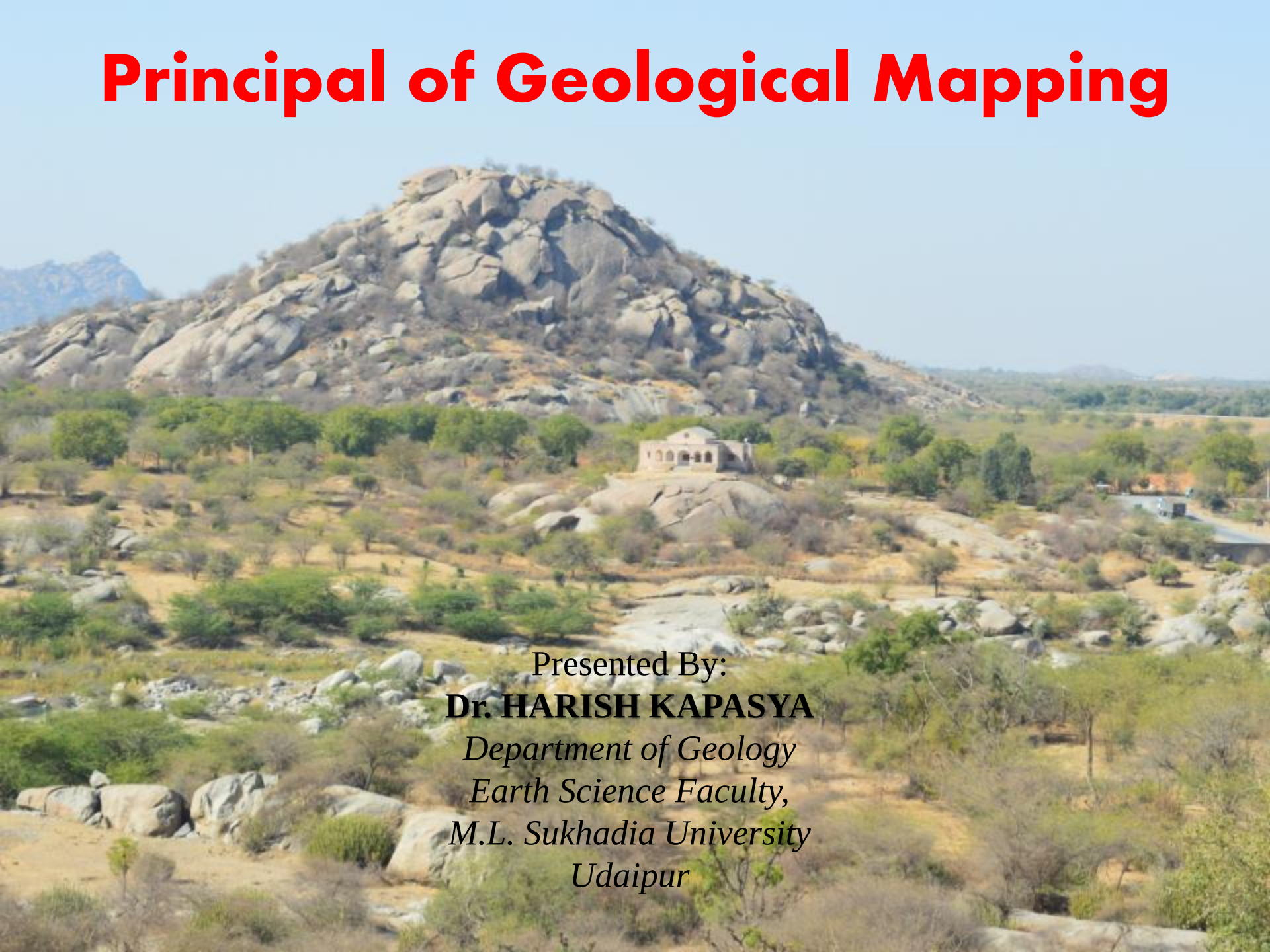
Principal of Geological Mapping



Presented By:

Dr. HARISH KAPASYA

Department of Geology

Earth Science Faculty,

M.L. Sukhadia University

Udaipur

Simply speaking structure is introduced in rocks by applied forces including the force of gravity

****

This is the reason why all the structures that develop in rocks after their formation are called secondary structures

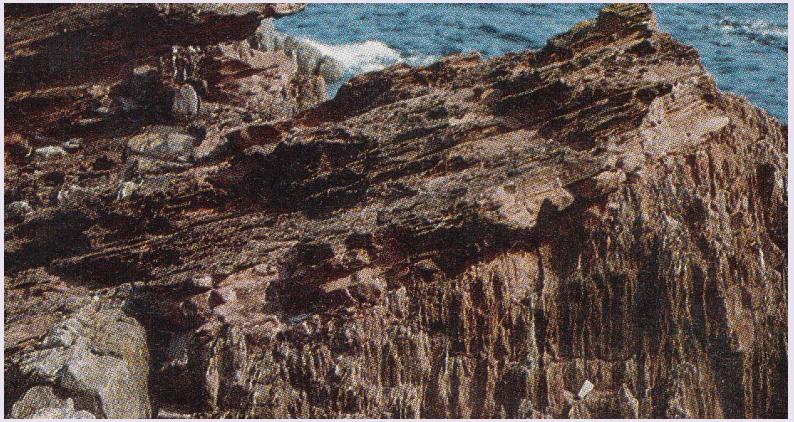
The introduced structure is a changed form resulting from deformation of an earlier feature like bedding

Original bedded form — horizontal layers →

Changed or deformed bedded layers →

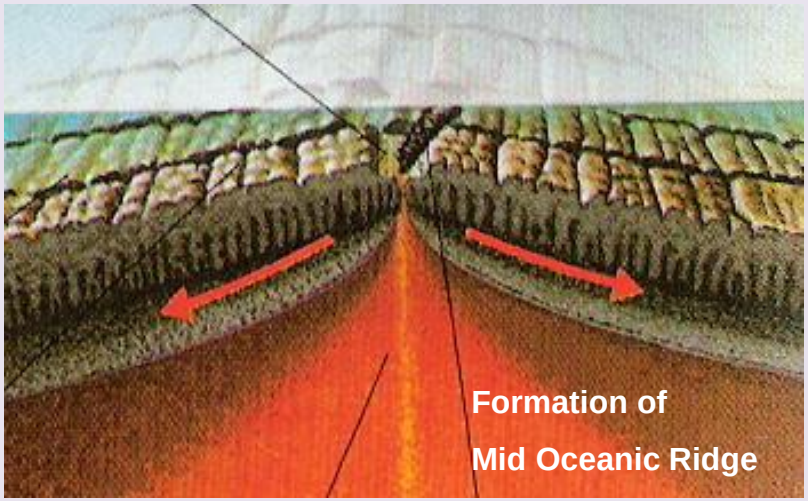
Structures need not only be from sedimentary bedded rocks

