STUDY OF ROCK

The rocks are aggregate mass of minerals. They are the essential materials making the crust of the earth which forms the outer part of the earth.

There are three types of the rocks are as under :-

1. Igneous Rocks
2. Sedimentary Rocks
3. Metamorphic Rocks.

1. IGNEOUS ROCKS :

Igneous rocks are formed from the consolidation of magma below the surface or after its eruption as lava over the surface of the earth..

These rocks are mainly of two types
(a) Intrusive Igneous Rocks
(b) Extrusive Igneous Rocks.

These rocks are also known as primary rocks.

Mineralogical composition :

The Igneous rocks consist of felsic and mafic minerals. The felsic minerals are light in colour and low in specific gravity. They are Quartz, Orthoclase, muscovite plagioclase apatite nepheleme etc. The mafic minerals are dark in colour and high in specific gravity. They are biotite(mica), augite, hornblende, olivine, magnetite, tourmaline etc. These minerals are the main constituents of the igneous rocks.

Texture :

It is defined as the mutual relationship of mineral constituents and glassy matter or ground mass of the rock. It is determined by the size, shape and arrangement of these constituents within them. There are three types of the textures of Igneous rocks.

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(a) Phaneric texture :

When mineral grains in a rock are visible to the naked eye, or with the aid of a pocket lens, the rock is said to have phaneric, texture or the rock is said to be phanerocry--stalline. The mineral constituents may be equal or unequal in size and hence the texture may be called equigranular or Inequigranular accordingly e.g. Granite,Gabbro etc.

(b) Aphanitic :

When mineral grains in a rocks are too small to be seen in hand specimen. The rocks are usually fine grained, in nature. Such rocks are called aphanitic rocks. They may be microcrystalline. e.g. Basalt.

(c) Glassy :

The mineral grains are too small to be seen or distin--guish even in microscope. They are as like as glassy matter. Such rock is known as Glassy. e.g. Obsidian.

Classification :

Classification of Igneous rocks is mainly done on two bases as under.

i) Based on mineral constituents.
ii) Based on mode of occurrence.

Classification based on mineral constituents.

The Igneous rocks are classified as acidic, Inter--mediate, basic or ultrabasic depending on the presence and proportion of Felsic and Mafic minerals. High proportion of felsic minerals in a rock makes the rock acidic to intermediate and high proportion of mafic minerals makes the rock basic to ultrabasic.

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Classification based on mode of occurrence

Based on mode of occurrence the rocks are classified into following three categories.

i) Plutonic Rocks :

These igneous rocks are formed at a deeper depth from the magma below the surface. These rocks are generally phaneric in texture. e.g. Granite, Gabbro, syenite, Diorite etc.,

ii) Hypabyssal Rocks :

These rocks are formed at an intermediate depth from the magma below the surface. These rocks also show phaneric texture. e.g. Dolerite.

iii) Volcanic Rocks :

These rocks are formed on the surface of the earth from the lava. They usually show aphanitic or glassy texture. e.g. Basalt, Obsidian.

Structures

The structures are the visible feqtures of the rocks in field. They may be large scale or small scale features. The igneous rocks show a variety of structures.

(a) Large scale features :

Such as blocky lavas or ropy surfaces of lavas, pillow structures, flow-banding, etc. These structures are mostly shown by volcanic rocks. e.g. Basalt & rhyolite.

(b) Small scale features :

Such features include amygdaloidal structures, spherulitic structures and vesicular structures of volcanic rocks. e.g. Amygdaloidal basalt, vesicular besalt. etc.

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TABULAR CLASSIFICATION OF IGNEOUS ROCKS

	SiO_2 % →	> 66% over saturated	48 % to 66 % Saturated			40% to 48% Under saturated
		Acidic	Intermediate		Basic	Ultrabasic
Texture ↓	Essential Minerals →	Quartz + Orthoclase, Mica, Hornblende.	Felds pathoids + Felspar, mica, Hornblende.	Orthoclase + plagioclase, Quartz, Augite, Mica.	Plagioclase, Augite, olivine.	Hornblence, Biotite, Augite Olivine.
Equigranular phaneric	Plutonic Rocks →	Granite	Syenite	Diorite	Gabbro	Peridotite
Inequigranular.	Hypabyssal Rocks →	← Porphyry →			Dolerite	
Inequigranular	Volcanic Rocks →	Rhyolite, Obsidian, pumice.	Trachyte	Andesite	Basalt Scoriae	

iii) Cementing material :

