

10. After deposition of basal part, a wide shelf lagoon regime developed resulting carbonate sedimentations which comprises mudstone and wackestone with intercalated oolitic grainstone facies. These are results of periodic transgression and regression. The Fort and Badabag members were represented by sandy limestone with intercalation of sandstone, which indicate a very shallow setting of deposition in intertidal environment.

11. The upper part of Jaisalmer Formation ie Kuldhar Member in surface area indicate restricted to shelf lagoonal deposit which corresponds to wackestone-mudstone association in subsurface section, which followed by the regressive phase resulting in oolitic grainstone facies on the top of the formation.

12. On the basis of variation in microfacies and occurrence of their different constituents, prevailing energy conditions has been identified and in general five sedimentary cycles (1-V) have been established in Jaisalmer Formation (Fig. IX.1). In general mudstone and wackestone facies were deposited in low energy condition, packstone and grainstone facies in moderate to high energy condition. The sandstone which is basically calcareous quartz wacke and quartz arenite represent moderate to high energy condition in near shore environments.

13. Predominantly four stage of diagenesis have been recongnised in the clastic sequence viz (i) Early phase of diagenesis (cementation, lithification and formation of clay rims around quartz grains) in quartz wacke, quartz arenite of Lathi, Baisakhi and Bhadasar formations (ii) Dissolution of feldspar and replacement of calcite by iron oxide (iii) Pressure solution phenomenon like development of quartz overgrowth and microstylolitization and (iv) Neomorphism and dolomitization in Lathi and Basal part of Jaisalmer Formation (clastic sequence).

14. Integrating the different analytical data from petrography; X-ray mineralogy, SEM and chemical analysis, three stages of diagenesis have been consipicuosly, recognised in the carbonate sequence of Jaisalmer Formation viz. (i) Early burial diagenesis (microcrystallisation, submarine cementation (ii) Unconformity related diagenesis (extensive leaching and fresh water cementation in grainstone and oolitic wackestone facies of upper part of Jaisalmer

Formation and (iii) Deep burial diagenesis (stylolitisation, fracturing, burial cementation, neomorphism and dolomitizationa) in Hamira, Joyan and Fort members of Jaisalmer Formation.

15. The Pelletal wackestone, bioclastic wackestone and oolitic grainstone microfacies are the best developed reservoir facies in Jaisalmer Formation. Predominantly, four types of porosities such as micro, intergranular, dissolution and fracture porosities have been observed. However, due to recrystallisation and pressure solution phenomenon the reservoir characteristics have been lost to a large extent, adversely affecting the pore geometry.

16. The Jurassic sequence in the Jaisalmer Basin represents a typical shelf zone sedimentation of orthoquartzite-limestone association resting on a peneplained Precambrian surface. The sedimentation started from Lias with continental deposits of Lathi Formation, where sediments were derived from the peneplained Precambrian basement consisting of acid igneous, and metamorphic rocks. This is followed by first marine transgression in Callovian-Oxfordian time during deposition of Jaisalmer Formation.

17. Eustatic movement of the sea commenced in Callovian during silting up of the basin as evidenced by intertonguing contact of Jaisalmer limestone and Lathi sandstone. Subsequently subsidence brought in neritic to infraneritic environment under life supporting marine facies. The clastic dominating lower part of Jaisalmer Formation were deposited in near shore, coastal water environment influenced

by fresh water influx. The middle part of Jaisalmer Formation represented by Fort and Badabag members indicate a coastal marginal marine environment. The presence of evaporite minerals in association of dolomite and oolites in upper part of Jaisalmer Formation represented by Kuldhar Member suggests restricted lagoonal environment with varying energy condition indicating rythmic movement of marine environment during highly unstable shelf.

18. The succeeding Baisakhi Formation had continental, epineritic marine facies, as evidenced by the presence of frequent alternation of sandstone, shale and gypseous shale suggesting oscillatory deposition.

19. In the late Tithonian, the sedimentation of Bhadasar Formation shows repetitive cyclic changes in environment from shallow oscillatory marine to continental, suggesting end of regressive phase.