GEOLOGICAL SETTING

3.1. GENERAL

Rocks of the study area mainly belong to the Precambrians consisting of granitic- and pelitic - gneissic rocks, dolomitic limestones /calc-silicate rocks and intrusive granites. The earlier authors have distinguished two major groups of rocks in this region;

1) Rocks belonging to *Champaner Fold Belt*, comprising quartzites, phyllites, impure dolomitic limestones and calcsilicate rocks. These rocks have undergone low-grade (Greenschist Facies) metamorphism.
2) Unclassified granites and granitic- and pelitic- gneisses

The former was termed as *Champaner Series* by Blanford, (1869) and subsequently modified as *Champaner Group* by Heron (1934); whereas the unclassified granite and granite gneiss was termed as *Banded Gneissic Complex (**BGC**)* by Heron (1934). Gopalan et al (1979) dated the intrusive granite of the area and gave an age of 955±20 M.a. and it was termed as *Godhra Granite*. Gupta et al (1992), however, did not distinguish between the intrusive granite and granite gneiss of the area. Later Gopinath et al (1977) described gneissic rocks of the area around Chhota Udepur as *Lower Champaner Gneissic Suites*. Subsequently Das and Srikarni (1999), has described the detailed diastrophic structures of the Granite Gneiss and placed it as the oldest Precambrian unit of Gujarat.

There are patches of Lameta Beds (Upper Cretaceous) and dykes of Deccan Trap (Cretaceous-Eocene age). However, emphasis of the study is given mainly on the study of Pre-Champaner Gneisses, which occupy about 70% of the study area. In the present study the author has considered three main stratigraphic units of the Precambrian rocks in this region which are namely;

1. Pre-Champaner Gneisses, 2. Champaner Group and 3. Godhra granite.

3.2. DESCRIPTION OF ROCK TYPES

3.2.1. Pre-Champaner Gneisses

The Pre-Champaner Gneisses mainly comprise two major components; 1) Granite Gneiss and 2) Pelitic gneiss, with minor amount schists and micaceous/ ferruginous quartzite component. The granite gneiss occupy about 65% area of are Pre-Champaner Gneisses ***(PCG)*** whereas the pelitic gneiss, schists and quartzite occupy the rest 35%.