The grains of various sizes and shapes are cemented together by various types of cementing materials which are supplied during transportation and by percolating water. The various substances which make the cementing materials are silica, calcium carbonate Iron oxide, clay etc. Depending upon the type of substance making the cementing material the various types of cementing materials are named accordingly such as siliceous(SiO_2) calcareous (CaCO3), Ferrugenous (Feo), Argillaceous(Clay) and carbonaceous (Carbon).

Classification :

All the sedimentary rocks are grouped mainly under two divisions (a) Clastic rocks
(b) Non clastic rocks.

(a) They are mechanically formed rocks. The mineral grains are bound by one or more type of cementing materials. Depending on the grain size these rocks are again sub-divided into following types.

(i) Rudaceous rocks :

This group includes the coarse grained clastic rocks.(Grain size is more than 2mm) e.g.Breccia, conglomerate.

(ii) Arenaceous Rocks :

This group includes the medium grained(2-1/16mm) clastic rocks. e.g. Sandstone, greywacke, arkose.

(iii) Argillaceous Rocks :

They are fine-grained clastic rocks. The grain size is less than 1/256 ,,. e.g.Shale, mudstone, clay etc.

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(b) Nonclastic Rocks :

These rocks are chemically and organically formed rocks. They have been formed through precipitation or evaporation of natural mineral solutions.

e.g. Chemically formed rock - Limestone
Organically formed rock- Fossiliferous limestone, coral etc.

Structures :

The sedimentary rocks have mainly three types of structures depending upon their mode of formation.

i) Mechanical structures :

They are stratification lamination, cross bedding current bedding, mud cracks etc.

ii) The chemical structures :

They are concretionary, pisolitic, oolitic, nodular and Geode etc.

iii) The organic structures :

They are fossiliferous, shellular, woody etc.

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3. METAMORPHIC ROCKS :

These rocks are formed due to the action of internal pressure, temperature and chemically active fluids on the pre-existing rocks (i.e. igneous and sedimentary rocks) The pre-existing rocks are altered texturally, and mineralogically and are termed as metamorphic rocks. All changes in the rock-body are due to variation in pressure, temperature and chemically active fluids which are known as agents of metamor--phism and the process is termed as metamorphism.

Mineralogical composition :

The minerals making the metamorphic rocks are generally Quartz, feldspars, micas, amphibole, chlorite, calcite, garnet, stanrolite, tourmaline, tala, etc.

Classification :

The classification of metamorphic rocks is based on the structures, degree of metamorphism and mode of origin. There are mainly two groups.

1. Foliated Rocks :

   e.g. slate, phyllite, schist gneiss etc.

2. Non-foliated Rocks :

   e.g. Quartzite, marble and Hornfels etc.

Structures :

Depending upon the variable effects of temperature and pressure on the pre-existing rocks, a varieties of structures are formed in metamorphic rocks.

i) Cataclastic structure :

It is characterised by the development of extremly fine-grained rock mass. It is produced under the influence of crushing and shearing effects during metamorphism. e.g. Skate.

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ii) Schistose structure :

The rock consists of parallel or sub-parallel bands of flaky, platy or rodelike minerals. It is produced due to temperature and pressure effect during metamorphism. e.g. Phyllite, schist.

iii) Gneissose structure :

The rock consists of bands of flaky or platy minerals alternative with equidimentional minerals of different colours, This is also due to temperature and pressure effects. e.g. Gneiss.

iv) Granulose structure :

In the rock the individual mineral grains are irregular in shape and show interlocking arrangement It is produced due to temperature effects.
e.g. Quartzite and Marble.

-x-x-x-x-x-x-x

RJ/493.

S E D I M E N T A R Y R O C K S

CONGLOMERATE

Texture : The rock is compact, Non crystalline, coarse grained and shows clastic texture.

Mineral Constituents : The rock is composed of rounded and sub-rounded fragments of white and colourless quartz and Jasper which are cemented together by means of white siliceous cementing material. The matrix is hard and can not be scretched with knife.

