CHAPTER II

BACKGROUND INFORMATION

Rajasthan and North Gujarat have received much attention from geologists during the last hundred years, and a wealth of data is available on various aspects of this region's geology. In this Chapter, only an outline of the geology of Rajasthan and N. Gujarat based on the account of the various previous workers, has been given with a view to provide a suitable background to the present study. For more details the interested reader is referred to the works of Blanford (1869), Hacket (1881), Oldham (1893), La Touche (1902)

Heron (1917, 1936, 1953), Middlemiss (1921), Auden (1931), Sharma (1931, 1953), Coulson (1933), Ghosh (1933), Gupta (1934), Fermor (1936), Sharma and Nandy (1936), Heron and Ghosh (1938), Gupta and Mukherjee (1938), Misra (1949, 1969), Merh (1950, 1967), Niyogi (1952, 1960), Jhingran (1958), Ghosh and Naha (1962), Naha et al. (1968, 1969), Patel and Merh (1967), Naha and Mukherji (1969), Gangopadhyaya (1970), Gangopadhyaya and Sen (1971) and Mitra (1971).

BRIEF GEOLOGY OF RAJASTHAN AND NORTH GUJARAT

The most salient feature of the geology of the region is the presence of several groups of rocks belonging to the Archaean and pre-Cambrian, forming a folded mountain system (Aravalli mountain chain) running across from the N. of Dlhi in the N.E. to as far as the gulf of Cambay in the S.W. The central part of these Aravalli ranges is occupied by a great synclinorium comprising the Delhi and Aravalli metasediments. These metasedimentaries are intruded by granites and mafic rocks of more than one generation, and the overall geology is of great complexity. The major formations are of pre-Vindhyan age, and have been classified as under:

5. Malani suite of igneous rocks	Upper pre-Cambrian
4. Delhi system	
3. Raialo series	
2. Aravalli system	Lower pre-Cambrian
1. Banded gneissic complex (including Bundelkhand gneiss)	

The Banded gneissic complex and the Bundelkhand gneiss, make up the oldest rocks, constituting the Archaeans. The Aravallis are supposed to be resting over the gneissic basement, and are perhaps equivalent to the Dharwars of south India. These constitute an enormously thick sequence of mainly argillaceous rocks. The Raialo series (about 600 m. thick) is considered to be intermediate in age between the Aravallis and the Delhis. Raialos are dominantly calcareous. The Delhis consisting originally of sandstones and shale resemble Cuddapahs and are probably 6000 m. thick. After the deposition and folding of the Delhi sediments there occurred a series of successive acid igneous activities which include the Erinpura and Jalor-Siwana granites as well as Malani suite of volcanic and plutonic rocks.

Banded Gneissic Complex

The rocks belonging to the Banded gneissic complex consist of alternating bands of biotite-gneiss and granite. These rocks are ideally exposed in southern, central and northern Mewar and near Ajmer. The exposures of somewhat non-foliated granite in Berach valley between Chitor and Bhilwada considered by Heron equivalent to the Bundelkhand gneiss. According to Heron (1953) there is a distinct erosional unconformity between the Banded gneisses and the overlying Aravallis. Earlier Crookshank (1938) had stated that the schistose components of these gneisses in northern Mewar were essentially the same as Aravalli schists, and that they represented granitised Aravallis. Misra (1949) has also found that the Bundelkhand granite is (at least in part) of post Aravalli age. According to Krishnan (1968, p.120) recent work by the Geological Survey of India seems to indicate that generally the Aravallis are younger than the Banded Gneissic Complex, though the latter may contain later granite constituents.

Aravalli System

The basal beds of the Aravalli system, which rest on Bundelkhand gneiss or the Banded gneissic complex are arkose and gritty quartzites. Above these come slates

and phyllites with which are associated some altered basic volcanics in places. Impure argillaceous and ferruginous limestones occur in two facies. One being lenticular ferruginous, as in Bundi and Mewar, and the other black and massive, as near Udaipur. In some places, there are quartzites instead of limestones. The youngest members of the Aravalli system are the reddish sandstones and granites seen near Ranthambhor and Sawai Madhopur. The Aravalli rocks show increasing grade of metamorphism as they are followed from E. to W. into the highly folded region.