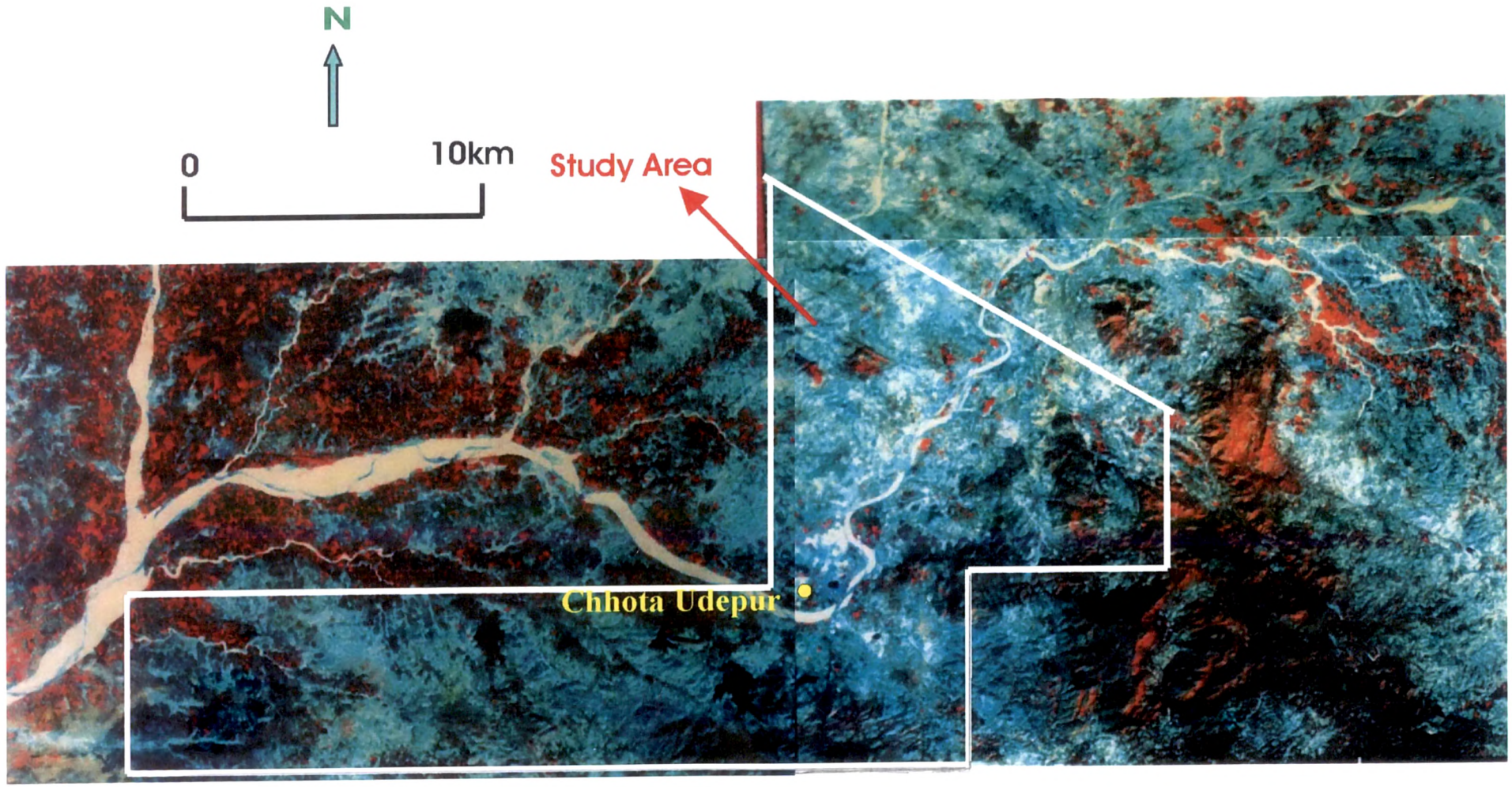


Fig.3.1a Satellite Imagery (LISS-III) of the study Area

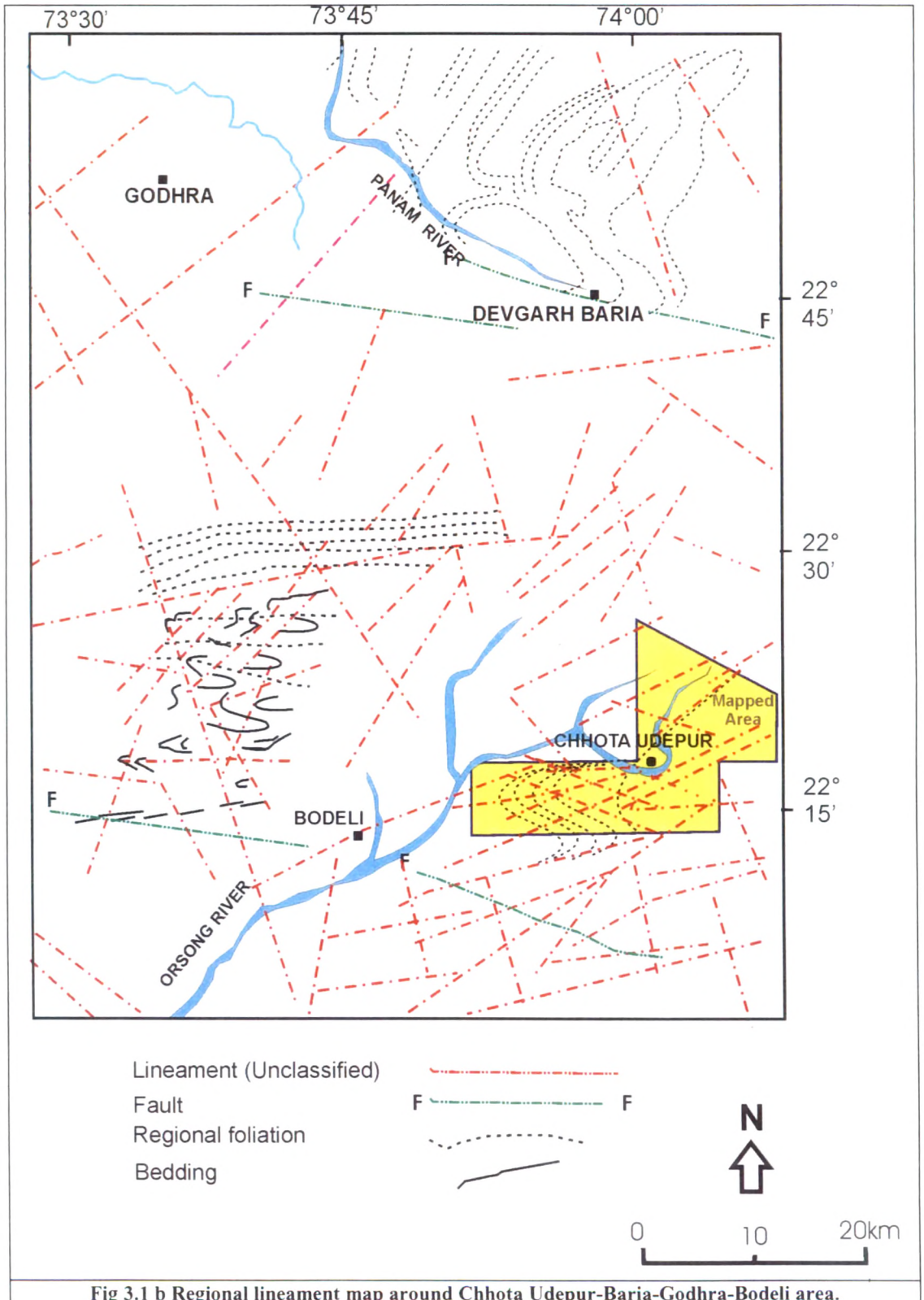


Fig 3.1 b Regional lineament map around Chhota Udepur-Baria-Godhra-Bodeli area.

Although the outcrops of schists and quartzites are small for structural analysis they play an important role. The dominant gneissic suites of rocks are deformed by successive episodes of folding accompanied by metamorphic events that have been given rise to mineralogical and textural changes.