Conclusion : The clastic texture and coarse nature of the rock suggest its sedimentary origin and rudaceous nature. From the mineral composition it can be identified as sedimentary rock known as CONGLOMERATE.

2. BRECCIA

Texture : The rock is compact, non crystalline, coarse grained and shows clastic texture.

Mineral Constituents : The rock is composed of angular and sub angular fragments of quartz, jasper etc. which are cemented together by ferrugenous (brown) cementing material. The matrix is hard and can not be scretched by knife.

Conclusion : The clastic texture and coarse nature of the rock suggest its sedimentary origin and redeceous nature. From the mineralogical composition it can be identified as Sedimantary rock known as BRECCIA.

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matrix = Ground mass

e.g. Concrete — Aggregate
Cement — mud + water
matrix

3. SANDSTONE

Texture	:	Rock is compact, hard, homogeneous, medium grained, non crystalline and shows clastic texture.
Mineral Constituents	:	The rock is entirely composed of quartz grains of medium size which are cemented together by means of siliceous material which does not give effrvesces with Hcl.
Conclusion	:	The clastic texture and medium grained nature of the rock suggest its sedimentary origin and arenaceous nature. From mineral composition it can be identified as sedimentary rock SANDSTONE.
Uses	:	Used as good building stones, road metals, aggregates etc.
Note :	:	Sometimes stratifed structure may be present and hence the rock is called "Stratified sandstone."

4. SHALE

Texture	:	The rock is moderately compact non crystalline and very fine grained, and shows clastic texture.
Structure	:	The rock shows laminated structure produced by alternate bands of white and dark colour.
Mineral Constituents	:	Since the rock is very fine grained, the mineral constituents can not be identified with naked eye. The earthy smell of the rock indicates that it is essentially composed of clay materials.
Conclusion	:	The texture and laminated structure suggest its sedimentary origin and argillaceous nature. From the mineral comp. it can be identified as sedimentary rock knwon as SHALE

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5. LIMESTONE

Texture : The rock is compact, hard homoganeous, non crystalline and very fine grained nature.

Mineralogical composition : Since the rock is very fine grained the mineral constituents can not be identified by naked eye. It gives effervescance with Hcl. which suggests that the rock is composed of calcareous material-carbonate minerals. Mostly CaCO3. The other impurities like clay and quartz may be present.

Conclusion : The texture and very fine grained nature of of the rock indicate its sedimentary origin and calcareous nature. From the mineral comp. it can be identified as sedimentary rock known as LIMESTONE

Uses : Used as raw material in cement industry, lime manufacturing, flooring tiles etc.

6. FOSSILIFEROUS LIMESTONE

Texture : The rock is moderately compact, non crystalline and shelly in nature.

Mineralogical Comp. : The rock is chiefly composed of fossil shells and skeletones of marine organisms which are cemented together by means of white calcareous material which can be easily scretched and gives effervescence with Hcl. This suggests that the rock is essentially composed of carbonate materials mostly CaCO3 and shells.

Conclusion : Texture and shelly nature of the rock suggests its organic sedimentary origin and qrgilleceous nature from mineral comp. it can be identified as organically formed sedimentary rock known as SHELLY LIMESTONE.

RJ/593.

STUDY OF IGNEOUS ROCKS (PLUTONIC)

GRANITE

GRANITE :

COLOUR : LEUCOCRATIC (LIGHT COLOUR)

STRUCTURE : Massive crystalline

TEXTURE : The given rock specimen is holocrastaline Medium to coarse grained phaneric and equigranular in texture.

MINERALOGICAL COMPOSITION : The rock shows the presence of following minerals which can be identified as under.

1. **QUARTZ :** Colourless & Irregular grains with vitreous lustor.
2. **ORTHOCLASES :** Pink to pale pink dirty white lath shaped crystals with vitreous luster cleavage present.
3. **HORNBLENDE :** Black and elongated crystals with shining luster.
4. **BIOTITE AND MUSCOVITE :** Fine flakes with pearly luster easity scrateher.

