Techno India NJR Institute of Technology

Course File

Engineering Geology Lab (3CE4-25)

Session 2022-23

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SYLLABUS

II Year - III Semester: B.Tech. (Civil Engineering)

3CE4-25: GEOLOGY LAB

Credit: 01
0L+0T+2P

Max. Marks: 50 (IA:30, ETE:20)

List of Experiments

1. Physical Properties of Minerals
2. Physical Properties of Rocks
3. Identification of Minerals in Hand Specimen
4. Identification of Rocks in Hand Specimen
5. Identification of Geological features through wooden Models
    a. Structural Geological Diagrams
    b. Petrological Diagrams
    c. Engineering Geological Diagrams
6. Interpretation of Geological Map (10 Nos.)
7. Dip & Strike Problems (8 Nos.)

Course Overview:

Engineering geology is the application of the geological sciences to engineering projects. ... Engineering geologists provide geological and geotechnical recommendations, analysis, and design associated with human development and various types of Structure .Geological engineering studies are conducted by a geologist or engineering geologist who is educated, trained and has experience in recognizing and interpreting natural processes ; Understanding how these processes affect human – made structures (and vice versa) and knowledge of ways to mitigate hazards caused by adverse natural or human – made conditions. The engineering geologist's main objective is to protect life and property from damage caused by different geological

Course outcomes:

CO.NO.	Cognitive Level	Course Outcome
1	Comprehension	Explain different types of rocks & minerals found on earth
2	Application	Explain faults and folds in earth crust
3	Analysis	Explain the difference between several minerals by examining their physical & chemical properties
4	Synthesis	The students will interpret subsurface information such as thickness of soil, weathered zone, depth of hard rock and saturated zone by using geophysical methods
5	Evaluation	The students will learn the techniques in the interpretation of LANDSAT Imageries to find out the lineaments and other structural features for the given area..

Prerequisites:

1. Fundamental's knowledge of Engineering Geology Practically.

Course Outcome Mapping with Program Outcome:

PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
3	1	2	2	1	1	1	1	1	1	1	1	1	1	2
3	1	2	2	1	1	1	1	1	1	1	1	1	1	2
3	1	2	2	1	1	1	1	1	1	1	1	1	1	2
2	1	1	1	2	1	2	1	2	1	1	2	1	1	1
2	1	2	1	1	2	1	1	1	1	1	1	1	1	1
2.6	1	1.8	1.6	1.2	1.2	1.2	1	1.2	1	1	1.2	1	1	1.6

Course Coverage Module Wise:

Lab No.	Experiments List According to RTU Syllabus
1	Physical Properties of Minerals
2	Physical Properties of Rocks
3	Identification of Minerals in Hand Specimen
4	Identification of Rocks in Hand Specimen
5	Identification of Geological features through wooden Models a. Structural Geological Diagrams b. Petrological Diagrams c. Engineering Geological Diagrams
6	Interpretation of Geological Map (10 Nos.)
7	Dip & Strike Problems (8 Nos.)

Faculty Lab Manual Link

1. https://r.search.yahoo.com/_ylt=Awrx1MnBp6xhOnYABwa7HAx.;_ylu=Y29sbwNzZzMEcG9zAzEEdnRpZAMEc2VjA3Ny/RV=2/RE=1638733890/RO=10/RU=https%3a%2f%2fwww.iare.ac.in%2fsites%2fdefault%2ffiles%2flab1%2fEngineering%2520Geology%2520Lab%2520Manual.pdf/RK=2/RS=685jWJGW9bT6aFKc73sqZj.Urzc-

Assessment Methodology:

1. Practical exam based on Geology Syllabus.
2. Internal exams and Viva Conduct.
3. Final Exam (practical paper) at the end of the semester.

STUDY OF PHYSICAL PROPERTIES AND IDENTIFICATION OF MINERALS

STUDY OF MINERALS

Mineral

A mineral may be defined as a natural, inorganic, homogenous, solid substance having a definite chemical composition and regular atomic structure.

Common methods of study for the identification of minerals

Method	Principle
X-ray analysis	Based on the study of atomic structure, distinctive for every mineral. Its limitation is expensive, time consuming.
Chemical analysis	Based on the study of chemical composition. Its limitation is expensive, time consuming and not suitable for minerals exhibiting polymorphism (two or more minerals exhibit different physical properties in spite of possessing the same chemical composition).
Optical study	Based on the net effect of chemical composition and atomic structure. Its limitation is expensive.
Study of physical properties	Based on the consistency in physical properties which are due to the definite chemical composition and regular atomic structure. Its limitation is liable for erroneous inference, sometimes.

LABORATORY STUDY

In laboratories minerals are identified preferably by the method of study of physical properties.

Advantages

loss or wastage of minerals. Hence repetitive study is possible.

The following are the physical properties identified in the laboratory

Form

The form represents the common mode of occurrence of a mineral in nature.

Form	Description	Example
Lamellar form	Mineral appears as thin separable layers.	Different varieties of Mica
Tabular form	Mineral appears as slabs of uniform thickness.	Feldspars, Gypsum
Fibrous form	Mineral appears to be made up of fine threads.	Asbestos
Pisolitic form	Mineral appears to be made up of small spherical grains.	Bauxite
Oolitic form	Similar to Pisolitic form but rains are of still smaller size.	Lime stones

Rhombic form	Rhombic shape	Calcite
Bladed form	Mineral appears as cluster or as independent rectangular grains.	Kyanite
Granular form	Mineral appears to be made up of innumerable equidimensional grains of coarse or medium or fine size.	Chromite, Magnetite
Columnar form	Mineral appears as long slender prism.	Topaz
Prismatic form	As elongated	Apatite, quartz
Spongy form	Porous	Pyrolusite
Crystal form	Polyhedral, Geometrical shapes.	Garnets, Galena
Massive form	No definite shape for mineral.	Jasper, Graphite
Concretionary Form	Porous and appears due to accretion of small irregularly shaped masses.	Laterite
Nodular form	Irregularly shaped compact bodies with curved surfaces.	Flint

Colour

It is the usual body colour of mineral.

Name of the Mineral		Colour
Olivine	Olivine green	
Biotite, Graphite, Magnetite	Black	
Chlorite	Green	
Garnet	Red	
Kyanite	Blue	
Amethyst	Violet	
Quartz	Colorless, White, Green, Violet, Grey, yellow, Pink, etc..	

Feldspar	White, Grey, Shades of Red, Green, Dirty white, etc
Calcite	Colorless, white, shades of Red, Grey, Yellow, etc

1. Streak

The colour of the mineral powder is called the streak of a mineral. This is tested by rubbing the mineral on streak plate (An unglazed white porcelain plate).

Name of the Mineral	Body Colour	Streak
Hematite	**Steel Grey**	**Cherry Red**
Chromite	**Black**	**Dark Brown**
Magnetite	**Black**	**Black**
Graphite	**Black**	**Black**
Molybdenite	**Black**	**Greenish Black**

2. Lustre

Lustre is the nature of shining on the surface of the mineral.

Lustre	Description	Example
Metallic Lustre	It is the type of shining that appears on the surface of a metal.	Galena, Gold, Pyrite
Sub metallic Lustre	If the amount of shining is less when compared to metallic luster.	Hematite, Chromite, Magnetite
Vitreous Lustre	Shining like a glass sheet.	Quartz, Feldspar
Sub Vitreous Lustre	Less shining when compared to vitreous lustre.	Pyroxenes
Pearly Lustre	Shining like a pearl	Talc, Muscovite mica

Silky Lustre	Shining like silk	Asbestos
Resinous Lustre	Shining like a resin	Opal, Agate
Greasy Lustre	Shining like grease	Graphite
Adamantine Lustre	Shining like a diamond	Garnet, Diamond
Earthy or Dull Lustre	No Shining	Bauxite, Magnesite

3. Fracture

Fracture is the nature of the randomly broken surface of a mineral.

Fracture	Description	Example
Even fracture	If the broken surface is plain and smooth.	Magnesite, Chalk
Uneven fracture	If the broken surface is rough or irregular.	Hornblende, Bauxite
Hackly fracture	If the broken surface is very irregular like end of a broken stick.	Asbestos, Kyanite
Conchoidal fracture	If the broken surface is smooth and curved	Opal
Sub Conchoidal fracture	If the curved nature is less prominent.	Agate, Flint, Jasper

1. Cleavage

The definite direction or plane along which a mineral tends to break easily is called cleavage of that mineral. It occurs as innumerable parallel planes along which the mineral is equally weak. Such parallel planes of weakness are referred to as a set.

Cleavage	Example
One set of cleavage	Mica, Chlorite, Talc
Two sets of cleavages	Feldspars, Pyroxenes, Amphiboles
Three sets of cleavages	Calcite, Dolomite, Galena
Four sets of cleavages	Fluorite
Six sets of cleavages	**Sphalerite**
No cleavage	**Quartz, Olivine, Garnet**

7. Hardness

Hardness may be defined as the resistance offered by the mineral to abrasion or scratching. It is determined with the help pH Moh's scale of hardness which consists of ten reference minerals arranged in increasing order of hardness and numbered accordingly.

Name of the Mineral	Hardness
Talc	1
Gypsum	2
Calcite	3
Fluorite	4
Apatite	5
Feldspar	6
Quartz	7
Topaz	8
Corundum	9

Diamond	10

2. Specific gravity or Density

Specific gravity or Density of minerals depends on their chemicalcomposition and atomic structure.

Density	Range	Example
Low density	Specific gravity less than 2.5	Gypsum (2.3), Graphite (2-2.3)
Medium density	Specific gravity between 2.5 and 3.5	Quartz (2.7), Feldspar(2.5)
High density	Specific gravity greater than 3.5	Chromite (4.5- 4.8)

Degree of transparency

Degree of transparency is tested along the thin sharp edges of mineral keeping it against a powerful source of light. Depending upon the resistance offered by the minerals to the passage of light through them the transparency is classified.

Degree of Transparency	Example
Transparent	Thin layers of Muscovite, rock crystal
Translucent	Agate, Calcite
Opaque	Galena, Pyrite

9. Special properties

Some minerals exhibit unique characters which enable them to be identified easily.

Name of the Mineral	Special property
Talc	smooth touch or soapy feel
Graphite	Marks on a paper easily
Pyrolusite	Soils the fingers
Halite	Saline taste
Magnetite	Strongly attracted by any ordinary magnet
Chalk	Rough feeling of touch, adheres strongly to the tongue

Moh's Scale of Hardness

NAME OF MATERIAL	HARDNESS
Talc	1
Gypsum	2
Calcite	3
Fluorite	4
Apatite	5
Feldspar	6
Quartz	7
Topaz	8
Corundum	9
Diamond	10

PHYSICAL PROPERTIES OF MINERALS

OBSERVATIONS

Mineral 1

	PROPERTIES	OBSERVATION
1.	Form	Tabular
2.	Colour	Usually white, pink, grey or brown. Also colourless, yellow, orange, red, black, blue, green.
3.	Streak	Colourless/White
4.	Lustre	Vitreous. Pearly on some cleavage faces.
5.	Fracture	Even to uneven
6.	Cleavage	2 SETS
7.	Hardness	6 to 6.5
8.	Specific Gravity	2.5 to 2.8
9.	Diaphaneity	Usually translucent to opaque. Rarely transparent.
10.	Diagnostic Property	Perfect cleavage, with cleavage faces usually intersecting at or close to 90 degrees. Consistent hardness, specific gravity and pearly lustre on cleavage faces.
11.	Chemical composition	KaAlSi3O8
12.	Uses	Crushed and powdered feldspar are important raw materials for the manufacture of plate glass, container glass, ceramic products, paints, plastics and many other products. Varieties of orthoclase, labradorite, oligoclase, microcline and other feldspar minerals have been cut and used as faceted and cabochon gems.
13.	Varieties	Microcline, moon stone, orthoclase, plagioclase
Result: Based on above physical properties the given specimen is identified as *Felspar*		

	PROPERTIES	OBSERVATION
1.	Form	MASSIVE
2.	Colour	Quartz occurs in virtually every color.Common colors are clear, white, gray, purple, yellow, brown, black, pink, green, red.
3.	Streak	Colorless (harder than the streak plate)
4.	Lustre	Vitreous
5.	Fracture	Uneven to conchoidal
6.	Cleavage	None - typically breaks with a conchoidal fracture
7.	Hardness	7
8.	Specific Gravity	2.6-2.7
9.	Diaphaneity	Translucent
10.	Diagnostic Property	fracture, lustre, hardness
11.	Chemical composition	SiO_2
12.	Uses	Glass making, abrasive, foundry sand, hydraulic fracturing proppant, gemstones
13.	Varieties	Rose quartz, milky quartz, grey quartz etc.,
Result: Based on above physical properties the given specimen is identified as QUARTZ		

1.	Form	Massive
2.	Colour	Gray, black, brown, red, white and other colors due to staining
3.	Streak	Colourless
4.	Lustre	Vitreous
5.	Fracture	Conchoidal
6.	Cleavage	N/A
7.	Hardness	6.5-7
8.	Specific Gravity	2.6-2.73
9.	Diaphaneity	Opaque
10.	Diagnostic Property	Colour, Form
11.	Chemical composition	SiO_2
12.	Uses	Decorative Aggregates, Homes, Interior Decoration, Creating Artwork, Gemstone, In fire-starting tools, Manufacture of tools, Metallurgical Flux, Jewellery, To ignite fire.
13.	Varieties	Hornstone, Chert
Result: Based on above physical properties the given specimen is identified as *FLINT*		

1.	Form	:	Massive
2.	Colour	:	Brown, yellow, orange, red, green, or blue.May also refer to any form of opaque Chalcedony in all colours. Jasper is usually multicolour or banded.
3.	Streak	:	White
4.	Lustre	:	Vitreous
5.	Fracture	:	Conchoidal
6.	Cleavage	:	N/A
7.	Hardness	:	6
8.	Specific Gravity	:	2.7
9.	Diaphaneity	:	Opaque
10.	Diagnostic Property	:	LUSTRE, CLEAVAGE
11.	Chemical composition	:	SiO2
12.	Uses	:	Ornaments, as a gem stone
13.	Varieties		-
Result: Based on above physical properties the given specimen is identified as Jasper.			

