CHAPTER 1

INTRODUCTION

The Lunavada Group of Aravalli rocks occupying large area in the northeastern part of Gujarat State have remained practically uninvestigated. Forming the southeastern flank of the *Aravalli Mountain Belt* (AMB), a major part of this region surprisingly did not attract much attention either by the Geological Survey of India (G.S.I) or by other workers. Although Gupta and Mukherjee (1938) mapped the area, their account more or less comprised a generalized description of the rock types. However, they prepared an excellent geological map ideally showing the complex outcrop pattern of the quartzite ridges. But, they somehow did not elaborate the structure of the area. Their map so obviously shows a complex pattern clearly pointing to a deformational history consisting of more than one fold event with different geometries. It is rather intriguing why this important aspect did not attract attention of subsequent workers, when the Pre-Cambrians of Rajasthan were studied in great detail by a succession of workers. Although the area around Kadana dam site was briefly investigated by Iqbaluddin (1989), the other parts of the region around Lunavada, Santrampur and north of Kadana did not receive any attention. It is therefore ironical that whereas a wealth of information on the Aravallis of Rajasthan is now available, so little has been done to investigate these Aravalli rocks of Gujarat though they are so promising while looking at the satellite imageries and topographical maps of Survey of India. A perusal of the map of Gupta and Mukherjee (1938) and also the work of the Geological Survey of India in areas to the north of Lunavada makes the point very clear that the Pre-Cambrian rocks of

Lunavada area have preserved within them such elements in respect of lithology, metamorphism and deformation which could prove vital to the proper understanding of the Aravalli rocks to the east of the Delhi belt. Numerous questions remain unanswered and it will not be an exaggeration to state that the deformational history of the Pre-Cambrian rocks of Gujarat till this date remains unravelled. It is with this background that a detailed study of the Lunavada Pre-Cambrians was taken up by the present author with a view to work out the sequence of deformational events and fold interference patterns and hence understand the mechanisms of deformation. Prompted by the excellent map prepared by Gupta and Mukherjee (1938), the present author took up investigation on the Lunavada Pre-Cambrian rocks in a 900 sq. km area around Lunavada, Santrampur and Kadana in Panchmahal district, Gujarat (Survey of India Topographical Sheets No. 46 E/12, 46E/15 and 46 E/16). Fig. 1.1 shows the location of the study area. The study emphasises on the structural geology, fold history, deformational mechanisms and related metamorphic aspects. Subsequent chapters of this thesis present details of the author's investigations.

1.1. TOPOGRAPHY

The study area forms southern part of the Aravalli Mountain Belt (AMB) that extends from southern Rajasthan in north to Mainland Gujarat in the south. It comprises a much eroded peneplain and presents a diversified terrain consisting of rocky hills, long straight or sinuous ridges alternating with narrow valleys or flat alluvial plains. Topographical variations are direct reflections of the lithological differences of the constituent rocks. The valleys and plains are mainly occupied by

