CHAPTER SEVEN

SUMMARY

7.1 GENERAL

Geology and structure of the Chhota Udepur region was only meagerly worked out by earlier workers, particularly the Pre-Champaner Gneisses. The present study provides a considerable data to construct the geological history of the region.

7.2 SALIENT FINDINGS

The salient findings of the study is given below:

1) The area, mainly comprising Pre-Champaner Gneisses, has undergone four episodes of deformation- D_1, D_2, D_3 and D_4. The first two generations i.e. D_1 and D_2 have produced isoclinal reclined folds with N-S and E-W axial trends respectively (Karanth and Das,2000). The third phase has given rise E-W tending upright folds, which incidentally forms the earliest phase of deformation in the cover rocks viz. Champaner Group. The fourth phase is a shallow depth deformation, which has produced NNE-SSW to N-S trending warps and kink bands.
2) Superposition of the later phases of folds on the earlier phases has given rise to different interference patterns. Interference of F_2 upon F_1 have given rise *Type II*, whereas interference of F_3 upon F_2 has produced *Type III* superposed folds of Ramsay (1969).
3) The early lineations have been deformed by later folds giving rise to various patterns, such as type **'2a'**, type **'4'**. (Ghosh and Chatterjee 1985). These two types have developed in restricted conditions such as in the case of flexural slip folding followed by homogeneous flattening. Study of the deformed lineations, stereographic projections of different lineations and foliations gives an idea about the mechanism of F_2 and F_3 folding events. F_2 is developed by flexural slip folding followed by homogeneous flattening, and F_3 is the product of buckle folding with post buckle flattening.
4) Regional metamorphism (M_1) during D_1 reached up to Upper Amphibolite Facies producing sillimanite, garnet in the northwestern part (Moti Sadli and Longami area) and kyanite in southwestern part (Wawadi area).The later metamorphism (M_2) that

accompanied (D_2) had also reached Amphibolite Facies, as inferred by the folding of M_1 kyanite and recrystallised M_2 kyanite parallel to the axial planes of F_2 folds. Petrographic and geothermobarometric studies also indicate a phase of decompression that took place during D_2 (i.e later stage of M_2). This is indicated by resorption of garnet and formation of cordierite. By and large M_3 metamorphism is a retrogressive phase in Pre-Champaner Gneisses. Biotite, plagioclase and muscovite formation from garnet, cordierite and potash feldspar were the possible for retrogressive hydration reactions that took place during M_3 For Champaner Group, however, M_3 is the earliest metamorphism in which the pelitic rocks were metamorphosed to phyllites. Intrusion of granite at the end of D_3 has yielded contact metamorphic minerals in dolomitic limestones, manganiferous rocks and phyllites belonging to Champaner Group. D_4 has no significant metamorphic effect on either Pre-Champaner Gneisses or Champaner Group of rocks.

5).Trends of the folds in Chhota Udepur region differs from nearby rocks Aravalli – Delhi Supergroups. While in Aravalli Fold Belt trend of F_1 fold is E-W and that of F_2 is NNE-SSW, in Chhota Udepur region F_1 has north south trending (fold axis) and F_2 and F_3 trend E-W 6) Pre-Champaner granite gneiss is a product of partial melting of biotite bearing sialic crust as indicated by the mineralogy and chemistry. Tectonic discrimination diagrams suggest that the granite gneiss belonging to the Pre-Champaner evolved in *continental collision tectonic environment* (Moniar and Piccoli, 1989), Godhra granite has a separate identity and has intruded the Pre-Chamapner Gneiss as well as Champaner Group at around 935±20 Ma (Srimal and Das, 1998).

7) The strongest metamorphism and recrystallisation probably took place around 1168±30 Ma(Srimal and Das,1999)) as indicated by Rb/Sr isochron age. The tectonic activity recorded in this region after 1168±30 Ma is followed by the intrusion of Godhra Granite (935±20 Ma).

8) As 1168±30 Ma metamorphic event is not recorded in Champaner Group; it can be envisaged that Champaners were deposited in between 1168±30 Ma and 935±20 Ma.

9) Geophysical data (Bouguer anomaly map, Fig 4.5) compiled by the author also suggest that the Pre-Champaner Gneisses are strikingly different from Godhra granite and they

have geophysical characteristics similar to a basement rock, that separates Godhra Granite and Aravalli metasediments (Lunavada Group).

10) The tectonostratigraphic status based on the structural data of the present study and geophysical data of Agrawal et al (1995) indicate two possibilities;

A) Based o the differences in structural set up the gneisses of Chhota Udepur region (Pre-Champaner Gneiss)have evolved with a different tectonic history than the Precambrian rocks Aravalli Fold Belt.

or

B) The Precambrian rocks of Chhota Udepur region formed as a part of Aravalli Fold Belt , which has been disrupted later by concealed NE-SW transcurrent fault and rotated around triple junction shown by Agrawal et al(1995).

When the structural trends of Pre-Champaner Gneisses are compared to the main Aravalli Fold Belt (Table 4.3), the Pre-Champaner Gneisses cannot be correlated to any gneissic terrain within the main Aravalli Fold Belt. The Champaner Group overlying the Pre-Champaner Gneisses strikingly exhibits E-W trend, which is not present in the comparable Sirohi Group of Delhi Supergroup of the Aravalli Fold Belt (Rajasthan-Gujarat). Similarly, as explained in Chapter V, while in this area the metamorphic reaction follows a clockwise path, i.e. high temperature progressive metamorphism at isobaric condition first; followed by decompression at constant temperature, and then retrogression with cooling at almost constant pressure (**Fig 5.11**); an anticlockwise path was observed by Guha and Bhattacharya (1995) in Sand Mata Complex of BGC. Thus most likely the two regions appear to have different tectonic evolution and subsequently fused together to a single block. .