Igneous rocks forming between two sets of



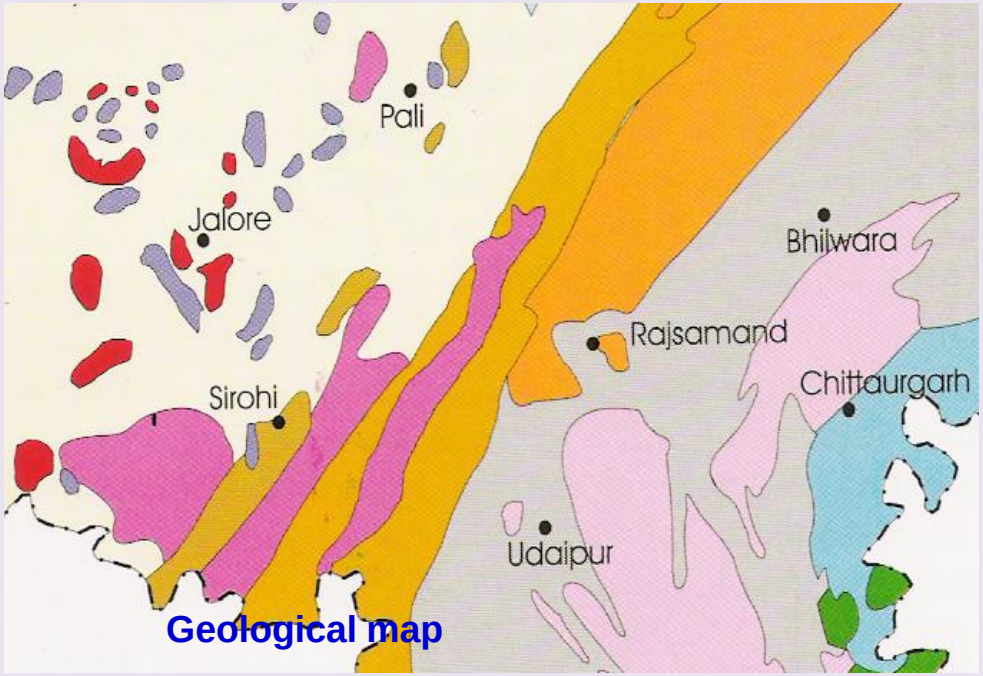
The relationships intrusive structures

beds are also a type structure

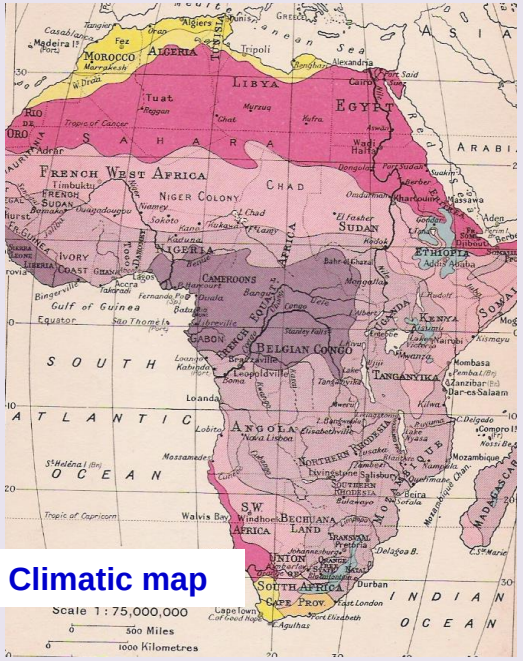


- **Tectonics is often thought a synonym of structure**
- **The term structure provides impression more of a geometry or form, while tectonics is concerned more about mechanism.**
- **In fact, tectonics has much wider significance**

A map is a scale down two dimensional representation of different parameters



Geological map



Climatic map

Geological map shows distribution of lithology In space

Climatic map shows distribution of climatic zones in space

Articles needed

- **Base map**
  1. **Survey of India toposheets**
  2. **High resolution Satellite imageries**
  3. **Aerial photographs**

- **Clinometer compass/Brunton Compass**

- **GPS is useful in a featureless country for the purpose of location only**

- **Other field accessories**

Toposheet

- Toposheet / GT Sheet is a short name of topographic map.
- Toposgraphic map is a plane sheet which shows topography of specific area and also man - made features such as roads, railways, settlements, canals, rivers, electric poles, post office etc.

The topographical maps of India are prepared on 1 : 10,00,000, 1 : 250,000, 1 : 1,25,000, 1 : 50,000 and 1: 25,000 scale providing a latitudinal and longitudinal coverage of 4° x 4°, 1° x 1°, 15' x 15' respectively.

These maps are prepared and published by the National Mapping Organisation of each country. For example, the Survey of India prepares the topographical maps in India for the entire country. The topographical maps are drawn in the form of series of maps at different scales.

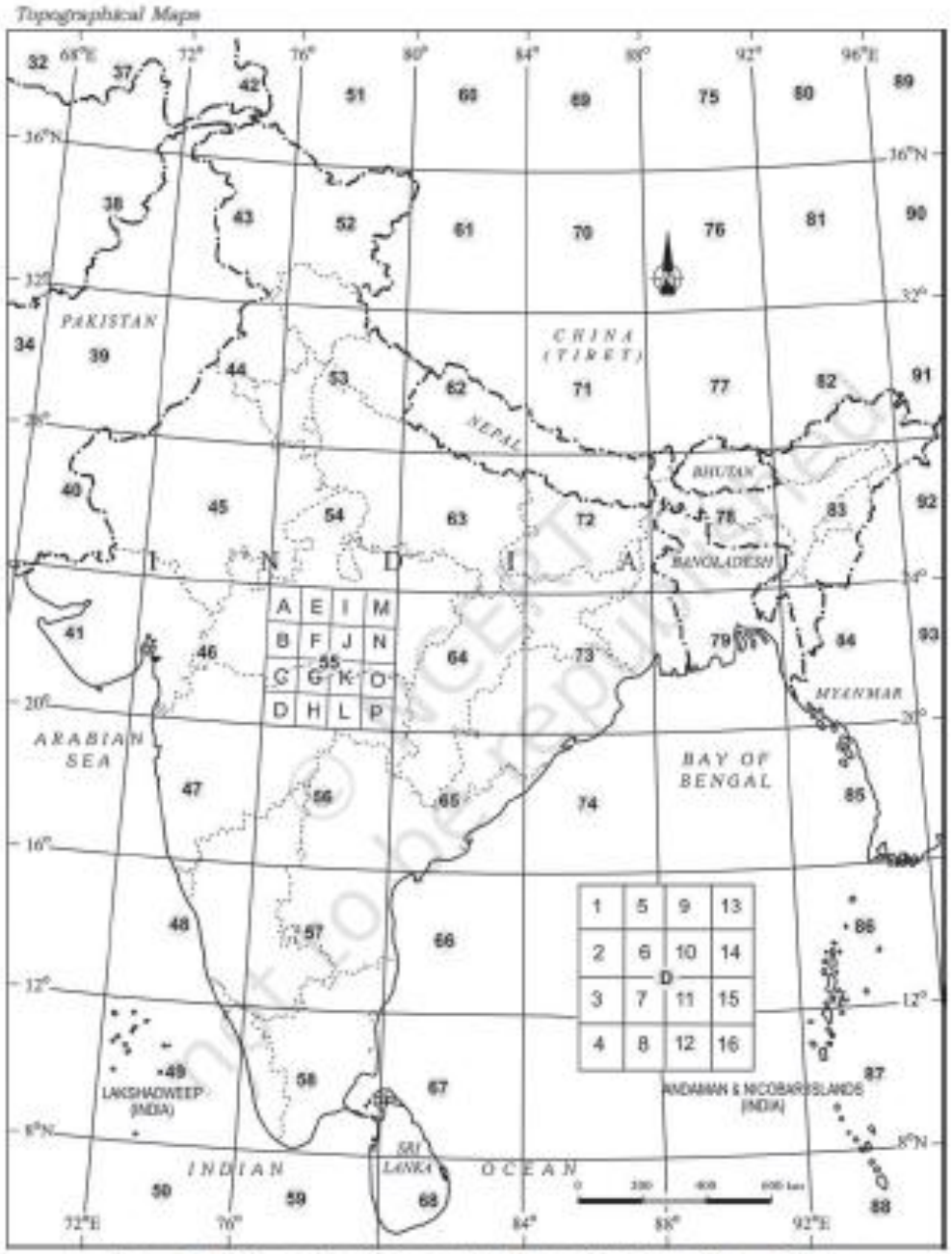


Figure 5.1 Reference Map of Topographical Sheets Published by Survey of India

International Map Series of the World:

Topographical Maps under International Map Series of the World are designed to produce standardised maps for the entire World on a scale of 1: 10,00,000 and 1:250,000.

Contours: Imaginary lines joining all the points of equal elevation or altitude above mean sea level. They are also called “level lines”.

Contour Interval: Interval between two successive contours. It is also known as vertical interval.

Some basic features of contour lines are

° A contour line is drawn to show places of equal heights.

° Contour lines and their shapes represent the height and slope or gradient of the landform.

° Closely spaced contours represent steep slopes while widely spaced contours represent gentle slope.

° When two or more contour lines merge with each other, they represent features of vertical slopes such as cliffs or waterfalls.

° Two contours of different elevation usually do not cross each other.

Types of slope

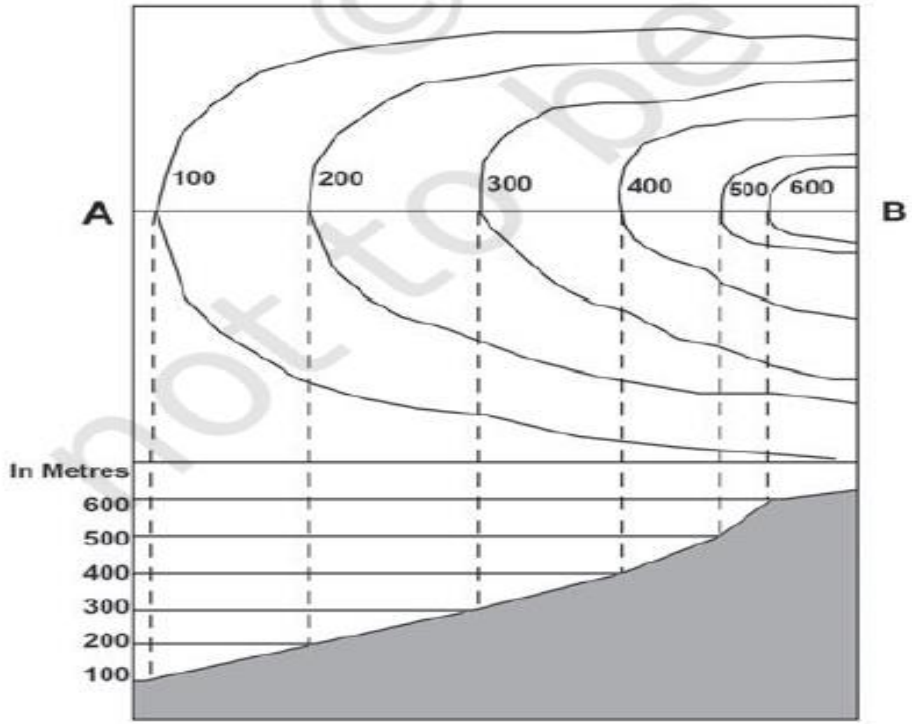
The slopes can broadly be classified into gentle, steep, concave, convex and irregular or undulating. The contours of different types of slopes show a distinct spacing pattern.

