CHAPTER I

I N T R O D U C T I O N

GENERAL:

The geology of Kutch - its stratigraphy, structure and palaeontology - is very interesting and is still to be fully investigated. The Mesozoic rocks of the region, especially the Jurassics, form one of the important formations of the world, well-known for their stratigraphical and palaeontological interest. In the past, the palaeontology of the rocks of Kutch has attracted more attention, though they offer an equally interesting opportunity of the study of their

sedimentological aspects. The present work has been undertaken with a view to make a beginning in this direction.

BRIEF GEOGRAPHY AND GEOLOGY OF KUTCH:

Geography:

The terrain of Kutch in general is classified into three zones from north to south :-

(1) The Rann, (2) The central hilly region and (3) The southern coastal plains.

The Rann forms a unique salt-crusted wasteland to the north of mainland. It is divided into the Great Rann and the Little Rann. The latter lies to the east-south-east of the former. The area covered by Rann mostly remains dry except for the rainy season when it is covered by saline waters. During dry period, practically the whole region is covered with a fairly hard salt-encrustation.

The central hilly region comprises four parts, as under:

(a) Island Belt - There are four islands i.e. Patcham, Khadir, Bela and Chorar from west to east.

(b) Banni - This region lies between Patcham island in the north and Mainland in the south and covers a wide area. Banni area rises a little higher than the surrounding Rann and is covered with grass and other shrubs.

(c) Mainland - The area lying south of 'Banni' and extending upto the Gulf of Kutch in south, is called 'Mainland.'

(d) Wagad - This region lies to the northeast of Mainland and forms an isolated mass.

Physiographically, the Kutch region comprises a number of east-west hill ranges in Island belt, Mainland and Wagad area, separated by large tracts of low ground. All hill ranges and low grounds in between almost run parallel - a characteristic feature in this part of the country giving some clue to the fact that topography has been controlled by the geological features. The highest (465 m.) - peak point in Kutch is that of Kala-doongar of Patcham island i.e. Pachhamai Pir. In the mainland, Dhinodhar hill forms the highest peak with a height of 388 metres.

The southern coastal plains border the mainland against the Gulf of Kutch in south and the Arabian Sea in west. The coastal plains are marshy. Seacoasts along the Kutch peninsula, afford not only scenic beauty and different varieties of coast lines but also have been found quite suitable to be used as natural ports.

Kutch has a semi-arid climate which belongs to the 'Steppe-Bsh-Type' as per Koeppen's classification. The steppe is a transitional belt, bordering a real desert and separating it from the humid climate beyond. The Tropic of Cancer passes through Kutch region and hence the area records the extremes of temperature, typical of an arid climate. Maximum temperature in May is about 38.28°C which sometimes goes as high as 47.80°C. Minimum temperature in January is 11.2°C which goes as low as 10.0°C. Hottest month is May while the coldest one is January. The winter season is from December to February and is not severe, though short-spells of cold waves are not uncommon. Easterly and Northerly cold winds blow over the region during winter months. The winter season is

followed by the summer from March to about the middle of June. It is during this period, especially in April and May, that violent dust storms are registered at times, particularly in the interior northern portion. These dust-storms caused by the strong cyclonic winds spread over a large area, restricting visibility and causing damage to properties sometimes. The dust-storms are of short duration of a few hours only and are generally common in the afternoons. The period from middle of June to middle of September constitutes the southwest monsoon season. October and November months form the post-monsoon transition period from the rainy to the cold season. Days are very hot, sultry while nights are breezy, cool and pleasent.

In general, humidity in the coastal area is high throughout the year. The relative humidity exceeds 60% on the average. During southwest monsoon, relative humidity is as high as 80% in the coastal region and over 65% in the interior. The air is generally dry during the rest of the year in the interior, with the afternoon relative humidities of the order of 25% or less.

The rainfall in Kutch is rather scanty as this region escapes the heavy monsoon, that visits the western shores of India. The average annual rainfall is 32.2 cm. The heaviest rainfall was 37.6 cm. recorded at Mandvi in the year 1881 and an exceptionally high rainfall was recorded in the year 1967. Insufficient rainfall causes famine and other scarcity conditions.

From the point of view of vegetation, the Kutch region presents a somewhat desolate landscape and in a broad way represents a terrain with scanty vegetation. Apart from a few irrigated green patches viz., nearabout towns and villages, the rest of the area offers a vegetation, that could be classified into two main types:-

(a) 'Halophytic' vegetation near the sea and (b) Typical low thorny shrubs of 'Xerophytic' in dry sand plains.