CONCLUSION :

1. **TYPE :** Leucocratic colour of the specimen indicates predominance of felsic (light) minerals which classify the rock as an acidic type.
2. **ORIGIN :** Texture and mineral composition of the rock indiciate the plutonic igneous origin for the rock.
3. **NAME :** The given rock specimen is the plutonic igneous rock know as GRANITE

USES : *Good building stones and road metals, aggregates and polished vertities* are used for decorative purposes, table rops, kitchen top etc.

PORHYRITIC GRANITE :

COLOUR : LEUCOCRATIC (LIGHT COLOUR)

STRUCTURE : Massive crystalline.

TEXTURE : The given rock specimen is holocrastaline, coarse grained phaneric and porphyritic in texture.

MINERALOGICAL COMPOSITION : The rock shows the presence of following minerals which can be identified as under.

1. **QUARTZ :** Colourless & Irregular grains with vitreous lustor.
2. **ORTHOCLASES :** Pink to pale pink lath shaped coarse crystals (phenocryst) with vitreous luster cleavage present.
3. ***HORNBLENDE :*** *Black and elongated crystals with vitreous luster.*
4. ***BIOTITE AND MUSCOVITE :*** *Fine flakes with pearly luster easily scratcher.*

CONCLUSION :

1. **TYPE :** Leucocratic colour of the specimen indicates predominance of felsic (light coloured) minerals which classify the rock as an acidic type.
2. **ORIGIN :** Texture and mineral composition of the rock indiciate the plutonic igneous origin for the rock.
3. **NAME :** The given rock specimen is the plutonic igneous rock *know as (PORPHYRITIC GRANITE)*

USES : Building stones and road metals.

SYENITE

COLOUR : LEUCOCRATIC (LIGHT COLOUR)

STRUCTURE : Massive crystalline

TEXTURE : The given rock specimen is holocrastaline medium grained, phaneric and porphyritic in texture.

MINERALOGICAL COMPOSITION : The rock shows the presence of the following minerals which can be identified as under.

1. ***ORTHOCLASES :*** *Pale pink/dull white crystals with vitreous luster cleavage present.*

2. ***PLAGIOCLASE :*** *Whitish or dirty white crystals with vitrous luster.*

3. ***HORNBLENDE :*** *Black and elongated crystals with shining luster.*

4. **BIOTITE AND MUSCOVITE :** Fine flakes with pearly luster easity scratcher.

CONCLUSION :

1. **TYPE :** Leucocratic colour of the specimen indicates *dominance of felsic (light coloured) minerals which* classify the rock as sub- acidic type or intermediate typel.

2. **ORIGIN :** Texture and mineral composition of the rock indiciate the plutonic igneous origin for the rock.

3. **NAME :** The rock specimen is the plutonic igneous rock know as SYENITE

USES : Building stones and road metals, table, kitchen tops and decorative purposes when polished.

GABBRO

COLOUR : Meso cratic (Intermediate colour)

TEXTURE : The given rock specimen is holocrastaline and equigranylar in texture.

MINERALOGICAL COMPOSITION : The rock shows the presence of the following minerals which can be identified as under.

1. PLAGIOCLASE : Greyish white crystals with vitreous luster.
2. AUGITE : *Creenish black crystal with shining luster.*
3. HORNBLENDE : **May be present as** Black crystals.
4. MAGNETITE : *Black grains*
5. BIOTITE : *Fine flakes of dark brown colour with pearly shinging luster, easily scratched, the mafic minerals form about* 50 of the rock bulk.

CONCLUSION :

1. TYPE : Melanocratic colour of the rock indicates *predominance of mafic (dark coloured) minerals which* classify the rock as Basic type.
2. ORIGIN : Texture and mineral composition of the rock indiciate the plutonic igneous origin for the rock.
3. NAME : The given rock specimen is the plutonic igneous rock know as GABBRO.

USES : *Building stones and road metals, aggregates etc.*

PEGMATITE

TEXTURE : The give rock specimen is very coarse grained holocrastaline and Shows hypidiomorpaic texture. The rock is lecocratic in colour.

MINERAL CONSTITUENTX : The following are the essential minerals

1. **QUARTZ :** It occurs as colourless or smoky crystals of large size with vitreous luster.

2. **ORTHOCLASE :** It occurs as dull white of pink crystals of large size with vitreous luster.

Besides above minerals sometimes rock may contain biotit, muscovite and tourmal-in occasionally.

