PETROLOGY

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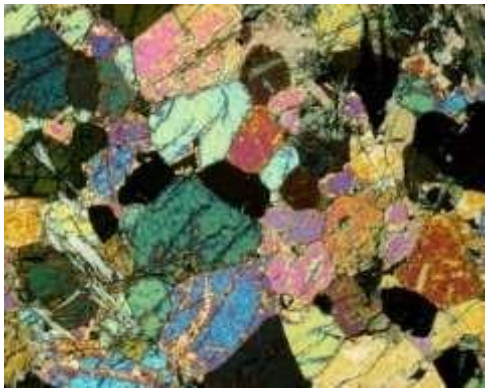
PETROLOGY AND ITS DEFINITION

Petrology (from Greek: Petra, rock; and logos, knowledge) is the branch of GEOLOGY that studies rocks, and the conditions in which rocks form.

The subject matter of PETROLOGY consists the origin, association, occurrence, mineral composition, chemical composition, texture,structure,physical properties, etc., of rocks .

Where as PETROGRAPHY deals with the descriptive part of rocks and PETROGENY deals with the mode of formation of rocks.

These two together makeup Petrology



GEOLOGICAL CLASSIFICATION OF ROCKS

The rocks are classified in various ways based on different principles such as Physical, Chemical 'n' Geological Classifications. Among the different classifications. Geological classification of rocks is the most proper because grouping of rocks is more logical , less ambiguous, orderly and comprehensive.

The Geological classification of rocks is based on their their MODE OF ORIGIN. They are

1) *IGNEOUS ROCKS*
2) *SEDIMENTARY ROCKS and*
3) *METAMORPHIC ROCKS.*

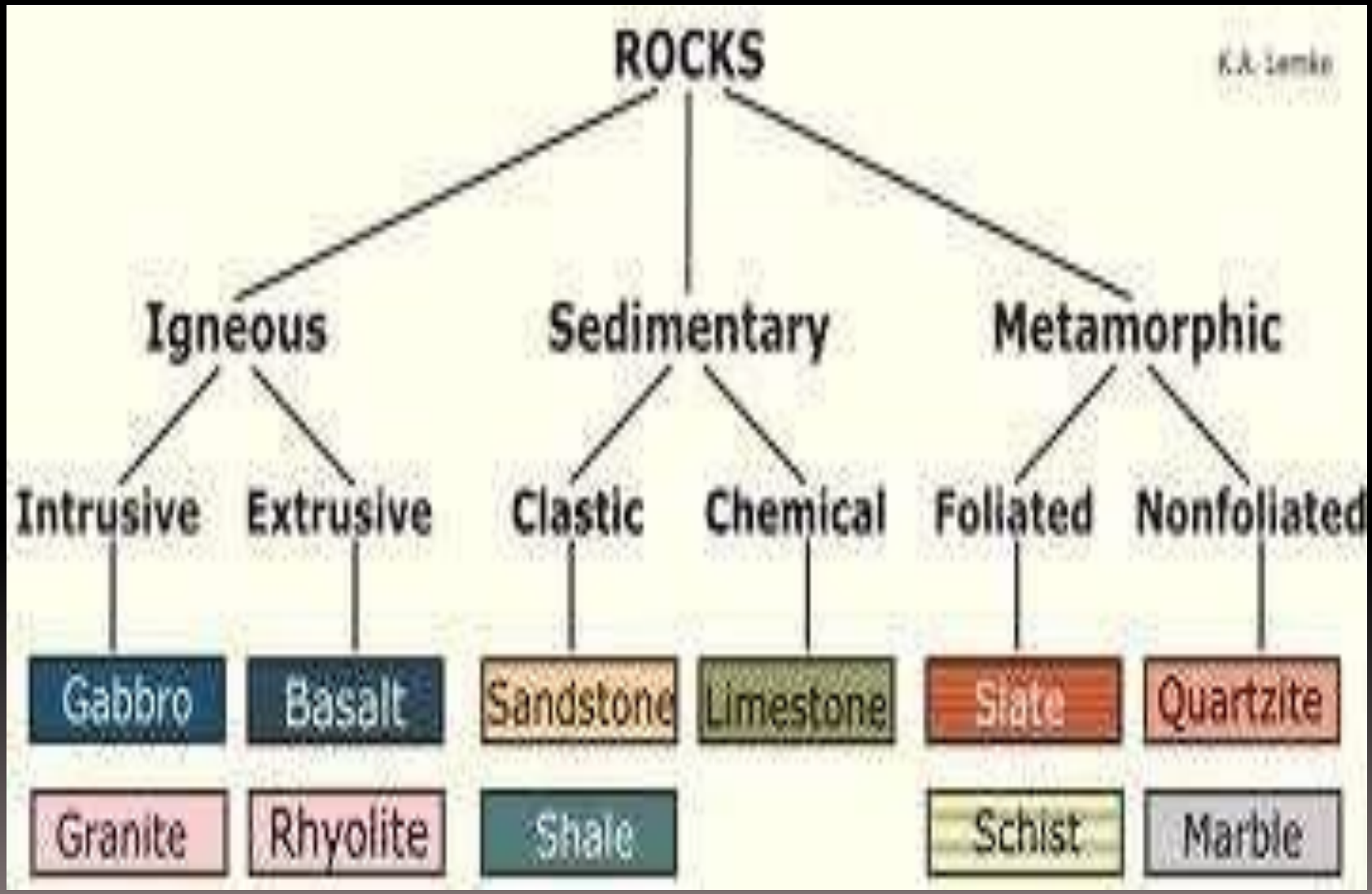
DEFINITIONOF ROCK

Natural solid massive aggregate of minerals forming the crust of the earth.

