CHAPTER IV

G E O L O G Y

Geologically the Gujarat State comprises the rocks ranging from Archaean to Recent and those of Saurashtra Peninsula range from upper most Jurassic to Recent. The general geology of Saurashtra is given in a Stratigraphic Column (Appendix I.1 p.243). The geological map of Gujarat State (Census Atlas - 1961) is reproduced (Map IV.1).

STRATIGRAPHY

The geological mapping of the study area, was carried out on a base map of one inch to a mile Toposheet No. $41\frac{N}{2 \& 6}$ on which the geological boundaries between Dhrangadhra Group, Wadhwan Group and Deccan trap were delineated (Map IV.2 Folder). The general geological sequence of this area, is as follows:

Soils	:	Sandy to loamy and medium black soils
Deccan trap	:	Lavaflows and intrusives
----------Unconformity----------		
Wadhwan Group		UPPER - White and ferruginous sandstone having quartzite on top
		MIDDLE- Limestone and Sandstone
		LOWER - Dull brick and coloured sandstone
Dhrangadhra Group		Ranipat Formation - UPPER
		Surajdeval Formation - MIDDLE
		Than Formation - LOWER
---------- Base not exposed----------		

DHRANGADHRA GROUP

Dhrangadhra Group of rocks of Upper Gondwana system, are the oldest rocks of the study area and are well exposed in the greater part of this region. The general dip varies from nearly horizontal to 5°. The dip becomes as high as 35° at a place 4 km north of Than near the contact of dyke. The hill slopes are gentle in dip direction and steep in the opposite direction forming dipslope and escarpment. The hills are rugged in outline due to variation in amount of dip. In the Western Region, rocks of this group, are well exposed in hilly terrain while in the Eastern Region, they form plain grounds. These hills are generally barren of vegetations and show honeycomb type weathering near Lakhamachi Bhet and Songadh (Plates IV.1, IV.2 & IV.3). The Machhu and the Maha rivers flowing through the rocks of this Group, show dendritic drainage pattern and have made the soil more fertile along their banks. The sandstones of this Group show cross bedding or cross lamination. They are medium to coarse grained and often gritty. The prominent joint directions are E-W and N-S. The Dhrangadhra Group is subdivided into three formations (GSI, 1976) as follows:

Ranipat Formation - UPPER

Surajdeval Formation - MIDDLE

Than Formation - LOWER

PLATE NO. IV.1

Honeycomb type weathering of Dhrangadhra sandstone, 6 km N of Than.

PLATE NO. IV.2.

Weathering of Dhrangadhra sandstone near Lakhamachi.

PLATE NO. IV.3 Weathering of Dhrangadhra Sandstone, N of Bhet

There is no continuity of the exposures of these three formations in this area.

(a) THAN FORMATION:

It is the oldest formation and its base is not exposed in this area. The rocks of this formation are exposed near Mahika, Than, Songadh, Jodhpur, Navagam, Khakhrathal and Vagadia. The typical Than Formation as observed in an opencast mine section near Songadh, 3 km NNE of Than, is as follows:

Ferruginous sandstone

Grey shale

Carbonaceous shale

White and ferruginous sandstone

White and ferruginous sandstones are very soft and medium to coarse grain in texture. The quartz grains are loosely cemented by argillaceous materials. They are moderately to poorly graded and show current bedding, at the quarry site near Mahika. Ferruginous sandstone is generally yellow to light brown.

Grey shale overlies the carbonaceous shale showing plant impressions. These shales are often separated by thin bands of ferruginous sandstone or coalseam (Plate IV.4).

PLATE No.IV.4

Coalseam, opencast mine, S of Khakhrathal

(b) SURAJDEVAL FORMATION:

It overlies grey and carbonaceous shales and is exposed on the plain grounds near Waori, Samatpara, Gugaliana, Sarla and Bhasol (Kanpar). The typical Surajdeval Formation as observed at Makkabedi hill section near Waori 1.5 km WSW of Surajdeval, is as follows:

Gritty sandstone
Ferruginous shale
Ferruginous sandstone (mottled)
White sandstone

White sandstone is fine to coarse grain in texture. It is very soft and friable. The quartz grains are loosely cemented by argillaceous and felspathic materials. On disintegration it gives silicasand. Red shale is separated by thin lenses of ferruginous sandstone.

(c) RANIPAT FORMATION:

It is the youngest formation of Dhrangadhra Group and is exposed in the prominent hills of this area near Dharadungri, Ranipat, Bhet, Jodhpur, Bherda and hill ranges running from Jamvali to Ratharia. The typical Ranipat Formation as observed at hill range 3 km south

of Ranipat is as follows:

Quartzitic sandstone often gritty

White clay

Ferruginous sandstone

Ferruginous sandstone is exposed in this area at the base of the prominent hills. It is yellowish brown to brown in colour and medium to coarse grain in texture. The quartzitic sandstone is exposed on the top of the hills. It is purplish red to brownish black with coarse to gritty texture. The quartz grains with ferruginous and argillaceous cementing materials are fused as a result of the baking effect of Deccan trap lavaflows which in geological past covered upper part of Dhrangadhra Group. Gritty sandstone contains small pebbles of agate, chalcedony and quartz in the topmost part of Ranipat Formation located on Makkabedi hill near Waori and on the small hill on the right bank of the Machhu river between Paj and Garia.

