CHAPTER III

GEOLOGICAL SETTING

In this Chapter the salient features of the investigations carried out by the previous workers on the Pre-cambrian formations of Panchmahals and Baroda districts are summarised.

Earlier workers like Blanford (1869), Hobson (1926), Fermor (1909-1936), Beer (1918), Rama Rao (1931) and Gupta and Mukherjee (1938) carried out geological studies on a regional scale in Central and Western India.

Blanford (1869), was one of the pioneers in Indian Geology and the first to investigate the geology of the

Western India and to name 'Champaner Series'. He classified the rocks of this part of the country into four series as follows:

4. Vindhyan series
3. Bijawar series
2. Champaner series
1. Metamorphic series

The relative positions of these series were not established by him.

The Metamorphic series is comprised of the basement rocks including granite, syenite, gneiss, hornblende schist, quartzite and other crystalline formations.

The Champaner beds resting over the Metamorphic series constitute quartzite or quartzitic sandstone, very similar in character to rocks which occur in Bijawar and Metamorphic series. The other beds are mostly slate, conglomerate, limestone and occasional ferruginous bands. Some of the limestones are highly crystalline. All the rocks are highly cleaved.

Fermor (1909), visited Champaner area in connection with his investigations of manganese deposits of India.

He found that the rocks of the Champaner series were lithologically similar to those of Dharwar age, exposed in Central and South India. Consequently he correlated the rocks of Champaner series with those of Dharwar facies.

Fermor and Sambasiva (1918), stated that the majority of the slate, phyllite, mica-schist, and quartzite of Dharwar; and highly crystalline limestone and calcium rich gneiss of Madhya-Pradesh, were metamorphosed sediments.

Beer (1919), was one of the earliest geologists who carried out the geological investigations of this area and was first to report the occurrences of graphite bearing rocks near Baria.

Jayaram (1925), stated that the limestone, and sillimanite and cordierite bearing rocks of the Sakar Sanhalli area were of sedimentary origin. Later, Rama Rao (1927), suggested that some of the Dharwar rocks, particularly crystalline graphite schists are of sedimentary origin.

Hobson (1926), investigated the metamorphic rocks and intrusive granite of Chhotaudepur. According to him, the granite or granitoid gneiss covers the whole area with the exception of the north-western corner. The crystalline

schist or gneiss, limestone and quartzite occur as isolated patches. The granite or granitoid gneiss is intrusive into the Champaner rocks and therefore Post-Dharwar in age.

Rama Rao (1931), surveyed the northern extension of the Champaner series in the former Baria State. The geological succession of the area is as follows:

Champaner series	Rajgad shales
	Dharia limestone
	Baria quartzites
	Poyelli felsphatic quartzite
	--------Conglomerate----------(?)
	Poyelli limestone, argillite etc.
	Micaceous gneiss of Dhanpur (?)
	---------- (?)
	Archean crystalline schists and gneisses.

According to Rama Rao, the oldest recognizable rocks of Baria State, are a group of crystalline schists consisting chiefly of hornblende schist, amphibolite, pyroxene hornblende granulite, thin bands of pyroxenite and limestone forming the

Archean complex. These are seen as shreds or stringers, interbanded with biotite gneiss in south-east corner of the State. Rama Rao concluded that there is no rock type which can be considered as of aqueous origin, and that the altered phases of sediments near contact were considered to be due to secondary processes of alterations. He correlated the Archean complex of Baria State to that of the Peninsular gneissic complex of Mysore and their modifications to Lower Dharwar rather than the typical Aravalli system of Rajasthan.

Dhanpur schists consist of coarse textured micaceous gneiss or micaceous hornblendic gneiss, intercalated with highly bedded micaceous quartzite at the top. The friable nature was considered to be probably due to the effects of hydration and alteration.