(or)

An unit of the earth's crust which is formed with minerals.

CLASSIFICATION CHART



IGNEOUS ROCKS

These are primary rocks, Most abundant rocks in the earth's crust.

These are formed at a very high temperature and pressure conditions directly as a result of solidification of magma or lava.

MAGMA: The term magma is applied when the melt is underground.

LAVA: The melt when it reaches the earth's surface and flows over it, is called lava.

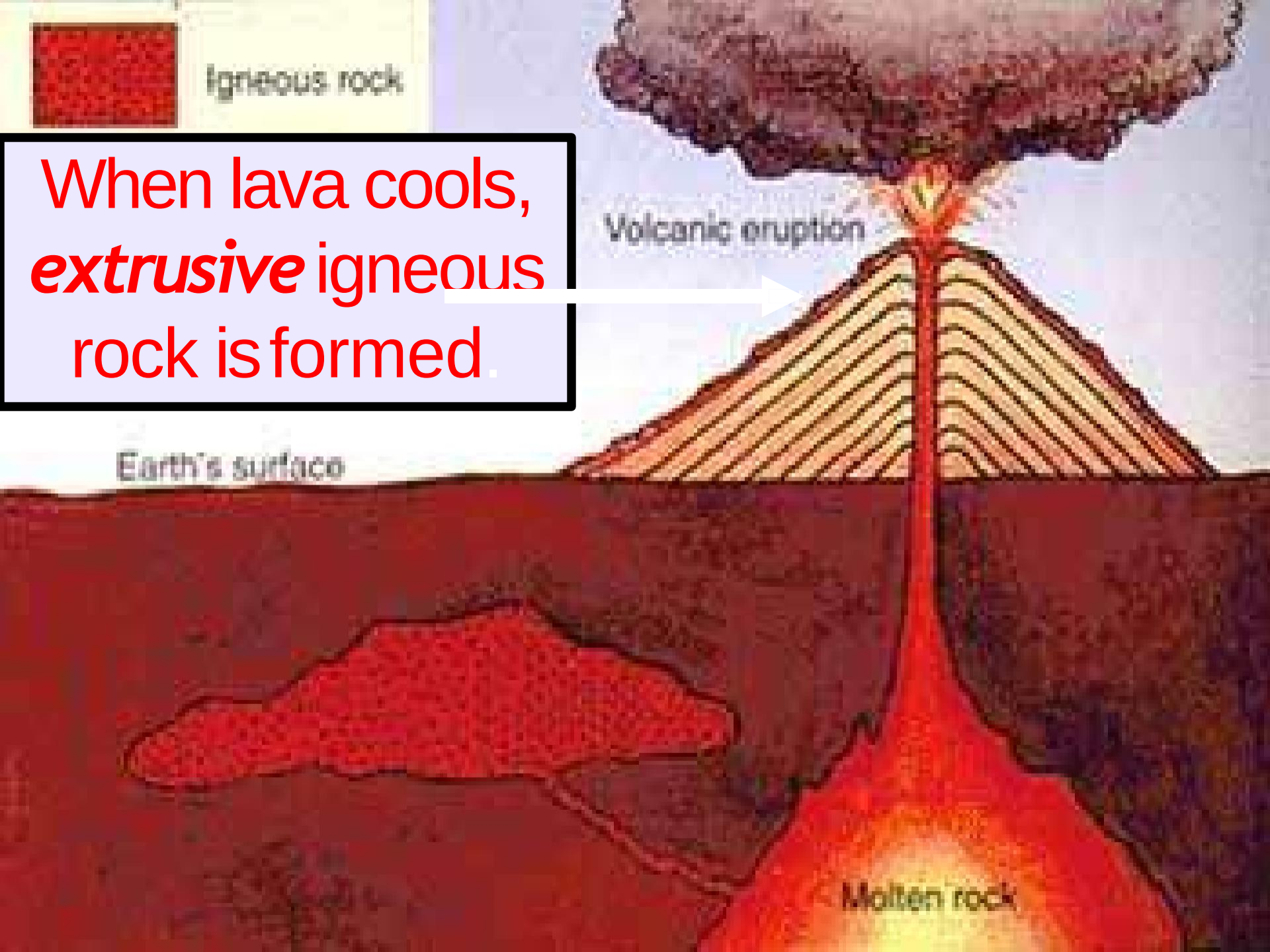
SOME IGNEOUS ROCKS

Types of Igneous rocks

- *Volcanic or Extrusive*
- *Plutonic or Intrusive*
- *Hypabyssal*

Volcanic/ Extrusive rocks

- *Rocks that results when lava solidifies*
- *These rocks cools quickly and usually has small grains*
- *Some rocks cools so fast and don't has grains at all*
- *Eg: The Deccan traps of India spread over more than 4 lakh sq.km in Peninsular India*



When lava cools, ***extrusive*** igneous rock is formed.

