CHAPTER - IX

CHAPTER - IX

SUMMARY AND CONCLUSIONS

1. Paleogene sediments covering Olpad, Cambay, Ankleshwar and Dadhar formations of Broach Depression are well developed in subcrop as revealed in the eight shallow wells drilled by the Oil & Natural Gas Commission at Gandhar, Pakhajan, Dahej, Palej and Matar areas.

2. The subsurface Eocene to Oligocene sediments encountered in Gandhar, (Gandhar-A, B, C, D), Pakhajan (Pakhajan-A), Dahej (Dahej-A) and Palej (Palej-A) contain moderate to rich microfloral assemblages, whereas Palej-A has paleocene sediments in Olpad Foramtion encountered in well Gandhar-A (yielded only fair microfloral assemblages).

3. Palynofloral analysis of 750 core and cutting samples obtained from the subsurface sediments form these wells in their systematic trends and in their quantitative and qualitative assemblage variation studies show that in the past fluvial and marine transport were the dominant factors in determining the nature and distribution of the Palynofloral assemblage in different stratigraphic units, studied by the author.

4. 193 Palynospecies belonging to 144 general and 35 families of index/zonal significance ranging in age from Paleocene to Oligocene have been identified and described in detail and also illustrated by microphotographs for the first time by the author.

5. It has been significant importance to note that palynofloral assemblage recorded from the subsurface Paleogene sequence from Broach Depression south Cambay Basin are closely comparable with the palynological assemblage of Paleogene sediments of Kutch and Cauvery basins.

6 Following palynozones are recognised and interpreted by the author:

a) Monocolpopollenites sp - Proxapertites sp assemblage zone (Paleocene).

b) Polybrevicolporites cephalus - Pellicieroipollis langenheimii assemblage zone (Early Eocene).

c) Proxapertites cursus - Polycolpites flavatus assemblage zone (Middle Eocene).

d) Palmaepollenites kutchensis - Margocolporites tsukadai assemblage zone (Upper Eocene).

e) Magnastriatites hawardii - Couperipollis rarispinosus assembalge zone (Oligocene).

7 Age determination on the basis of floral evidences indicate that Olpad Formation belongs to Paleocene age, Cambay Formation to Lower Eocene, Ankleshwar Foramtion ranges from Middle to Upper Eocene and Dadhar Formation ranges from Upper most part of Upper Eocene to Oligocene age.

7.1 The author has been able to tentatively place below the base of Polybrevicolporites cephalus - Pollicieroipollis langenheimii assemblage zone paleocene/Lower Eocene boundary.

7.2 Lower Eocene/Middle Eocene boundary is marked at the extinction level of Polybrevicolporites cephalus - Pellicieroipollis langenheimii. This boundary falls below Proxapertites cursus - Polycolpites flavatus assemblage zone.

7.3 Middle Eocene/Upper Eocene boundary is marked at the extinction level of Proxapertites cursus - Polycolpites flavatus. This boundary falls below the Palmaepollenites kutchensis - Margocolporites tsukadai assemblage zone.

7.4 Upper Eocene/Oligocene boundary is marked at the extinction level of Palmaepollenites kutchensis - Margocolporites tsukadai assemblage zone. This boundary falls below Magnastriatites howardii - Couperipollis rarispinosus assemblage zone.

8 The palynofloral assemblages recorded from the subsurface Paleogene sediments are grouped under following ecological complexes according to their ecological habitats and adoptabilities.

a) Montane plant complex
b) Inland plant complex.
c) Fresh water plant complex.
d) Palm complex.
e) Fungal complex,
f) Fern complex,
g) Low salinity water plant complex,
h) Mangrove plants complex, and
i) Phytoplankton complex.

Detail paleoenvironmental analysis by the author indicate that:

8.1 The Olpad Formation was deposited in a fluvial to slightly brackish water condition. This is supported by the dominance of ferns and inland flora alongwith fairly distributed palm and low salinity water plants in the sediments

8.2 Cambay Formation contains dominance of palms, mangrove and marine phytoplanktons indicating that the Cambay Shale was deposited in fluctuating environments ranging between nearshore to shallow marine conditions under a transgressive phase.