Next in succession is the Poyelli group of Champaner series which consists of quartzite, shale, micaschist, phyllite, jaspery hematite, conglomerate and limestone forming the northern fringe of the area. These two series of rocks have been invaded by granite and granitic gneiss of probably more than one epoch of igneous intrusion. These Champaner beds (Poyelli group) show characteristics of both true sedimentary and distinctly igneous rocks.

Poyelli beds have distinct bands of magnesian limestones which are not found in other series. The ripple marked feldsphathic quartzite and slaty argillite are considered to be of sedimentary origin. Among the Poyelli beds some of the quartzite and slaty schist show distinct signs of sedimentation. Well exposed conglomerates in the Poyelli region, suggest an autoclastic origin. It is very difficult to judge the true mode of the origin of limestone on account of its considerable metamorphism but it is presumed to be primarily of aqueous origin.

The Baria quartzites are separated from Rajgad shales by a wide stretch of granitic country. The quartzites are dark bluish grey, light blue, greenish, pinkish grey and pink. They are interbedded with a series of fine grained, gritty, flaky, micaceous schist with thin intercalated bands of siliceous amphibole rocks. The sedimentary structures such as ripple marks, indicative of shallow water origin, are seen at some places in Baria quartzites.

The Rajgad shales comprises of shale, hornstone, amphibolite, quartzite and pyroxenite. Rajgad shales are dark bluish gray to light blue, ash gray, and greenish gray. Sedimentary structures are better preserved in

Rajgad shales and are obliterated at places due to dynamic and contact metamorphism. Intercalated beds of the hornstone occurs as distinct continuous bands in the shale and are quite conformable and parallel to their strike.

The Rajgad shales differ from Poyelli group in following respects. Phyllitic schists of Rajgad series show more biotite and the absence of sericite than the Poyelli group. The quartzite in this group occurs only as thin intercalated bands. They are fine grained argillitic and impure. Definite bands of limestones characteristic of the Poyelli group are not found among the Rajgad shales. Hornstone type is absent in Poyelli group.

According to Rama Rao, "The types of Archean crystalline schists are all mainly igneous in origin or at any rate do not show sufficient evidence for postulating a primary clastic origin. Among the Champaners, there are bands which are distinctly sedimentary, like the phyllite and slaty schist, ripple marked and current bedded quartzitic sandstone and bedded crystalline limestone mixed up with distinct igneous intrusives like granite porphyry and mica traps. The conglomerates noticed are

like the majority of those among the South Indian Dharwars and are either autoclastic or modifications of intrusive breccia. Many of the quartzitic outcrops have undergone such alterations with the obliteration of all their original characteristics that it becomes impossible to solve at a glance their precise mode of origin. The granites have been classified as of different epochs of intrusions of probably two or even three distinct periods. Individually their behaviour in the field and their appearance are strikingly similar to the corresponding granitic divisions of Mysore (Karnataka). Middlemiss and Heron suggest that these rocks in Idar and Rajputana are essentially sedimentary while the geologists of Mysore hold the views that the types as found in Dharwars are primarily igneous in origin.

Fermor (1934-1936), in his subsequent investigations observed that the Champaners, the Aravallis, the Chlipighat series and the Dharwars of Mysore were roughly contemporanous and suggested that the Champaners were found to be continuous with the typical Aravallis of Rajputana.

Gupta and Mukherjee (1938), considered the Champaners to be equivalent to the Aravallis. They regarded the granite and gneiss associated with the Champaners as

Post-Aravalli but Pre-Delhi. While the granitic rocks to the north, in the vicinity of Godhra, were thought to be equivalent to Erinpura granite.

Rasul (1963, 1964, 1965): On the basis of chemical composition, Rasul suggested that the phyllites of Shivrajpur were derived from pre-existing meta-sediments and that even after metamorphism the rocks did not suffer change in bulk composition except loss of water.