Gentle Slope

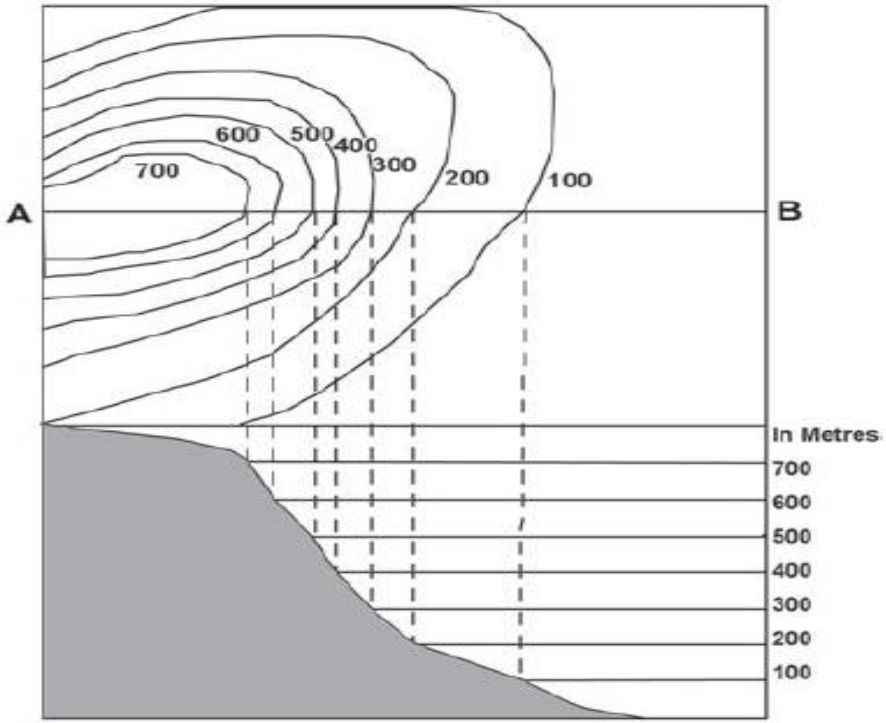
When the degree or angle of slope of a feature is very low, the slope will be gentle. The contours representing this type of slope are far apart.

Steep Slope

When the degree or angle of slope of a feature is high and the contours are closely spaced, they indicate steep slope.



Gentle Slope



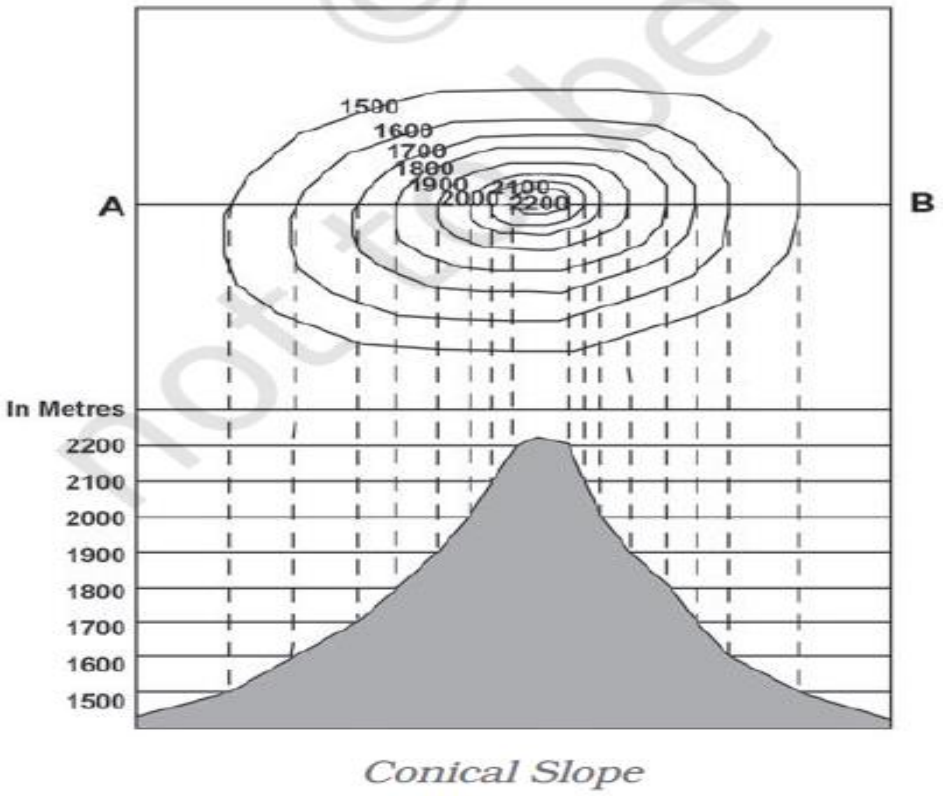
Steep Slope

Conical Hill

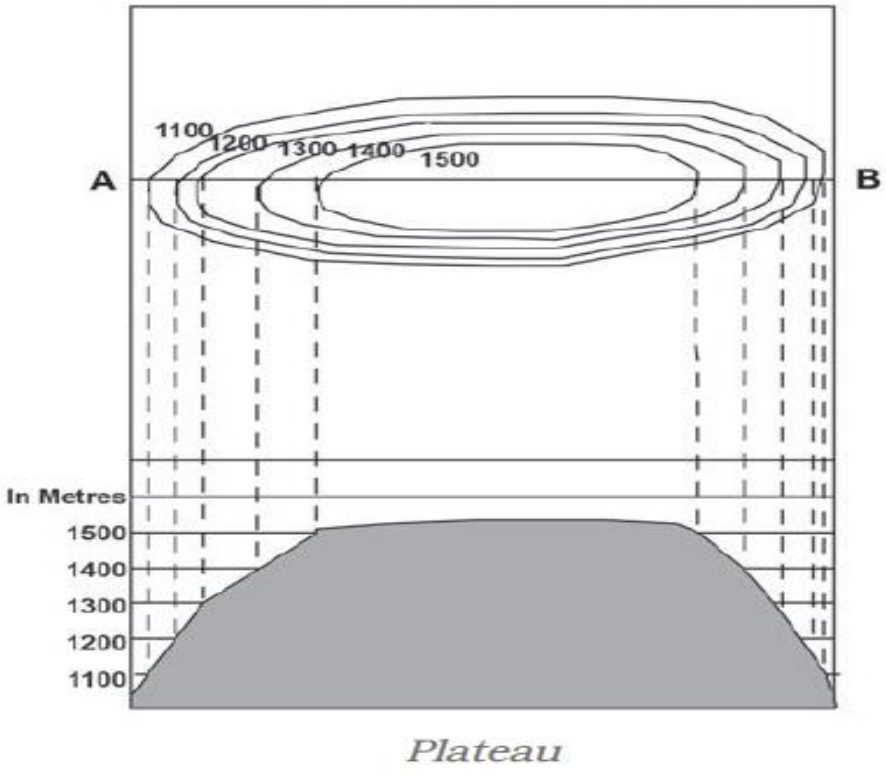
It rises almost uniformly from the surrounding land. A conical hill with uniform slope and narrow top is represented by concentric contours spaced almost at regular intervals.

Plateau

A widely stretched flat–topped high land, with relatively steeper slopes, rising above the adjoining plain or sea is called a plateau. The contour lines representing a plateau are normally close spaced at the margins with the innermost contour showing wide gap between its two sides.



