GEOLOGICAL SETTING OF THE AREA

A. Geographic introduction:

The area under investigation, geographically occupies the western part of Cutch (Toposheet No. 41 A/11 and 41 A/15 of the Survey of India). The village Waior is situated approximately NW of Bhuj, the Subdivisional headquarter (Text fig. 1). The southern part of the investigated area is located in Abdasa Subdivision (taluk) and the northern part goes within Lakhpat Subdivision.

Ahmedabad and Bhuj railway stations are connected by a single metre-gauge line. Most of the villages of Cutch, including Waior, Cheropodi, Lari, and Neghat are communicated with Bhuj by metalled and/or non-metalled road with regular State - Bus service.

Climate of the area is rather extreme as day and night temperature varies considerably in a particular season.
Average rainfall is low which hinders sufficient growth of vegetation and causes greater duration of dry season.

The area, in general, is flat but occasionally shows a gentle undulation. General slope of the country is towards SSE. The highlands are represented by a few hillocks (maximum height being 267 feet above the sea level) and these are mostly capped by laterites. The most significant features in the physiography of the area, are the presence of some natural nalahs (drains) traversing the area from north to south and running in a subparallel fashion. The investigated area covers at least five such nalahs. Some of these nalahs are deeper and wider so much so that they may be designated as rivers (e.g. the Khari river). Most of them have their origin from highlands situated towards the north. Generally, these nalahs remain dry during the summer and winter but are fed by water during the monsoon. The easternmost Khari river is the widest and deepest having an arcuate trend convex towards the east.

The two nalahs, trending N-S and occupying the central part of the area, are designated here as the Waior-Cheropodi and the Laghopadar - Cheropodi. They unite at Cheropodi forming a common river, the Barkhan, flowing towards SW. The two western nalahs are smaller and have a NE-SW trend. The westernmost one is referred to as Berwali nalah and the other one as Kumbharamwaliwand-Lakhapar nalah. The nalah-cliffs are the main sites of exposures of Tertiary rocks. The depth of the nalahs varies from 10 feet to more than 100 feet. As these nalahs are running roughly parallel to the dip direction of
the Tertiary rocks, successively younger rocks are met with when one proceeds towards the south along the nalah sections.

B. Basement of the Tertiary rocks:

Biswa (1971) explained the nature of basement on which the Jurassic-Tertiary rocks were deposited in the Cutch basin. The tectonic map of Cutch was prepared by Biswas and Deshpande (1970).

The Tertiary rocks of Cutch were laid down on an uneven country, the basin itself being a pericratonic embayment, bordered by Nagarparkar uplift on the north, Ruchanpur - Barmer arch on the east (which separates the Cutch basin and Cambay graben) and Kathiawar uplift on the south. The structure of the Cutch basin includes six major uplifts which have given rise to highland areas of Cutch-mainlands, Wagad and Island belt (i.e. Fachham, Khadir, Bela and Chorar). These highlands were uplifted mainly in the pre-Tertiary times exposing the Mesozoic sediments. The uplifts are surrounded by residual depressions of the Great and Little Rann of Cutch, parts of which were the sites for Tertiary deposition. Each uplift is bordered at least on one side by fault and/or flexure and on the other side the beds gently dip towards adjacent basin. A 'Median high' runs across the basin in a more or less N-S direction with considerable influence on the structure, facies, and the thickness of sediments. The structures appear to have been
produced by differential movements of discrete basement blocks and the consequent 'drape-folding' of the blanketing sediments while some of the folds are attributed to syntectonic plutonic intrusions. The main structural style which seems to have been controlled by the primordial fault pattern in the Precambrian basement was set up during the major tectonic cycle in the Upper Cretaceous. This was followed by unidirectional movements in later periods so that the first order topography is maintained till today.

The basement Archaean rocks are exposed in Meruda hill, 16 miles north of Khadir island in the Great Runn of Cutch, represented by some syenitic rocks believed to be equivalents to Erinpura granites (Biswas, 1971). A granite-boulder conglomerate, exposed in Cheriyabet at the northern-most point of Khadir, is considered as the basal conglomerate marking the beginning of Mesozoic sedimentation in Cutch on Precambrian basement (Biswas et al., 1968). The Mesozoic basin was deeper towards western Cutch, where both lithofacies and biofacies show maximum development of marine characters. The sharp difference in lithofacies and biofacies of Jurassic rocks between western and eastern Cutch is attributed to the presence of that 'Median high' on the basement. Sedimentation of the Mesozoic times represents a complete cycle beginning with marine transgression in Middle Jurassic which gave rise to the deposition of rocks of Jhurio, Jumara, Kaladongar and Khadir formation which represent
typical marine sediments. The Jhuran formation and Lower Wagad formation are paralic; and the youngest units, the Bhuj formation and Wagad sandstone are deltaic to fluviatile.