Lakshminarayan (1969) studied the Precambrian formations around Godhra in Gujarat State. The various rock formations in this area consisting of mica schists and quartzites, belong to Aravalli formations and granites and its derivatives like pegmatites, aplites and quartz veins are Post-Aravalli. The geological succession of the area is as follows:

Fine grained granite		(Malani)
Quartz veins	}	Post Aravalli (Erinpura granite)
Pegmatite and aplites	}	
Fine grained granite	}	
Coarse grained granite	}	
Porphyritic granite	}	
Quartzites	}	Aravalli
Mica-schists	}	

According to Lakshminarayan, the mica schists belonging to Aravallis are the oldest rocks of this area and represent the biotite zone of Barrovian type of regional metamorphism. The presence of ripple-marks and bedding features in the quartzites suggest aqueous nature of their deposition which were later subjected to a low-grade regional metamorphism during the Aravalli orogeny. The presence of sillimanite in quartzite at some places suggest that sillimanite might have been formed due to contact metasomatic effect by invaded granite. The strike of the sillimanite quartzite patches exposed in the contact with granitic body differs from that of Aravalli formations indicating the disturbance due to intrusion of granite.

Post-Aravalli granitic rocks are of magmatic origin due to their intrusive nature and aplites and pegmatites are the residual products of the differentiation of magma. The granitic rocks of this area are correlated with the Post-Delhi Erinpura granite. The presence of dynamothermal metamorphic effects in the granite and muscovite and tourmaline bearing pegmatite, support this view and help in correlation of these rocks with those of Post-Delhi in north-eastern Rajasthan (Gupta and Mukherjee, 1938). Later it has been suggested that the Godhra granite represents

the last intrusive phase of granitic activity related to Champaner orogeny. (Merh, Jambusaria and Patel, 1968). The Godhra granite extends into Baria Taluka where it has been described as Havelli granite, and is correlated with Post-Champaner closepet and Idar granites.

Jambusaria (1970) carried out detailed investigations regarding stratigraphy and regional geological setting of the Champaner series in the Shivarajpur area of Panchmahals district. The geological succession, based on his investigations, is as follows:-

Cretaceous		Bhamaria sandstone (Bagh beds)
----------Unconformity----------		
Post-Champaner (Pre-Delhi)		Intrusive granites
Champaner series (Aravallis)	Upper	Rajgad slates
	----------Para conformity----------	
	Middle	Bamankua limestones
		Shivarajpur quartzites and phyllites
		Bhat slates
		Jaban conglomeratic Graywackes
		Jabban slates
		Narukot quartzites
	---------- Disconformity----------	
		Gandhra Pelitic group
		Chhotaudepur Dolomites
		Basal conglomeratic quartzites
----------Unconformity----------		
Pre-Champaners		Basement gneisses etc.

The names, given to various rock groups in the above succession, are based on the localities where the exposures are typically observed.

Several workers (Merh and Patel, 1968, Naha and Chaudheri, 1968, Naha and Mukherjee, 1969) have shown that the Aravalli of North Gujarat and South Rajasthan show clear imprints of two episodes of folding - one superimposed over the other and the present NNE-SSW strike of the Aravallis, was impressed during the Delhi folding. Merh and Patel (1968) have considered the original Aravalli folds to be E-W. The E-W folding of the Champaner series, thus coincides with the original Aravalli fold trends. According to Jambusaria, the rocks of the present area having escaped the effects of Delhi orogeny, have preserved the original trends. Similarly, the metamorphism of the Aravallis differs from the Champaners on account of this superimposition of deformation. The rocks of Champaner, having undergone only a low grade of regional metamorphism have preserved most of the pre-existing sedimentary structures. On the other hand, the Aravallis in the north, show greater effects of shears in their metamorphic assemblages. These shears obviously took place at the time of the Delhi folding. A very conspicuous metamorphic phenomenon shown by the Aravalli schists is the development of crinkling and a late strain-slip cleavage. These structures are developed in Champaners.