Conical Slope



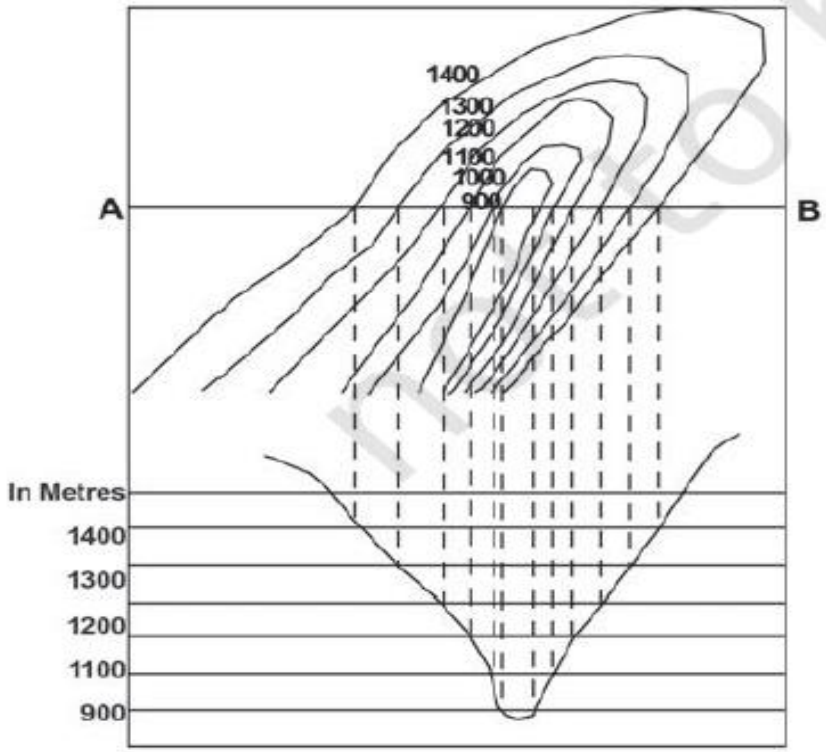
Plateau

‘V’-shaped Valley

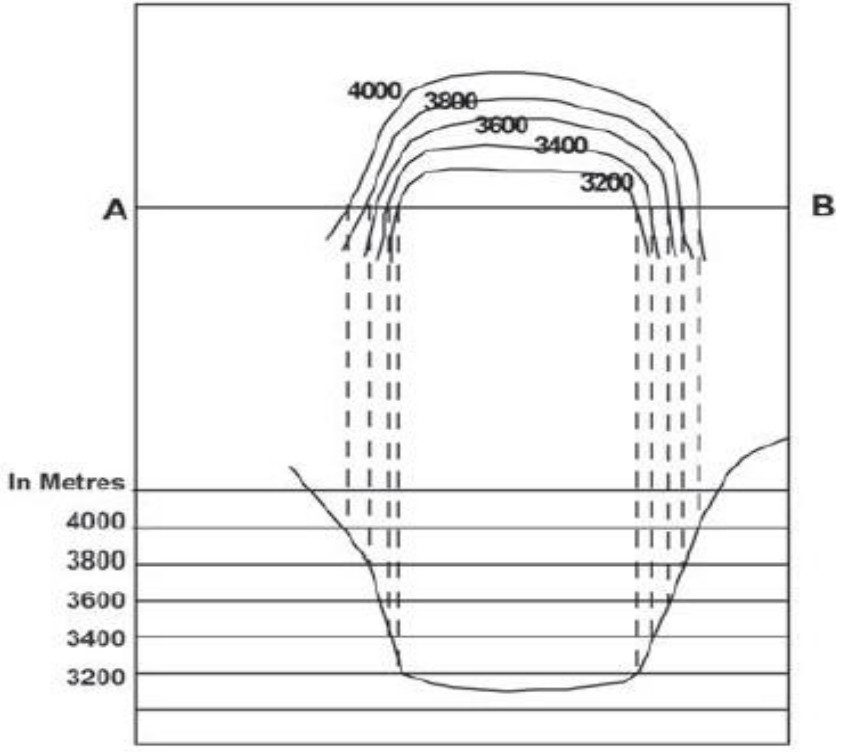
It resembles the letter V. A V-shaped valley occurs in mountainous areas. The lowermost part of the V–shaped valley is shown by the innermost contour line with very small gap between its two sides and the lowest value of the contour is assigned to it. The contour value increases with uniform intervals for all other contour lines outward.

‘U’ – shaped Valley

A U–shaped valley is formed by strong lateral erosion of glaciers at high altitudes. The flat wide bottom and steep sides makes it resemble the letter ‘U’. The lowermost part of the U–shaped valley is shown by the innermost contour line with a wide gap between its two sides. The contour value increases with uniform intervals for all other contour lines outward.



V-Shaped Valley



U-Shaped Valley

Scale of mapping

- Scale of mapping is important & to be determined before the start of the work

- Scale may vary from 1:50,000 to 1:1000 (or less), depending on the necessity of the work

- Large scale mapping (i.e., small RF ratios) is usually Surveyor supported.

Four different methods are used for geological mapping

- Contact tracing
- Outcrop mapping
- Traverse mapping (using grid pattern)
- Traverse mapping (using irregular tracts)

****

Actual methodology depends on the nature of outcrop, terrain, and purpose of study

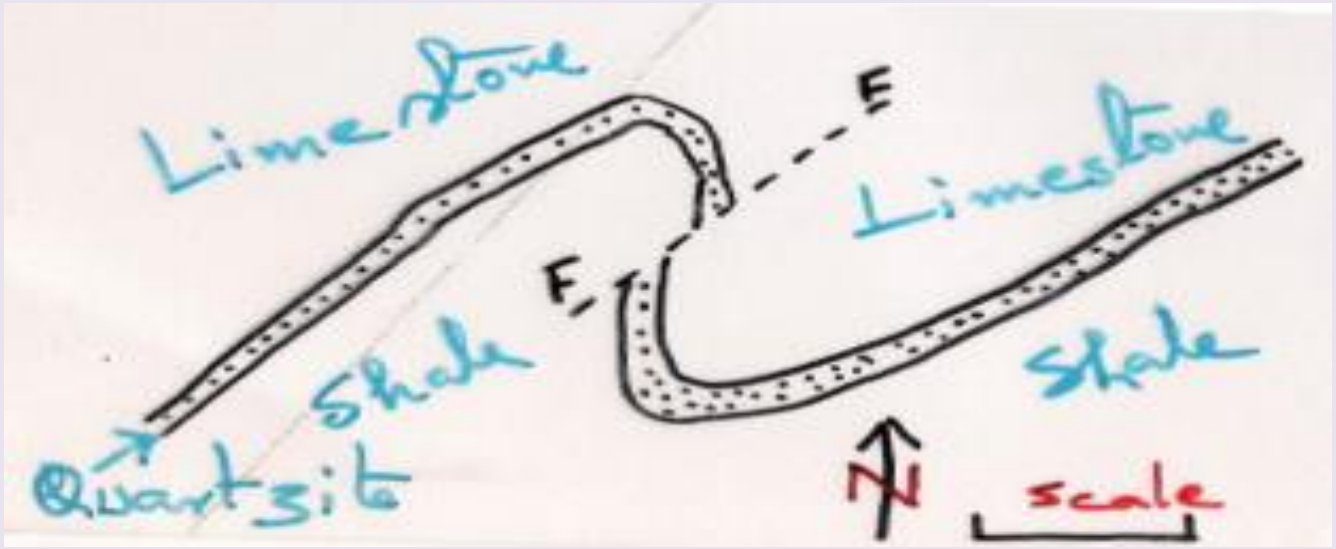
Contact Tracing Method / Contact Mapping

- Method adopted where rocks are well exposed such as in Aravalli Supergroup, Delhi Supergroup, Sirohi Group, Satpura hills.
- A contact between two different lithology is picked up by moving across the strike and mapping/ tracing is along the contact.

- Contact, if any complexion – fold, fault, intrusion or any other, will come in front. So is marked for original surface / bedding plane.
- S_1, S_2, S_3, S_4 for deformed surfaces, such as cleavage planes.

Contact tracing method

is used where rocks can be traced continuously & effect of topography is minimum. Fault is drawn through extrapolation



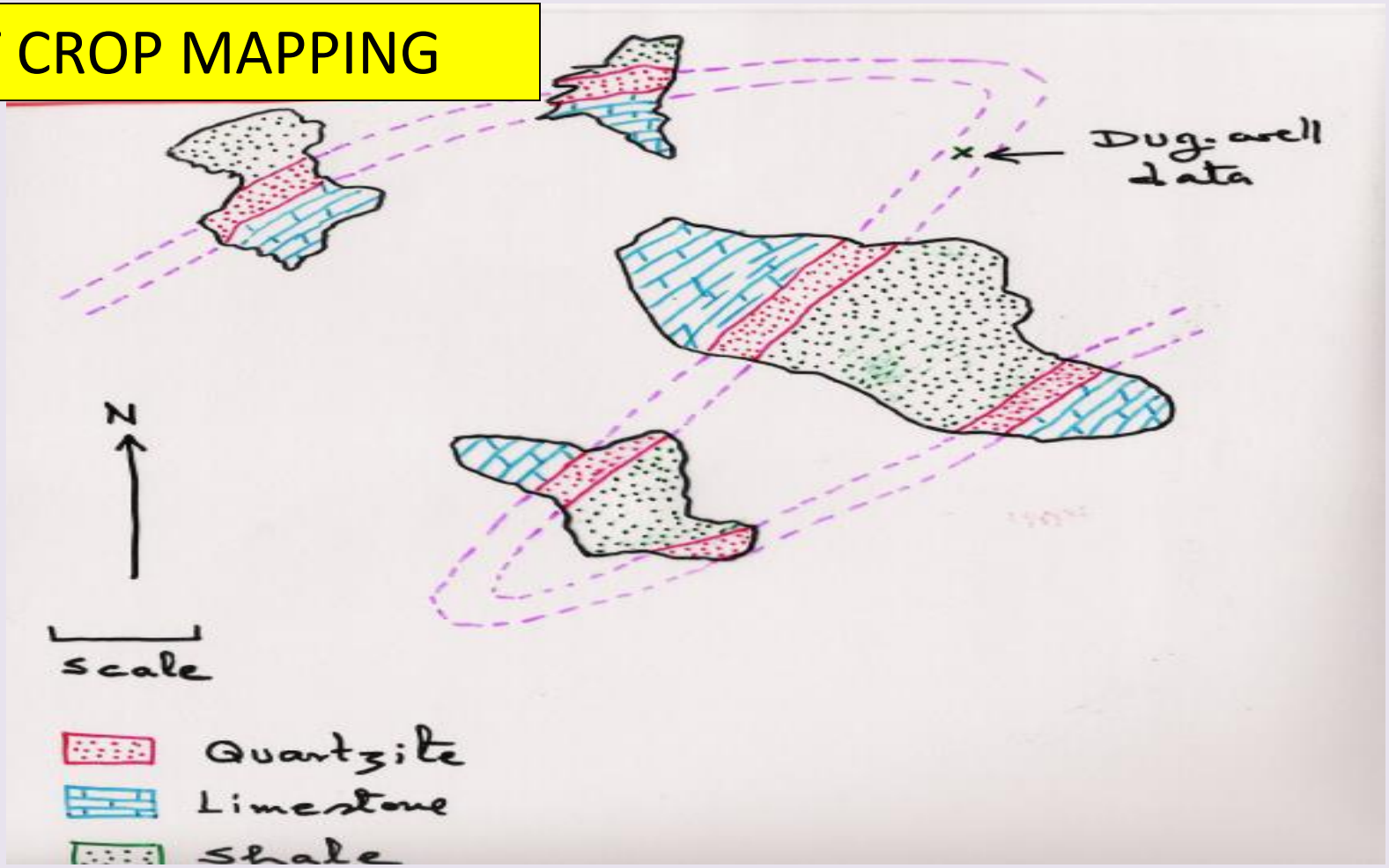
Methodology: 1.Stand on the contact & locate position