Raialo Series

The Raialo series overlies the Aravallis and is, in turn overlain by the Delhi system, the junction in both cases being markedly unconformable. The Raialos mainly consist of limestones - about 600 m. thick, with basal sandstone and conglomerate. In the Rajsamand area in Mewar, the limestones are overlain by micaceous quartzite and mica-schist, which have been highly metamorphosed and partly converted into gneiss. The main exposures are those of Alwar-Jaipur around Raialo, the type locality.

Delhi System

The Delhi system forms a synclinorium extending almost along the main axis of the Aravalli fold mountains from near Delhi in the north through Ajmer and Mewar to Idar and Palanpur in the south. The exposures are fuller and much broader in the main part of the synclinorium in the Ajmer-Merwara and Mewar. Here, they consist of two major synclines separated by a tongue of pre-Aravalli gneisses. The synclines coalesce in the south, and when traced southwestward its rocks are profusely intruded by granitic rocks of Erinpura age, so much so that they almost obliterate the Delhi sedimentaries. The Delhi system has been classified into a lower Alwar series ~~and~~ and an upper Ajabgarh series. The succession is fully developed in Alwar, where two extra horizons namely Kushalgarh limestone and Hornstone breccia intervene between Alwar and Ajabgarh series. The Alwars are 3000 to 4000 m. thick consisting of compact quartzites, grits and conglomerates. The Kushalgarh limestones overlie the Alwars and comprise dolomitic banded limestones. The Hornstone breccia appears at some horizons only in the Kushalgarh limestone, more often near the top. The Ajabgarh series is mainly argillaceous forming synclinal valleys, though

it contains subordinate siliceous limestones, calcareous silts and ferruginous quartzites.

The Delhis in the N.E. area consist of narrow strike ridges in which rocks show moderate folding. The general strike is N.N.E.-S.S.W. The rocks, however, are overfolded in the S.E. and comprise a series of isoclines.

The Delhis are generally correlated with the Cuddapahs of south India, but they differ from the latter in that they have been subjected to extensive folding and igneous intrusions.

Erinpura Granite

The Delhi system is intruded by Erinpura granite which shows a great deal of variety in its form, size, texture, and degree of foliation. It is generally a biotite-granite, and occurs in two forms - a "Massive Granite" forming massifs and bosses, and a broad and foliated "Sheet Complex" type. These granitic rocks occupy large areas on the southwestern side of the Aravalli range obliterating part of the western portion of the Delhi synclinorium in the south. Ideal exposures of the granites are recorded in Palanpur, Idar, Sirohi

Beawar, Jaipur and Alwar. Mount Abu forms a large batholith of this granite.

Malani Igneous Suite

A still younger acidic igneous phase is represented in fairly vast exposures of Malani rhyolites in Jodhpur. The rocks consist of layers of rhyolite and ash beds with subordinate porphyries and felsites. These overlie the Aravallis and lie below the Vindhyan sandstones, and are of early Vindhyan age. Jalor and Siwana granites perhaps represent the intrusive equivalents of Malanis.

Mafic Rocks

The various mafic and ultramafic rocks occuring in the different parts of Rajasthan and N. Gujarat, could be assigned to the following three main phases:

3. Post-Erinpura granite,
2. Delhi and post-Delhi (but pre-Erinpura),
1. Aravalli and post-Aravalli.

The earliest occurences of mafic rocks are of Aravalli age and consist of scattered patches and lenses of hornblende schists and amphibolites. These metamorphosed mafic rocks related to the Aravalli

orogeny (Aravalli and post-Aravalli) are much more developed in S.W. Rajasthan and N. Gujarat. As compared to mafic, the ultramafic rocks of Aravalli age are better developed. Talc serpentine rocks are abundantly recorded from the neighbourhood of Kherwara, Rakhabdev and Dungarpur. In N. Gujarat too, similar rocks occur near village Shamlaji.

The mafic rocks of Delhi and post-Delhi age are seen to occur in the phyllites of Aravalli system as well as in the schists and calcic rocks of Ajabgarhs (Delhi). In their present state, these mafic bodies can best be described as epidiorites and amphibolites, and are seen to consist of aggregates of green hornblende and partly altered plagioclase still preserving coarse ophitic texture. Some of these mafic rocks appear to have been involved in the Delhi folding, while others indicate their post-folding emplacement. This igneous phase shows widespread development in Ambaji area of N. Gujarat.