CONCLUSION :

1. The texture of the rock suggests the plutonic hypabyssal origin. for the rock.
2. The mineralogy of the rock reveals the more acidic nature of rock as there occurs large amount of free silica (quartz) thus the given rock specimen is acidic plutonic hypabyssal igneous rock known as PEGMATITE.

USES : Large crystals of quartz & feldspar present in the rock serve as raw materials for ~~ceramic~~ ceramic industries.

PRACTICAL NO. 6

IDENTIFICATION OF IGNEOUS ROCKS (VOLCANIC)

1) RHYOLITE

Colour: Leucocratic (light colour).

Structure: Flow structure is clearly visible.

Texture: The given rock specimen is very fine grained, merocrystalline and aphanitic in texture.

Mineralogical Composition: The given rock specimen is fine grained and hence the minerals cannot be identified by naked eye. But from the colour of rock, it can be said that the light coloured minerals may be present.

Conclusions:

i) Type: Leucocratic colour of the rock indicates predominance of felsic minerals, which classify the rock as an acidic type.
ii) Origin: Texture and flow structure of the rock indicates the volcanic igneous origin for the rock.
iii) Name: The given rock specimen is Rhyolite.

2) OBSIDIAN (RHYOLITE GLASS)

Texture: The given rock specimen shows glassy or holohyaline texture and melanocratic colour with marked conchoidal fracture.

Mineral Constituents: Due to glassy nature of the rock, the mineral constituents cannot be identified. The rock is glassy, showing vitreous luster and conchoidal fracture. Black colour indicates the presence of mafic minerals, which chiefly include augite and magnetite.

Conclusion: From the glassy texture, black colour and marked conchoidal fracture it can be said that the given rock specimen is ~~acidic~~ basic volcanic igneous rock known as Obsidian.

3) PUMICE

Texture: The given rock specimen is very rough, light in weight, spongy and like mass with highly vesicular texture. It is light in colour.

Mineral Constituents: As the rock is very fine grained the mineral constituents can be identified microscopically. But since the rock is very light and like mass, it can be said that it is composed of acid. The escaped gases have produced the vesicular structure of the rock. Due to very low specific gravity these rocks float on water.

Conclusion: From the texture, colour and spongy nature of the rock, it can be concluded that the given rock specimen is volcanic igneous rock known as pumice.

4) BASALT

Colour: Melanocratic.

Structure: Massive crystalline.

Texture: The given rock specimen is very fine grained and hence the minerals cannot be identified with naked eye. But from melanocratic colour of the rock, it can be said that it may be composed of mafic minerals like plagioclase and augite.

Conclusion:

i) Type: Melanocratic colour of the rock indicates predominance of mafic minerals like plagioclase and augite.
ii) Origin: Very fine-grained structure of the rock indicates volcanic igneous origin.
iii) Name: The given rock specimen is known as Basalt.

Varieties of Basalt:

Vesicular Basalt: When basalt contains open cavities on the surface it is known as vesicular basalt.

Amygdaloidal Basalt: When the basalt contains partly or completely filled up cavities with secondary minerals like calcite, zeolite, quartz etc., then these varieties are called amygdaloidal basalt.

Scoriaceous Basalt: Rock is dark red in colour and contains numerous interconnected empty cavities and hence it is porous. The structure is called scoriaceous structure. Due to high specific gravity it does not float on the water.

SPECIMEN NO. 26

GNEISS

1 GNEISS

Texture: The rock is medium to coarse grained, hard, compact and crystalline in texture.

Structure: Gneissose/banded/Augen

Mineralogical Composition:- The rock is composed of the following minerals which can be identified as under:-

i) Quartz:- Colourless grains and lenticular crystals with vitreous luster./Cleavage absent.

ii) Orthoclase:- Dull white and lenticular crystals with vitreous luster H-6, cleavage distinct.

iii) Hornblende:- Black and elongated crystals with vitreous luster.

iv) Muscovite and Biotite: Fine flakes with pearly-shining luster which are easily scratched.

Conclusion: From the crystalline texture banded/gneissose structure and mineralogical composition, it can be identified as metamorphic rock known as GNEISS.

Uses: Building stones, road metals, aggregates etc. depending on the quality of the rock.