2. Note rock types & structural elements

3. Repeat the same in the next spots

4. Join all the points to get the trace

OUT CROP MAPPING

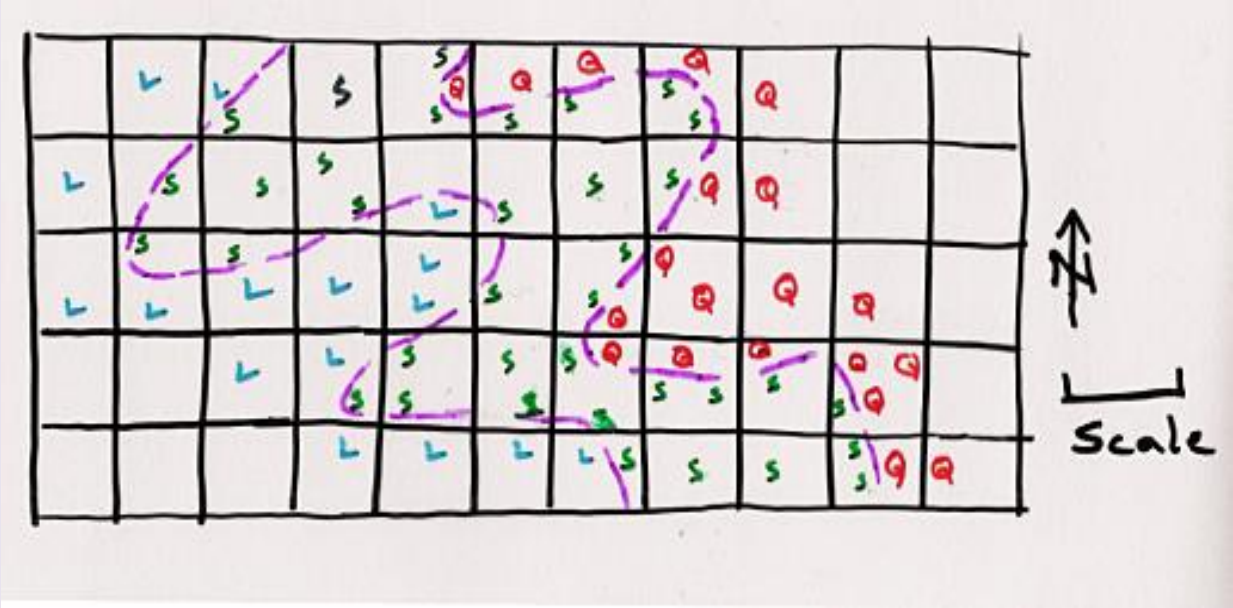


Separated outcrops are mapped and outcrop pattern is extrapolated on the basis of the bedding/foliation trend and 'younging' data. Method is useful in poorly exposed terrains,

Traverse Mapping

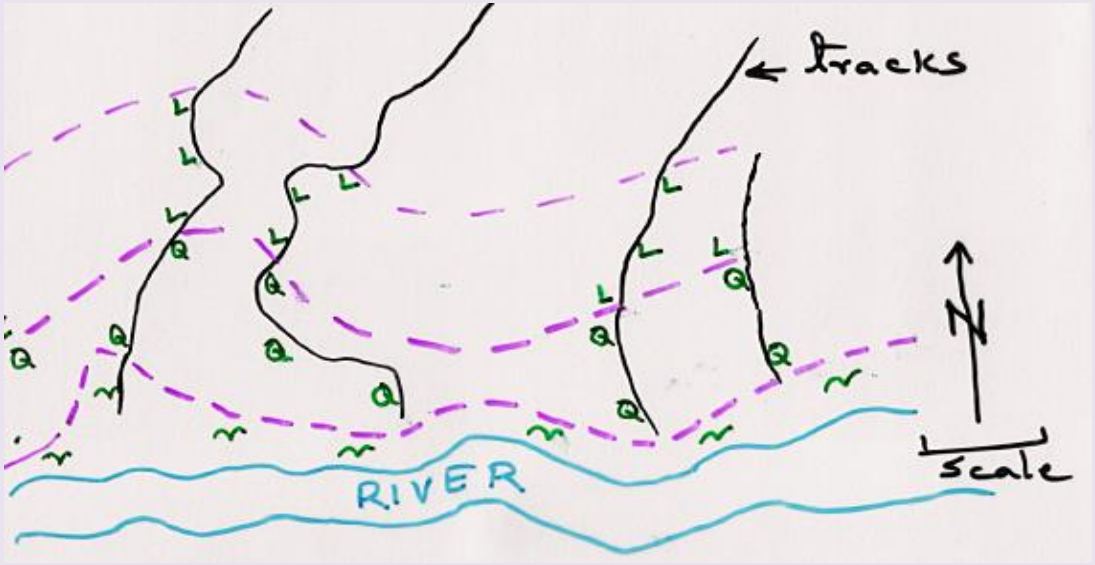
- It is done in higher mountains chains such as Himalayas, Alps etc.
- Details of rocks and contact are taken across traverses (across the strike).
- For such areas, photogeology and remote sensing are alternatives.

Traverse mapping (on grid pattern)



1. This method is applied in poorly exposed and virtually flat terrain.
2. Lithology is plotted at each exposed spot and structural data are noted
3. Contact is traced through extrapolation and available ‘younging’ data

Traverse Mapping (track tracking)



- Traverse for mapping depends on the availability of tracks through forested & / or mountainous terrain
- Data base is usually very poor
- Location is better done with a GPS

Structural Mapping

- Collection of basic structural data during the course of systematic geological mapping to bring out of different types of structural features e.g. folds, faults, cleavages, foliations, lineations, joints, pitch, plunge etc.

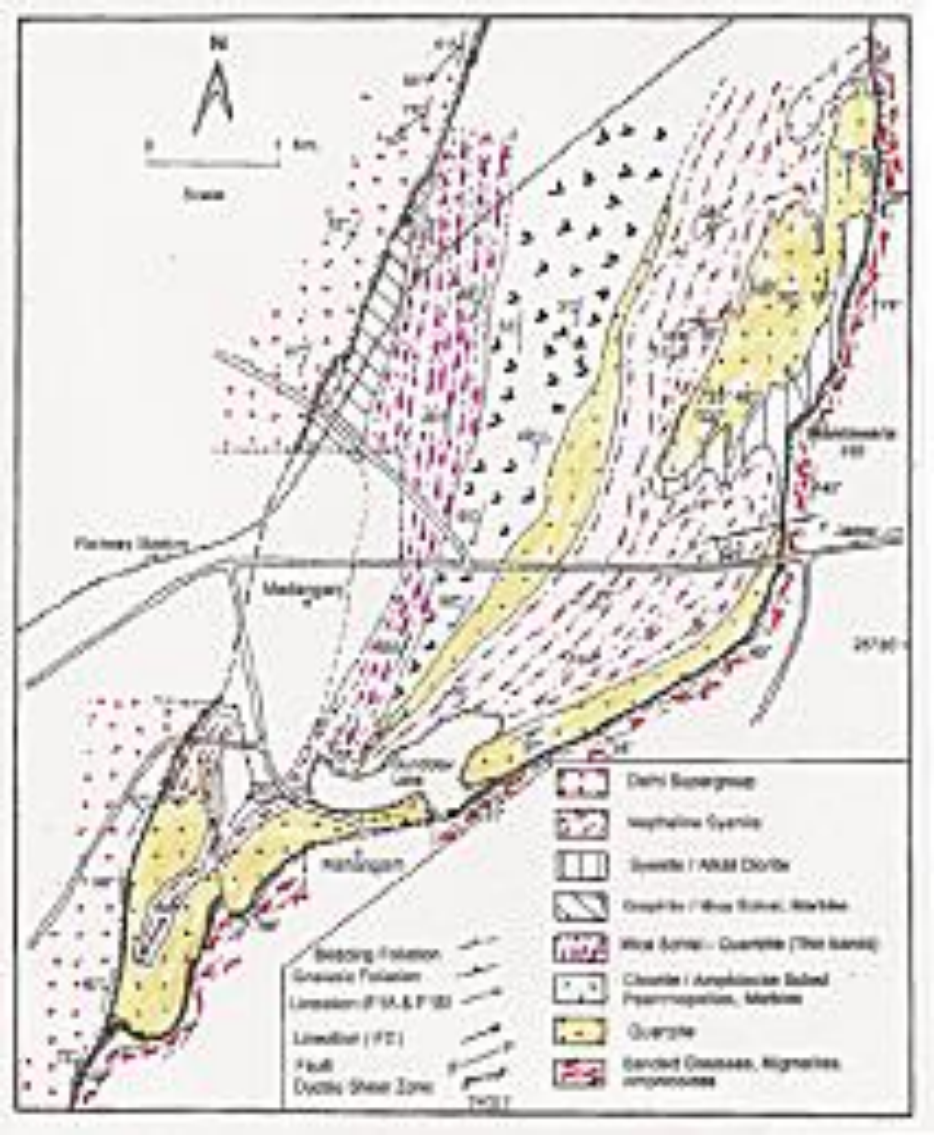
- In this type of mapping, attitude of rock beds and all structural data are plotted at different locations.
- Structural analysis of the data obtained during mapping.