1.	**Form**	**:**	**Massive**
2.	Colour	:	Usually olive green, but can be yellow-green to bright green; iron-rich specimens are brownish green to brown
3.	Streak	:	Colorless/White
4.	Lustre	:	Vitreous
5.	Fracture	:	Uneven
6.	Cleavage	:	N/A
7.	Hardness	:	6.5 to 7
8.	Specific Gravity	:	3.2 to 4.4
9.	Diaphaneity	:	OPAQUE
10.	Diagnostic Property	:	Green colour, vitreous lustre, conchoidal fracture, granular texture
11.	Chemical composition	:	(Mg, Fe)2SiO4
12.	Uses	:	Gemstones, a declining use in bricks and refractory sand
13.	Varieties		Forsterite, fayalite
Result: Based on above physical properties the given specimen is identified as OLIVINE			

1.	Form	:	Massive
2.	Colour	:	Multicolour in banded formation. Colours include white, blue, red, green, yellow, orange, brown, pink, purple, grey, and black. Some rarer forms of Agate are iridescent.
3.	Streak	:	Colourless/ white
4.	Lustre	:	Vitreous
5.	Fracture	:	Conchoidal
6.	Cleavage		N/A
7.	Hardness		7
8.	Specific Gravity		2.6-2.7
9.	Diaphaneity		Opaque to Translucent
10.	Diagnostic Property	:	Lustre, Colour
11.	Chemical composition	:	SiO2
12.	Uses	:	ornamental objects, Most commonly as beads in necklaces, bracelets, earrings, etc.,
13.	Varieties		Cloud Agate, Fire Agate, Eye Agate, Grape Agate
Result: Based on above physical properties the given specimen is identified as AGATE			

1.	Form	:	Bladed
2.	Colour	:	Blue, white, grey, green, colorless
3.	Streak	:	White, colorless
4.	Lustre	:	Vitreous, pearly
5.	Fracture	:	Hackly
6.	Cleavage	:	2 sets
7.	Hardness	:	Kyanite often occurs in long, bladed crystals. These have a hardness of 4.5 to 5 along the length of the crystals and 6.5 to 7 across the width of the crystals.
8.	Specific Gravity	:	3.5 to 3.7
9.	Diaphaneity	:	Transparent to translucent
10.	Diagnostic Property	:	Colour, cleavage, bladed crystals
11.	Chemical composition	:	Al2SiO5
12.	Uses	:	Ceramics, gemstones
13.	Varieties		Orange Kyanite and Black Kyanite
Result: Based on above physical properties the given specimen is identified as KYANITE			

1.	Form	:	Granular
2.	Colour	:	Usually black, dark green, dark brown
3.	Streak	:	White, colourless - (brittle, often leaves cleavage debris behind instead of a streak)
4.	Lustre	:	Vitreous
5.	Fracture	:	Uneven
6.	Cleavage	:	2 sets
7.	Hardness	:	5 to 6
8.	Specific Gravity	:	2.6-2.73
9.	Diaphaneity	:	Opaque
10.	Diagnostic Property	:	Cleavage, colour
11.	Chemical composition	:	(Ca,Na)2–3(Mg,Fe,Al)5(Al,Si)8O22(OH,F)2
12.	Uses	:	Decoration
13.	Varieties		Magnesio-hornblende, Hornblende-asbestos
Result: Based on above physical properties the given specimen is identified as HORNBLENDE			

1.	Form	:	Foliated
2.	Colour	:	Various shades of green. Rarely yellow, white, pink, black
3.	Streak	:	Greenish to greenish gray
4.	Lustre	:	Vitreous, pearly, dull
5.	Fracture	:	Uneven
6.	Cleavage	:	1 set
7.	Hardness	:	2 to 3
8.	Specific Gravity	:	2.6 to 3.3
9.	Diaphaneity	:	Opaque
10.	Diagnostic Property	:	Color, hardness, foliated appearance, feels slightly greasy
11.	Chemical composition	:	A generalized formula: (X,Y)4-6(Si,Al)4O10(OH,O)8 The "X" and "Y" in the formula represent ions, which might include: Fe+2, Fe+3, Mg+2, Mn+2, Ni+2, Zn+2, Al+3, Li+1, or Ti+4. The composition and physical properties of chlorites vary as these ions substitute for one another in solid solution.
12.	Uses	:	Very few industrial uses. Used as a filler and as a constituent of clay.
13.	Varieties		Chanosite, Ritidolite
Result: Based on above physical properties the given specimen is identified as CHLORITE			

1.	Form	:	Fibrous
2.	Colour	:	White pale colour
3.	Streak	:	White
4.	Lustre	:	Silky
5.	Fracture		Uneven to hackly
6.	Cleavage	:	1 set
7.	Hardness	:	5-6
8.	Specific Gravity	:	2.9-3.2
9.	Diaphaneity	:	Opaque
10.	Diagnostic Property	:	Form, Colour
11.	Chemical composition	:	CA2(MgFe)5Si8O22(OH)2
12.	Uses	:	Fire proof bricks
13.	Varieties		Mountain Paper, Pilolite.
Result: Based on above physical properties the given specimen is identified as ASBESTOS			

1.	Form	:	Lamellar
2.	Colour	:	Thick specimens often appear to be black, brown, or silver in colour; however, when split into thin sheets muscovite is colourless, sometimes with a tint of brown, yellow, green, or rose
3.	Streak	:	White, often sheds tiny flakes
4.	Lustre	:	Pearly to vitreous
5.	Fracture		Uneven to Hackly
6.	Cleavage	:	1 Set
7.	Hardness	:	2.5 to 3
8.	Specific Gravity	:	2.8 to 2.9
9.	Diaphaneity	:	Transparent to translucent
10.	Diagnostic Property	:	Cleavage, colour, transparency
11.	Chemical composition	:	KAl2(Si3AlO10)(OH)2
12.	Uses		Used in the manufacturing of paint, joint compound, plastics rubber, asphalt roofing, cosmetics, drilling mud.
13.	Varieties		Sodium mica, lithium mica
Result: Based on above physical properties the given specimen is identified as MUSCOVITE			

1.	Form	:	Lamellar
2.	Colour	:	Brown
3.	Streak	:	Brownish
4.	Lustre	:	Pearly
5.	Fracture	:	Uneven
6.	Cleavage	:	1 Set
7.	Hardness	:	2-3
8.	Specific Gravity	:	2.7-3.1
9.	Diaphaneity	:	Transparent to Translucent
10.	Diagnostic Property	:	Form, Lustre
11.	Chemical composition	:	K(MgFe)3(Si3Al)O10(OH,F)2
12.	Uses	:	Used in the manufacturing of insulating materials
13.	Varieties		Lepidolite, Biotite
Result: Based on above physical properties the given specimen is identified as MICA			

1.	Form	:	Massive
2.	Colour	:	Typically red, but can be orange, green, yellow, purple, black, or brown. Blue garnets are extremely rare.
3.	Streak	:	Colourless
4.	Lustre	:	Vitreous
5.	Fracture	:	Uneven to conchoidal
6.	Cleavage	:	N/A
7.	Hardness	:	6.5 to 7.5
8.	Specific Gravity	:	3.5 to 4.3
9.	Diaphaneity	:	Transparent to translucent
10.	Diagnostic Property	:	Hardness, specific gravity, isometric crystal form, lack of cleavage
11.	Chemical composition	:	X3Y2(SiO4)3
12.	Uses	:	Waterjet cutting granules, abrasive blasting granules, filtration granules, abrasive grits and powders, gemstones
13.	Varieties		Pyrope
Result: Based on above physical properties the given specimen is identified as GARNET			

OBSERVATIONS

Mineral 14

1.	Form	:	Foliated
2.	Colour	:	Green, white, grey, brown, colourless
3.	Streak	:	White to pale green
4.	Lustre	:	Pearly
5.	Fracture	:	Uneven to Hackly
6.	Cleavage	:	1 set
7.	Hardness	:	1
8.	Specific Gravity	:	2.7 to 2.8
9.	Diaphaneity	:	Translucent
10.	Diagnostic Property	:	Soapy feel, colour, softness, cleavage
11.	Chemical composition	:	$Mg_3Si_4O_{10}(OH)_2$
12.	Uses	:	Used as a filler and anti-stick coating in plastics, ceramics, paint, paper, roofing, rubber, cosmetics
13.	Varieties		Stealite, Soap stone
Result: Based on above physical properties the given specimen is identified as TALC			

Mineral 15

1.	Form	:	Rohmbic
2.	Colour	:	Usually white but also colorless, gray, red, green, blue, yellow, brown, orange
3.	Streak	:	White
4.	Lustre	:	vitreous
5.	Fracture	:	Even
6.	Cleavage	:	3 sets
7.	Hardness	:	3
8.	Specific Gravity	:	2.7
9.	Diaphaneity	:	Translucent
10.	Diagnostic Property	:	Rhombohedral cleavage, powdered form effervesces weakly in dilute HCl, curved crystal faces and frequent twinning
11.	Chemical composition	:	KAl2(Si3AlO10)(OH)2
12.	Uses	:	Acid neutralization, a low-hardness abrasive, soil conditioner, heated for the production of lime
13.	Varieties		Island spar
Result: Based on above physical properties the given specimen is identified as CALCITE			

1.	Form	:	Cubic, Granular
2.	Colour	:	Brass yellow - often tarnished to dull brass
3.	Streak	:	Greenish black to brownish black
4.	Lustre	:	Metallic
5.	Fracture	:	Uneven
6.	Cleavage	:	3 sets
7.	Hardness	:	6 to 6.5
8.	Specific Gravity	:	4.9 to 5.2
9.	Diaphaneity	:	Opaque
10.	Diagnostic Property	:	Colour, hardness, brittle, greenish black streak, specific gravity
11.	Chemical composition	:	Iron sulphide, FeS_2
12.	Uses	:	Ore of gold
13.	Varieties		Marcasite
Result: Based on above physical properties the given specimen is identified as PYRITE			

1.	Form	:	Massive
2.	Colour	:	Black to steel-gray to silver; red to reddish brown to black
3.	Streak	:	Red to reddish brown
4.	Lustre	:	Metallic, submetallic, earthy
5.	Fracture	:	Uneven
6.	Cleavage	:	N/A
7.	Hardness	:	5 to 6.5
8.	Specific Gravity	:	5.0 to 5.3
9.	Diaphaneity	:	Opaque
10.	Diagnostic Property	:	Red streak, specific gravity
11.	Chemical composition	:	Fe2O3
12.	Uses	:	The most important ore of iron. Pigment, heavy media separation, radiation shielding, ballast, polishing compounds, a minor gemstone
13.	Varieties		Ironore
Result: Based on above physical properties the given specimen is identified as HEMATITE			

OBSERVATIONS

Economic Mineral 3

1.	Form	:	Granular
2.	Colour	:	Black to silvery grey
3.	Streak	:	Black
4.	Lustre	:	Metallic, submetallic
5.	Fracture	:	Uneven
6.	Cleavage	:	N/A
7.	Hardness	:	5 to 6.5
8.	Specific Gravity	:	5.2
9.	Diaphaneity	:	Opaque
10.	Diagnostic Property	:	Strongly magnetic, colour, streak.
11.	Chemical composition	:	Fe2O4
12.	Uses	:	The most important ore of iron. Heavy media separation. Studies of Earth's magnetic field.
13.	Varieties		-
Result: Based on above physical properties the given specimen is identified as MAGNETITE			

1.	Form	:	Massive/Spongy
2.	Colour	:	White, grey, sometimes stained yellow, orange, red, pink, or brown by iron or included iron minerals
3.	Streak	:	Usually white, but iron stain can discolor
4.	Lustre	:	Dull, earthy
5.	Fracture	:	Uneven
6.	Cleavage	:	N/A
7.	Hardness	:	1 to 3
8.	Specific Gravity	:	2 to 2.5
9.	Diaphaneity	:	Opaque
10.	Diagnostic Property	:	Soft, low specific gravity, colour
11.	Chemical composition	:	AlO(OH), Al(OH)3
12.	Uses	:	The primary ore of aluminum. Synthetic bauxite is used as an abrasive and as a fracking proppant
13.	Varieties		Corundum, Spinel
Result: Based on above physical properties the given specimen is identified as BAUXITE			

1.	Form	:	Massive
2.	Colour	:	Steel grey to black
3.	Streak		Black
4.	Lustre	:	Metallic, sometimes earthy
5.	Fracture	:	Uneven
6.	Cleavage	:	1 SET
7.	Hardness	:	1 to 2
8.	Specific Gravity	:	2.1 to 2.3
9.	Diaphaneity	:	Opaque
10.	Diagnostic Property	:	Color, streak, slippery feel, specific gravity
11.	Chemical composition	:	C
12.	Uses	:	Used to manufacture heat and chemical resistant containers and other objects. Battery anodes. A dry lubricant. The "lead" in pencils.
13.	Varieties		-
Result: Based on above physical properties the given specimen is identified as GRAPHITE			

1.	Form	:	Granular
2.	Colour	:	Dark gray to black, rarely brownish black
3.	Streak	:	Dark brown
4.	Lustre	:	Metallic to submetallic
5.	Fracture	:	Uneven
6.	Cleavage	:	N/A
7.	Hardness	:	5.5 to 6
8.	Specific Gravity	:	4.0 to 5.1
9.	Diaphaneity	:	Opaque
10.	Diagnostic Property	:	Luster, streak
11.	Chemical composition	:	$FeCr_2O_4$
12.	Uses	:	An ore of chromium
13.	Varieties		-
Result: Based on above physical properties the given specimen is identified as CHROMITE			

1.	Form	:	Cubic
2.	Colour	:	Fresh surfaces are bright silver in colour
3.	Streak	:	Dark brown
4.	Lustre	:	Metallic to submetallic
5.	Fracture	:	Uneven
6.	Cleavage	:	3 sets
7.	Hardness	:	2.5
8.	Specific Gravity	:	7.4 to 7.6
9.	Diaphaneity	:	Opaque
10.	Diagnostic Property	:	Colour, lustre, specific gravity, streak, cleavage
11.	Chemical composition	:	PbS
12.	Uses	:	An ore of lead
13.	Varieties		-
Result: Based on above physical properties the given specimen is identified as GALENA			

1.	Form	:	Massive
2.	Colour	:	White, greyish, yellowish, brownish, rarely colourless
3.	Streak		White
4.	Lustre	:	Dull, earthy, chalky, rarely vitreous
5.	Fracture	:	Even to Uneven
6.	Cleavage	:	N/A
7.	Hardness	:	3.5 to 5.0
8.	Specific Gravity	:	3.0 to 3.2
9.	Diaphaneity	:	Opaque
10.	Diagnostic Property	:	Colour, Fracture
11.	Chemical composition	:	$MgCO_3$
12.	Uses	:	Heated to produce MgO which is used to produce refractory bricks, refractory cements, and magnesium metal. High-quality pieces of magnesite are used to cut beads, cabochons, tumbled stones, and other lapidary projects
13.	Varieties		Epsomite
Result: Based on above physical properties the given specimen is identified as MAGNESITE			

ROCKS

MEGASCOPIC AND MICROSCOPIC DESCRIPTION AND IDENTIFICATION OF ROCKS REFERRED UNDER THEORY

STUDY OF ROCKS

A rock is defined as an aggregate of minerals. It is also described as unit of earth's crust. Based on their origin, geologically rocks are classified into igneous rocks, Sedimentary rocks, metamorphic rocks.