Based on the results of study of Landsite imageries (**Fig 3.1 a**) and aerial photos a lineament map has been prepared (**Fig 3.1 b**) and the geological map (**Fig 3.2**) with structural details has been mapped on 1:50,000 scale for 350 sq km area. A broad outcrop pattern of the region can be sketched as given below;

1) There are detached quartzite ridges within Pre-Champaner Gneiss, which stand out prominently within granite gneiss (e.g. Luni area) and within intrusive Godhra Granite (e.g. Goidia area).
2) Arcuate ridges of pelitic gneisses associated with minor schists stand out within granite gneiss of Pre-Champaner Gneisses.
3) Flat low lying crystalline limestone terrain belongs to Champaner Group that occurs as triangular exposures occupying about 75 sq km area in parts of toposheets 46 J/3 and 46 F/15 in the eastern part above granite gneiss (Fig. 3.2).

The exposures of Deccan Traps and Lameta Beds (Upper Cretaceous) are too meagre to be accounted. Stratigraphic relationship between the granite gneiss of Pre Champaner Gneiss and the crystalline limestone of Champaner Group is based on the structural discordance between the two, as seen in Manka and Gabdia near Chhota-Udepur (**Fig 3.2.a**). The angular unconformity between the two is best recorded near Poyali, which, however, falls outside of the area under study. At this place basal conglomerate and quartzite of Champaner Group rest over the Gneisses of Pre Champaners.

Depending on the abundance as recorded in the field different lithounits have been described chronologically.

A. Granite Gneiss
B. Pelitic Gneiss
C. Pelitic Schist
D. Manganiferous and Ferruginous quartzite
E. Micaceous quartzite.
F. Quartz veins and pegmatite Veins.

A. Granite Gneiss

Granite gneiss is exposed in the northeastern fringe of the study area (north of Deohat) and is continuously exposed from Runwad in the northeast to Kasum in the southwest through Vagtaldungar, Manka, Gabdia, Nalej, Singla, Deola, Bordha, Pratappura and Chokadi villages. The rock is generally exposed along the undulatory terrain forming irregular ridges to the east near Chhota Udepur, Singla, Deola, Gondarya

villages, but towards west it gradually forms low topographic flat terrain. In some of the hills the strongly foliated rocks show dip slope as well as escarpment slope (particularly around Singla and Deola villages). Variable degrees of weathering are exhibited by this lithology. Of the hills of Vagtaldungar, the 317m peak is made up of granite gneiss. The rock is strongly foliated, deformed, pink coloured (where fresh) with variable amount of dark mineral like biotite and magnetite. Mineralogically it is quartz and K-feldspar rich (microcline), with minor amount of plagioclase. Biotite and muscovite are occurring in variable amount. However, in most of the places biotite dominates over muscovite. Around Runwad, Gondarya and Chokadi muscovite, magnetite and occasionally garnet are present.

B. Pelitic Gneiss

Pelitic gneiss mainly comprises quartz-muscovite gneiss with occasional patches of quartz-biotite gneiss. This unit forms hilly outcrop in the south-western part and occurs within relatively flat granite gneiss terrain. Because of high amount of quartz the rock is less weathered and about 20% of the study area is occupied by quartz-muscovite (± feldspar) gneiss around the following villages; Chokadi, Bordha, Maghigam, Konchya and Koiwav. The rock is dominantly composed of quartz, muscovite, and variable amount of microcline, albitic plagioclase, biotite and magnetite. Both gneissic and schistose texture are exhibited by this rock.

C. Pelitic Schists

The pelitic schists are of two types:

1). Kyanite- muscovite schist and 2). Biotite schist.

The former occurs near Wawadi as lenticular patches. It grades into quartz-muscovite gneiss. In hand specimen fresh broken rock is milky white in colour and is very hard. The folded weathered surface shows distinct mineral lineation defined by needles / blades of 1cm to 3cm long bluish kyanite crystals on quartz, muscovite and feldspar dominated grey- white mass. These idiomorphic crystals of kyanite show distinct mineral lineation. The latter is common around Longami and in the easternmost part of Gujarat border near Moti Sadli and Deohat. This rock is melanocratic, distinctly foliated and dominated by biotite, quartz and feldspar. At places it also comprises muscovite/sillimanite/garnet/cordierite in various proportion. In these places biotite schist can further be divided into different assemblages based on important pelitic mineral content. These assemblages are described in detail in petrographic section of Chapter 5.

D. Manganiferous and ferruginous quartzite

This rock occurs as bands within micaceous quartzite near Goidia within arcuate hill, particularly in the southwestern fringe of the hill. Lenses of dark coloured quartzite of 2 to 4 m width and tens of meters long bodies are seen cofolded with micaceous quartzites. This rock occurs as dark coloured mass with light yellow color bands.

E. Micaceous quartzite & banded hematite quartzite

Micaceous quartzite occurs within the hill of Guda, Wawadi, Konchya, Chowkadi, Wawadi and Luni. Muscovite and sericite make the quartzite fissile. These phyllosilicates are mainly aligned on regional schistosity. Micaceous as well as banded hematite quartzite with occasional manganese oxide is recorded in Goidia Hill.