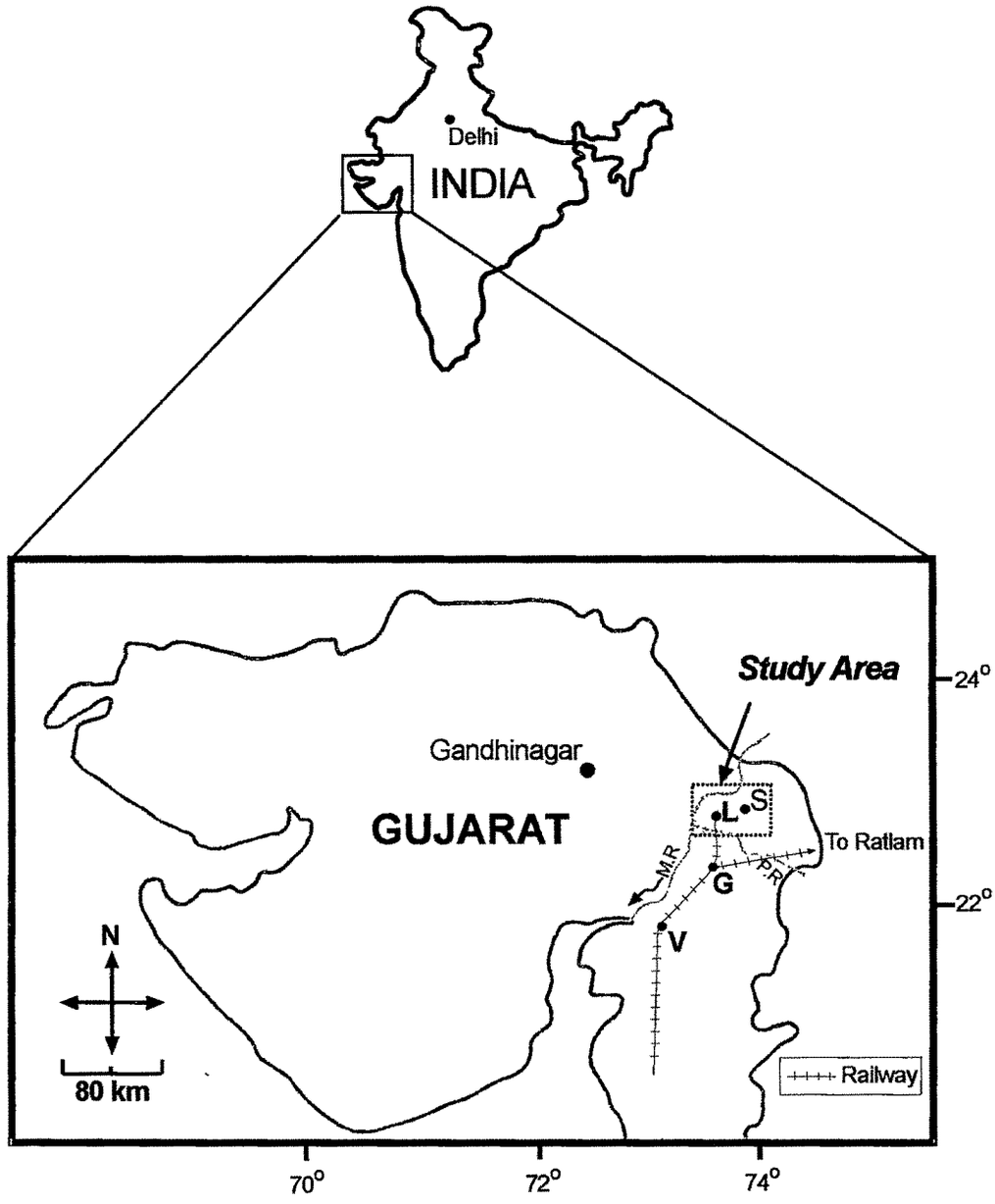

Fig. 1.1. Location map of the study area. L is Lunavada; S is Santrampur; G is Godhra V is Vadodara; M.R is Mahi river; P.R is Panam river.

softer rocks like chlorite schists and mica schists prone to be eroded rapidly and buried under a soil cover whereas the quartzites associated with the mica schists and chlorite schists withstand the weathering better because of their superior hardness and thus form steep narrow ridges. The highest ridge in the study area is 281 m which lies 8 km S of Santrampur.

1.2. DRAINAGE

Mahi is the largest river of the study area. It rises from the Malwa hills (northeast of the study area) and thereafter crossing the Rajasthan State it enters Gujarat and flows through Santrampur, Lunavada and Godhra talukas of the Panchmahal district in Gujarat and then enters Kaira district ultimately debouching into the Gulf of Cambay. Panam, Khatlaer, Anas, Sukhi and Chibota are the important tributaries and subtributaries of the Mahi. The Panam river rises in the territory of Madhya Pradesh and enters the Panchmahal district of Gujarat near the village Limadia of Limkheda taluka. It courses largely through forests and hilly tracts and merges into the Mahi river near Verama village in Lunavada taluka (i.e. west of Lunavada town). It passes through Devgadh Baria, Limkheda, Godhra, Santrampur, Shehera and Lunavada talukas of the Panchmahal district. The stream Chibota originates from Surpur village of Santrampur taluka and flows past Surpur, Pichhoda, Garia, Umber and Santrampur villages and meets Khatlaer river near Santrampur town. The Suki river starts from the village Vansia of Jhalod taluka. It flows past several villages of Santrampur and meets the Khatlaer at Santrampur. The Khatlaer originates at the confluence of Suki and Chibota in Santrampur and meets the Mahi at Paniyar.

1.3. FLORA

Major part of the forests occupy flat and gently undulating areas at the foot of the hills along the lower slopes of the hills, and in the valleys, supports crop of teak type trees ranging between quality classes III (average height 0.6-12 m) and IV (average height < 6 m). The main associates of teak are Sadad (*Terminalia tomentosa*), Shisham (*Dalbergia latifolia*), Khair (*Acacia cutechu*), Timru (*Diospyros melanoxylon*), Mahuda (*Bassia latifolia*), Dhavdo (*Angeissus latifolia*), Rohan (*Soymida febrifuge*), Khakhar (*Butea monosperma*), Kalam (*Mitragyna parvifolia*), *Bondaro (Lagerstroemia parviflora*), Bili (*Aegle marmelos*), Bor (*Zizyphus mauritiana*), Moina (*Lanea coromandeliea*), and Shivan (*Gmelina arborea*). Some bushes of Kado (*Holarrhena antidysentrica*), Awal (*Cassia auriculata*), Puwad (*Cassia tora*), and Sadi (*Nyctanthes arbor-tristis*) are common. Bamboo (*Dendrocalamus strictus*) is also a present. Besides these some medicinal plants like *Bombusa vulgaris*, *Tectona grandis*, *Daedalacanthus roseus*, *Morus indica*, *Morus alba* and *Erythina indica* are common around Santrampur.