Igneous rocks:

These are characterized by vesicular structure, amygdaloidal structure and Aphanitic structure if they are volcanic. If they are Hypabyssal or plutonic, they are dense, compact and exhibit interlocking texture.

Sedimentary rocks:

Occurrence of normal or cross bedding, cementing material, fossils, ripple marks, mud cracks, tracks and trails and peculiar forms such as modular, concretionary, Pisolitic, Oolitic, etc indicate that the rocks under study of sedimentary rocks.

Metamorphic rocks:

Occurrence of alignment of minerals (lineation, foliation) and metamorphic minerals indicate the rocks under the study of metamorphic group.

IGNEOUS ROCKS

Terminology related for the description of igneous rocks

Texture

Phaneric	If minerals are visible to naked eye by virtue of their size.
Aphanitic	If minerals are too fine to be seen by naked eye.
Phaneric coarse	If minerals are greater than 5mm in size.
Phaneric medium	If minerals are 2mm to 5mm in size.
Phaneric tine	If minerals are less than 2mm in size.
Equigranular	If minerals are nearly of same size.
Inequigranular	If some minerals are distinctly larger than others.
Porphyritic	If larger minerals are surrounded by smaller minerals.
Interlocking	If minerals are closely interlinked and cannot be separate without damaging surrounding minerals.
Graphic	If angular quartz grains occur with some orientation in feldspars.

1. Colour

Leucocratic	If the rock looks pale coloured or white coloured, it indicates that the rock may be acidic.
Melanocratic	If the rock looks dark coloured or black coloured, it indicates that the rock may be basic or ultra basic.
Mesocratic	If the rock is neither dark coloured nor pale coloured.

2. Structure

Vesicular	If the rock is having empty cavities
Amygdaloidal	If the rock has cavities filled with amygdales

3. Minerals

Primary	**If the minerals are present from the beginning of formation of rock.**
Secondary	**If the minerals are present after the formation of rock.**
Essential	**If they are major constituents and decide the name of the rock.**
Accessory	**If they occur in small quantities and their presence or absence has nothing to do in naming a rock.**

4. Silica Saturation

Oversaturated	**If a rock has free quartz.**
Under saturated	**If a rock has unsaturated minerals like Olivine.**
Saturated	**If a rock has neither free quartz nor unsaturated minerals.**

5. Depth of Formation

Plutonic/Hypabyssal	**If a rock is Phaneric and has interlocking texture.**
Volcanic	**If a rock is vesicular or amygdaloidal and Aphanitic.**

IGNEOUS ROCK -1			
1.	Colour	:	Mesocratic
2.	Texture		
	A) Crystallinity	:	Holocrystalline
	B) Granularity	:	Coarse grained
	C) Mutual relationship of minerals	:	Inequigranular
	D) Shape of the mineral	:	-
3.	Mineral Composition		
	a) Essential Minerals	:	Quartz
	b) Accessory Minerals	:	Mica, magnetite
4.	Structure	:	Compact, massive
5	Mode of Origin	:	Greater depths under high pressure
6	Distribution in India	:	Tamilnadu, Karnataka
7	Engineering Properties & Uses	:	Charnockites are massive & compact, hence can be used forroad material
Result: Based on above physical properties the given specimen is identified as *CHARNOCKITE*			

IGNEOUS ROCK -2			
1.	Colour	:	Leucocratic
2.	Texture		
	A) Crystallinity	:	Holocrystalline
	B) Granularity	:	Coarse grained
	C) Mutual relationship of minerals	:	Interlocking
	D) Shape of the mineral	:	Subhedral
3.	Mineral Composition		
	a) Essential Minerals	:	Alkali feldspar, quartz
	b) Accessory Minerals	:	Cassiterite, Spodumene
4.	Structure	:	-
5	Mode of Origin	:	Intrusive igneous rock
6	Distribution in India	:	Bihar, Rajasthan
7	Engineering Properties & Uses	:	Nil
Result: Based on above physical properties the given specimen is identified as *PEGMATITE*			

IGNEOUS ROCK -3			
1.	Colour	:	Leucocratic
2.	Texture		
	A) Crystallinity	:	Holohyaline
	B) Granularity	:	Medium to fine grained
	C) Mutual relationship of minerals	:	Equigranular
	D) Shape of the mineral	:	Subhedral
3.	Mineral Composition		
	a) Essential Minerals	:	Plagioclase feldspar
	b) Accessory Minerals	:	Hornblende, iron oxide
4.	Structure	:	Vesicular or amygdaloidal
5	Mode of Origin	:	Volcanic extrusive rock
6	Distribution in India	:	Maharashtra, Kutch, Gujarat, Madhya Pradesh
7	Engineering Properties & Uses	:	Massive basalts are highly durable and strong with highest load bearing capacity. It is used as building stone and also suitable in tunnelling since it doesn't require lining.
8	Varieties	:	-
Result: Based on above physical properties the given specimen is identified as *BASALT*			

IGNEOUS ROCK -4			
1.	Colour	:	Leucocratic
2.	Texture		
	A) Crystallinity	:	Holo crystalline
	B) Granularity	:	Coarse or medium grained
	C) Mutual relationship of minerals	:	Equigranular
	D) Shape of the mineral	:	Subhedral
3.	Mineral Composition		
	a) Essential Minerals	:	Alkali feldspar, plagioclase, quartz
	b) Accessory Minerals	:	Hornblende, pyroxenes, emphiboles
4.	Structure	:	-
5	Mode of Origin	:	Intrusive igneous rock
6	Distribution in India	:	AP, TS, Rajasthan, Karnataka
7	Engineering Properties & Uses	:	Granite can be used as foundation rock, building stone, it doesn't require lining in tunnels.
Result: Based on above physical properties the given specimen is identified as *GRANITE*			

IGNEOUS ROCK -5			
1.	Colour	:	Melenocratic
2.	Texture		
	A) Crystallinity	:	Holo crystalline
	B) Granularity	:	Fine grained
	C) Mutual relationship of minerals	:	Equigranular
	D) Shape of the mineral	:	-
3.	Mineral Composition		
	a) Essential Minerals	:	Ferro magnesium, small amounts of quartz.
	b) Accessory Minerals	:	pyroxenes, iron oxide
4.	Structure	:	Massive, Compact
5	Mode of Origin	:	Intrusive igneous rock (DYKES)
6	Distribution in India	:	Jharkhand, all over south India
7	Engineering Properties & Uses	:	It is suitable as railway ballast, bitumen aggregate, and concrete structures.
Result: Based on above physical properties the given specimen is identified as *DOLORITE*			

SEDIMENTARY ROCKS

Details relevant for the study of sedimentary rocks

1. Bedding or stratification

a) Different beds can be recognized based on colour, grain size, texture, hardness andother physical properties.

b) In case of cross bedding sets of layers will not be parallel but mutually inclined.

2. Cementing Material

Calcareous	It imparts white colour and pale colour to sand stones andcan be known by acid test.
Feriginous	Imparts shades of brown, red, or yellow colour to sand stone
Argillaceous	It provides only weak cohesion for sand particles, which fall of rubbing the sand stone
Siliceous	Resembles calcareous cementing material but provides competence and durability to sand stone.
Glaucontic	It provides green colour to sand stone.

3. Fossils

May be plant (leaf) fossils or shells (complete or broken) - common in shales and lime stones.

4. Ripple Marks

Rare, may appear in sandstones, shales and lime stones. These appear as wareundulations on rock surface.

5. Peculiar forms

Concretionary, nodular	**Laterites, Lime stones**
Pisolotic	**Lime stones, Laterites**
Oolitic	**Lime stones**
Solution cavities	**Lime stones**
Lamination	**Shales**

6. Flaggy

Tendency to break in to slab, due to parallel fractures. Sometimes these are noticedin lime stones and sand stones.

7. Fissility

Tendency to split along bedding planes. Some shale has this character.

8. Conchoidal fracture

In dense compact Lime stones, less distinctly in shales

9. Composition

Argillaceous	**Shales**
Arinaceous	**Sand stones**
Calcareous	**Lime stones**

10. Grain Size

Too fine to be seen as separate particles in shales and lime stones.

11. Surface touch

Gritty or rough in sand stones, smooth in shales and lime stones.

SEDIMENTARY ROCK -1			
1.	Colour	:	Reddish brown
2.	Texture		
	A) Grain size	:	Medium to fine grained
	B) Sorting	:	Loose , sometimes compact
	C) Cementing material	:	siliceous material
	D) Shape of grains	:	Rounded
	E) Roundness of grains	:	Poor
3.	Mineral Composition		
	c) Essential Minerals	:	Aluminium silicate
	d) Accessory Minerals	:	-
4.	Structure	:	Bladed bedding
5	Mode of Origin	:	Argillaceous sedimentary rocks
6	Distribution in India	:	Mangalore, Tamilanadu
7	Engineering Properties & Uses	:	As road material and can't be used in construction
Result: Based on above physical properties the given specimen is identified as *Lateriate*			

SEDIMENTARY ROCK -2			
1.	**Colour**	**:**	**Reddish brown**
2.	**Texture**		
	A) Grain size	**:**	**Medium to fine grained**
	B) Sorting	**:**	**Poorly sorted**
	C) Cementing material	**:**	**siliceous material**
	D) Shape of grains	**:**	**Rounded**
	E) Roundness of grains	**:**	**Good**
3.	**Mineral Composition**		
	a) Essential Minerals	**:**	**Flint, Quartz, Jasper**
	b) Accessory Minerals	**:**	**-**
4.	**Structure**	**:**	**Bladed bedding**
5	**Mode of Origin**	**:**	**Mechanically formed**
6	**Distribution in India**	**:**	**Rajasthan**
7	**Engineering Properties & Uses**	**:**	**Can be used as building material, however it is undesirable for major construction works.**
Result: Based on above physical properties the given specimen is identified as *COGLEMERATE*			

SEDIMENTARY ROCK -3			
1.	Colour	:	Reddish, yellow , white
2.	Texture		
	A) Grain size	:	Medium to Coarse grained
	B) Sorting	:	Well sorted
	C) Cementing material	:	siliceous material
	D) Shape of grains	:	Rounded
	E) Roundness of grains	:	Poor
3.	Mineral Composition		
	a) Essential Minerals	:	Quartz
	b) Accessory Minerals	:	Muscovite
4.	Structure	:	Bedding
5	Mode of Origin	:	Arenaceous sedimentary rock
6	Distribution in India	:	AP, Assam, Gujarat, Harayana
7	Engineering Properties & Uses	:	Due to less permeability sand stone is best for all civil engg. Projects.
Result: Based on above physical properties the given specimen is identified as *SANDSTONE*			

SEDIMENTARY ROCK -4			
1.	Colour	:	Reddish, brown, grey , white
2.	Texture		
	A) Grain size	:	Fine grained
	B) Sorting	:	Compact
	C) Cementing material	:	Absent
	D) Shape of grains	:	Undefined
	E) Roundness of grains	:	Undefined
3.	Mineral Composition		
	a) Essential Minerals	:	Silt & Clay
	b) Accessory Minerals	:	-
4.	Structure	:	Sheet like
5	Mode of Origin	:	Argilaceous sedimentary rock
6	Distribution in India	:	AP, Assam, Maharashtra
7	Engineering Properties & Uses	:	Undesirable at site or foundation or civil structures like Dams and tunnels.
Result: Based on above physical properties the given specimen is identified as *SHALE*			

SEDIMENTARY ROCK -5			
1.	**Colour**	**:**	**White, pink, green , blue**
2.	**Texture**		
	A) Grain size	**:**	**Fine grained**
	B) Sorting	**:**	**Absent**
	C) Cementing material	**:**	**Absent**
	D) Shape of grains	**:**	**Undefined**
	E) Roundness of grains	**:**	**Undefined**
3.	**Mineral Composition**		
	a) Essential Minerals	**:**	**Calcite**
	b) Accessory Minerals	**:**	**Magnesium**
4.	**Structure**	**:**	**Laminated**
5	**Mode of Origin**	**:**	**Inorganic sedimentary deposits**
6	**Distribution in India**	**:**	**AP, Assam, Maharashtra**
7	**Engineering Properties & Uses**	**:**	**Compact and massive limestones may be used for construction**
Result: Based on above physical properties the given specimen is identified as *LIMESTONE*			

METAMORPHIC ROCKS

Details relevant for the study of metamorphic rocks

1. Foliation

It refers to the parallel alignment of platy or lamellar minerals in metamorphic rocks.

2. Lineation

It refers to the parallel alignment of prismatic or columnar minerals in metamorphic rocks.