The Tertiary sediments were deposited on the eroded surface of the Deccan traps and Mesozoic rocks after a fresh marine transgression in Palaeocene–Eocene times which covered the coastal plains of Cutch-mainland and peripheral plains of other major uplifts. The rocks are found to warp around the Mesozoic structures forming noses and embayments. The nature of development of Tertiary belt (Palaeocene–Pliocene) of Cutch is shown in Text figure 2. In general, the Tertiary rocks were deposited on a stable basin under uniform conditions but there are evidences of existence of a few locked basins where black shales were deposited e.g. the black shales deposits (Lower Eocene) of Jhulrai.

C. Tertiary rocks of the investigated area:

The villages Waior and Cheropodi (including Cheropodinani and Cheropodimoti) are located in western Cutch, geographically occurring in between Lakpat and Vinjhan. Low dipping beds of Tertiary rocks, ranging in age from Palaeocene to Lower Miocene, are exposed here. The deposition took place on the basement of the marine Jurassic rocks and/or Deccan traps. The approximate thickness of the Tertiary strata is

2972
nearly 2000 feet. Structurally this Tertiary belt occupies
the southern limb of Narayansarobar anticline. The strike of
the beds is broadly E - W and the maximum dip is 10° towards
south or southwest (average being 7°).

The basement of Oligo - Miocene succession is
represented by white limestone of Middle Eocene age characterized
by the presence of a large number of foraminifera fossils. The
important larger foraminifera are: *Nummulites atacicus,*
*Nummulites obtusus, Nummulites stamineus, Nummulites laevigatus,*
*Nummulites beaumonti, Nummulites acutus, Discocyclina
dispansa, Discocyclina sowerbyi, Discocyclina omphalus,*
*Discocyclina (Aktinocyclina) cuichense, Assilina exponens,*
*Alveolina elliptica, Dictyoconoides cooki, Asterocyclina
alticostata* etc. Some of the common smaller foraminifera
are: *Calcarina sp., Amphistegina sp., Rotalia sp., Uvigerina sp.*
etc.

The associated megafossils are represented by mollusca,
corals and echinoids, the latter being more frequent and
represented by forms such as *Eupatangus sp., Peripneustis sp.,
Echinolampas sp., Cidaris sp.* etc.

The Middle Eocene rocks are followed by Oligocene
limestones. The lithologic boundary is paraconformable marked
by a slight change of lithology (Oligocene limestones are
more impure). The foraminifera fossils are also common within
the rocks of which the important forms, represented at the
lower part, are *Nummulites fichteli, Nummulites clipeus* and
*Lepidocyclina dilatata.* At the upper part, *Miogypsinoides*
compianata, Lepidocyclina (Nepni olepidxna) parva and Spiroclypeus ranjanae are frequent. The common smaller foraminifera are represented by the following forms:

Nonion sp., Asterigerina sp., Rotalia sp.,
Textularia sp., Cibicides sp., Bolivina sp.,
Bulimina sp. etc.

The above foraminifera fossils are generally associated with megafossils such as corals like Astrocoenia sp., Stylophora sp., Porites sp., Montlivaltia sp. etc. and echinoids like Schizaster sp., Cidarid sp., Breynia multituberculata etc.

The boundary between Oligocene and Lower Miocene of this area is marked by abrupt change of lithology. Miocene rocks are represented by brown coloured impure marl. The common Lower Miocene foraminifera of this area may be listed as follows:

Miogypsinoideas bantamensis, Miogypsinoideas dehaarti,
Miogypsina gunteri, Miogypsina tani, Miogypsina
globulina, Miogypsina bhogatensis, Lepidocyclina parva,
Lepidocyclina morgani, Lepidocyclina tournoueri,
Spiroclypeus ranjanae, Archaias angulatus, Sorites
marginalis, Taberina malabarica, Austrotrillina
howchini, Austrotrillina striata, Operculinoides sp.,
Rotalia sp., Elphidium sp., Nonion sp., Cibicides sp.,
Peneroplis sp., Discorbis sp., Triloculina sp.,
Quinqueloculina sp., Textularia sp., Bolivina sp.,
Ammonia sp., Legena sp., Bolivinida sp., Pulliminella
sp., Uvigerina sp., Asterigerina sp., Amphistegina
sp., Globigerina sp., Cassigerinella sp. etc.

The associated megafossils are as follows:

Echinoids: Schizaster sp., Clypeaster sp.,
Breynia carinata.

Lamellibranchs: Ostrea latimarginata, Pecten sp.,
Venus sp., Lucina sp., Arca sp.

Gastropods: Turritella angulata, Turbo sp., Conus sp.
Cerithium sp., Voluta sp., Chlamys sp.,
Cyprea sp. etc.

Besides these, ostracoda and marine algae have been
found within the sediments from Eocene to Lower Miocene but
the latter is more common in lower most Miocene rocks.