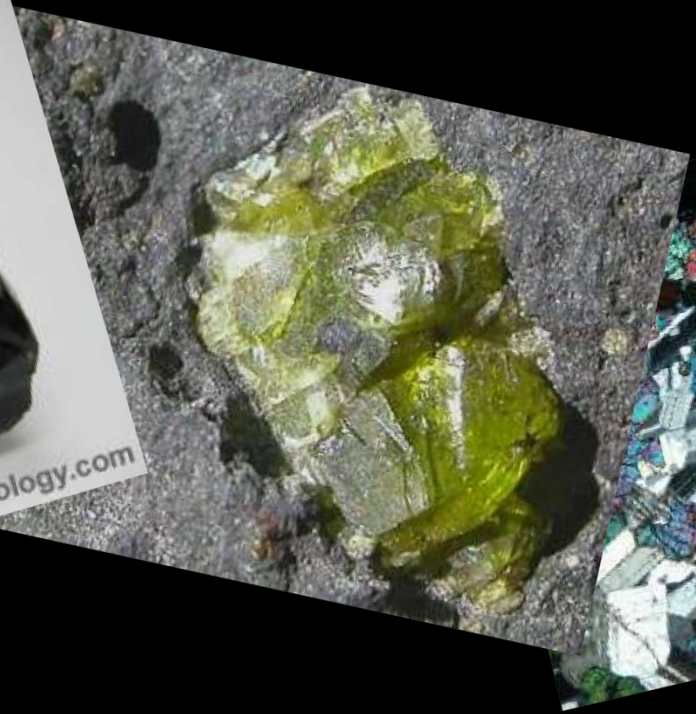
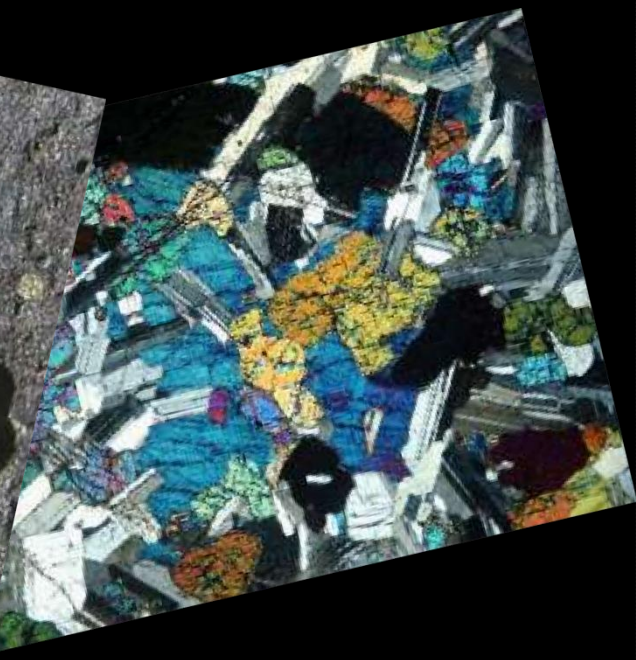
Melt

✓*liquid portion of a magma body.*

✓*composed of ions that move about freely.*

Crystallization

✓*random movements of the ions slow, and the ions begin to arrange themselves into orderly patterns.*

- *cooling strongly influences crystal size.*
- ✓ *slow cooling results in the formation of large crystals.*
- ✓ *quick cooling results the formation of solid mass of small intergrown crystals.*