Structural mapping involves

****

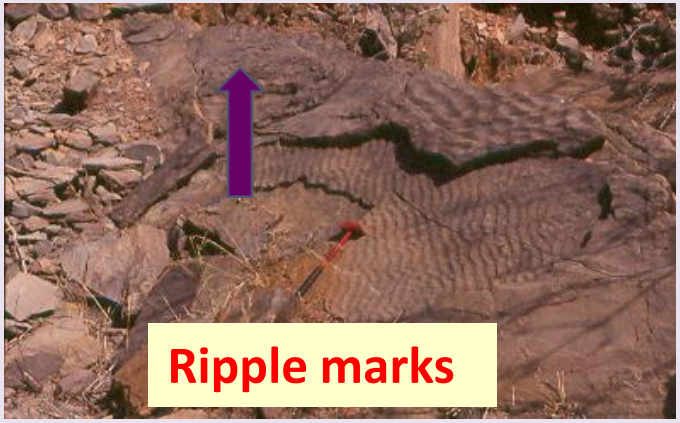
- **Tracing of lithological boundaries**
- **Study of the nature of contacts**
- **Identification of structural elements**
- **Measurement and plotting of data on structural elements**
- **Interpretation of field data**

Structural analysis starts with geological mapping followed by elucidation of structural geometry



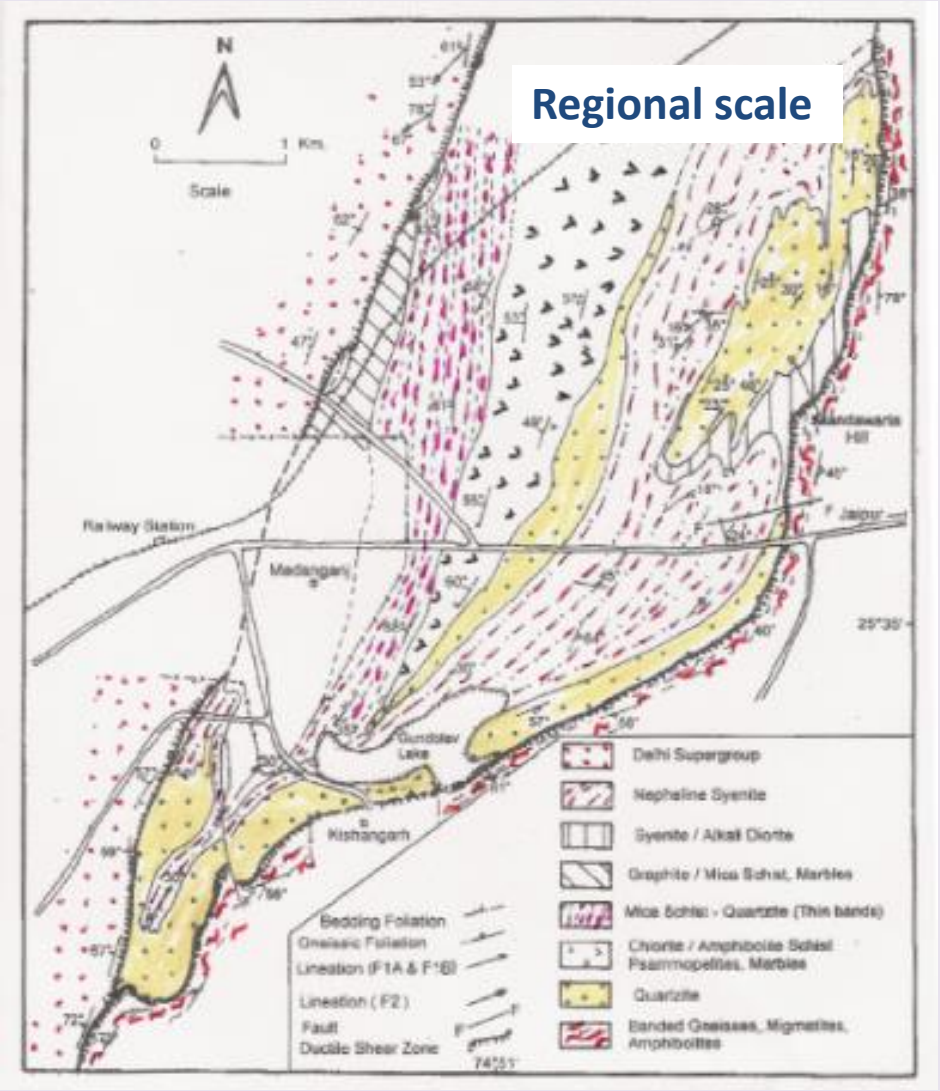
Recognition of stratigraphy by identifying the direction of younging is an important step in interpretation of structure of a region where the juxtaposed lithological units represent a single stratigraphic sequence. Most of the features that indicate 'younging' in rocks sequences are the primary depositional features

Some features which indicate the direction of younging in rocks



Primary features indicating younging

Structures are described in three scales



Structural interpretation

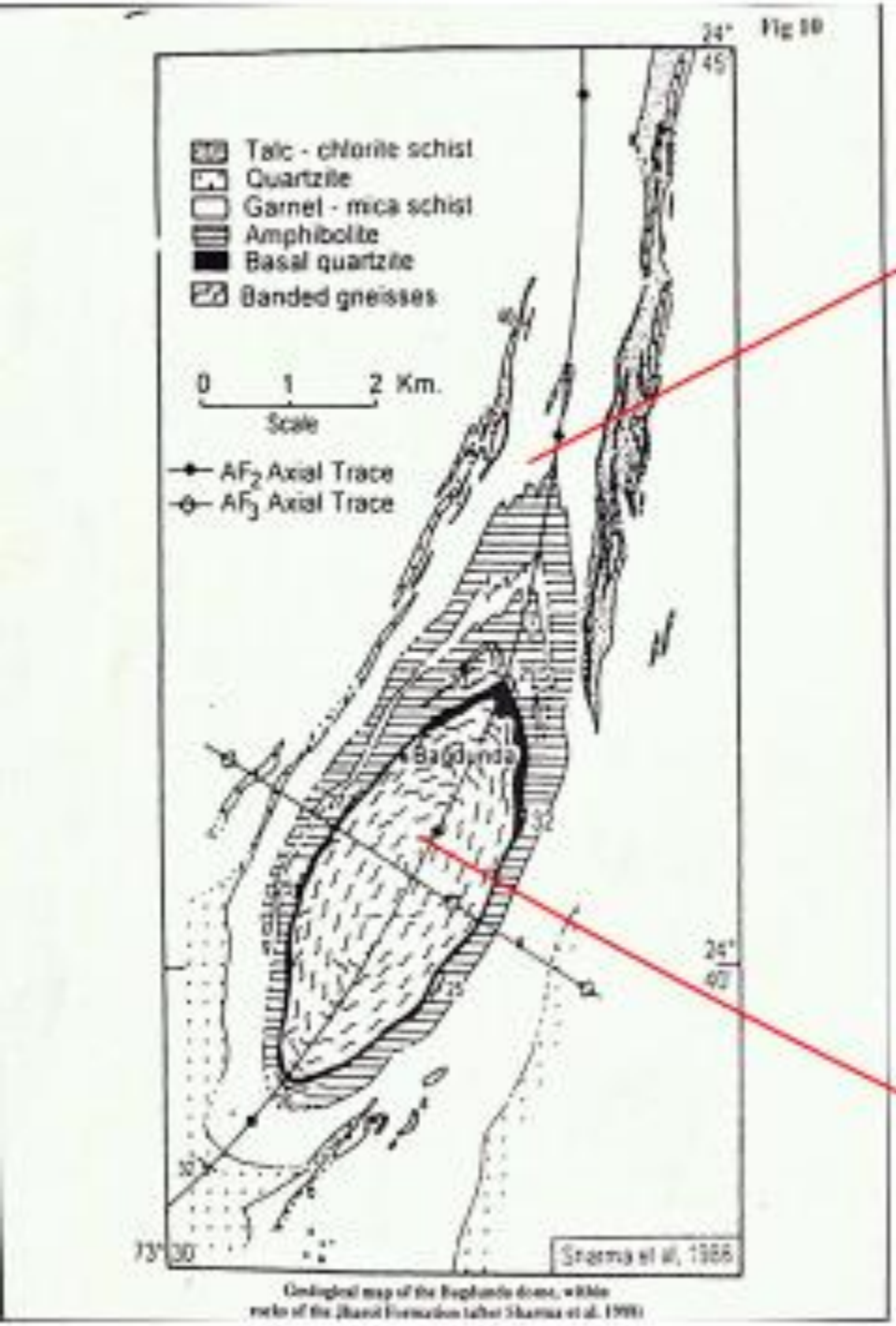
The final structural interpretation structure of a region is based on