The Halophytic vegetation is predominantly represented by Chenopodium sanda, Aleuropu sp. and Cress cretica. The thorny shrubs mainly consist of an association of the low trees of Accacia arabica (Babul), Prosopis julifera (Vilayti babul),

Prosopis spicigera, Salvadora persica (Piludi), etc. interspersed with shrubs like Catotropis gigantia (Akdo), Capparis aphylla (Kerdo), Aerva etc. Besides these shrubs few trees of wild date, mango, common Nim, Pipal, Tamarind, Banyan are commonly found near villages and on the sides of the roads. There are no dense forests in Kutch.

As regards the fauna of the Kutch region, wild animals are scarce, and only deer, fox, wildcats and rabbits are occasionally come across in the hilly terrain. In the Rann areas, forest donkeys or 'Khar-Gadha' are also reported. Kutch is well known for its flamingos - a rare species of bird, which arrive in the area during winter months.

Because of the scanty rainfall, the position of agriculture, and water supply is highly precarious. The lakes are utilized for the irrigation purposes. Generally, the central hilly region does not yield any ground water. The plains, however, comprising porous rocks furnish good

aquifers. Since last four years the Exploratory Tubewell Organization (Govt. of India) has been exploring the plains for groundwater. With the help of such water resources, the plains and the hill-slopes have been brought under cultivation and the crops include Millet (Penicillaria Spicata), Jowar (Sorghum Vulgaree), Wheat (Triticum Oestivum), Bajra and other cereals. Cotton (Gossypium herbaceam) is also grown but is of an inferior quality. Plantations of sugar-cane (Saccharum Officinarum), castor seeds (Ricinus Communis) and ochards of mango (Mangifera indica), Banana (Musa sp.) are also common. Apart from agriculture the main source of livelihood is the raising of cattle and sheep.

The inhabitants of Kutch are Hindus with a fair proportion of Mohammadans. Common language spoken is Kutchhi (a dialect of Gujarati). Hindi is now becoming quite popular. Total population of Kutch is about 0.7 million.

Bhuj, the district headquarter, is connected with Ahmedabad via Palanpur by a Meter-gauge

railway line. Daily I.A.C. flights connect Bhuj with Jamnagar and Rajkot. All-weather good motorable roads connect this town with various important towns of the district, viz. Lakhpat, Mandvi, Mundra and Gandhidham. The State Transport Buses regularly ply on many routes and link even small villages. In addition, there are many metalled roads and cart-tracks and thus the various parts of the area are easily accessible.

Geology:

It is proposed here to give the salient features of the Geology of Kutch to serve as a suitable background before detailing the results of investigations. The rock formations show the following generalised sequence:

Alluvium, Coastal sands, Rann, Miliolite limestones	Recent, Sub-Recent and Pleistocene
Marls, shales, sandstones and limestones etc.	Tertiary
Basalts	- Deccan Trap
Sandstones	- Cretaceous
Sandstones, shales and limestones, etc.	Jurassic

(Base not exposed)

The central hilly portion comprises Jurassic and Cretaceous rocks while the southern part of the peninsula is mostly covered by the lavas of the Deccan Trap which along the western and southern coastal areas, are in turn, overlain by Tertiary and Recent deposits. To the north, the Jurassics go below the Banni Rann - a Recent silty deposit. A few outcrops of older Jurassics again crop out as inliers surrounded on all sides by the Great Rann. Structurally, the Jurassic rocks form three parallel chains of domes, decreasing in size from north to south, and each chain being flanked by an E-W fault on its northern side. The highest and the biggest domes make inliers in the Rann and form the islands of Patcham, Khadir, Bela and Chorar. The another chain of domes borders the Kutch mainland, and marks the hills of Jhura, Jumara and Lodai. The southernmost anticlinal flexure forms a chain of low domes forming the Katrol-Charwar ranges and the northern flank of these ranges, are marked by a fault, (Katrol fault), which has brought younger Cretaceous rocks against the older Jurassics.

As has been mentioned in the opening lines of this Chapter the geology of Kutch region, offers facinating opportunities to geologists of varied interest. Apart from a number of interesting lithological types of different ages, showing variety of structures both primary and secondary, the rock formations contain a rich fossil assemblage. Geologists have been attracted to this region since last 100 years or more, who have worked on different aspects of the geology of the area. Palaeontology has been the main attraction. Dome structures shown by the Jurassic rocks have intrigued many workers. Apart from these academic aspects, Kutch is also now being variously explored for a number of economic minerals. Oil and Natural Gas Commission has been looking for petroleum in the Tertiary rocks. The Geological Survey of India and the Directorate of Geology and Mining of Gujarat State have been exploring for bauxite, lignite, gypsum and limestones. The reclamation of the Little Rann and the search for ground water, are again the problems which involve considerable geological interest.