Basalt

Andesite

Olivine

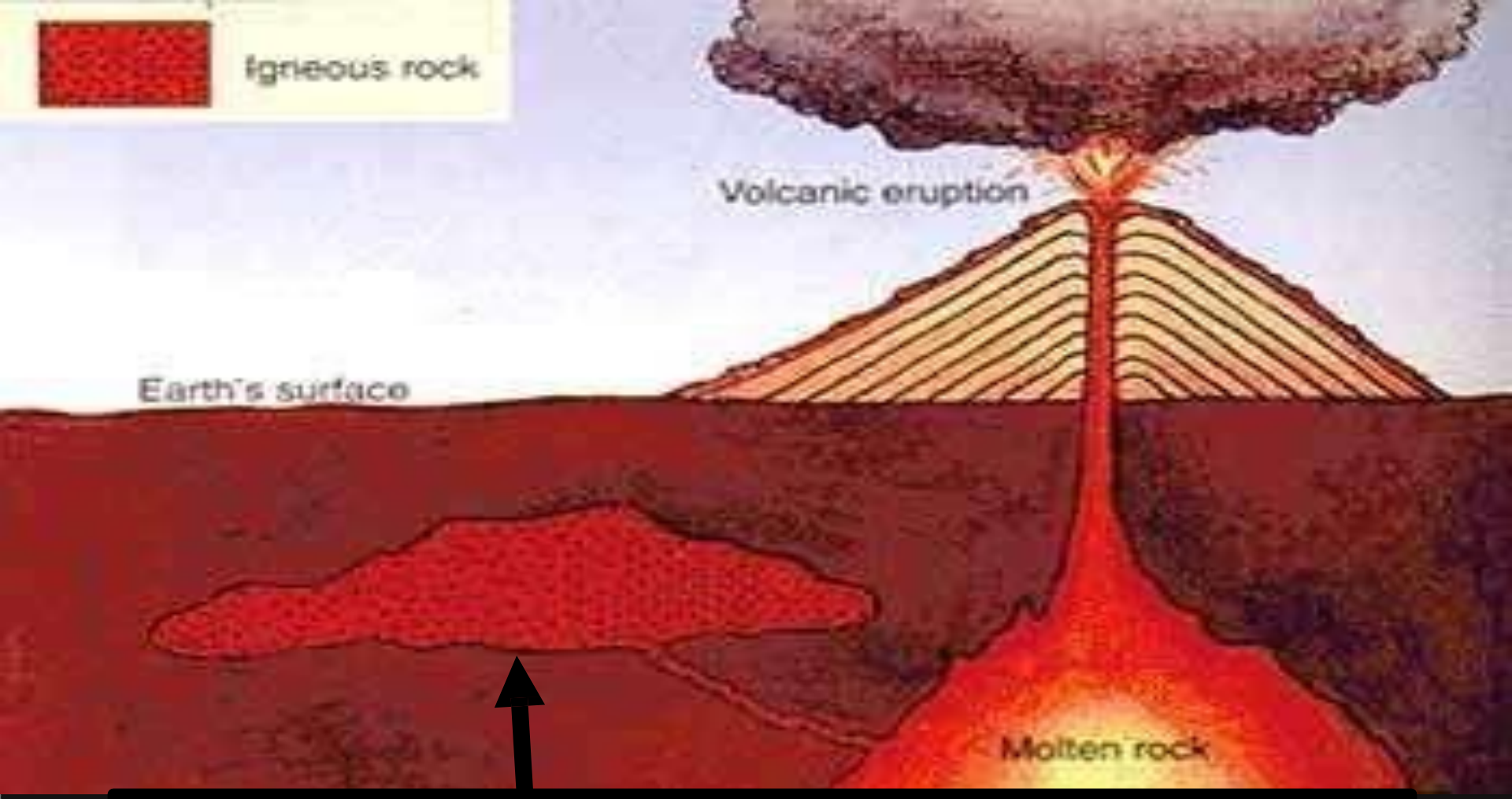
Rocks with small grain
s

Pumic

Granite

Plutonic/ Intrusive rocks

- *Rocks that results when magma solidifies*
- *Rocks that formed at considerable depths between 7-10 sq.km below the surface of the earth*
- *These rocks cools quickly and usually has large grains*

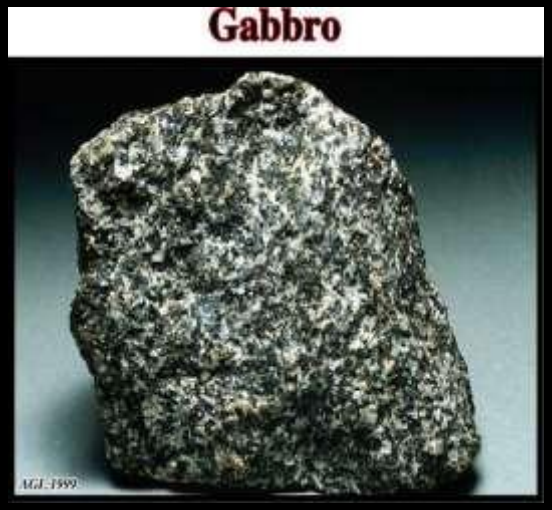


When magma cools, it forms ***intrusive*** igneous rock

Plutonic rocks

Granite

Syenite



Pegmatite

Diorite

Hypabyssal rocks

- *These are formed at intermediate stage below the earth surface*
- *Rocks that formed at considerable depths up to 2kms*
- *They show mixed character of volcanic and plutonic rocks*
- *Eg: porphyries with different compositions*