F. Quartz Veins and pegmatite veins:

Numerous deformed quartz veins and pegmatite veins (5cm to 25cm thick) are seen along the major schistosity and gneissosity planes within quartz-muscovite gneiss and granite gneiss respectively. Boudins, pinch and swell structures are common in this rock. The Quartz veins are common around Majhigam, Wawadi and Konchya.

3.2.2. Champaner Group

Champaner group is represented by impure Limestone with some calcsilicate rocks in the study area and they are exposed in vast area to the north of Chhota Udepur and also as a separate linear body in the southeast of Chhota Udepur. There is a structural discordance between the Pre-Champaner Gneisses and the overlying Champaner Group.

3.2.3. Godhra Granite

Intrusive granitic rocks namely *Godhra Granite* occurs in the area northwest of Chhota Udepur. Veins and apophyses of the intrusive rocks are seen to have intruded into the Champaner Limestones and thereby has formed skarn zones. The Godhra granite shows high degree of weathering and form flat cultivated lands. Within the study area they are exposed mainly in the nala section and at places west of Chhota Udepur form bouldery exposures. Godhra Granite is broadly classified into two categories on the basis on structures and gross texture depicted in the field; foliated granite and nonfoliated porphyritic granite. These have been described in detail in chapter 7.

3.3. DESCRIPTION OF THE IMPORTANT SECTORS

In the study area stratigraphic interrelationship among the different units within Pre Champaner Gneiss could not be established, because all the units show similar structural

history and same lithology. Therefore, the author has attempted to describe the geology of areas sector wise on the basis of outcrop pattern and structural elements: 1) *Sector I-* Goidia –Barwada; 2) *Sector II-* Wawadi-Kasum; 3) *Sector III-* Luni; 4) *Sector IV* -Chhota Udepur- Vagtaldungar; 5) *Sector V* -Longami and 6) *Sector VI-* Moti Sadli.

Sector I- Goidia –Barwada: In this sector quartzite and conglomerate bearing arcuate ridge is exposed within intrusive granitic terrain. NW-SE trending ridge in Goidia-Barwada region consist of deformed autoclastic conglomerate, interbanded within ferruginous and manganiferous quartzite, micaceous quartzite. The conglomerate occurs in two distinctly separate bands of 40 - 60m thickness with formational contact across the ridge axis (**Fig 3.2.1**)

Sector II- Wawadi-Kasum: In this sector the paragneiss, schist and quartzite occur as crescentic ridge with a well-developed escarpment slope towards the west, which exposes the various deformation structure of the rocks. The main lithology is quartz-muscovite gneiss, which contains lenses quartzite and kyanite bearing muscovite schist having 250 m to 500m-strike length (**Fig 3.2.2**).

Sector III- Luni: A linear micaceous quartzite ridge stretching for 2 km forms and a sub parallel elliptical outcrop with a general NNE-SSW trend is exposed in this sector around Luni village. This body is exposed within granite gneiss (**Fig 3.2.3**).

Sector IV -Chhota Udepur- Vagtaldungar: Area to the east of Chhota Udepur town shows the relationship of granite gneiss with the intrusive Godhra Granite. The pink coloured granite gneiss of this area contains thin detached layers of quartzite in the form of rootless folds. The pegmatite veins are seen to have isoclinally folded at places. Apophyses and tongues of Godhra granite are recorded within this older granite gneiss (**Fig 3.2.4**).

Sector V -Longami:. Melanocratic Pre-Champaner Gneiss occurs within the calc-silicate and calcareous quartzite of Champaner Group which are cut across by foliated Godhra Granite (**Fig 3.2.5**)

Sector VI- Moti Sadli: The area around Moti Sadli comprises granite gneiss, paragneiss and schist of Pre-Champaners, crystalline limestone and calc-silicate rocks of Champaner Group and intrusive Godhra granite.