SCOPE OF THE PRESENT INVESTIGATION:

The present study dwells upon the Jurassic and Cretaceous rocks of the area to the south and southwest of Bhuj, which forms western part of the Survey of India 1 inch Topographic Sheet No. 41E/8 & 12. The area under investigation belongs to the central part of the Mainland, and lies between the North Latitudes 23°4' to 23°14',5" and East Longitudes 69°30'45" to 69°43' (Fig.4), covering about 175 sq.km. The limits of the area extend upto the villages Kera and Daisara in the south and Samatra in the west. The basaltic hill-ranges running almost east-west, limit the area in the south while in the north, the boundary is marked by the villages Bhuj, Bhavanipur and Nangiari.

Physiographically, the area is divisible into three parts from north to south. The northern and southern parts constitute low lying plains while the central region is hilly and covers a part of Chavad and Katrol hill ranges. Significantly, the northern slopes of these hills

are steep and conspicuous while the southern slopes are rather gentle and coincide with the dips of the strata. The basaltic hill-ranges in the south have moderately steep northern slopes. In the low grounds, a very common feature is the presence of small mounds and hillocks composed of sandstones and basic intrusions. Besides these mounds, the plains are traversed by low north-south narrow ridges of basic dykes. The hills in the area are not very high, the highest peak being 323.5 m. above M.S.L. - two miles east-north-east of Bharapur.

The central hill-ranges in the area form the water-shed. The numerous small streams draining the southern slopes of these ranges merge to form two streams, flowing southwards. One is the tributary of Bhukmavati river, while the other is known as Nag river. Many small streams originating in the northern slopes of Katrol range merge to form Khari river flowing northwards. The various small streams and rivulets easily erode the softer rocks (shales) while harder rocks (calcareous siltstones) stand out prominently. All the streams

in the area are seasonal and get almost dry during the summer though some stagnant water may remain in their beds here and there. Small dams have been constructed across some of these streams near Godpur, Sukhpur, where water is stored in big tanks throughout the year. A north-south dyke near Prag-Sar forms a natural barrier across one of the tributaries of Bhukmavati river and this feature has been well exploited by building a small dam.

The rock-types encountered in the area are sandstones, siltstones, shales, conglomerates, limestones (Middle Jurassic to Cretaceous). These are seen intruded by the basic rocks of Deccan Trap.

The degree of rock exposures, on the whole, is fairly good, and the rocks are well exposed all over the area. Hard, calcareous siltstones and sandstones generally provide better exposures being resistant to erosion while shales and softer varieties of sandstones get eroded easily resulting into low ground and valleys. However, because of low dips, frequent unexposed patches and absence of

clear diagnostic field characters, considerable difficulty was experienced while mapping the area.

The author spent an aggregate period of about 20 weeks during two field seasons - first during February and March 1966 and second during January, February and March of 1967. The mapping was done on a scale of 1:15840. To begin with, a large number of traverses were taken along and across the strikes of the various formations and then all the important exposures were individually visited and systematically investigated. In addition to a comprehensive collection of samples of various lithologic types from all over the area, exhaustive and detailed structural data such as sedimentary bedding, laminations and current bedding were noted. Initially, 675 samples were collected, out of which 300 were subjected to laboratory analysis. 2500 readings of dips were recorded and selected readings were plotted to bring out the structure of the area.

Based on his field work and the laboratory studies, the author has attempted to build up the stratigraphic sequence in the area - mainly taking into account the various sedimentological criteria. A detailed account of the various sedimentary characters as seen in the field, together with the various analyses to which the sediments were subjected, have enabled the author to put forth a succinct and interesting depositional history of the various rock units belonging to the Jurassic and the Cretaceous systems. An attempt has also been made by the author to explain the possible genetic relationship that is seen to exist between the various domes and the Katrol fault that flanks them to the north.

In the course of his field work, the author collected a number of fossils from the various fossil-bearing horizons. These fossils, however, have not been subjected to any critical study. Similarly, the various basic rocks encountered in the area, have only been described very briefly. No special study either of the fossils or of the

basic rocks could be undertaken, and only a very brief and general account of the two is included in the present work.