3. Metamorphic minerals

Minerals like garnet, tale, chlorite, graphite are suggestive of metamorphic origin of a rock.

4. Gneissose structure

It is generally observed in granite gneisses where in alternating black (hornblende) and white (feldspars and quartz) colour bands appear.

5. Schistose structure

They have predominantly lamellar (mica, tale, chlorite) or prismatic (hornblende, Kyanite etc) minerals. These do not have any alternating colour bands.

METAMORPHIC ROCK 1			
1.	**Colour**	**:**	**Black or Grey**
2.	**Texture**		
	A) Grain size	**:**	**Fine grained**
	B) Foliation / Lineation	**:**	**Foliation**
3.	**Mineral Composition**		
	a) Essential Minerals	**:**	**Mica, quartz**
	b) Accessory Minerals	**:**	**Biotite, muscovite, talc, chlorite, feldspar, calcite, pyrite**
4.	**Structure**	**:**	**Schistos**
5	**Mode of Origin**	**:**	**Formed due to dynamic metamorphism of shale**
6	**Distribution in India**	**:**	**Rajasthan, A.P**
7	**Engineering Properties & Uses**	**:**	**These are not suitable for site as foundation rocks, but may be used as building stone.**
Result: Based on above physical properties the given specimen is identified as *CHLORITE SCHIST*.			

METAMORPHIC ROCK 2			
1.	Colour	:	Reddish brown
2.	Texture		
	A) Grain size	:	Fine grained to medium grained
	B) Foliation / Lineation	:	Lineation
3.	Mineral Composition		
	a) Essential Minerals	:	Quartz
	b) Accessory Minerals	:	Mica, Garnet, Feldspar, Pyroxine, Chlorite, Magnetite
4.	Structure	:	Granular
5	Mode of Origin	:	Formed due to dynamo-thermal metamorphism of quartzite.
6	Distribution in India	:	Andhra Pradesh, Bihar, Delhi, Haryana, Karnataka, Kerala, Madhya Pradesh, Rajasthan, Tamil Nadu, Uttar Pradesh
7	Engineering Properties & Uses	:	These rocks are used as railway ballast and roadway metal.
Result: Based on above physical properties the given specimen is identified as *QUARTZITE*.			

METAMORPHIC ROCK 3			
1.	Colour	:	White or milky white
2.	Texture		
	A) Grain size	:	Fine grained to medium grained
	B) Foliation / Lineation	:	Lineation
3.	Mineral Composition		
	a) Essential Minerals	:	Calcite
	b) Accessory Minerals	:	serpentine
4.	Structure	:	Granular
5	Mode of Origin	:	Formed due thermal metamorphism of LimeStone.
6	Distribution in India	:	Rajasthan, Gujarat
7	Engineering Properties & Uses	:	These rocks are used as decorative, face stone, statues etc.
Result: Based on above physical properties the given specimen is identified as ***MARBLE***.			

METAMORPHIC ROCK 4			
1.	Colour	:	White , Grey
2.	Texture		
	C) Grain size	:	Coarse grained
	D) Foliation / Lineation	:	Both
3.	Mineral Composition		
	c) Essential Minerals	:	Feldspar, Quartz
	d) Accessory Minerals	:	Hornblende, Mica, Talc, Pyroxenes, Kyanite, Garnet
4.	Structure	:	Equigranular
5	Mode of Origin	:	Formed due dynamo-thermal metamorphism of Granite.
6	Distribution in India	:	Rajasthan, A.P, Karnataka
7	Engineering Properties & Uses	:	As building stone, Road metal and railway ballast.
Result: Based on above physical properties the given specimen is identified as *GNEISS.*			

METAMORPHIC ROCK 5			
1.	Colour	:	Black/Grey
2.	Texture		
	E) Grain size	:	Fine grained
	F) Foliation / Lineation	:	Foliation
3.	Mineral Composition		
	e) Essential Minerals	:	Mica, Quartz
	f) Accessory Minerals	:	Biotite, Muscovite, Talc, Chlorite, Feldspar, Calcite, Pyrite
4.	Structure	:	-
5	Mode of Origin	:	Formed due dynamic metamorphism of shale.
6	Distribution in India	:	Rajasthan, A.P, Karnataka
7	Engineering Properties & Uses	:	As building stone. But not as foundation rock.
Result: Based on above physical properties the given specimen is identified as *SLATE.*			

GEOLOGICAL

MAPS

INTERPRETATION AND DRAWING OF SECTIONS FORGEOLOGICAL MAPS SHOWING TITLED BEDS, FAULTS,
UNIFORMITIES, ETC.

GEOLOGICAL MAPS

Geological Map

A map is described as representation of an area on a plain paper to a scale. The geological map is one which reveals the geological information in terms of topography, litho logy, and geological structure, order of superposition, thickness of beds and geological history of that region. A geological map is a contour map over which geological formations,structures etc are marked.

Civil Engineering Importance

For safe, stable, successful and economical Civil Engineering constructions such as dams, reservoirs, tunnels, etc., detailed geological information is essential. Proper interpretation of a geological map provides all details which a Civil Engineer requires. This study of geological mapsis of great importance.

Aim

The purpose of interpretation of the following maps is not to tackle any specific Civil Engineering project but to equip with all necessary geological information, so as to enable the concerned to utilize the same as the required by the context.

Interpretation

In a geological map, normally contours are marked as dotted lines with elevation value and bedding planes, fault planes etc are marked as continuous lines. The interpretation comprises of details of topography, litho logy, structure and geological history.

Interpretation of Topography

From the study of contour the information noted is about

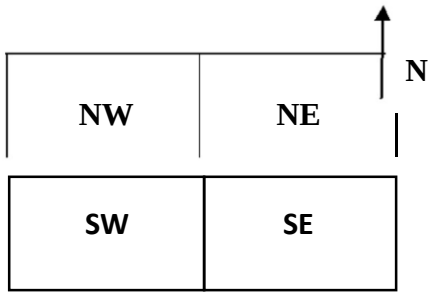
1. Maximum height, Minimum height, Surface relief

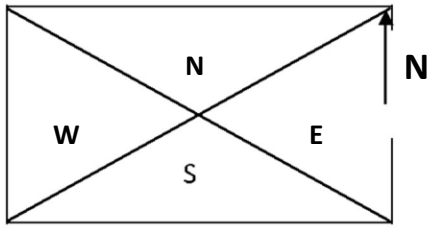
2. Number of Hills, Valleys, ridges, etc

3. Nature of slope, whether it is uniform or

irregular and steep orgentle Relevant details

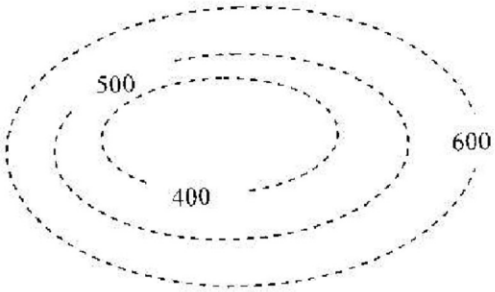
1. **Area in the map indicated as below**



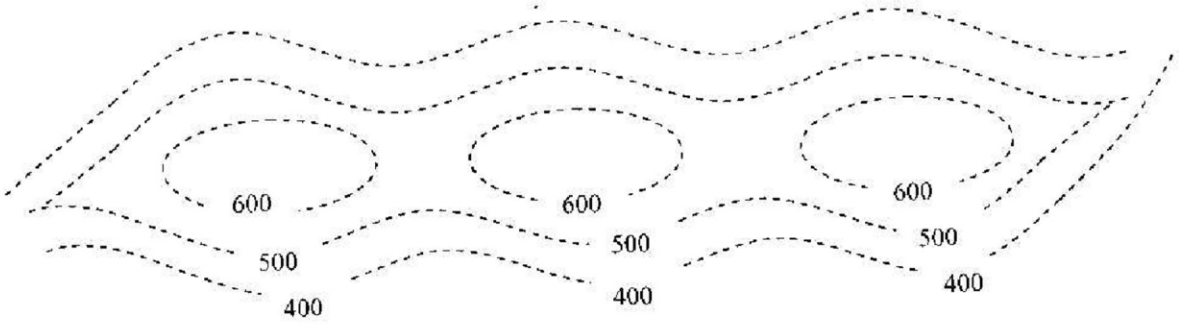


2. Hills or Hill ranges

- Closed contour with contour values increasing inwards
- Repeated appearance of the same in a row is Hill Range
- Contours also indicate the **shape of Hills**



Hill



Hill Range

3. (a) Maximum height is the elevation which is more than the highest contour markedin the map.

(b) Minimum height is the elevation which is less than the lowest contour marked in the map.

(c) Surface relief is the difference between the maximum height and the minimum height.

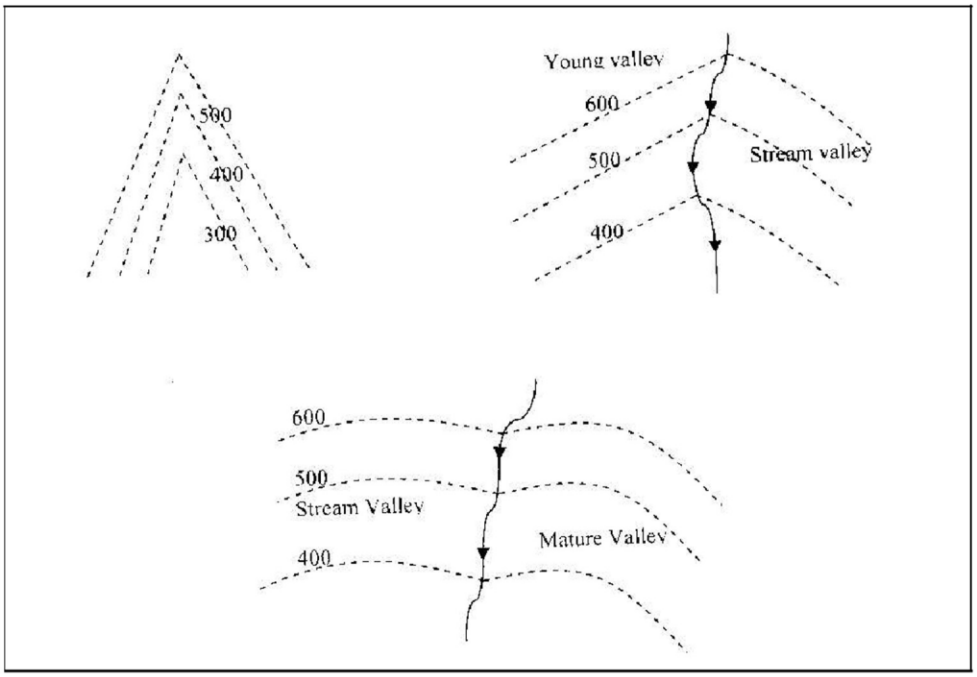
4. (a) Valleys: These are a series of V shaped (sharply bent) contours with successively higher elevation towards the pointed ends (convex side) of the contours.

bends indicates the stage of valley development

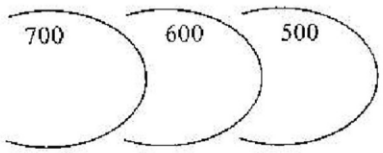
- The sharpness of

contours

Young valleys have sharply contours but mature valleys have bluntly curve

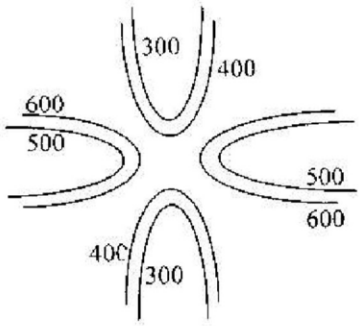


(b) Ridges: These resemble valleys but in these towards the convex side of the contours, successively lower elevations appear.



Ridges

(c) Saddle like structures:



Saddle like structure

SIMPLE STRUCTURAL GEOLOGY PROBLEMS

1. Problem:

The width of an outcrop of shale formation measured in east-west direction is 750m. The straight direction of shale. Formation is North-South dipping with an angle 25º towards East. Determine true and vertical thickness of formation.

Aim : To determine true and vertical thickness of the shale formation.

Objective(s): After solving the problem the student should be able to

1) Determine the true thickness of formation
2) Determine the vertical thickness of formation

Material : Set squares, Protractor, scale, Pencil.Method :

i) Assume scale as 1cm=100m
ii) Draw a horizontal line AB which represents the East-West direction.
iii) Draw one more vertical line on AB line and note it as OP which representsthe North-South direction.
iv) Take point "C" on line AB with a distance 7.5 cm from 1cm away from point A, make a point and note it as "D". CD is the width of outcrop
v) From point "C" draw a line CE at an angle of 25º with respect to line AB towards east direction.
vi) From the point D draw line parallel to CE
vii) Draw a line DI from point D at right angles to the horizontal line to get the vertical thickness and formation.
viii) Draw a perpendicular line GH from line DF to CE, this is the true thickness of formation.

Result : True thickness of formation = 310m Vertical thickness of formation=350m

2. Problem:

The width of an outcrop of a rock formation dipping towards east 200m on ground level. Its vertical thickness is 350m. Determine the amount of its dip and also find true thickness of formation.

Aim : To determine the dip amount and true thickness of formation.

Objective(s): After solving the problem the student should be able to

3) Determine the true thickness of formation
4) Determine the dip amount of formation

Method :

i) Assume scale as 1cm=100m
ii) Draw a horizontal line AB which represents ground level and East-Westdirection.
iii) Draw a vertical line OP on line AB which represents North-South direction.
iv) Take a point "C" on line AB, 1 cm away from "C", from point C measure the out crop as 2cm and mark the point as

D. CD is the width of outcrop.

v) From point D, draw a perpendicular line with a distance of 3.5cm, mark apoint and note it as E.

now line

vi) Join the point C and E with a line CE, representing the bottom of bed.

vii) Draw a line DG parallel to CE, line DG is the top of bed.

