Chapter 1

INTRODUCTION

The knowledge on the assembly, evolution and dispersal of landmasses is one of the fundamental aspects for understanding the continental dynamism and evolutionary history of the earth. The information related to different geological processes, operated within individual continental block in a particular geological time span also provide valuable signatures to know the cyclic phenomena of supercontinents. The sufficient imprints of geological, geochemical and geochronological and tectonometamorphic events are preserved in the various super continental cycles. These data would be useful in furnishing the evolutionary models of cratonic blocks as well as the correlation of their characters. Apart from this, these evidences may be effectively used for bridging the gaps between cratonic blocks and the super continents.

Precambrian shields of the world would have been the nerve centre for the global research and are meticulously studies by several workers to decipher the early history of the earth. The formation of the supracrustal rocks or first landmass, is in fact an irreversible process in the geological history of earth, which led the processes of initiation of stabilization, continental growth and micro-continent and supra-continental development. The peninsular India is known as one of the prominent Precambrian shield of the world, and is exposed in the south of the Son Narmada lineament. Rogers et. al., 1986 divided the peninsular shield into five distinct crustal areas viz. Bhandara, Singhbhum, Aravalli, Eastern Ghats and Dharwar granulite terrain. Later on they divided the Indian shield into several cratons (Radhakrishna 1989) viz. Eastern Dharwar, Western Dharwar, Bastar, Singhbhum and Bundelkhand-Arvallie. Each craton was perhaps characterized by a central part known as nucleus which is consisting of extensive outcrop of granite-gneisses and granitoids and is separated by a mobile belt. The core parts of these cratons are commonly associated with a sequence of metamorphosed rocks of green schist and amphibolite facies. These metamorphic sequences are mainly represented by common features such as the presence of ultramafic and mafic volcanism with wide occurrences of banded
magnetite quartz (BMQ) and chert formation. The granite appears as great batholithic massifs in all the cratonic blocks in Indian shield viz. closepet granite in the Dharwar, Singhbhum granite in the eastern region, the Bastar granite and Dongargarh granite in the Central India, the Untala, Berach and Gingla granite in Rajasthan and Bundelkhand granitoids in Bundelkhand craton. The granitoids were found as acidic intrusive in respective cratons. The relationship of widely exposed older granitoids with the ‘Schistose’ formation (metasedimentary and metavolcanic rocks) is a matter of petrological and geochemical interest for exploring the earlier crustal history of earth from these cratons.

The Bundelkhand massif occurs in the northern part of the Indian peninsular shield lies between the 24° 11’ to 24° 27’ latitude and 78° 10’ to 81° 34’ longitude which covers the area about 3600 sq. km. and is the 10% of central India. The entire massif is dominated by batholiths of acidic magmatism. The schists and banded iron formation from Baraitha basin of the southern part of massif was first reported by Medlicott in 1859. Subsequently, Mallet (1869) reported granite gneisses in the massif. Later on, Mathur (1954), Saxena (1961), Prakash et al., (1975), Mishra and Sharma (1974), Mishra (1975), Basu (1986), Sarkar et al., (1996), Shukla and Pati (1999), Prasad et al., (1999), Mondal et al., (2002), Malviya et al., (2006), Singh et al., (2007) and several workers have recognized various type of schist and gneisses as lensoidal bodies within the granitic massif. Singh and Dwedi (in press) have deduced the metamorphic history of high grade gneisses and suggested clock wise path for the crustal evolution of oldest gneisses of Bundelkhand craton.

The Bouger anomaly map of India (NGRI, Hyderabad, GPH/5, 1975) shows steep gravity gradient near the southern contact of the Bundelkhand granite massif with Bijawar and Vindhyan. It envisaged that there might be a sympathetic development of rifting along the Son-Narmada lineament. The northern part of Bundelkhand craton is covered by the Ganga-Yamuna alluvium that exhibits a very gentle gravity gradient. Sharma (2000) suggested that E-W trend of gneisses foliation in the Bundelkhand massif may continues westward and possibly joins with the Berach granite of Rajasthan before truncated by the NE-SW Aravalli and Delhi trend. The recent researches (Singh 2007, Basu 2007) suggest that Bundelkhand massifs is
fringed by Bijawar/Gwalior group of late Paleo-Proterozoic in two sectors and by the Vindhyan Supergroup of Meso to Neo Proterozoic period almost all around and has no continuity with BGC rocks of Aravalli.