1.4. FAUNA

Oxen, cows, buffaloes, donkeys, horses, goats, sheep and camels are the most common domestic animals of the region. The Panther-*Panthera pardus* (Linnaeus) (*Dipdo*), Blue Bull-*Boselaphus tragocamenlus* (Pallas) (*Nilgai*), Wild Boar-*Sus scrofa* (Linnaeus) (*Dukkar*), The Indian Porcupine-*Hystrix Indica* (Kerr) (*Shahudi*), Indian Hare-*Lepus nigricollis* (F.Cuiver) (*Saslu*), Small Indian Mongoose-*Herpestes auropunctatus* (Hodgson) (*Noliyo*), Jackal-*Canis aureus* (Linnaeus)

(*Shial*) and Chital or Spotted Deer-*Axis axis* (Erxleben) (*Haran*) are some of the common wild animals reported from the region.

Snakes are also observed in several parts of the region. Poisonous as well as non-poisonous varieties have been reported. Indian Python-(*Python molurus*) (*Ajgar*), The Rat Snake-(*Ptyas mueusus*) (*Dhamam*), The Common Wolf Snake-(*Lycodon aulicus*) (*Suvarpankhu*), The Common Blind Snake-(*Typhlops braminus*) are some of the non-posonous varieties and The Cobra-(*Naja naja*) (*Nag*), The Common Krait-(*Bungarus caeruleus*) (*Konotaro*), Russell's Viper-(*Vipera russelli*) (*Chital*) are the poisonous varieties of snakes.

Prominent birds are The Central Indian Redvented Bulbul-*Pycsonotus cafer humayuni* (Deignam), The Tailor Bird-*Orthotomus sutorius guzurata* (Latham), Grey Jungle fowl-*Gallus sonnerati* (Temm), The Large Indian *Parakeet-Psittacula eupatria nipalensis* (Hodgson), The Common Hawk-Cuckoo or Brainfever Bird-*Cuculus varius varius* (Vahl), The Grey Hornbill-*Tockus birostris* (Scopoli), The Large Green Barbet or Coppersmith-*Megalaima zeylanicus inornata* (Walden), The Golden-backed Woodpecker-*Dinopium benghalense benghalense* (Linnaeus), The Pied Kingfisher-*Ceryle rudis leucomelanura* (Reichenbach), The Central Indian Iora-*Aegithina tiphia humei* (Stuart Baker), The Indian Magpie Robin or Dhayal-*Copsychus saularis saularis* (Latham), The Malabar Racket-tailed Drongo-*Dicrurus paradiseus malabaricus* (Latham) and The Indian Sarus Crane-*Grus antigone antigone* (Linnaeus).

1.5. AGRICULTURE

Rice, wheat, jowar, bajri, maize, ragi, barley, tur, gram, sugarcane, potatoes, chillies, groundnuts, cotton, tobacco, sesamum (Til), castorseed, uduad, mag, peas and rape seed are the important agricultural crops of the area.

1.6. COMMUNICATION

The area is approachable by the road as well as by train. Highway from Delhi to Mumbai passing through Lunavada is the easiest way to approach the study area. Besides, the region can also be reached with the railway network Mumbai Central-Vadodara-Godhra-Delhi (broad gauge) and Godhra-Lunavada (narrow gauge).

1.7.SCOPE OF STUDY

The present study was undertaken with the aim of unraveling the deformational history of the Pre-Cambrian rocks of the Lunavada region and to understand the deformational mechanisms that were active during the tectonic evolution of the rocks. It incorporates field and laboratory studies. The following techniques and methods have been applied to understand the structural and tectonic evolution of the Pre-Cambrian rocks of Lunavada region.

1. Field work was carried out to record the planar and linear structural elements.
2. Structural analysis of the field data was done to determine the total number of episodes of deformation, the fold interference pattern and the orientations of the fold axes of the different fold events.

3. Petrography and microstructural studies from thin sections of the rocks were carried out to understand the relationship between deformation and metamorphic crystallization of various minerals, the genesis of microstructures such as crenulation cleavages and to decipher the mechanisms of deformation on the microscale.
4. Anisotropy of Magnetic Susceptibility (AMS) of the rocks was measured to understand the orientation of the magnetic ellipsoid which was correlated with the structural geology of the area.
5. Electron microprobe analysis of selected minerals present in the metapelites were made to understand (a) composition of the different minerals present, (b) zoning pattern in garnets and (c) Pressure-Temperature conditions of metamorphism.
6. Microthermometry and Raman microspectroscopy of fluid inclusions was carried out to evaluate the fluids present during metamorphism and to understand the thermal history of the rocks.