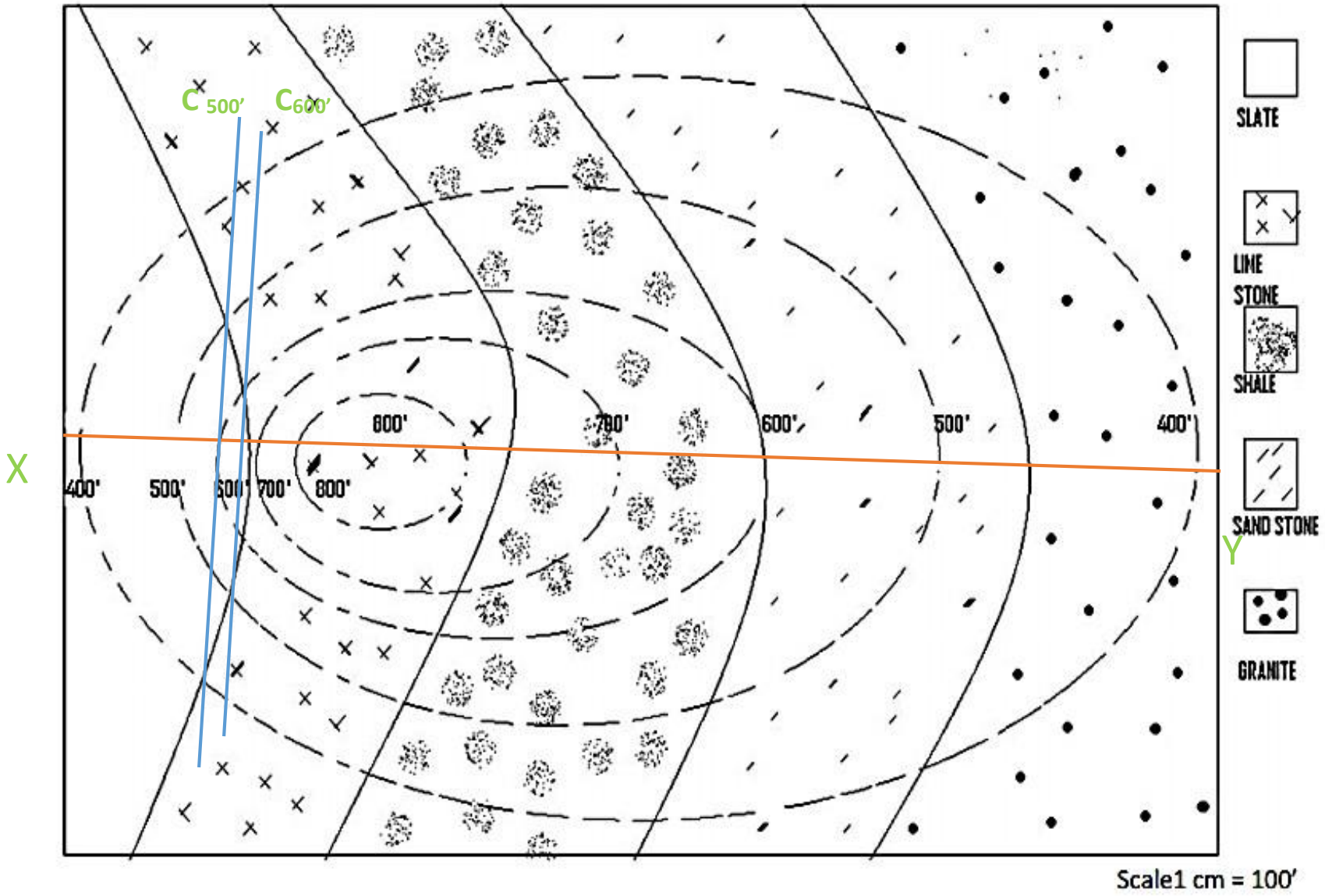
viii) Draw a perpendicular line HI on CG line and extend towards DG line. ThisHI is the true thickness of the formation.

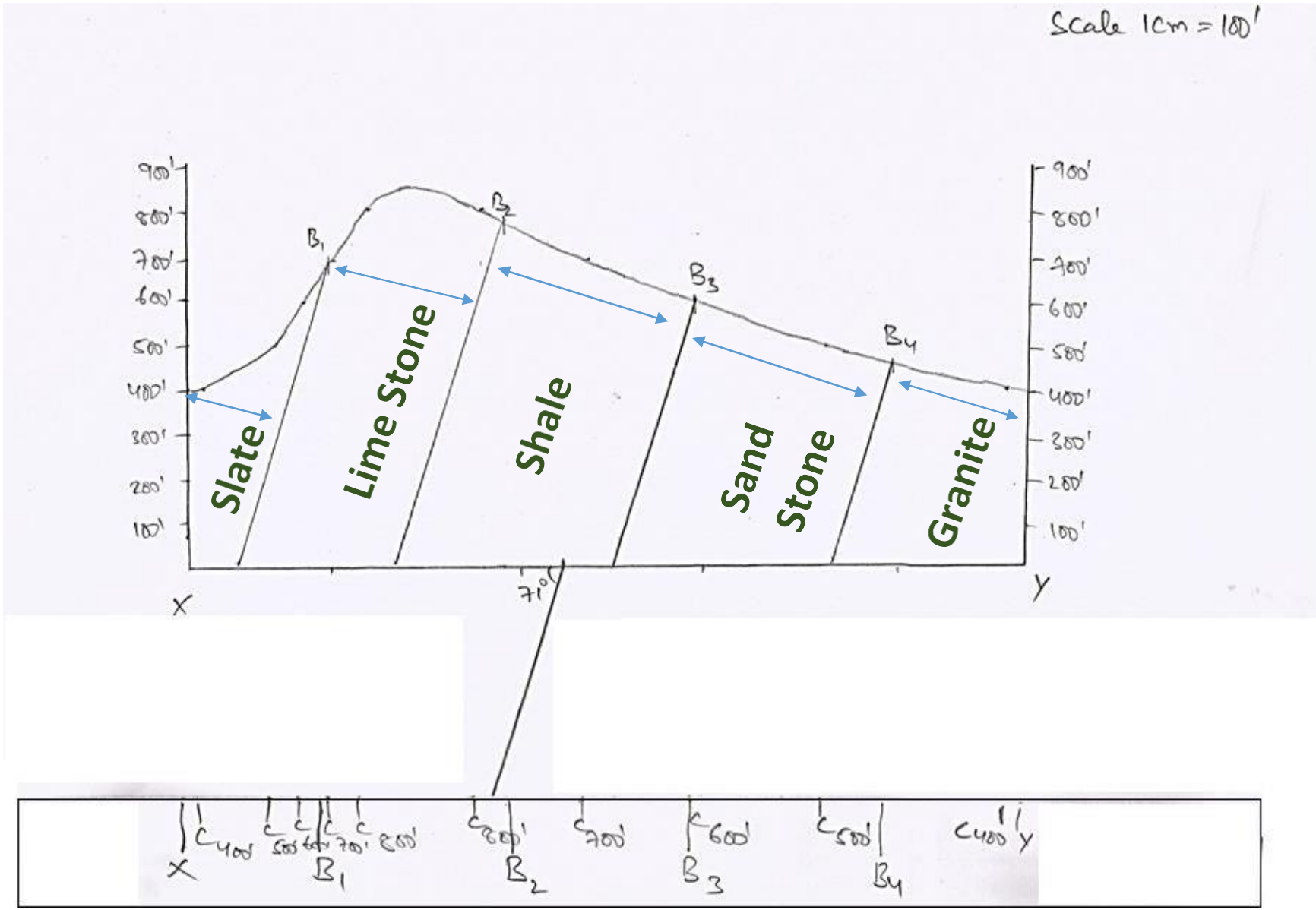
ix) Measure the angle DCE or BDG, this angle give the dip amount of the bed.

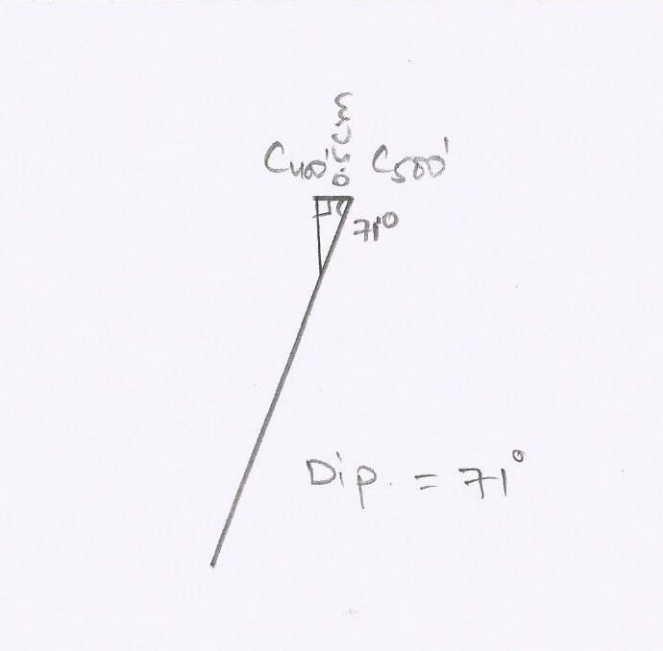
Result : True thickness of formation =

Dip angle of rock =

Q. Draw a neat cross-section of given map and write a brief description?

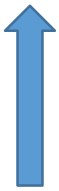



Scale 1cm = 100'
Slate
Lime Stone
Shale
Sand Stone
Granite
B1
B2
B3
B4
X
Y
71°



Map Interpretation

Order of Superpostion:



Slate
Lime Stone
Shale
Sand Stone
Granite

Thickness of beds:

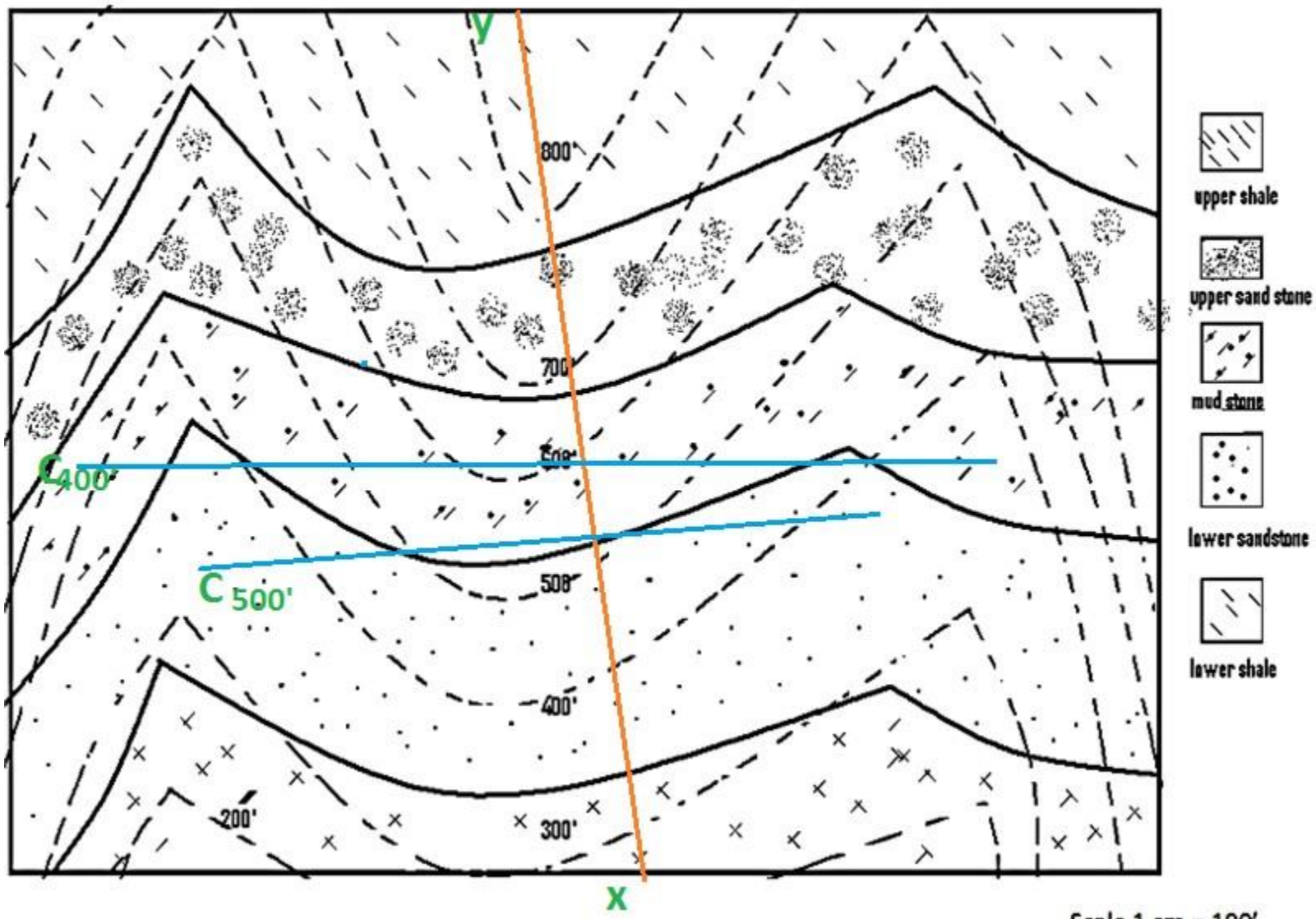
Slate	: Approximately 2.2 cms	= 220’
Lime Stone	: 3.5 cms	= 350’
Shale	: 4.7 cms	= 470’
Sand Stone	: 4.7 cms	= 470’
Granite	: Approximately 4 cms	= 400’

Dip: The beds are dipping toward X-direction with the angle of 71^0

Structure: The given map is showing simple bedding structure where the beds are dipping towards X-Direction.