The signature of several stages of crustal growth for the Archean of Bundelkhand is well preserved. Tonalite-Trondhjemite-Granodiorite (TTG) gneisses, forming one of the oldest rocks in the massif have been reported from several localities (Mondal et al 2008) but extensive occurrences are mainly in the central part of the massif. The rocks have been studied from different locations and have provided signature of Archean crustal evolution. The high-grade (BnGC) and low grade metamorphic (BMM) rocks trending in NW-SE and WNW-ESE respectively suggests two distinct phases of metamorphism in Bundelkhand (Singh et al., 2005). The field relations indicate an older age for the high grade metamorphic (BnGC) in comparison to the low grade BMM. The most extensively widespread occurrences of Bundelkhand Granitoids have been found intrusive relationship with both BnGC and BMM.

The NE-SW trending series of short and long shear zones occupied by quartz reef are unique in the Bundelkhand craton and are represented by NE-SW trending quartz reefs that may be related to the result of drags of Son Narmada sinisterly mega fault and rebound of the resultant collision of the Bundelkhand carton with the Aravalli craton. The NW-SE trending swarms of the mafic dykes possibly related to opening of the Bijawar basin mark the end of the magmatism in Bundelkhand. Coeval marks of crustal evolution in the Bundelkhand and Aravalli areas point to their close connection during the Precambrian crustal evolution. The griddle like combined Bijawar-Vindhyan basin around the granitic massif also points to their possible inherent linkage. The crustal evolution and magmatic activities in Bundelkhand in the light of recent researches are poorly known whereas the significant researches have been carried out on these objectives in Singhbhum, Bastar, Rajasthan and Dharwar cratons. Many geologists worked out the geochemistry and tectonothermal activity in these cratons. Mondal et al., (1998) and Sharma (2000) first time discussed a geodynamic evolution model for the Bundelkhand craton with limited geochemical and geochronological data of granites, gneisses and other associated rocks. Attempts
have also been made to unravel the tectonic evolution of the Bundelkhand craton on the basis of structural data of quartz reef, granitoids and associated rocks in the shear zones (Roday et al., 1995, Prasad et al., 1999). The recent researches (Sarkar et al., 1996, Basu 2001, Mondal et al., 2002, Rao et al., 2005) about evolution of Bundelkhand craton were based primarily on the acid magmatic evolution and geochronological data (Sarkar et al., 1996, Mondal et al., 1998, 2002) of the Tonalite-Trondjemite-Granodiorite (TTG), gneisses, granitoids and the mafic dykes only.

The junction between the early Proterozoic magmatic terrains of Bundelkhand and the northern part of peninsular shield is marked by central Indian tectonic zone (CITZ)). This view was firstly proposed by Yadekar et al., (1990) and suggested that the two ancient cratonic blocks represented by Bundelkhand protocontinent and Deccan protocontinent were separated by a narrow intra cratonic discontinuity basin, which can be marked by the central Indian shear zone (CIS). The current view of research is also growing the consensus on Son Narmada lineament that represents an ancient suture for the collision of Northern and Southern Indian shield (Archarya 2003). The lineament witness the repeated rejuvenation in geological past and continue to do so even today (Jokhan Ram et al., 1996, Acharya 2003). Thus Northern part of Indian shield may be considered as separate blocks that may include Bundelkhand, Aravalli and the Himalayas which were delineated amalgamated and welded by different mobile belts in the extra peninsula (Sharma 2000).

Bundelkhand craton is separated by three major faults viz. NW-SE trending Yamuna fault in the north, the NE-SW trending Great Boundary Fault in the west and ENE-WSW trending Son Narmada fault in the south. Besides these major dislocation boundaries of the Bundelkhand massif, the craton represents the several intra cratonic faults viz. Shivrupi Kalpi fault, Sawai Madhopur- Damoh fault and Nogaon Panna faults that may be related to different tectonic activity. These faults are also visible on the satellite imagery. The southern margin of craton is overlain by sedimentary of Vindhyan and they are also delineated by various NE-SW trending dextral faults viz. Ratlam-Basoda Narsingarh fault, Damoh fault, Kota fault and Shivrupi fault. The detailed geomorphological and Landsat imagery studies points three important lineaments viz. Kalpi-Shivrupi shear zone (KSS), Mohar Mauranipur Mahoba shear
(MMS) and Sonrai Shahgarh shear zone in the massif part of Bundelkhand craton. The extension of these shear zones were not found to continue in the Vindhyan sediments/ Bijawar and therefore, they are the Pre Vindhyan/Pre-Bijawar architects and must be part of Archean paleoproterozoic tectonics. The present study area is the eastern part of this zone where gneisses and granitoids have some distinct pattern.