(I) younging data to indicate the relative stratigraphic position of litho-units

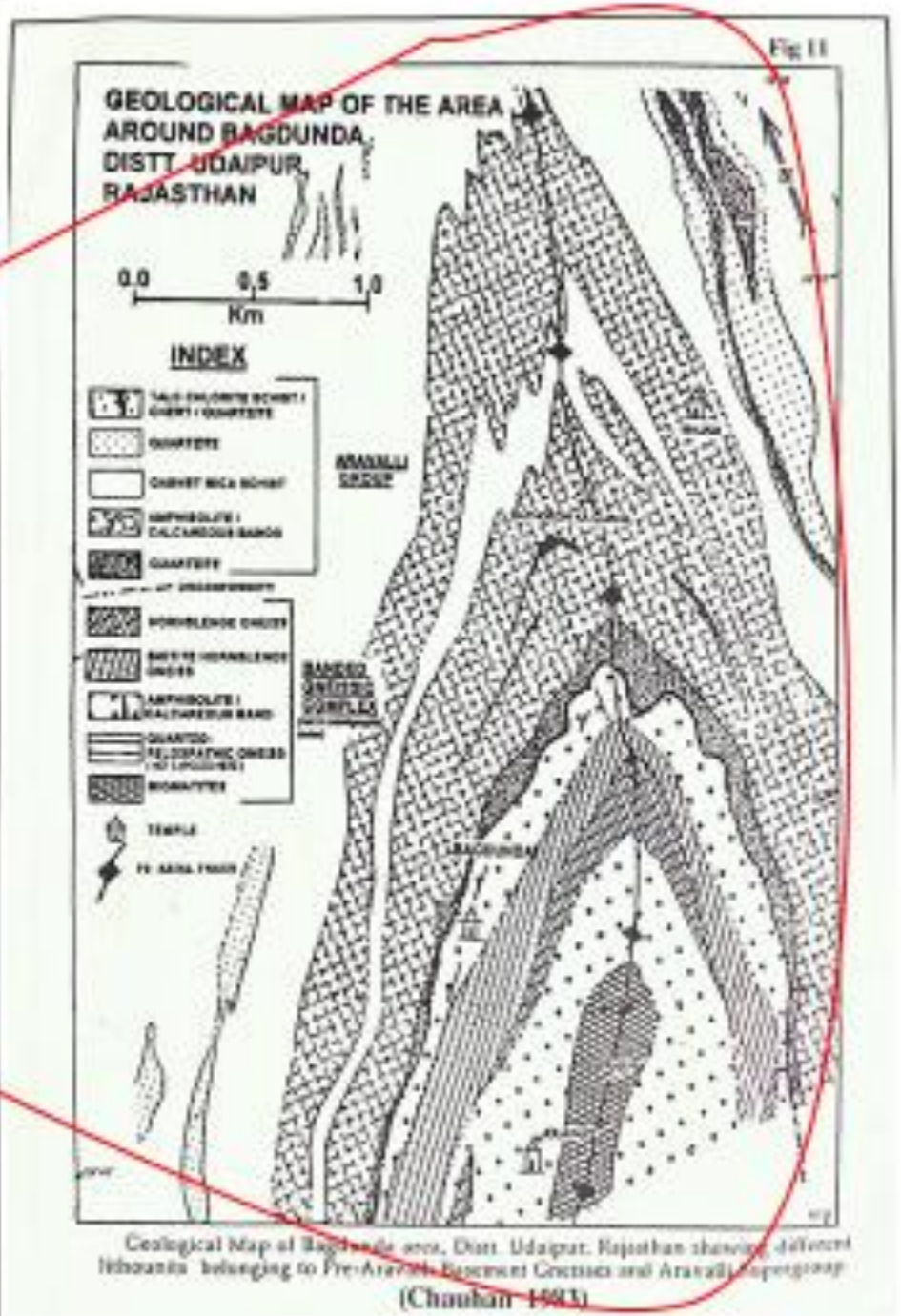
(ii) determination of fold generations based interpretation of small-scale structures

(iii) Orientation of large-scale folds in smaller domains of cylindrical fold axis

(iv) Elucidation of large scale structural geometry



Geological map of the Bagdunda dome, within rocks of the Jhamarkotra Formation (after Sharma et al. 1988)



Geological Map of Bagdunda area, Distt. Udaipur, Rajasthan showing different lithounits belonging to Pre-Aravalli Basement Gneisses and Aravalli Supergroup (Chauhan 1993)