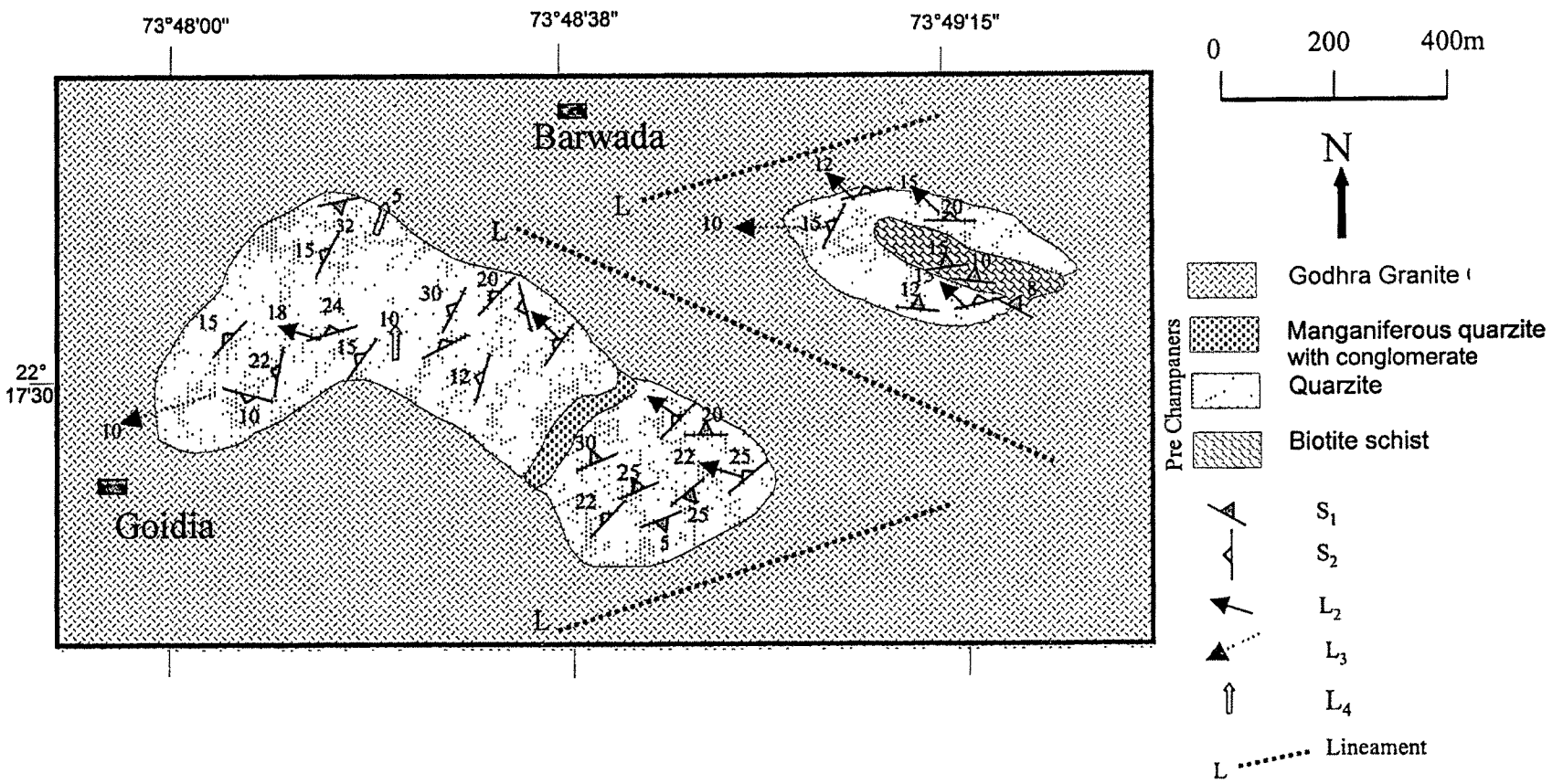
Structural complexity of the study area is revealed in the lineament pattern. Two sets of strong lineaments along WNW- ESE and WSW-ENE are present in the study area. The regional lineament pattern indicates that the NW-SE trending strong lineaments are the parasitic lineaments of the Rikabdeb Lineament, which divide the main Aravalli, fold belt and the Precambrians of Chhota Udepur -Alirajpur Region.