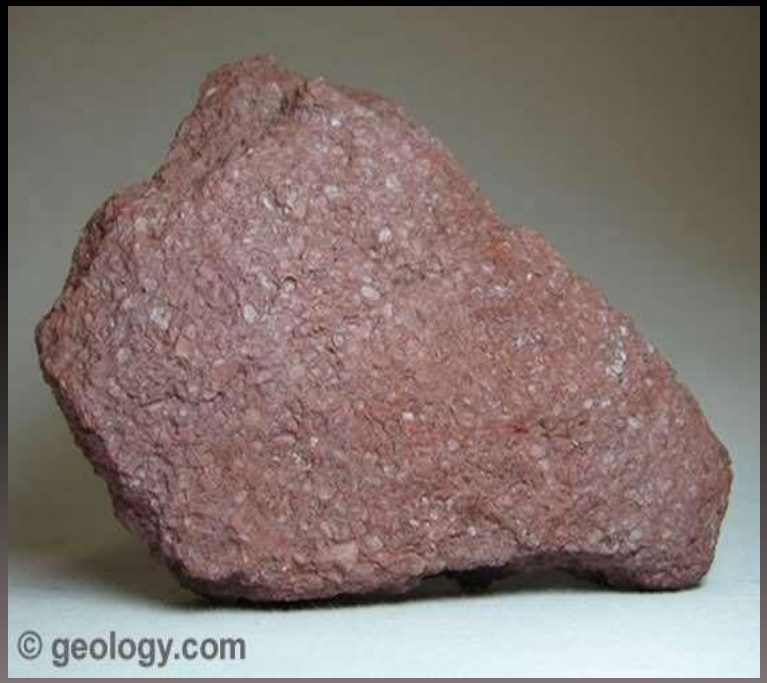
Sedimentary Rocks

- *Sedimentary Rocks are formed when rocks 'settle out' of water or air.*
- *Secondary rocks*
- *There are 2 Types of Sedimentary Rocks*
  - *Chemical*
  - *clastic*
- *The rock pieces are then cemented together for form Sedimentary Rocks*
- *They also contain many fossils from millions of years ago!*

Sediments are the products of weathering. Since these are secondary materials(i.e., derived from pre-existing rocks), the rocks formed out of them are called sedimentary or secondary rocks.

The origin of sedimentary rocks totally related to the weathering influence on rocks.

Eg: Shale, Sandstone, Conglomerate, Flint, Limestone



Sediments are loose, unconsolidated accumulations of mineral rock particles that have been transported by wind, water, ice, gravity and re-deposited.

Derived from the Latin ***sedimentum*** *means settling, reference to a solid material settling out of a fluid.*

Sedimentary rocks often look like glued together rocks, pebbles, or sand.

sandstone conglomerate

Formation:

- *weathering of pre-existing rocks either by physical breakup into finer and finer fragments, or by solution.*
- *precipitation of crystals out of solution.*
- *usually, the particle are broken down further during this transport phase.*
- *sediment become lithified, or turned to rock.*
- *Some rocks forms when water evaporates and minerals left behind*

Halite (salt) and gypsum are formed this way.

fossils are often found in sedimentary Plants & animals are caught in the layers of sediment and leave an imprint in the rock.

Lime stone

Flint

rock salt

Types of sedimentary rocks

Clastic(mechanically formed) rocks:

Clastic sedimentary rocks are rocks which are composed predominantly of broken pieces or clasts of older weathered and eroded rocks.

chemically (Non-clastic) formed:

- *Chemical sedimentary rock forms when mineral constituents in solution become supersaturated and inorganically precipitate. Common chemical sedimentary rocks include oolitic limestone and rocks composed of evaporite minerals such as halite (rock salt), sylvite, barite and gypsum.*

Metamorphic rocks

- *Metamorphism literally means change.*
- *The change in pre-existing rocks under the influence of temperature, pressure and chemically active solutions.*
- *The metamorphic rocks formed from igneous rocks are called Orthometamorphic rocks and those formed fromsedimentary rocks are called Parametamorphic rocks.*

- *Metamorphic Rocks are found in areas that have been under lots of pressure and/or temperature.*
  - *ex: mountains*
- *There are 2 types of Metamorphic Rocks:*
  - *Foliated*
  - *Non-foliated*
- *They can form from either igneous rocks or sedimentary rocks*

  Eg: Sandstone changes to quartzite

  Granite changes to gneiss

Heat & pressure can change sandstone into quartzite.

Granite can become gneiss,

…and shale can become schist!

Types of Metamorphic rocks

- Foliated:

As a result of compression and stress on the rock, the minerals within the rock align themselves perpendicular to the direction of stress.

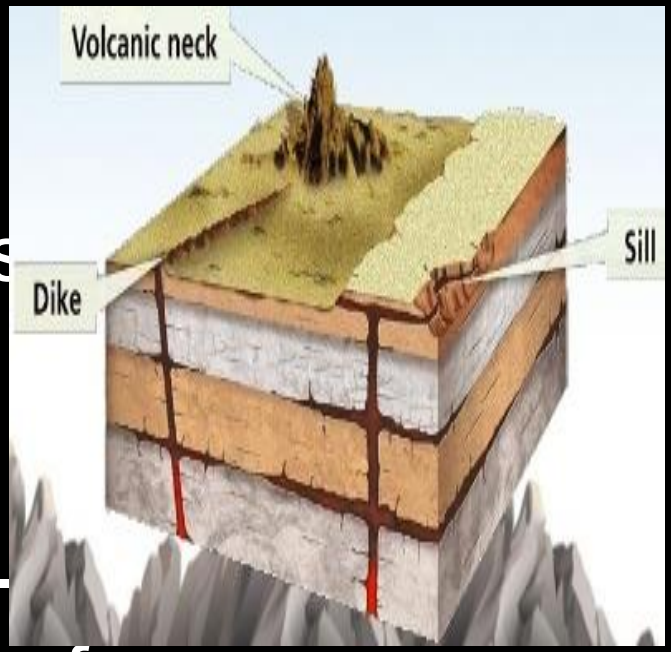
  - *This alignment creates the banding/foliation in the rock.*

Non-foliated:

- *In general, many non-foliated rocks have not undergone a great amount of stress, and therefore, do not show foliation.*
- *Also, the minerals that compose non-foliated rocks are equidimensional crystals. As a result, no foliation would appear because all the mineral grains look similar.*

Dykes and Sills

- Most common forms of igneous rocks
- Dykes are discordant, sheet like structures, vertically or inclined.
- Dykes are formed by the intrusion of magma into pre-existing fractures.
- Those igneous intrusions that have been injected along or between the bedding planes are sills.