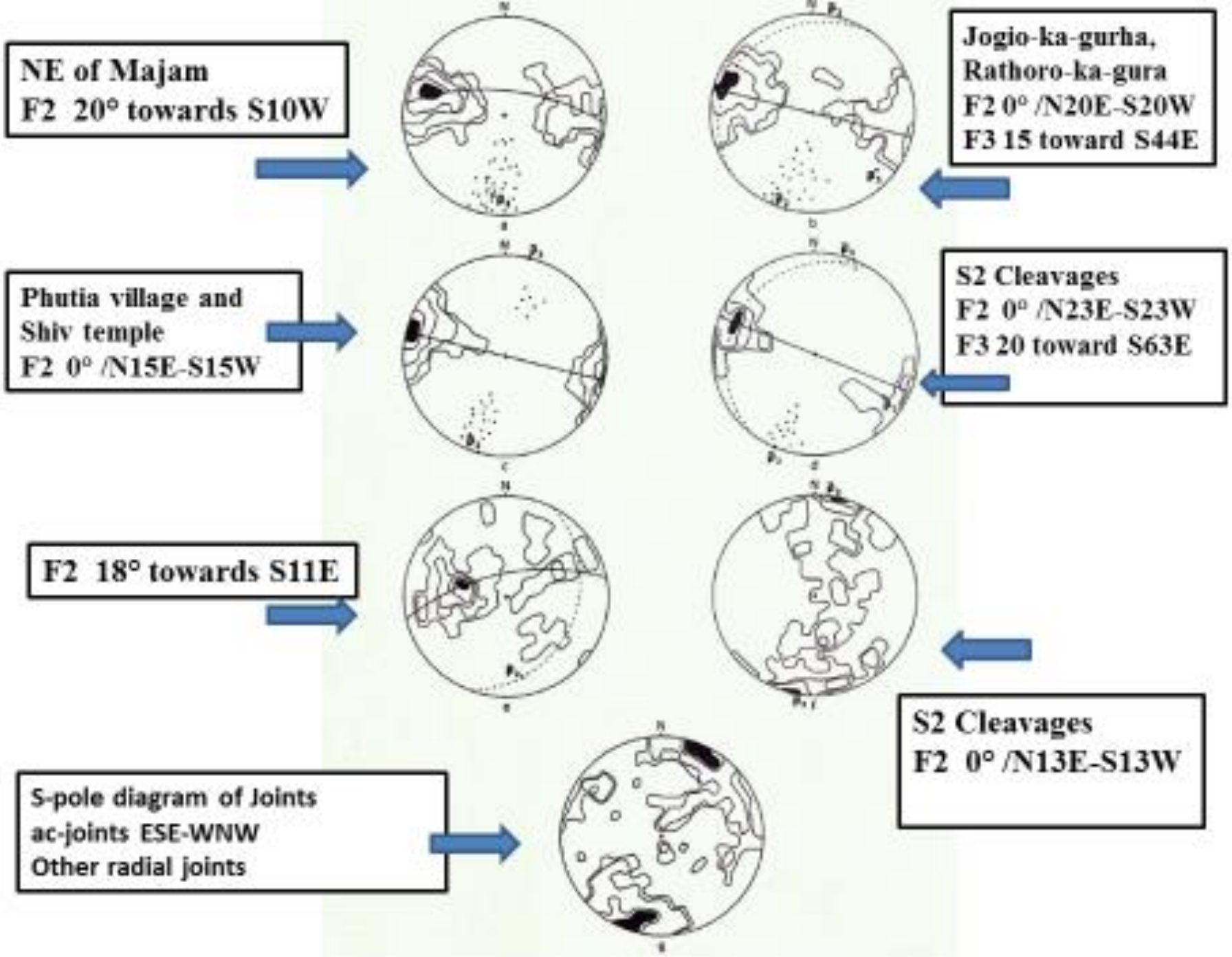
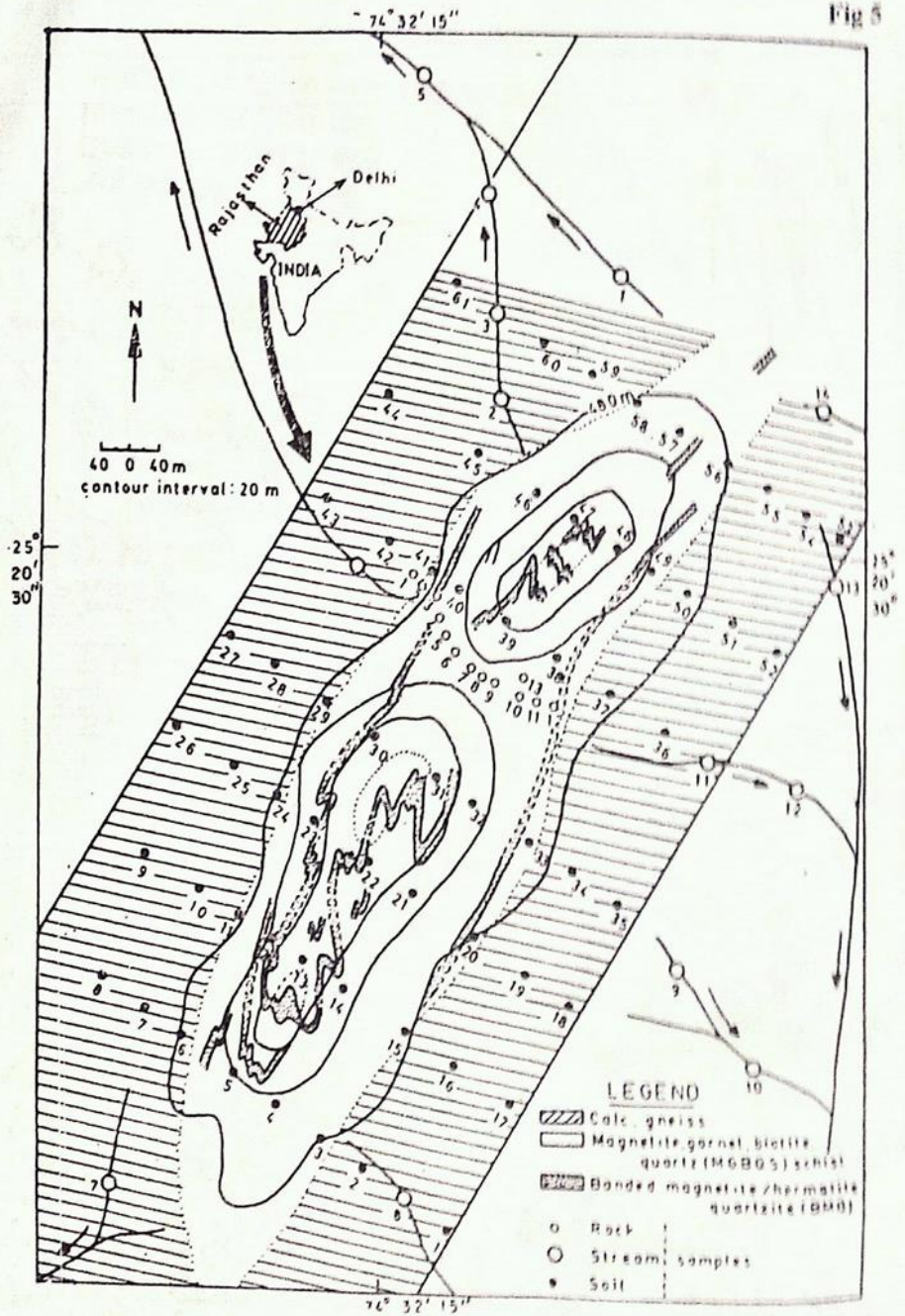
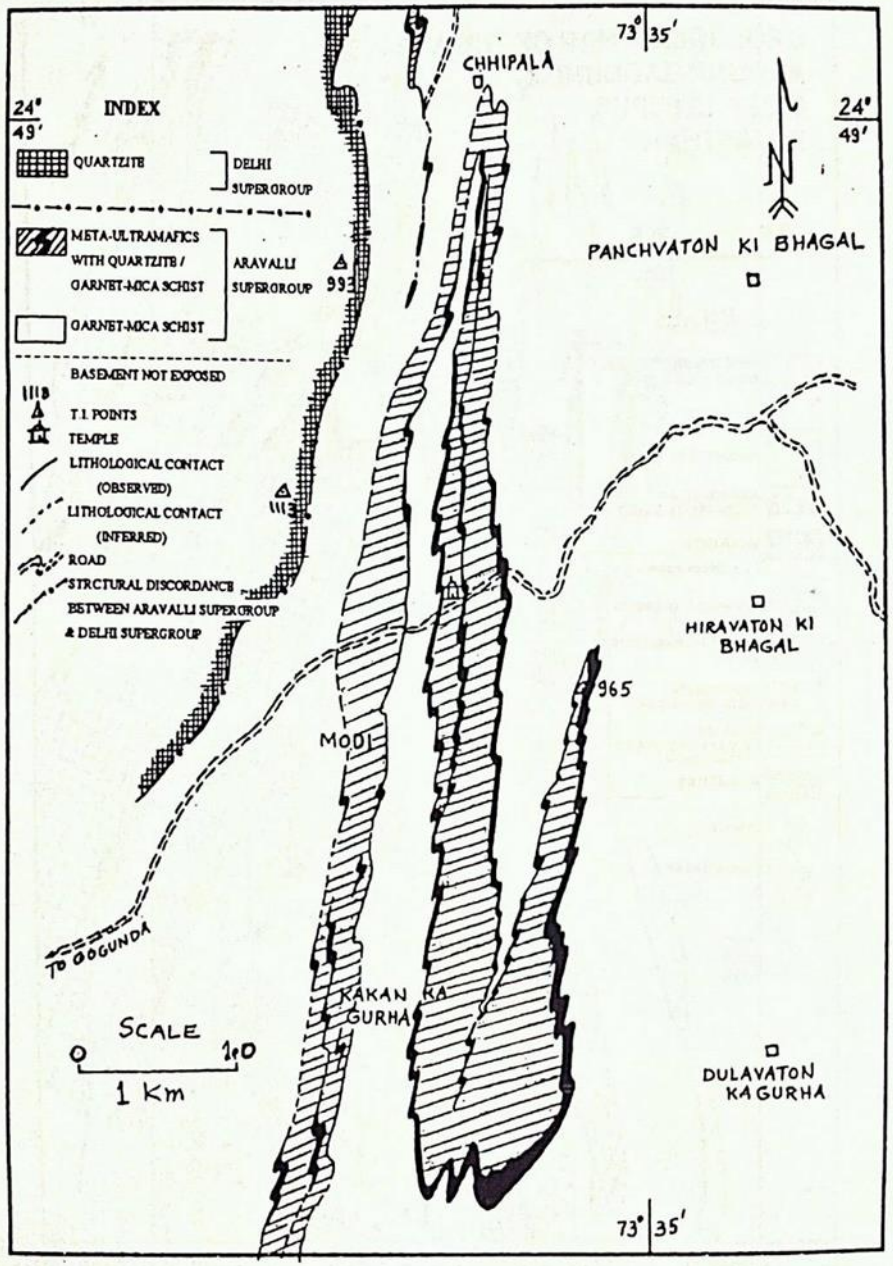

NE of Majam
F2 20° towards S10W
Jogio-ka-gurha,
Rathoro-ka-gura
F2 0° /N20E-S20W
F3 15 toward S44E
Phutia village and
Shiv temple
F2 0° /N15E-S15W
S2 Cleavages
F2 0° /N23E-S23W
F3 20 toward S63E
F2 18° towards S11E
S2 Cleavages
F2 0° /N13E-S13W
S-pole diagram of Joints
ac-joints ESE-WNW
Other radial joints

Fig 5



Geological map of Tiranga Hill, Bhilwara Dist. Rajasthan (Bhimalingeswara et al., 1986)

Fig 12



Geological Map of the area around Modi, Distt. Udaipur, Rajasthan
(Chauhan et al., 2004)

Random Sampling Method / Mapping

- In this type of mapping, samples of same / different rock units are collected from different locations.
- Then these samples are studied as hand specimens and after that send for chemical analysis which reveals every information about the sample. Thus giving details about lithology a nd mineral resource of the particular area.

Thank You