3.4. OVERVIEW

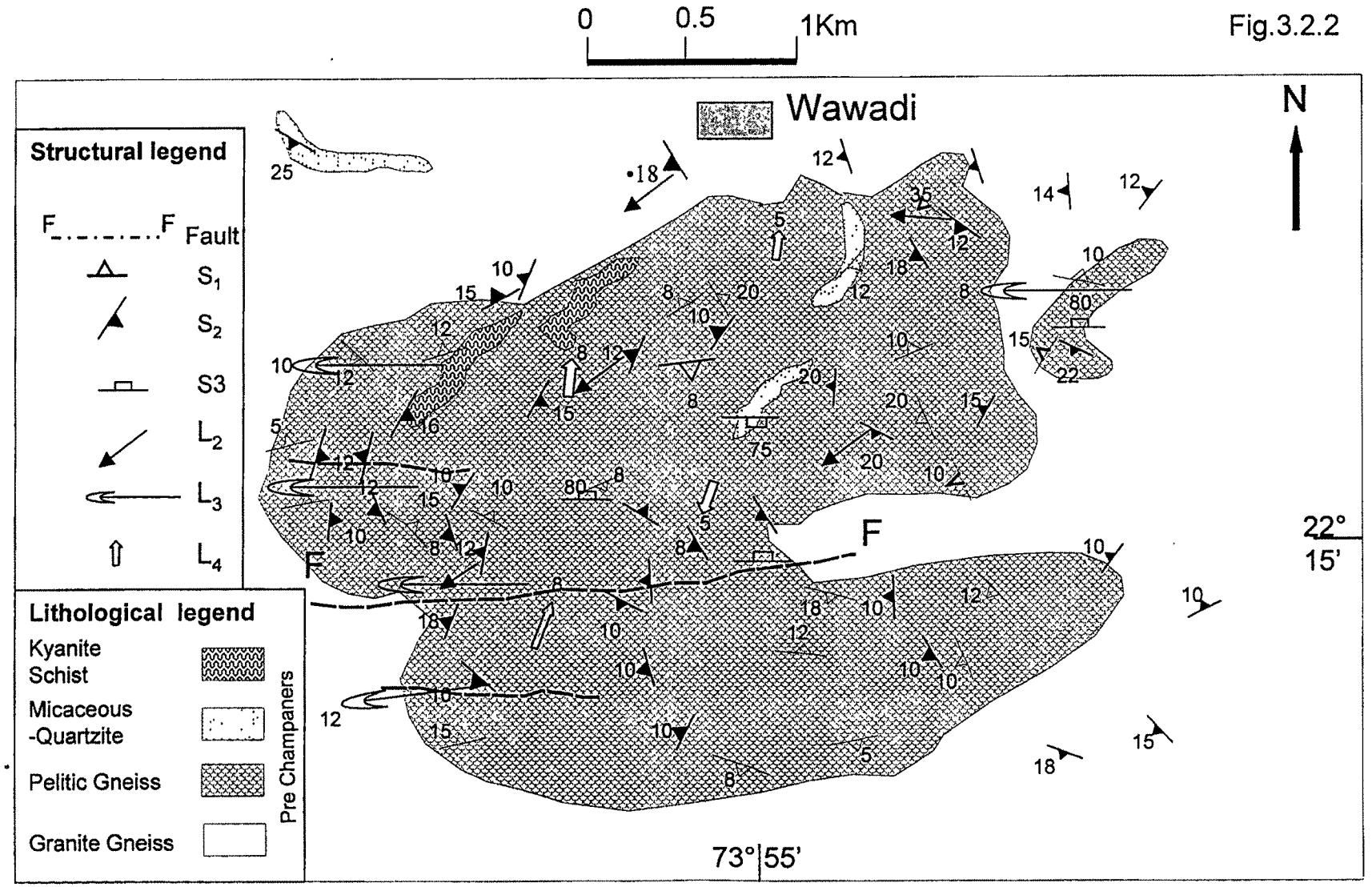
Description of the lithounits indicates that the area is dominated by deformed gneissic suite of rocks of 'Pre Champaner Gneisses which are mainly 1) granite gneisses and 2) metasedimentaries dominated by pelitic suits of rocks and quartzite. The Champaner group of rocks overlies this gneissic suite of rocks with an unconformity and is represented by crystalline limestones, calcsilicates and quartzites. The Pre-Champaner Gneisses occupy about 70% of the mapped area, whereas Chamapner Group covers about 20 % area and Godhra Granite occupies the rest, which show intrusive relationship with the former. The stratigraphic succession shown in the map (**Fig.3.2**) indicates a possible Palaeoproterozoic age for Pre-Champaner Gneisses, but detailed whole rock analysis can only give its exact age. Lithological units within Pre-Champaners are not put in stratigraphic order. Their mutual age relation is uncertain because of polyphase deformation.