1.1 LOCATION AND APPROACH OF THE JHANSI:

The study area belong to the northern part of the Bundelkhand lies between 78° 25'E to 79° 10' E longitudes and 25° 10' N to 25° 20' N latitudes in Mahoba district. The detail geological and structural mapping were carried on enlarge toposheet No. 54O/15 of survey of India. The Mahoba town can be easily approached as it is situated on the branch line of Jhansi - Allahabad railway line. Mahoba can also be arrived by the Jhansi Banda-Calcutta national highway road and is about 40 km east to Jhansi.

1.2 CLIMATE AND VEGETATION:

The Bundelkhand region exhibits a particular type of climate and is characterized by excessive heat during the summer months and chilled cold during the winter month. Thus the Bundelkhand falls under arid climate. The temperature rises upto the 50° C in May and June. The hot winds, locally known as “loo” is common in this period. The rainfall distribution pattern is irregular. Most of the rainfall is caused by the mansoon, falling from June to October in the region. The annual precipitation in Bundelkhand varies from 90cm to 100cm. The maximum rain occurs in the July to August months.

Northwestern area of the Bundelkhand region receive nearly 90cm while in southern area receives 120cm. There is scant winter rainfall in this region. April to November is the driest month of the year. The mean monthly temperature has been recorded as 45.7° C while the peak maximum temperature of 50° C in the May to June. The lowest temperature of 3° C recorded at the month of January. The soil of the region is generally found shallow to medium depth attaining a thickness ranging from a few cms to as much as 15 cms. The thickness of soil section is variable and
contains mixture of residual and transported soil. The Bundelkhand region different types of soils are present, reddish soils, grayish black soil and yellowish black soil locally known as rakar, parwa, mar and kabar soil respectively but the reddish rakar soil is characteristic of this region.

1.3 FLORA AND FAUNA :

The flora of the Bundelkhand region belongs to climatic condition of this region. The flora of the region is tendu, mango, timber, neem, macca, barged, palash, babool, peepal etc. The wood of the semal and mango tree are used for matchsticks, tendu for the pipe making, gum is also extracted from babool tree and the khair for preparing for katha, neem leaves are used for preparing medicine and sope industries. The therapeutic plant such as raljia, sprintine and usaka are used in blood pressure, hypertension and lung problems. The wheate, pulses, rice, groundnut are the main crop of this region. The wheat is grown in the October to March month. The Rice is grown in rainy season.

The fauna of the Bundelkhand are present as lion, elephant, bear, cheetal, neelgai, leopard, jackal, fox, rabbit, goat, monkey etc and also birds like crow, vulture, neelkhanth, eagle, koyal, parrot, peacock, duck etc.

1.4 AIM AND SCOPE OF THE WORK :

Detail account of geological work, field work, and laboratory work have been carried out under present studies as follows.

(i) A detailed geological mapping on the enlarged toposheet (No. 540/15) has been carried out and the emphasis is given to the older rock sequences found as lensiodal of biotite gneisses and tonalitic gneisses (TTG) etc with in the granitoids .

(ii) A detailed structural mapping at the contact of tonalitic gneisses has also been done and lineament study along with drainage system map prepared.

(iii) Based on the available radiometric data and the regional works on structural and geological data, a tectonothemal events and has been proposed for Bundelkhand and study area.
(iv) On the basis of satellite imaginary, the lineament and structural features of
the Bundelkhand area were examined with ground truth data obtained
during three years.

(v) The thin sections of different rocks of petrological interest were prepared
and their textural relationship and petrography of rocks with reference to
crystallization, deformation and time relationship were carried out to
describe the tectonic crystallization history of the rocks.

(vi) The fluid inclusion study for granite, gneisses, quartz reef were carried out
to find out nature and composition of fluid during the evolution and
continental growth. Its application is also used to deduced the tectonic
history of the area and genesis of rocks.

(vii) On the basis of textural study the metamorphic reaction involved in the
formation of different mineral parageneses were discussed through
graphical presentation and a chemogrphic relationship in the different
system of ACF, AKF, and AFM diagrams have been deduced in the
CFMASH, KFMASH, NCKFMASH systems.

vii. On the basis of petrographical works and their field relationship the 29
rock samples of petrological interest were submitted for chemical analyses.
The chemical analysis data portrayed in different models and varian
diagram for major and trace elements suggest the petrogenesis, tectonic
environment and crustal evolution of rocks developed during the different
events around the Mahoba area in the Mid Archean time.

viii. Geochemistry of the gneisses and granite were used to evaluate the nature
composition and possible tectonic environment responsible for the
continental crust in Archean period. On the basis of generated geochemical
data, and available field evidences as well as in laboratory works, an
attempt were made to describe the petrogenic evolutionary and tectonic
phases of the Bundelkhand cratonic rocks.