Note:

i) Banded Gneiss: If alternate bands of light and dark minerals are present, the rock is called Banded Gneiss

ii) Augen Gneiss: If gneissose structure resembling to "eye-like" (Augen) structure, is present, it is called Augen Gneiss.

SPECIMEN NO 25 .....

SCHIST

2 SCHIST.

Texture:- The rock is crystalline compact and shows foliated nature.

Structure:- Schistose/foliated

Mineralogical Composition:- The rock is mainly composed of flaky and rod-like minerals which are identified as under:

i) Muscovite & Biotite — Large amount of flakes with pearly luster. The flakes produce the foliated nature of the rock and are easily scratched; cleavage distinct.

ii) Hornblende:- Black, elongated crystals with vitreous luster.

iii) Tremolite & Actinolite — Needle like crystals with vitreous luster.

Conclusion: From the texture, structure and mineral composition it can be identified as metamorphic rock known as SCHIST

Varieties: Depending on the presence of a specific mineral, the rock is named after that mineral prefixing with mineral name.

e.g. i) Staurolite schist ii) Andalusite schist
iii) Talc schist iv) Chlorite scist
v) Garnet schist vi) Hornblende schist etc,

N.B. Moreover, Quartz, Kyanite, Staurolite, Garnet, Chlorite etc. may be present according to the varieties.

131, 13E

SPECIMEN NO. 23

SLATE

3 SLATE

Texture: The rock is dark, compact hard and very fine grained in texture.

Structure: Foliated i.e. the rock is thinly cleavable due to slaty cleavage which has given foliated nature to the rock.

Mineralogical Composition :- Due to the very fine grained nature of the rock the mineral constituents can not be identified with naked eye. Chlorite, Sericite and Quartz may be present.

Conclusion: From the texture and slaty cleavage(foliated nature) of the rock it can be identified as metamorphic rock known as SLATE

Uses: Roofing & paving materials, table tops etc.

N B : Some time due to very poor foliated nature the slate in hand specimen looks like a limestone. In such a case acid test is performed i.e. Limestone gives effervesces with Hcl while slate does not.

SPECIMEN NO ..24....

PHYLLITE

4 PHYLLITE

Texture: The given rock specimen is thinly cleavable, hard, compact crystalline, lustrous and shws foliated structure developed by minute scals of mica which suggest its metamorphic origin.

ROCK COMPOSITION:-

As the rock is finely crystelline, the individual mineral identification is not possible with unaided eye. But the flaky minerals are distinct. The rock is mainly composed of flaky minerals chlorite, muscovite, sericite and quartz grains.

The partly developed foliation/schistosity in the rock suggests the further metamorphism of slate rock with the larger growth of flaky minerals.

CONCLUSION: From the finely crystelline, foliated and lustrous nature of the rock and mineral constituents it can be concluded that the given rock specimen is metamorphic rock known as PHYLLITE.

SPECIMEN NO 27.....

QUARTZITE

5 QUARTZITE

Texture: The rock is hard, compact, crystalline and homogeneous in nature. The fracture surface gives saccharoidal appearance to the rock.

Composition: It is entirely composed of quartz grains interlocked due to pressure and temperature effects. The quartz is Greenish in colour with vitreous lustre. Cleavage is absent, hardness - 7

Concluaion: From the texture and mineral composition it can be identified as metamorphic rock known as QUARTZITE

Uses Building stones, road metal and in ceramic industries as raw material.

N.B.: Quartzite also occures in light pink colour, white and colourless translucent varieties.

SPECIMEN NO. 28

MARBLE

6 MARBLE

Texture : The rock is hard, compact crystalline and shows granoblastic texture. The fracture surface of the rock is brillient and gives saccharoidal appearance.

Mineralogical Composition:- The rock is homogeneous and gives effervesces with Hcl (hydrochloeric acid) which indicates that it is composed of carbonate minerals chiefly $CaCO_3$ ~~xmxx~~ which can be scratched with copper foil.

Conclusion:- Crystalline nature, saccharoidal appearance and mineral composition of the rock suggest that it is a metamorphic rock known as MARBLE

Uses:- Used as ornamental stones, statues, table tops and in pavings, wall facing etc.