Types of Dykes and Sills

Dykes

- Simple dykes
- Multiple dykes
- Composite dykes
- Ring dykes

Sills

- Simple sills
- Multiple sills
- Composite sills
- Differentiated sills
- Interformational sills

Common structures of igneous rocks

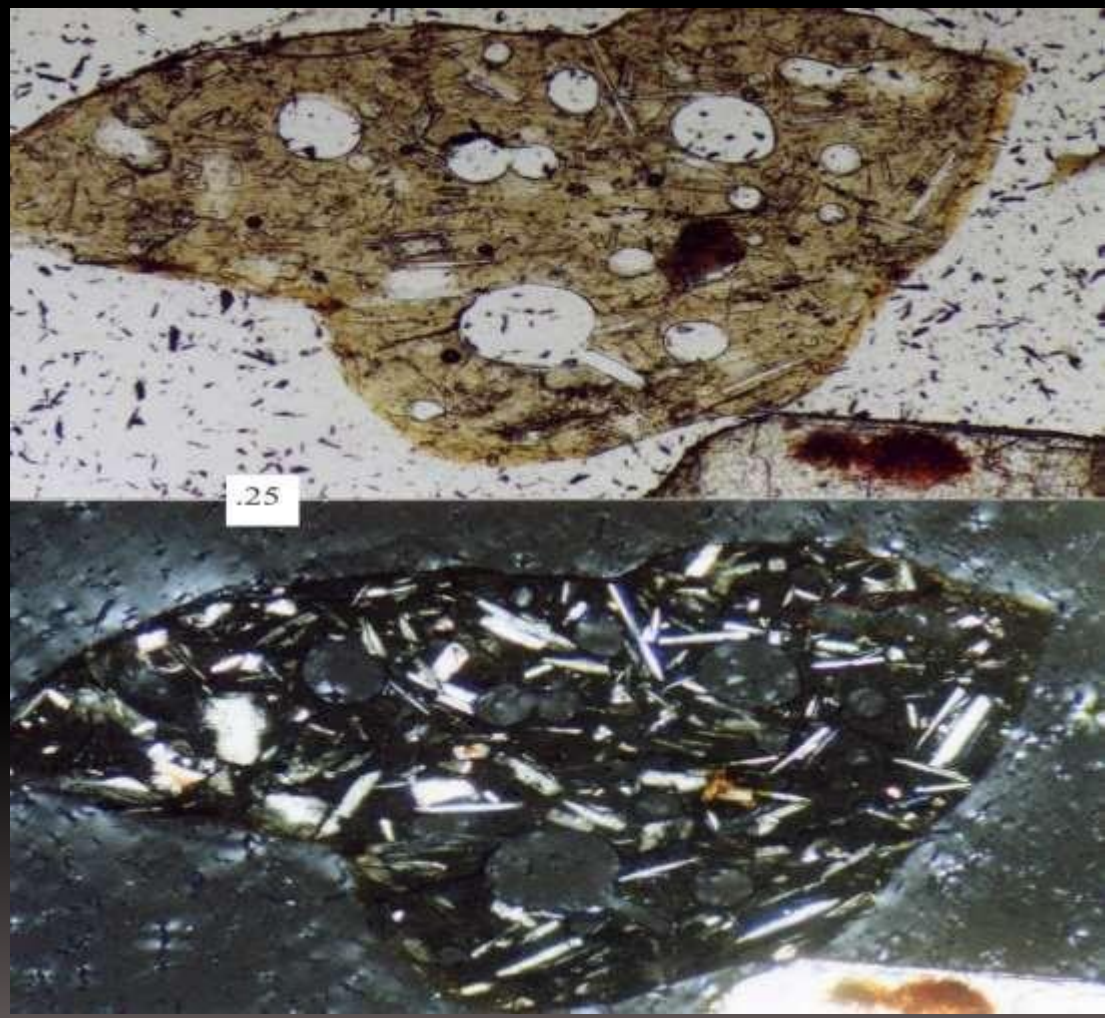
Physical appearance of rocks including size, shape and forms.

types

- *Vesicular structure*
- *Amygdaloidal structure*
- *Columnar structure*
- *Sheet structure*
- *Flow structure &*
- *Pillow structure*

vesicular structure:

Vesicular structure *is a volcanic rock structure characterized by a rock being pitted with many cavities (known as vesicles) at its surface and inside.*



Basalt

Amygdaloidal structure:

- *The drop in pressure that a experiences as it flows from underground to the Earth's surface allows water and gases in the lava to form bubbles. If the bubbles do not get large enough to pop, they are frozen in the lava as vesicules.* ***Amygdaloids*** *are simply vesicles that have been filled in with a secondary mineral long after the flow cooled. Such secondary minerals are commonly white: quartz, calcite, or zeolite. (A secondary mineral is one that formed after the rock originally formed.)*

Olivine basalt

Columnar structure:

- *the structure of a mineral aggregate that is made up of nearly parallel slender columns and that is intermediate between an equant and acicular structure (as in some amphiboles)*

Columnar Basalt

Sheet structure

- *The development of one set of well defined joints sometimes brings about a slicing effect on the massive igneous rock body. If all such slices are horizontal, the structure is said to be sheet structure.*

Rock with mica sheets

Flow structure:

- *These structure is planar or linear features that result from flowage of magma with or without contained crystals. Various forms of faintly to sharply defined layering and lining typically reflect compositional or textural in homogeneities, and they often are accentuated by concentrations or preferred orientation of crystals, inclusions, vesicles and other features.*

Pillow structure:

- *These structure consists aggregates of ovoid masses, resembling pillows or grain-filled sacks in size and shape, that occur in many basic volcanic rocks. The masses are separated or interconnected, and each has a thick vesicular crust or a thinner and more dense glassy rind. The interiors ordinarily are coarser-grained and less vesicular. Pillow structure is formed by rapid chilling of highly fluid lava in...*

Pillow basalts in a road cut along US 95, north of White Bird, Idaho

COMMON STRUCTURES OF SEDIMENTARY ROCKS

- *Sedimentary structures are those structures formed during sediment deposition.*

Stratification:

A layered arrangement in sedimentary rock. Different layers also called beds or strata may be similar or dissimilar.

Lamination:

layered structure similar to stratification but layers are quite thin.

Cross bedding: *layers lying above one another are not parallel having inclined relation.*

Graded bedding: *sediments are arranged according to their grain size.*

Mud cracks: *having many fine sized grains with irregular cracks.*

Ripple marks: *symmetrical wave-like undulations in a layer.*

COMMON STRUCTURES OF METAMORPHIC ROCKS

The most common structures found in metamorphic rocks are ;

1) Gneissose structure: bands of flaky minerals
2) Schistose structure: parallel layers
3) Granulose structure: having granular minerals

TEXTURE

The size, form and orientation of clasts or minerals in a rock is called its texture. The texture is a small-scale property of a rock, but determined many of its large-scale properties, such as the density, porosity or permeability

i. Coarse-grained Texture

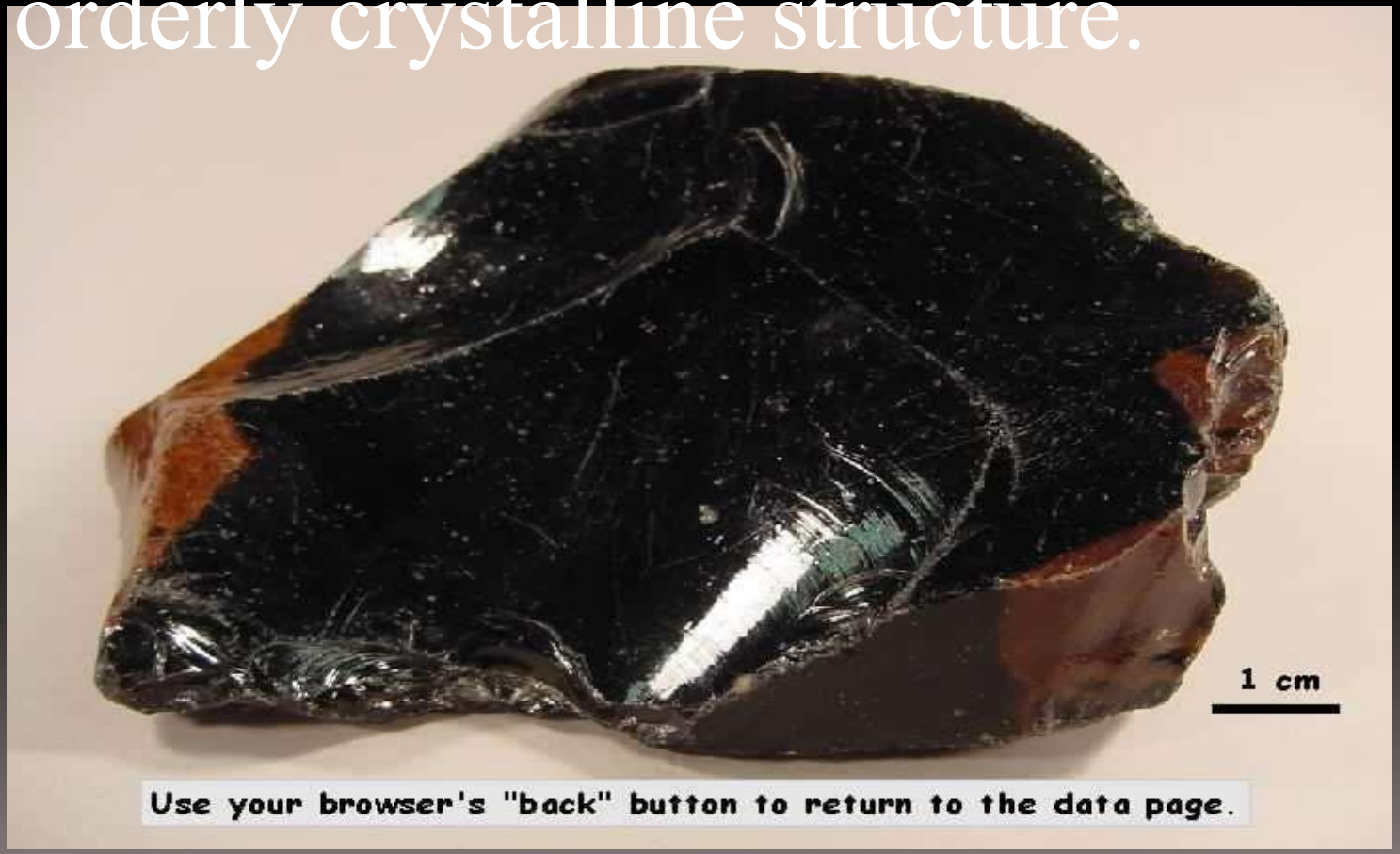
- appearance of a mass of intergrown crystals, which are roughly equal in size and large enough to be identified with the unaided eye.