The third mafic igneous phase belongs to a date later than the Erinpura granite. Igneous bodies belonging to this phase cut through the Aravallis, Delhis and Erinpura granite. Narrow dykes and thin

veins of fine-grained olivine bearing dolerites and basalts are widely distributed in various parts of Rajasthan and N. Gujarat.

Geochronology

The broad geochronological succession established in Rajasthan by Sarkar, et al. (1964, p.9) is given below in million years on the basis of all available data and regional geotectonic consideration:

Vindhyan	...	< 600 m.y.
Malani	...	600-783 m.y.
Delhi	...	734-844 m.y.
Raialo		
Aravalli	...	953-1020 m.y.

PREVIOUS WORK ON IDAR AREA

The study area forms a part of the regions worked by Middlemiss (1921) and Heron and Ghosh (1938). Except these workers no one has surveyed the area. Middlemiss (1921) under the Geological Survey of India, first visited the then Idar State during the years 1907 to 1914. He mapped most of the area within the limits of the Idar State and his field work led him to identify two main rock systems - Aravallis and Delhis underlain by stand-stones and traps of Cretaceous time. He gave the following list of formations:

Soil, blown sand, scree accumulations, river gravels, alluvium with Kankar and Kaolin deposits	Recent
Laterite and Deccan Trap (not actually visible in the described area but seen on the southern margin) Ahmednagar (Himatnagar) sandstone series - the probable equivalent of the Umia of Cutch-Drangdra Freestone of N.E. Kathiawar, and Songir Sandstone of Baroda	Cretaceous
Phyllite Series - with vein quartz ...	Purana?
Delhi quartzite Series - spranigly intruded by Aplite veins, Quartz-porphyry and with magnesian phase (Dolomite, Steatite, and Serpentine) at certain localities...	Purana?
Aravalli System - consisting of Calc-gneiss, Biotite-gneiss, Amphibolites, Mundeti Series, Muscovite-Biotite-Schists, Hornblende schists and Gneiss-freely intruded by Aplite veins, Quartz veins, and massive stocks of Idar granite and Quartz-porphyry and rare basic dykes...	Upper Archaean?

Subsequent mapping by Heron and his associates in the neighbouring areas considerably modified the findings of Middlemiss. Heron and Ghosh (1938) revised

the sequence of metamorphic rocks established by Middlemiss. Phyllite-Series of Purana age is now considered to belong to Aravalli System and the Delhi quartzites of Middlemiss are found to correspond partly with Aravallis and partly with Alwar quartzites of Delhi. As regards the age of the granites, Middlemiss assigned them post-Erinpura but pre-Vindhyan age and correlated the granitic rocks of Idar with Jalor and Siwana granites of Malani age. He also considered that the mafic rocks of Idar are younger than granites correlating them with the olivine dolerites of Jalor which cut Jalor granites and rhyolites. Heron and Ghosh (1938, p.386) however found that the Idar granites of Middlemiss were continuous with Erinpura granite and belonged to this post-Delhi granitic activity only. Thus these granitic rocks of Idar are in fact of Erinpura age. Heron and Ghosh recommended altogether dropping of the term Idar granite and they suggested that the granitic rocks equivalent to the Jalor and Siwana, should be called Malani.

The succession worked out by Heron and Ghosh (1938, p.369) and generally considered valid for the area is as under:

Alluvium, blown sand, river gravels.....Recent

INTRUSIVE

Olivine-dolerite and basalt dykes
Oligoclase-dolerite dykes
Gabbro and dolerite plugs .....Malani
Erinpura granite and pegmatites
Epidiorites and hornblende-schists

Phyllites		
Limestones		
Calc-gneisses	Ajabgarh series	Delhi system
Calc-schists		
Phyllites and biotite schists		
Quartzites ..... (Missing, but developed in adjacent areas)	Alwar series	

Mica-schists and composite gneisses.....Aravalli system

Though the interpretations of Middlemiss on Idar area have been radically modified by Heron and Ghosh, yet his account of the Idar rocks is still an important and valuable source of information. His mapping and detailed discussion of the various exposures, merit highest praise, and in the present study, the author has considerably derived from the work of Middlemiss.