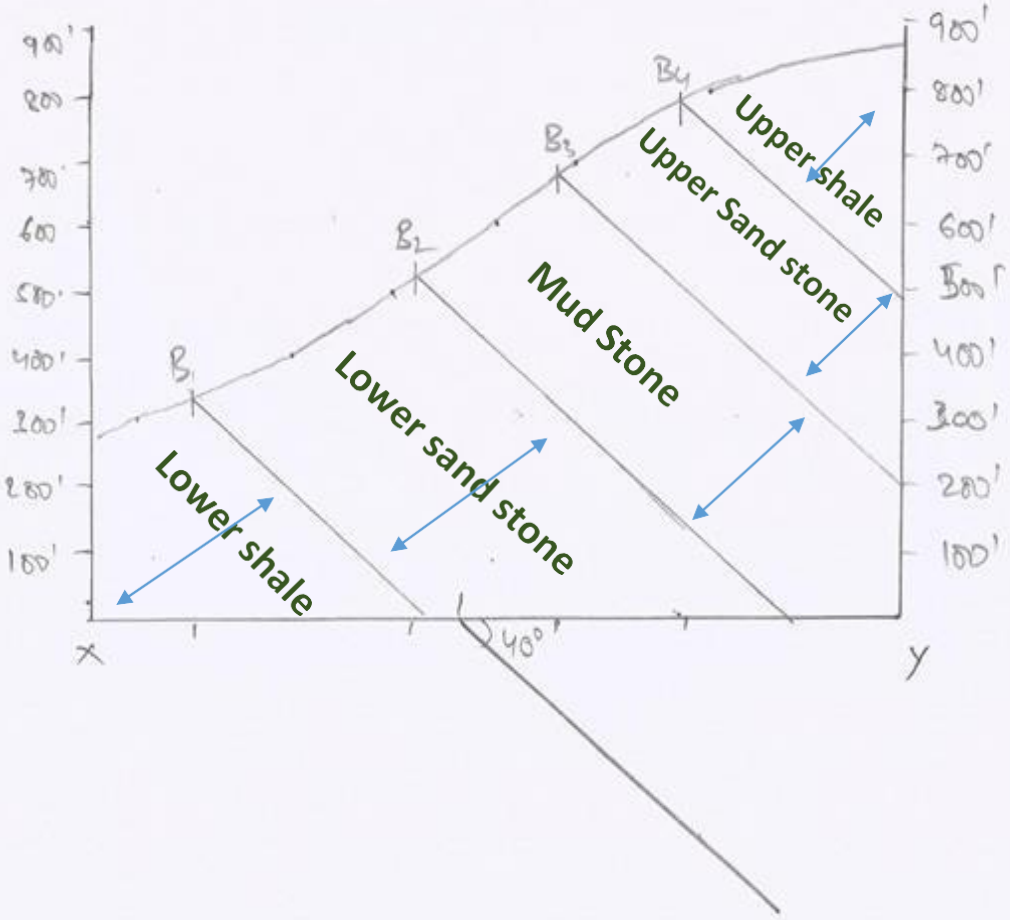
Elevation: Highest Contour is 800’ towards X-direction and Lowest Contour is 400’

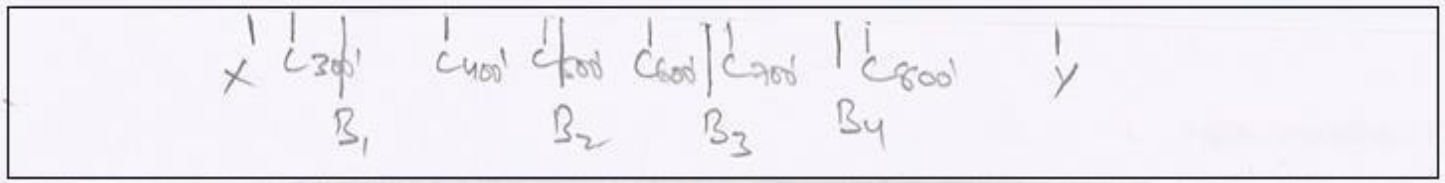
Q. Draw a neat cross-section of given map and write a brief description?

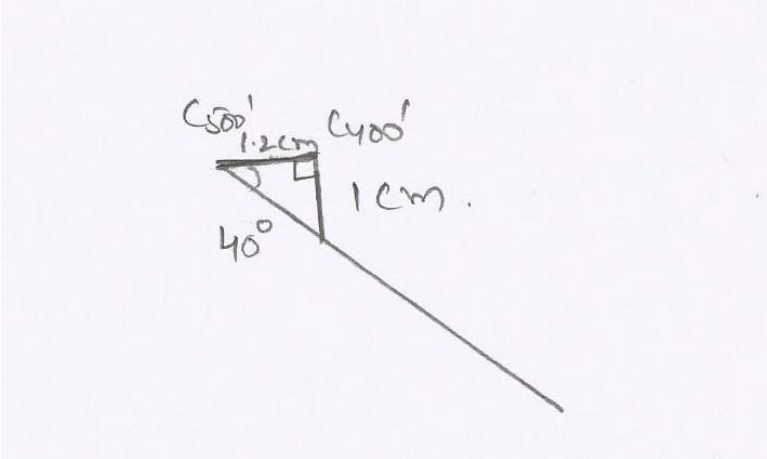


Scale 1 cm = 100'

Scale 1cm = 100'







Map Interpretation

Order of Superposition:

Upper shale
Upper Sand Stone
Mud Stone
Lower Sand Stone
Lower Shale

Thickness of beds:

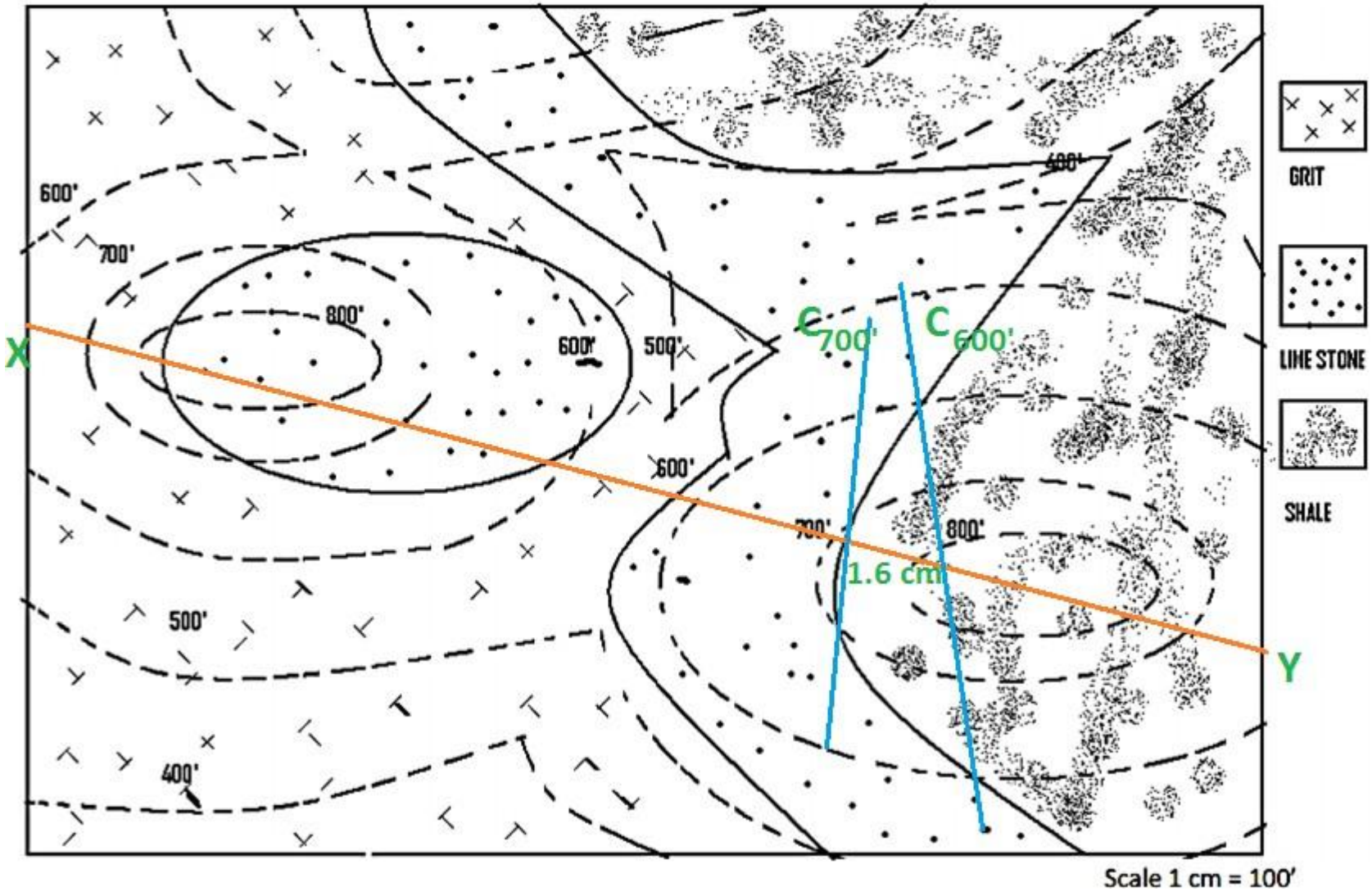
Upper Shale	: Approximately 3 cms	= 300’Upper Sand Stone
		: 2.2 cms = 220’
Mud Stone	: 2.7 cms	= 270’
Lower Sand Stone	: 3.8 cms	= 380’Lower Shale
	: Approximately 3.6 cms	= 360’

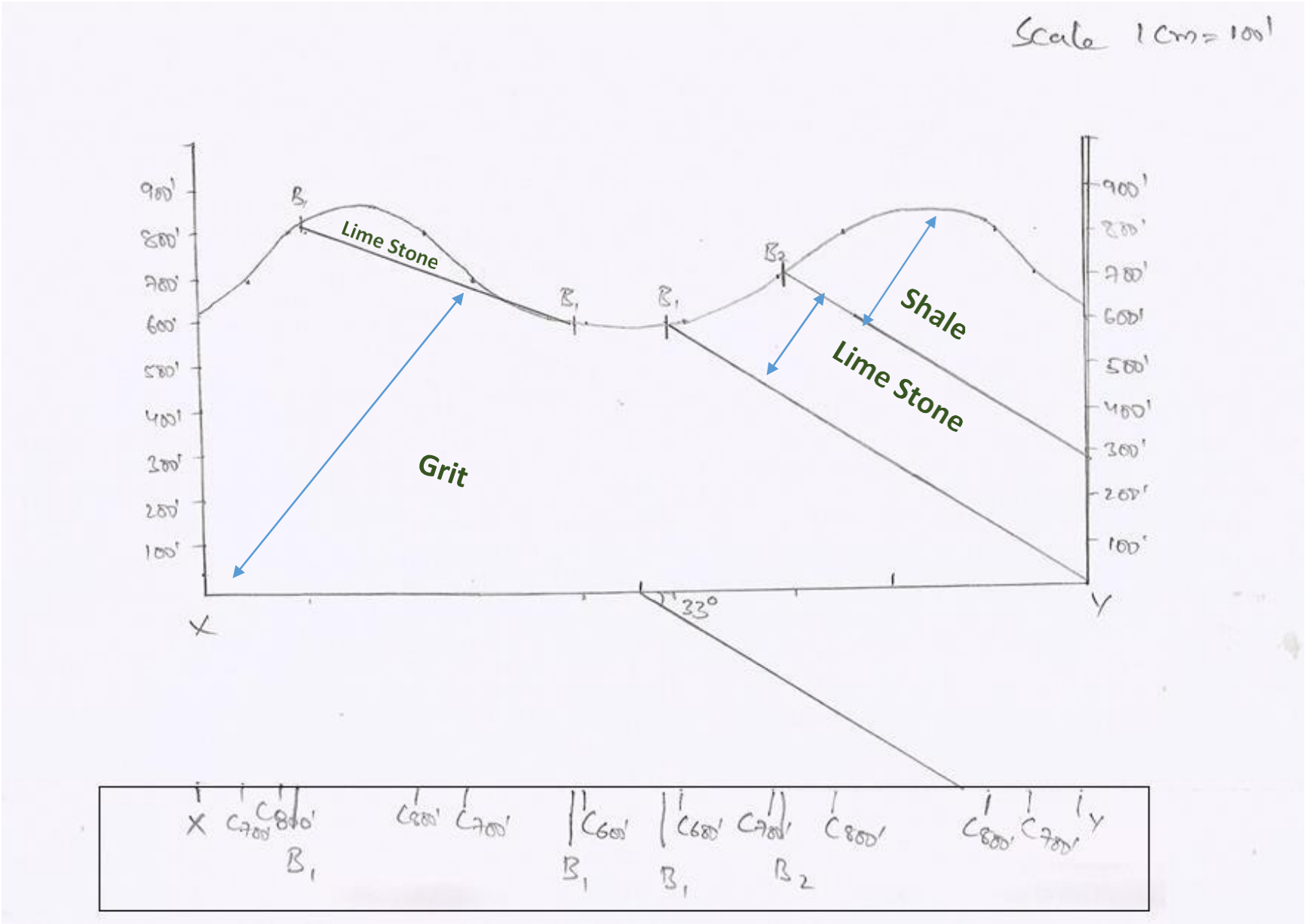
Dip: The beds are dipping toward Y-direction with the angle of 40^0

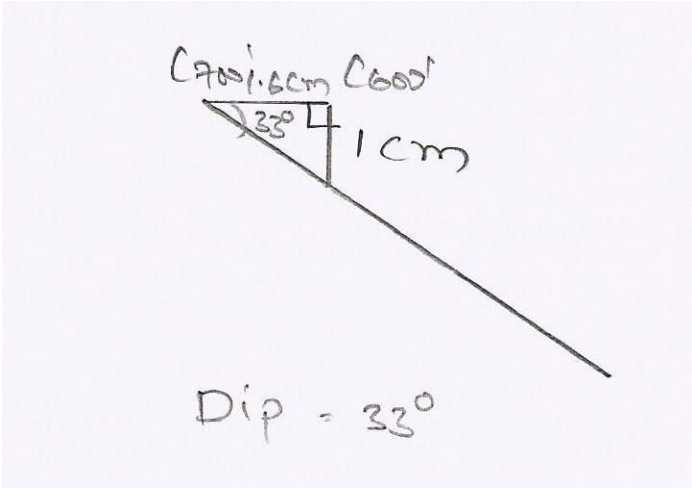
Structure: The given map is showing simple bedding structure where the beds are dipping towards Y-Direction. The repetition of rock indicated that the beds rocks are overturned.