WADHWAN GROUP

Scattered outcrops are observed in the Bhogeva-I (Wadhwan-Bhogavo) river sections near Muli, Gadhad, Tidna, Umarda, Bhaduka and Dolia. They show great variation in

dip especially near Bhaduka and SW of Muli in Bhogavo river sections. The dip is generally 5 to 10°. An inlier of Wadhwan Group occurs in the river section of Bhogavo-I, west of Muli. This Group has been further subdivided into Upper, Middle and Lower Formations (GSI-1976). The Lower Formation consists of dull brick red friable sandstone with slightly calcareous matrix. It is observed near Gadhad, Umarda, Tidna and Bhaduka. The middle Formation comprises of reddish brown argillaceous rock and red sandstone with a cherty hard limestone at the top near Aya Deriwala west of Bhaduka. The relationship of this limestone to rock of Wadhwan Group, is not clear but it is likely to belong to the middle Formation. The Upper Formation occurs near Vanalia, west of Chotila-Muli Road. It consists of ferruginous sandstone at the bottom and coarse grained felspathic sandstone with silicecus cement at the top.

DECCAN TRAP

The Deccan trap includes lavaflows and intrusives.

(a) LAVAFLOWS:

They lie unconformably over the Dhrangadhra Group of rocks near Bokadthamba, Dighalia, Kashiagala, Palasdi, and Daldi and over the Wadhwan Group of rocks near Bhaduka, Gadhad,

Khatdi, Sudamda Nava and Muli. The erosion of the Deccan trap lavaflows from the major part of this area, has exposed the older formations. The remnants of the lavaflows occur as outliers near Daldi and at Bhim Tekri near Sudamda Nava (Plate IV.5). The southern part of the Eastern Region is hilly and is covered by lavaflows. Basalt is greyish black to black in colour and fine to medium grain and porphyritic in texture. It consists of labradorite (Plagioclase felspar), augite, and magnetite. Near Sadharka, the top of the lavaflow is amygdaloidal basalt containing quartz, zeolite and calcite as secondary minerals. They show spheroidal weathering near Somasar and on the hillocks, south and south-west of Sayla. They are highly weathered on plain ground near Tikar. Sayla, and Gosal. On the quarry face north of Daldi the columnar joints are prominent near the top (Plate IV.6). The hills made up of lavaflows are generally conical in shape and rounded in outline (Plate IV.7). The natural vegetations are more on plain ground where the compact basalt is not well exposed due to soil cover.

(b) INTRUSIVES:

Numerous doleritic dykes connected with Deccan trap activity are exposed in this area near Somasar, Tarnetar,

PLATE NO. IV. 5

Deccan trap lavaflow above Wadhwan sandstone,
Bhim Tekri, S of Sudamda Nava.

PLATE NO. IV.6 Columnar joints in basalt quarrysite near Daldi

PLATE NO.IV.7

Deccan trap hill showing conical shape,
Bhim Tekri, Sudamda Nava.

PLATE NO.IV.8

Deccan trap dyke near Tarnetar

Than, Morthala, Jodhpur, Bherda, Shekhardi and Gugaliana (Plates IV.8 & IV.9). They are also exposed in openwell sections near Jali, Aya Deriwala, Rajgad, Sarla, Aya Dagdagia and Khakhravali. Dykes are running E-W, N-S, NW-SE and NE-SW but most prominent trend is E-W. The width of these dykes ranges from 2 to 5 m. The prominent joint directions are E-W and NE-SW. Some dykes whose trend is N-S, show cross-cutting relationship with E-W dykes near the western border of this area. These dykes are fine to coarse grained and show ophitic texture. Their mineral composition is similar to that of basaltic lavaflows but in addition to labradorite, augite and magnetite, olivine is also present in the dykes. Dykes are more concentrated in the Western Region than in the Eastern Region of this area (Map IV.2).

SOILS

The inorganic soils of this area are greyish brown to dark brown. The depth of soil varies from 30 to 120 cm. The alluvial soils on Dhrangadhra Group and Wadhwan Group are sandy to loamy while those on Deccan trap are loamy to clayey. The residual soils on Dhrangadhra Group and Wadhwan Group, are sandy while those on Deccan trap, are fine grained loamy.

PLATE NO. IV.9

Sill and dyke in Dhrangadhra sandstone
near Shekhardi.