Fig 3.2.1

Geological map of Goidia area, south-west of Chhota Udepur,Eastern Gujarat

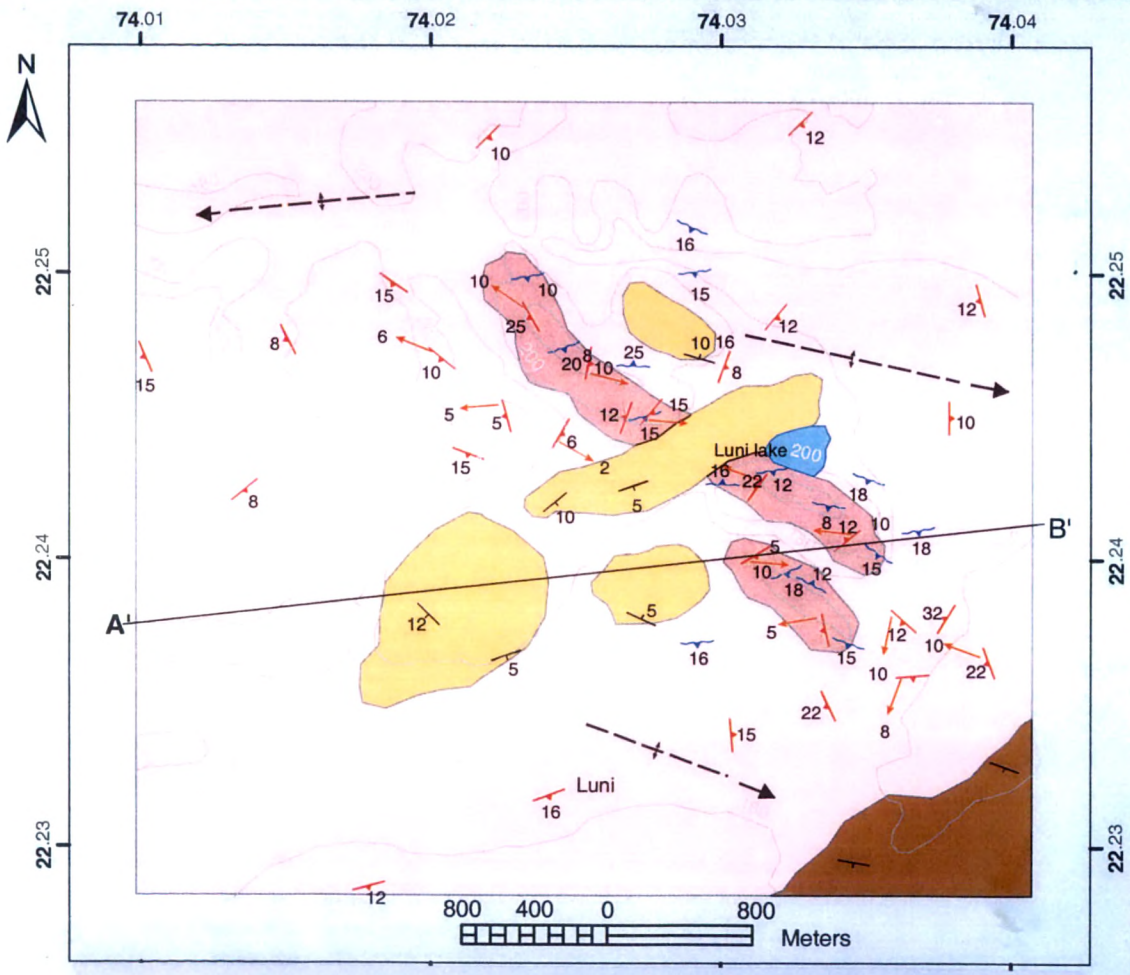


Geological map of Wawadi- Kasum area, south-west of Chhota Udepur, Eastern Gujarat



Geological Map of Luni area, South of Chhota Udepur, Eastern Gujarat

Fig 3.2.3



Legend

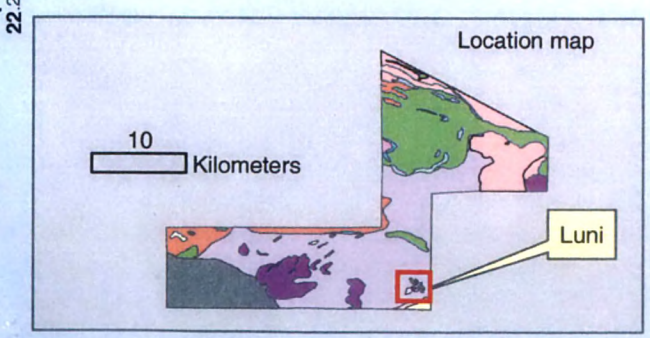
TOPOGRAPHY
- topographic contour(20m)
- lake

STRUCTURE
- F3 axial trace
- L3 punge direction
- L2 plunge direction
- S2 foliation
- S1 foliation
- S0 bedding

LITHOSTRATIGRAPHY

Group	*Lithology*
Deccan Traps	basic volcanic flow
Lameta	sandstone
Pre-Champaner Gneiss	micaceous quartzite
	granite gneiss

Mapped during 1999-2000,
data colecction density 200 nos. per sq. km
in average



GEOLOGICAL MAP AROUND CHHOTA- UDEPUR, EASTERN GUJARAT.