Elevation: Highest Contour is 800’ towards Y-direction and Lowest Contour is 300’towards X-direction.

Q. Draw a neat cross-section of given map and write a brief description?




Scale 1 cm = 100'
Lime Stone
Grit
Shale
Lime Stone
33°
X
Y
B1
B1
B1
B2



Map Interpretation

Order of Superposition:

Thickness of beds:

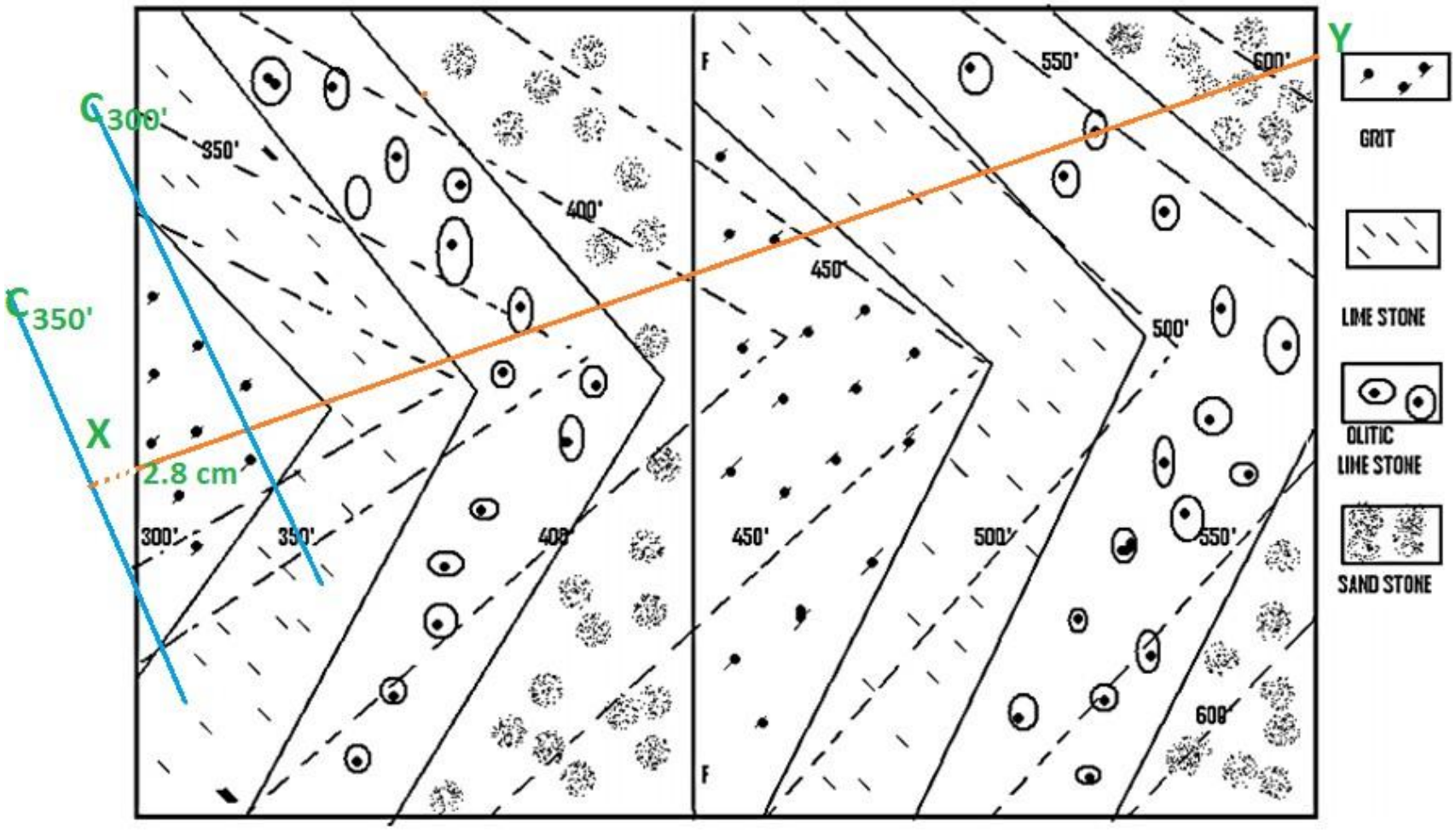
Shale : Approximately 3.4 cms = 340’ Lime Stone : 2.3 cms = 230’ Grit : Approximately 8 cms = 800’

Dip: The beds are dipping toward Y-direction with the angle of 330

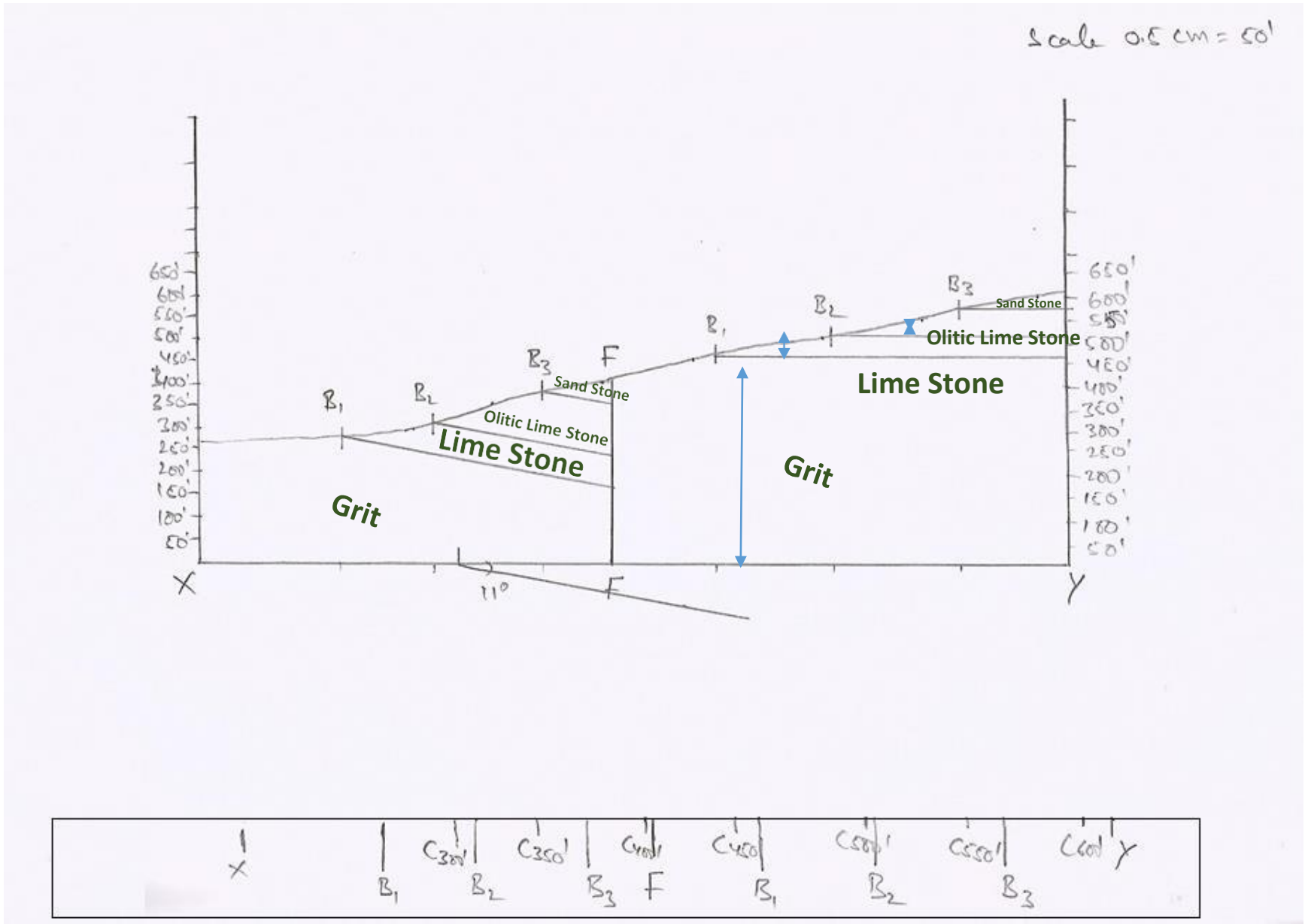
Structure: The given map is showing simple bedding structure where the beds are dipping towards Y-Direction. The repetition of rock indicated that the beds rocks are overturned.

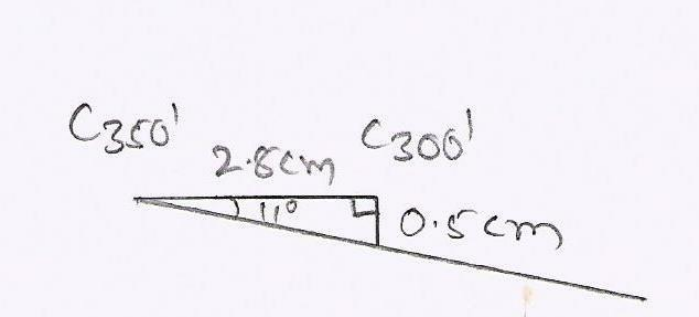
Elevation: Highest Contour is 800’ towards Y-direction and X-Directions, Lowest Contour is 600’ in center of profile.

Q. Draw a neat cross-section of given map and write a brief description?



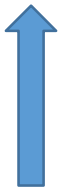
Scale 0.5 cm = 50'


Scale 0.5 cm = 50'
Sand Stone
Olitic Lime Stone
Lime Stone
Grit
Sand Stone
Olitic Lime Stone
Lime Stone
Grit
B1
B2
B3
F
X
Y
11°



Map Interpretation

Order of Superposition:



Sand Stone
Olitic Lime Stone
Lime Stone
Grit

Thickness of beds:

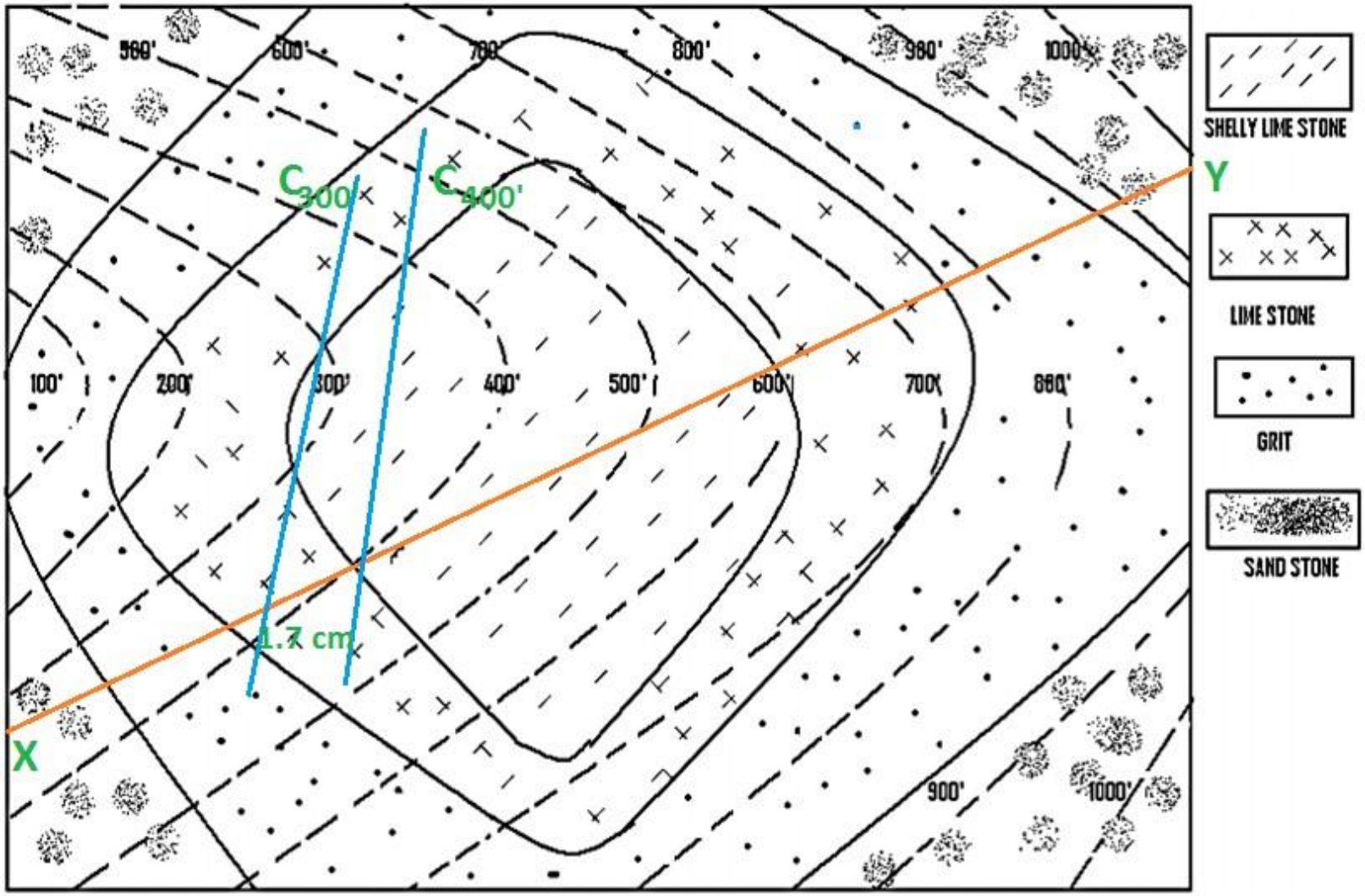
Sand Stone	: Approximately 0.3 cms	= 30’
Olitic Lime Stone	: 0.6 cms	= 60’
Lime Stone	: 0.5 cms	= 50’
Grit	: Approximately 4.6 cms	= 460’

Dip: The beds are dipping toward Y-direction with the angle of 11^0 at left side and0^0 at right side of the profile section.