8.3 In the Gandhar, Pakhajan and Palej areas, the Cambay Formation is depo-

sited in environments ranging between shallow marine and brackish water conditions. This is supported by the variations observed in the percentage of low salinity water plants, mangrove flora and marine phytoplanktons. In Matar area the marine floral elements are replaced by mangrove and low salinity water plants with the dominance of inland floral elements. This suggest near shore conditins of deposition with more fresh water influx. The depositional environments change laterally from shallow marine (towards Gandhar area) to nearshore (towards Matar area) during the depositional phase of the Cambay Foramtion.

8.4 The earliest marine conditions are encountered during Early Eocene in the entire Broach Depression. This assumption is supported from the evidence of marine phytoplanktons. The short lived 6 transgressive (T1-T6) and 7 regressive (R1-R7) phases have been noticed in Gandhar area during deposition of cambay Formation. This is also supported by the variation in percentage of mangrove and marine floral elements.

8.4.1 The Lowest Member of the Ankleshwasr Formation is the Hazad Member which deposited under nearshore to shallow marine conditions. In Gandhar area littoral to breackish water conditions prevailed during deposition of Hazad Member whereas in Pakhajan area brackish water to littoral conditions prevailed. In Dahej and Palej areas, the deposition took place under shallow marine conditions. The dominance of marine phytoplanktons are the characteristic feature of this environment. In Matar area nearshore conditions existed throughout the deposition of Hazad sands. In conclusion, considering the overall conditions of deposition and the presence of appreciable amounts of marine floral and dominance of terrestrial floral elements, the Hazad sands appears to have deposited in a regressive phase under marine in fluence during the Middle Eocene time.

8.4.2 Kanwa Shale Member is deposited under shallow marine conditions in Gandhar and Dahej areas, whereas littoral to shallow marine conditions prevailed during deposition of Kanwa shale in Pakhajan area. In Palej area, the deposition took place under shallow marine to nearshore environments. In Matar area nearshore conditions prevailed during deposition of Kanwa Shale Member. An overall increase in the marine phytoplankton percentage in the Kanwa shale suggests a transgressive activity during the Late Middle Eocene time.

8.4.3 The Ardol Member has almost equal percentage of low salinity water plants and marine floral elements but the palm floral elements are relatively more suggesting nearshore to shallow marine conditions of deposition in Gandhar area. Nearshore to littoral conditions prevailed during deposition of Ardol Member in Pakhajan area. In Dahej area, the deposition took place in littoral to shallow marine conditions, whereas in Palej and Matar areas the Ardol Member was deposited in a nearshore and brackish water conditions respectively.

8.4.4 The Telwa Shale is deposited in a shallow marine to nearshore conditions in Gandhar area whereas in Pakhajan areas the Telwa Shale Member was deposited under nearshore to littoral conditions. Littoral to shallow marine conditions prevailed during deposition of Telwa Shale in Dahej area. In Palej and Matar areas, the Telwa Shale was depsoited in a neashore and backish water conditions respectively. This suggests that the transgressive activity was less effective in the north eastern part of Broach Depression.

8.4.5 The Dadhar Foramtion is deposited under nearshore to shallow marine conditions in Gandhar area, littoral to shallow marine in Pakhajan area, shallow marine to nearshore conditions in Dahej area, nearshore

and brackish water of coastal conditions in Palej and Matar area respectively.

9 The analysis of different plant complexes indicates that the main vegetation which contributed the flora grew in the vicinity of the shore line in tropical to subtropical climatic conditions during the Paleogene time, and the provenance of the sediments was lowland area with comparatively a flat topography.

9.1 The paleoclimate in the provenance as indicated by the palynoflora was hot and humid to support the rich growth of vegetation. Such provenance is further envisaged to have supplied moderate sediment load and also moderate water discharge to the basin.

10 The Middle Eocene and Late Eocene transgressions in the basin corresponding to the Kanwa and Telwa were short lived but quite extensive, suggesting a gentle, slowly subsiding shallow shelf where even a moderate transgressive eustatic rise could have inundated large areas in the basin.

11 Finally it is argued that the detailed investigations on the Paleogene sediments of Broach Depression carried out by the author and his resultant findings will contribute meaningful guidelines and leads towards hydrocarbon exploration in similar sedimentary environments elsewhere.