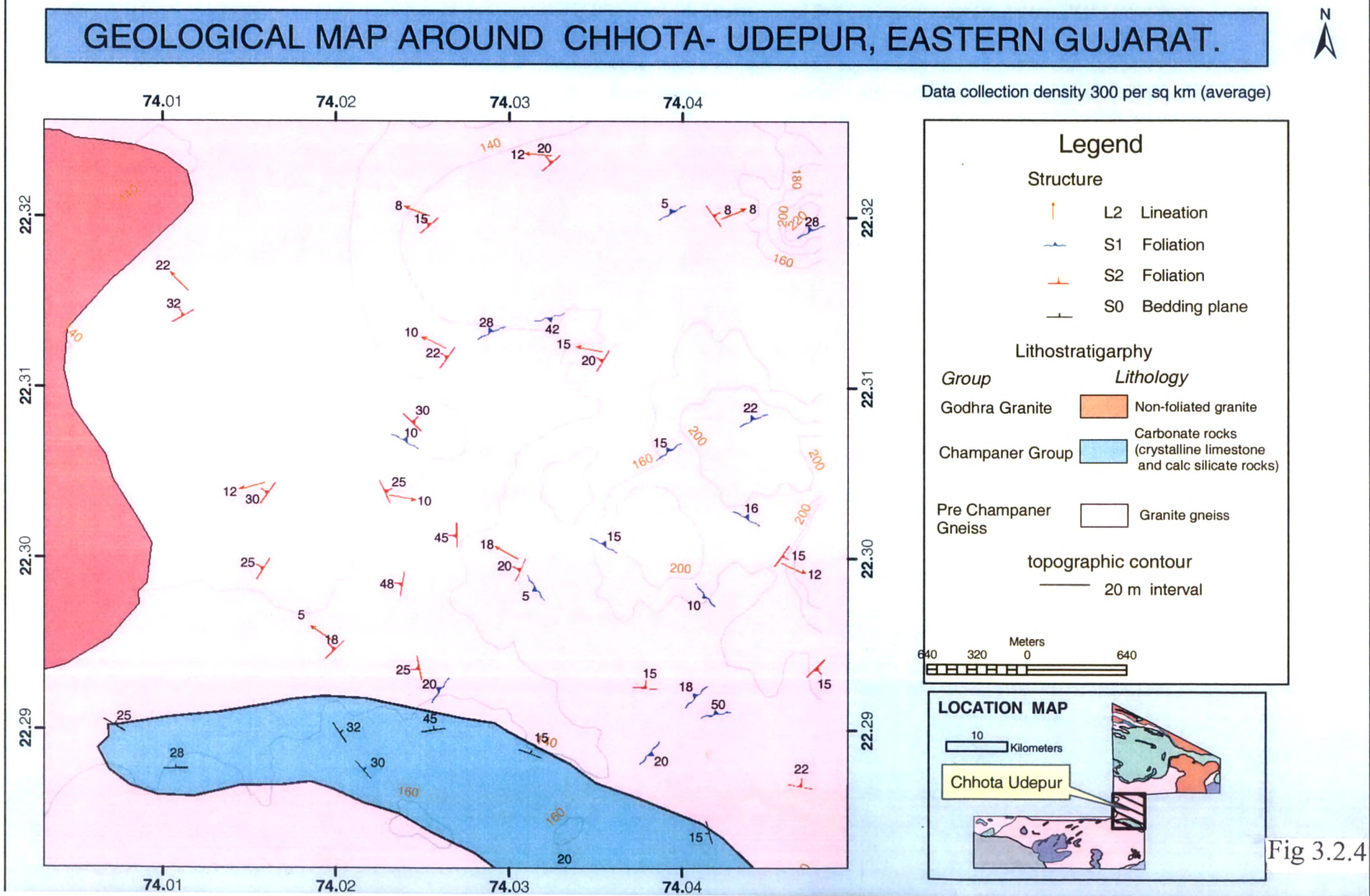


Fig 3.2.4

Geological map of Longami- Baroj area, north of Chhota Udepur, Eastern Gujarat

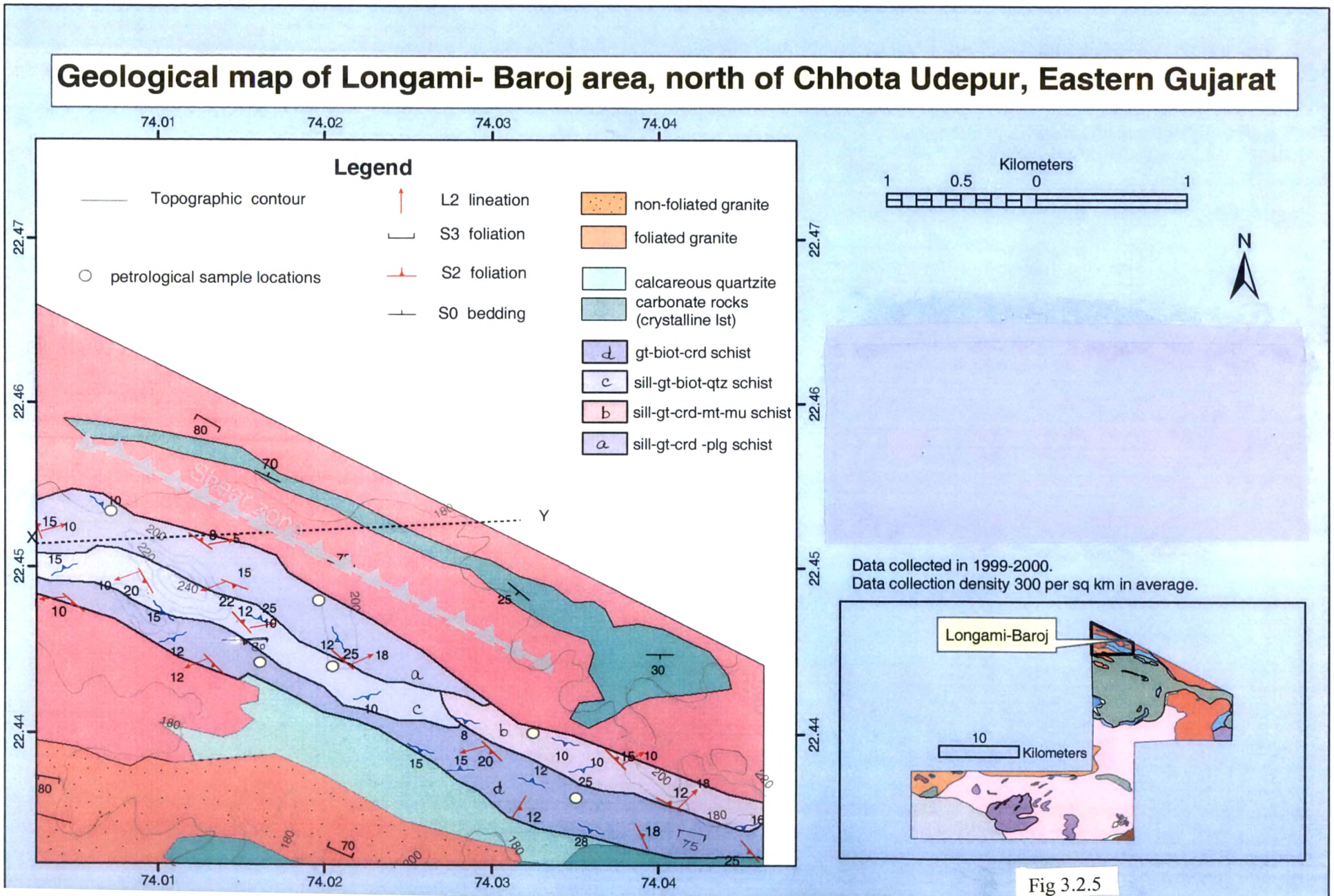


Fig 3.2.5