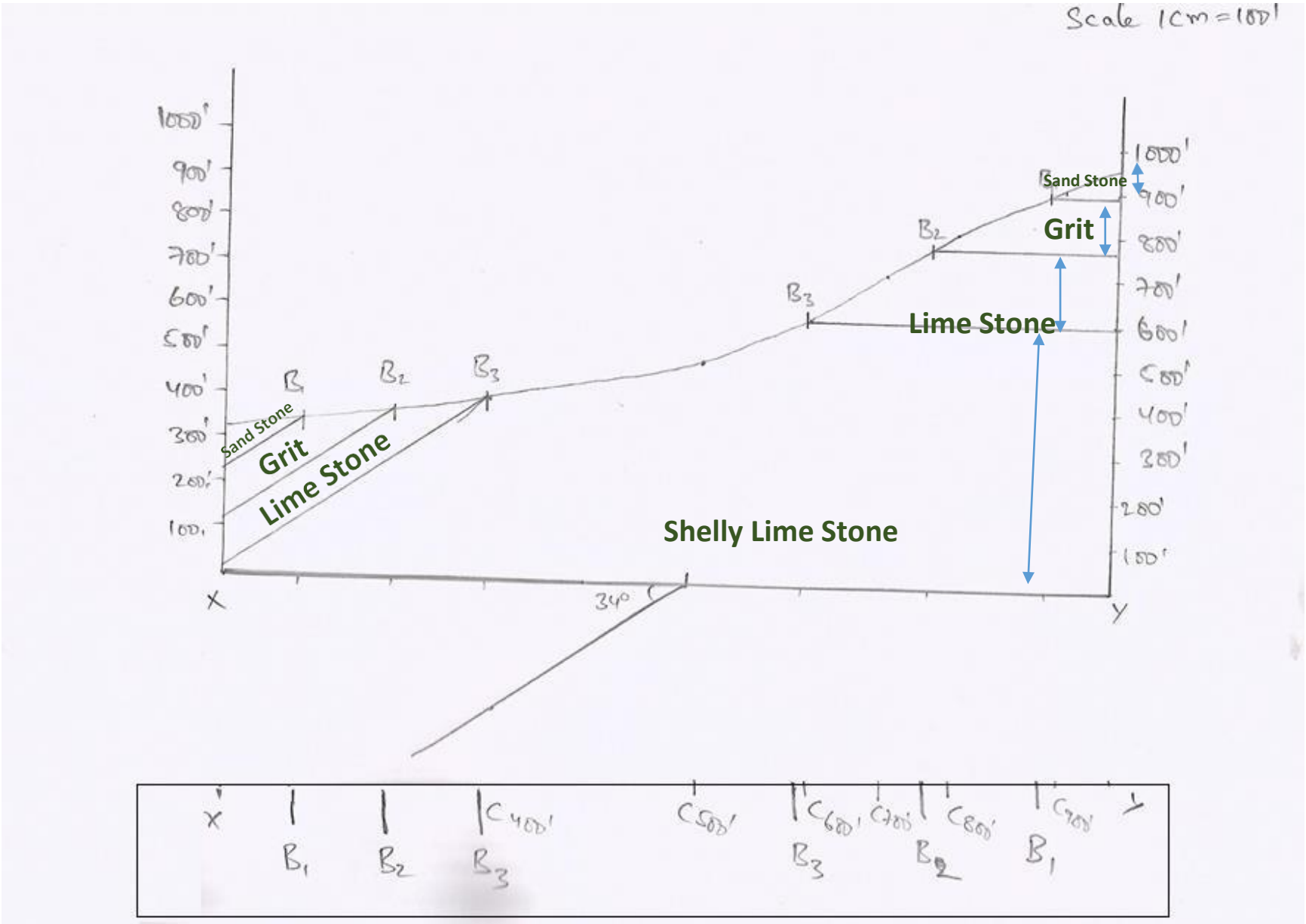
Structure: The given map is showing Faulted structure followed bedding structure where the beds are dipping towards Y-Direction.

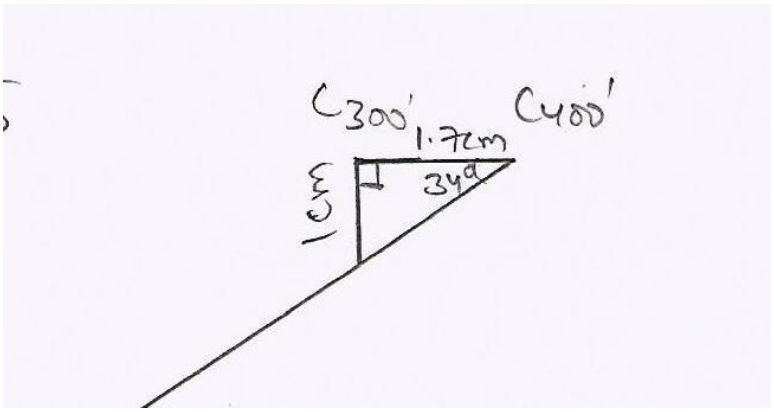
Elevation: Highest Contour is 650’ towards Y-direction and Lowest Contour is 300’towards X-direction.

Q. Draw a neat cross-section of given map and write a brief description?



Scale 1 cm = 100'


Scale 1cm = 100'
Sand Stone
Grit
Lime Stone
Shelly Lime Stone
X
Y
B1
B2
B3
Sand Stone
Grit
Lime Stone



Map Interpretation

Order of Superposition:

Sand Stone

Grit

Lime stone

Shelly Lime Stone

Thickness of beds:

Sand Stone	: Approximately 0.6 cms	= 60’
Grit	: 1.2 cms	= 120’
Lime Stone	: 1.7 cms	= 170’
Shelly Lime Stone		: Approximately 6 cms = 600’

Dip: The beds are dipping toward X-direction with the angle of 34^0 at left side and0^0 at right side of the profile section.

Structure: The given map is showing Folding structure followed bedding structurewhere the beds are dipping towards Y-Direction.

Elevation: Highest Contour is 900’ towards Y-direction and Lowest Contour is 400’towards X-direction.

Techno India NJR Institute of Technology

Engineering Geology Lab (3CE4-25)

B. TECH II– YEAR (III Sem)

Viva Question

1) Write notes on Lithosphere.

Answer: Litho is a Greek word, which means stone. Accordingly the lithosphere is the part of the earth, which is solid crust. The thickness of lithosphere is approximately 50 km. The crust thickness is not the some at all places. It is thicker in the continent and thinner on the ocean floors. Lithosphere is a source of various minerals. It contains variety of landforms such as mountains.plateous valleys, plains.

2) What is meant by NIFE?

Answer: The central part of the earth is called Core or barysphere. It has thickness of 2900km.This layer is made of very hard mineral like Nickel (Ni) and iron (Fe) and so it is called NIFE (Ni + Fe). Here there is intense heat and pressure and this region is elastic and viscous in nature.

3) Distinguish between SIAL and SIMA.

Answer: The upper most layers is called the crust of the earth. It has a thickness of 50 km and thus the crust is made of two layers. Silica (si) and Aluminium (Al) are the elements found in the first layer. Therefore this layer is called SIAL (Si + Al). This layer is also called 'Granitic layer.'

Below the SIAL ties a layer called SIMA which composes of silica (Si) and Magnesium (Mg). This layer is also called Basaltic layer.

4) What are plates?

Answer: The surface of the earth is the crust of the earth. It is made of interlocking pieces called plates. The continents and oceans rest in these places and are separated by wide cracks. The plates move constantly.

5) What is meant by atmosphere?

Answer: The outer gaseous part of the earth starting from the surface and extending as far as 700 km and even beyond is termed atmosphere.It makes only about one-million part of the total mass of the earth.

6) Define sea floor spreading.

Answer: Divergent boundaries occur at Oceanic ridges. In the process of plate separation, the magma rises up from the asthenosphere and fills the gap their created. In this way new crust is created along the trailing edges of the diverging plates. This phenomenon is called sea floor spreading.

7) What are the subdivisions in geology?

Answer: The subdivisions are:

a) Physical geology
b) Geomorphology
c) Mineralogy
d) Petrology
e) Historical geology
f) Economic geology
g) Geohydrology
h) Engineering geology
i) Metrology

8.What is meant by engineering geology?

Answer: Engineering geology may be defined as that of applied sciences which deals with the application of geology for a safe, stable land economical design and construction of a civil engineering project.

9) Define seismology.

Answer: Seismology is a branch of geophysics that deals with the study of elastic waves within the body of the earth during an earthquake.ie.The study of earthquake is called seismology.

10) Give the two types of discontinuity.

Answer: There are two important discontinuities:
Mohorovocic or Moh discontinuity Gutenberg or Oldharm discontinuity

11) Define denudation.

Answer: It is general term used when the surface of the earth is worn away by chemical as well as mechanical actions of physical agents and the lower layers are exposed. This happens when the rocks were exposed for a sufficient length of time to the attacks of physical agents.

12) What is mean by continental crust?

Answer: The continental crust consists of two layers separated by a well-defined discontinuity known as conard discontinuity. The layers have been defined on the basis of seismic waves velocities and densities.

In the upper layer the velocity of seismic waves corresponds to the velocity found by experimental to be characteristic of granite. Hence they are called as Granitic or sialic layer.

13) What is mean by physical weathering?

Answer: It is a physical breakdown of rock masses under the attack of certain atmospheric agents. A single rock block is broken gradually into smaller irregular fragments and then into particles of still smaller dimensions. Temperature variations are irresponsible to a great extent of physical weathering.

15) Define deflation.

Answer: Deflation is the process of simply removing the loose sand and dust sized particles from an area, by fast moving winds. Wind deflation can successfully operate in comparatively dry regions with little pr no rainfall and where the mantle is unprotected due to absence of vegetation.

16) What are Barchans?

Answer: The barchans are crescent or half moon shaped dunes of variable size. Their 'horns' point in the downward direction. Their height may vary from 15-200 mts. And width from a few to 1000s meter. They have a gentle windward slope and steeper leeward slope.

17) Define the terms

i) Focus

ii) Epicenter

Answer:

Focus:

The exact spot underneath the earth's surface, at which an earthquake originates, is known as its focus.

Epicenter:

The earthquake then moves in the from of wave which are spread in all directions. These waves first reach the point at the surface, which is immediately above the focus or origin of the earthquake. This point is called epicenter.

18) What are the causes of earthquake?

Answer: The earthquake may be caused due to various reasons:

Earthquakes due to superficial movements.

Earthquake due to volcanic eruptions. Earthquake due to folding or faulting

19) Define aquifer and the names the types of aquifers.

Answer: Groundwater occurs in permeable geologic formations is known as aquifers.i.e formations having structures hat permit appreciable water to move through them under ordinary field conditions.Aquifers may be classes as unconfined and confined, depending upon the presence or absence of a water table.

20) What do you understand by spheroidal weathering?

Answer: When weathering occurs, part of the disintegrated rock material is carried away by running water or any other transporting agent. Some of them are left on the surface of the bedrock as residual boulders. These boulders are then rounded off to spheroidal cores by the simultaneous attack of eroding agents on all sides. It is often seen that these boulders have an onion like structure. This kind of weathering is called spheroidal weathering.

21) Write short notes on:

***) Porosity**
***) Permability**

Answer:

Porosity:

The portion of a rock or soil not occupied by solid mineral matter may be occupied by ground water. These spaces are known as voids, interstices, pores or pore space. The interstices can act as ground water conduits; they are characterized by their size, shape, irregularity, and distribution.

Permability:

The groundwater is stored in the pores of a rock and will hence be available in the groundrocks. The porosity of the rock, thus defining the maximum amount of water that can be stored in the rock. This is called permeability.

22) What is mean by water table?

Answer: The depth to upper surface of zone of saturation in free ground water is called water table. In other words, a static level of water in wells penetrating the zone of saturation is called water table.

23) What are the movements of the oceans?

Answer: There are three movements of oceans:

i) Waves
ii) Tides
iii) Currents.

Waves are only the rise and fall of water caused by the action of the winds. There is no movement forward. These are at the surface and not at great depth.

Currents are rivers in the sea. The water moves forward and falls at the depth as well. These are caused by the unequal temperature of equator and Polar Regions.

Tides are the rise and fall of seawater occurring twice in a lunar day.

24) Distinguish between magnitude and intensity of the earthquake.

Answer: Intensity of an earthquake may be defined as the ratio of an earthquake based on actual effects produced by the quakes on the earth.

Magnitude (M) of a tectonic earthquake may be defined as the rating of an earthquake based on the total mount of energy released when the over strained rocks suddenly rebound causing the earthquake.

Techno India NJR Institute of Technology

Engineering Geology Lab (3CE4-25)

B. TECH II– YEAR (III Sem)

Quiz

1. Joints running parallel to hinge lines are called _____

a) Hinge joints

b) Radial joints

c) Bedding joints

d) Oblique joints

(b)

2. In which rock, joints may be classified on the basis of their lineation?

a) Sedimentary

b) Igneous

c) Metamorphic

d) Igneous and metamorphic

(d)

3. Joints traverse linear structure right angles in which type?

a) Q joints

b) S joints

c) B joints

d) T joints

(a)

4. Which are the joints parallel to linear structure?

a) Cross joints

b) Longitudinal joints

c) Alternate joints

d) Q joints

(b)

5. The joints developed due to tensile forces are _____

a) Tensile joints

b) Compressive joints

c) Shear joints

d) No particular name

(a)

6. The type of joint occurring in igneous rocks during cooling is _____

a) Shear joints

b) Tensile joints

c) Compression joints

d) Bend joints

(b)

7. Which joints are located in axial regions in the folded rocks?

a) Tension joints

b) Compression joints

c) Shear joints

d) T joints

(c)

8. The joints that are caused due to compressive forces are called as _____

a) T joints

b) C joints

c) Longitudinal joints

d) Compression joints

(d)

9. Compression joints usually occur in which part of fault?

a) Crust

b) Mantle

c) Core

d) Margins

(c)

10. Joints are not common and are very easy structures to study in rocks.

a) True

b) False

(b)