ii. ***Porphyritic Texture***

- has large crystals embedded with a matrix of smaller crystals.

iii. ***Glassy Texture***

- results when the ions do not have sufficient time to unite into an orderly crystalline structure.



Obsidian

- similar to a large chunk of manufactured glass.

Pumice

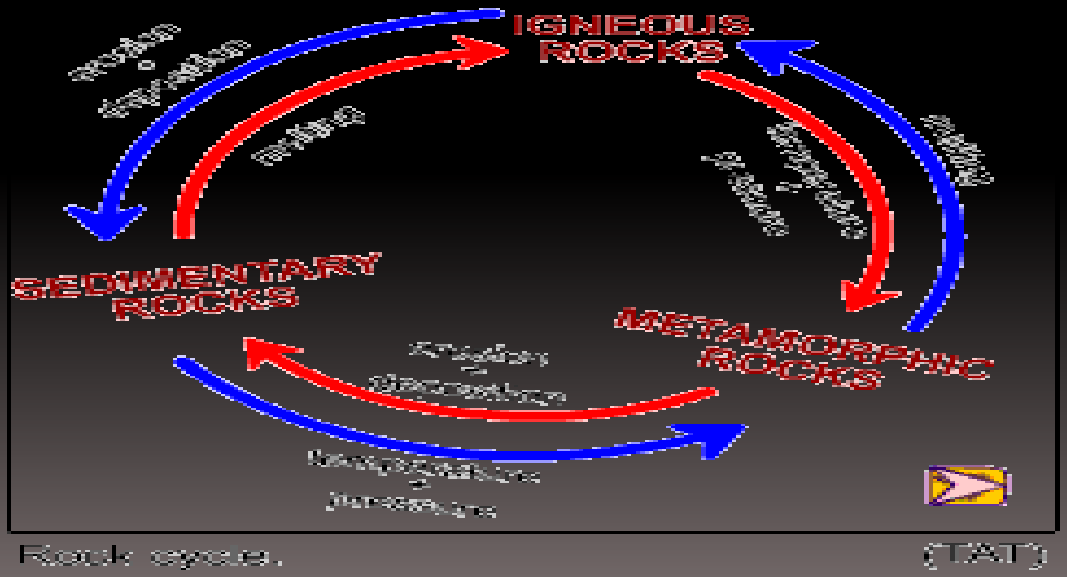
- volcanic rock that exhibits a glassy texture.

TEXTURES OF SEDIMENTARY ROCKS

- *origin of grains*
- *size of grain*
- *shape of grain*
- *packing of grains*

ROCK CYCLE

- *Orthometamorphic: (igneous to sedimentary).*
- *Parametamorphic: (sedimentary to igneous).*
- *Polymetamorphism:(when rock undergo metamorphism more than once).*



CIVIL ENGINEERING IMPORTANCEOF PETROLOGY

Petrologyis very importantfrom civilengineeringpointofview, as itprovides a proper conceptandlogicalbasisfor interpreting physicalpropertiesofrocks.The studyoftexture,structure, mineralcomposition,chemicalcompositionetc.,gives all necessarydetailsregardingthe strength,durabiliy,colour,appeareance,workability,etc., These inherentcharactersofrocksareofchiefconcernfor a civil engineerto judiciouslyassessthesuitabilityoccuringatproject sitefor requiredpurpose.

THANKS FOR YOUR KIND CO-OPERATION

QUERIES?
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IGNEOUS ROCKS	SEDIMENTARY	METAMORPHIC
1.Granite.	1.Sandstone.	1.Gneiss.
2. Dolerite.	2.Limestone.	2.Quartzite.
3. Pegmatite.	3.Conglomerite.	3.Marble.
4. Basalt.	4.Shale.	4.Slate.